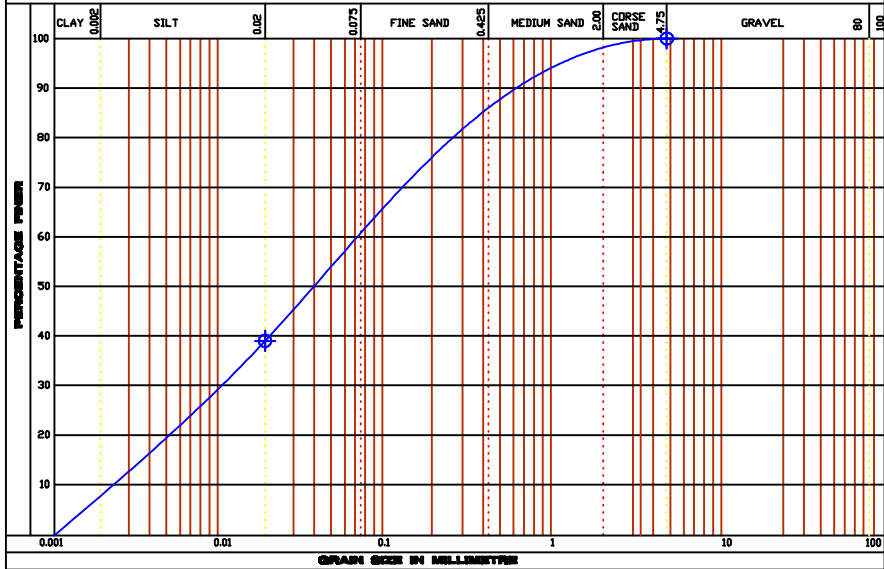
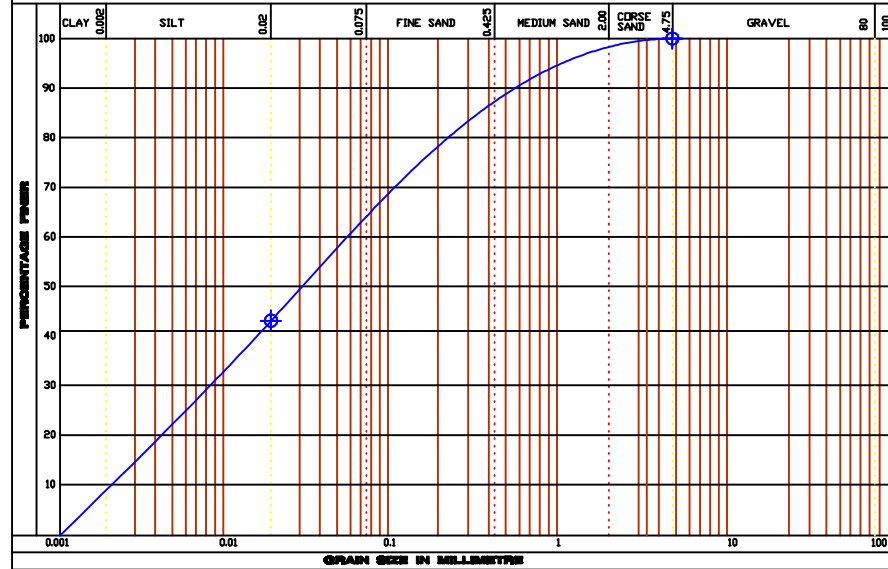


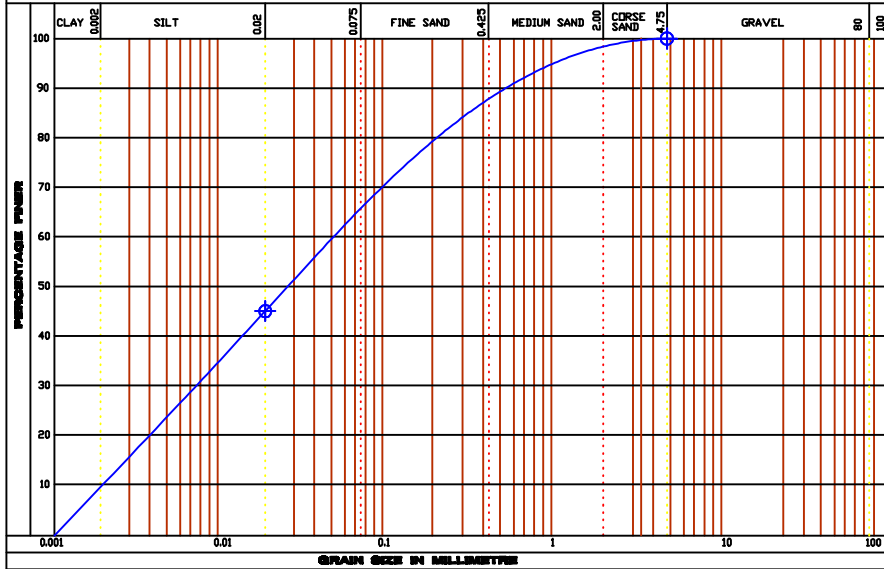
LOCATION - COAL STORAGE B.H NO- 01
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**



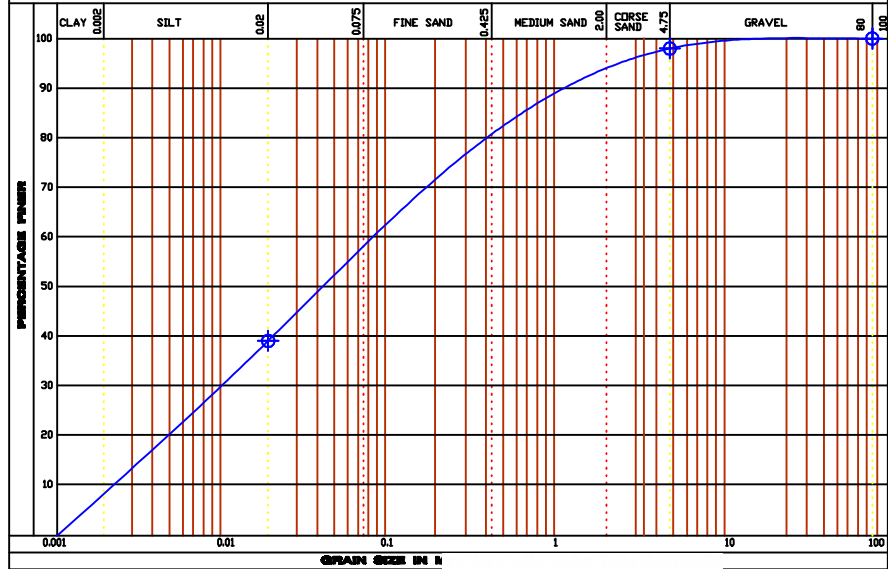
LOCATION - COAL STORAGE B.H NO- 01
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**

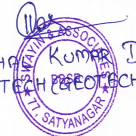


LOCATION - COAL STORAGE B.H NO- 02
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**

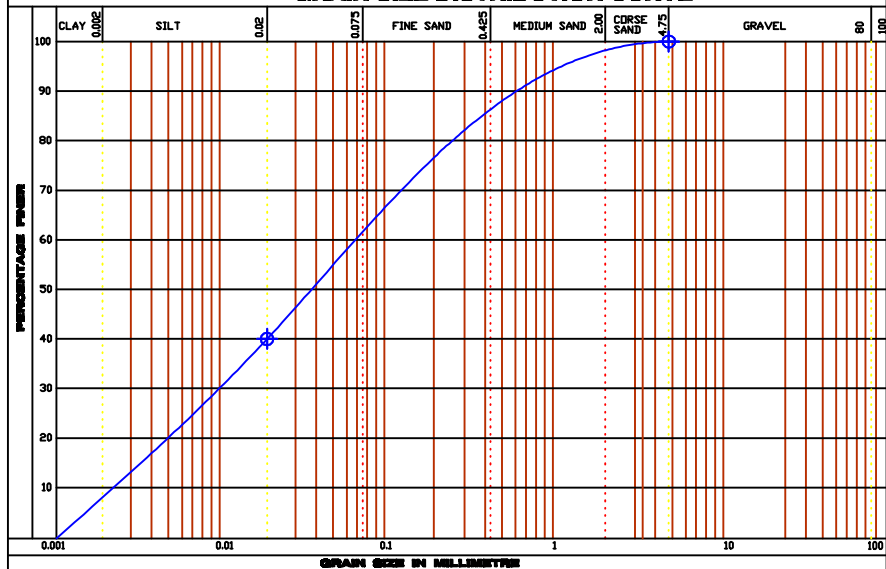


LOCATION - COAL STORAGE B.H NO- 02
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**

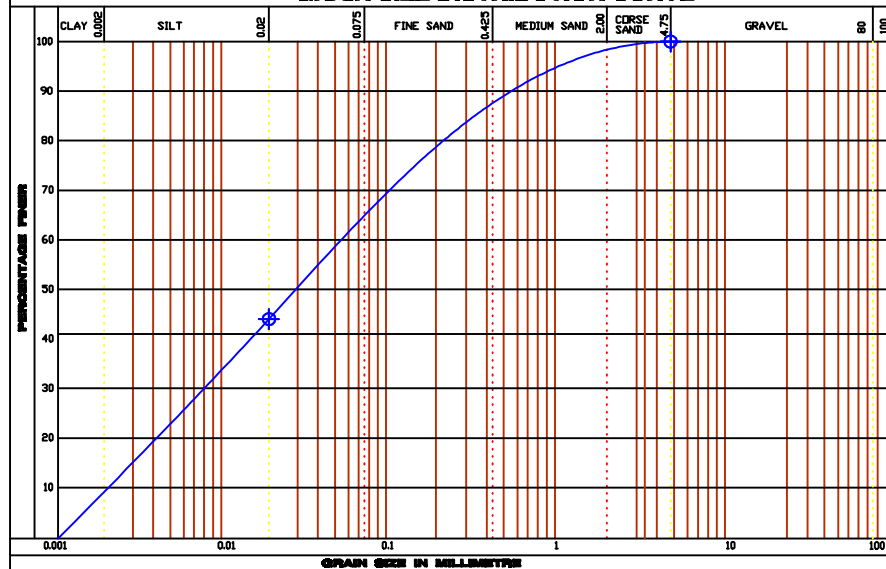



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 SATYANAGAR

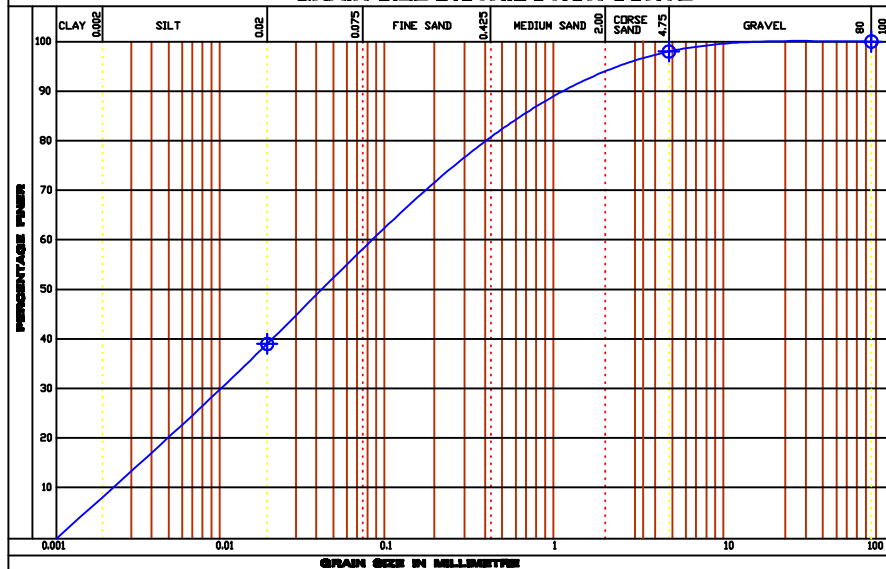
LOCATION - COAL STORAGE B.H NO- 03
DEPTH-12.00M **GRAIN SIZE DISTRIBUTION CURVE**



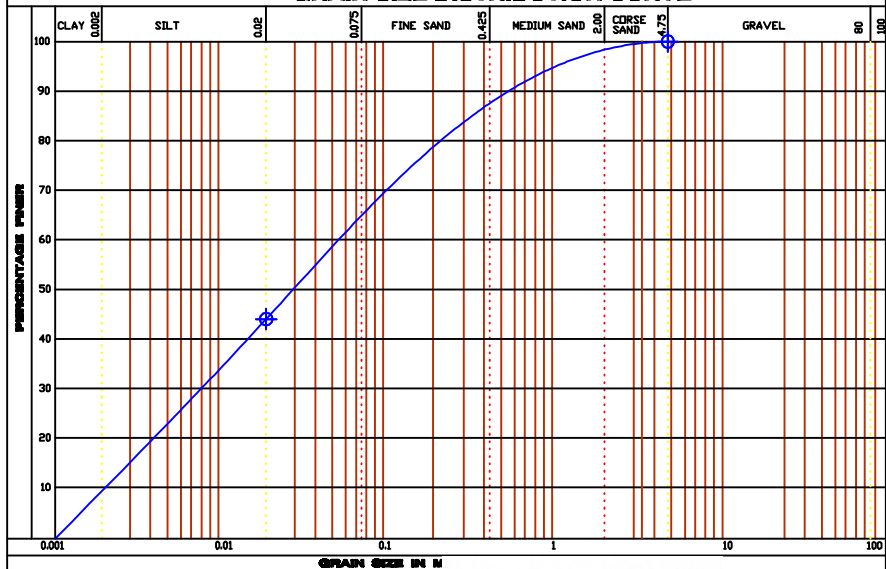
LOCATION - COAL STORAGE B.H NO- 04
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**




LOCATION - COAL STORAGE B.H NO- 03
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**

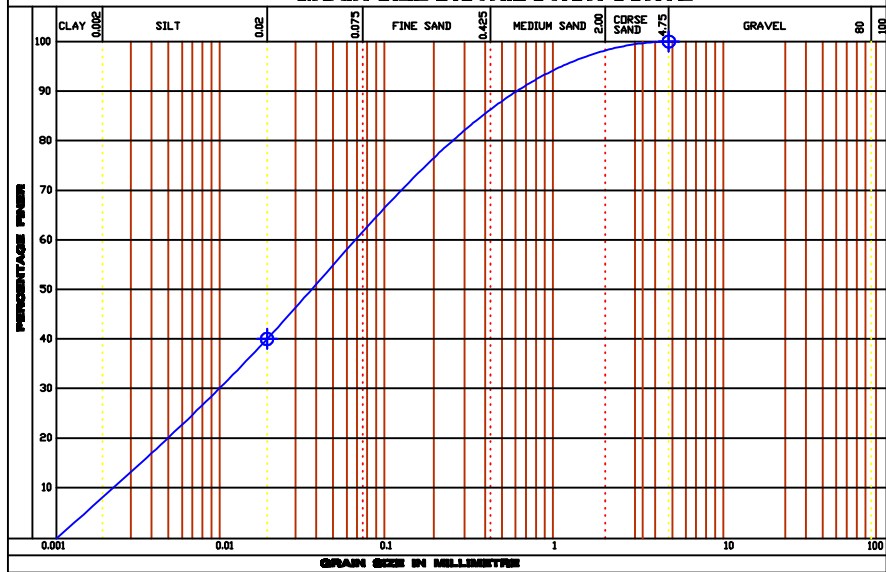


LOCATION - COAL STORAGE B.H NO- 03
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

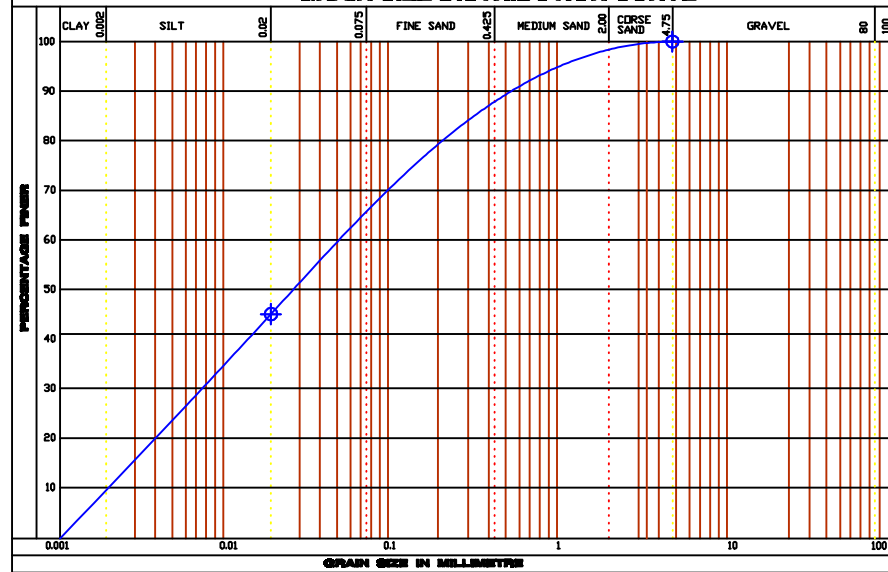



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 SATYANAGAR

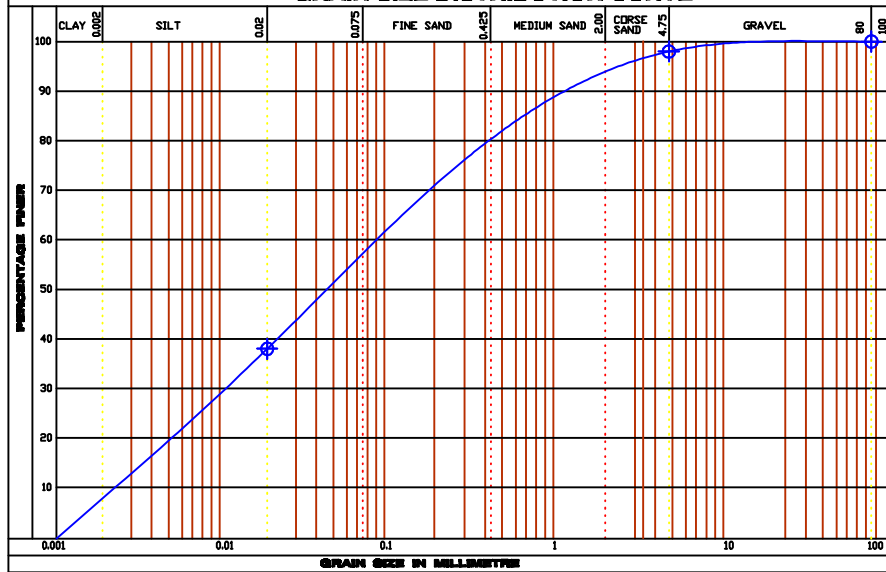
LOCATION - COAL STORAGE B.H NO- 66
DEPTH-7.50M **GRAIN SIZE DISTRIBUTION CURVE**



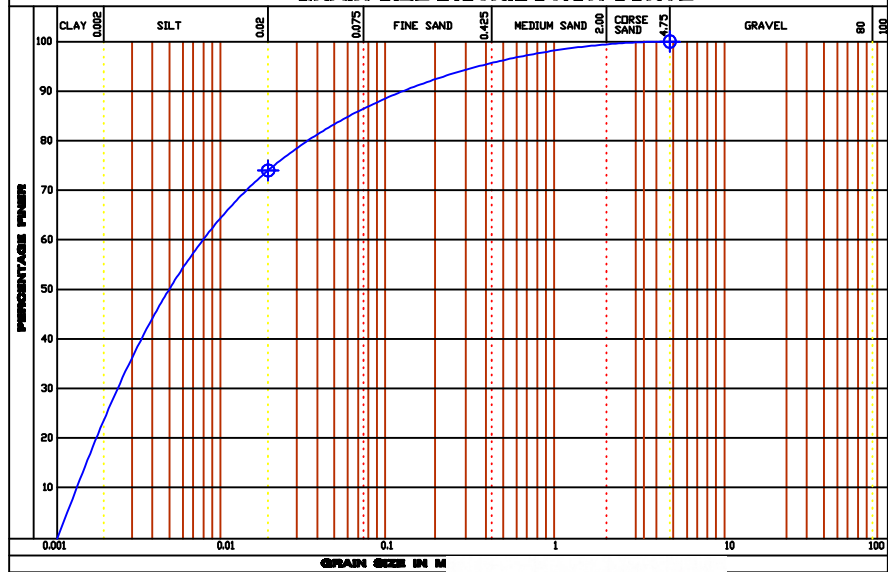
LOCATION - COAL STORAGE B.H NO- 67
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 67
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**

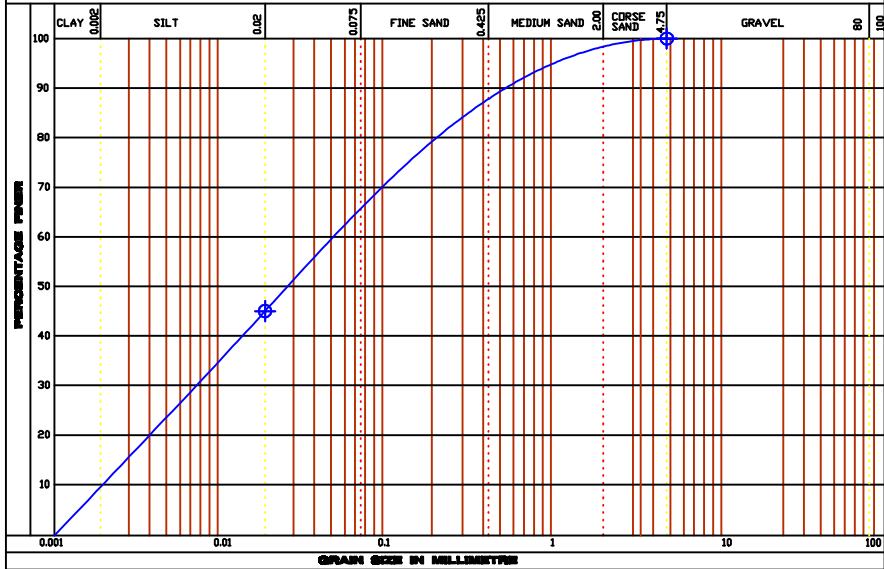


LOCATION - COAL STORAGE B.H NO- 66
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

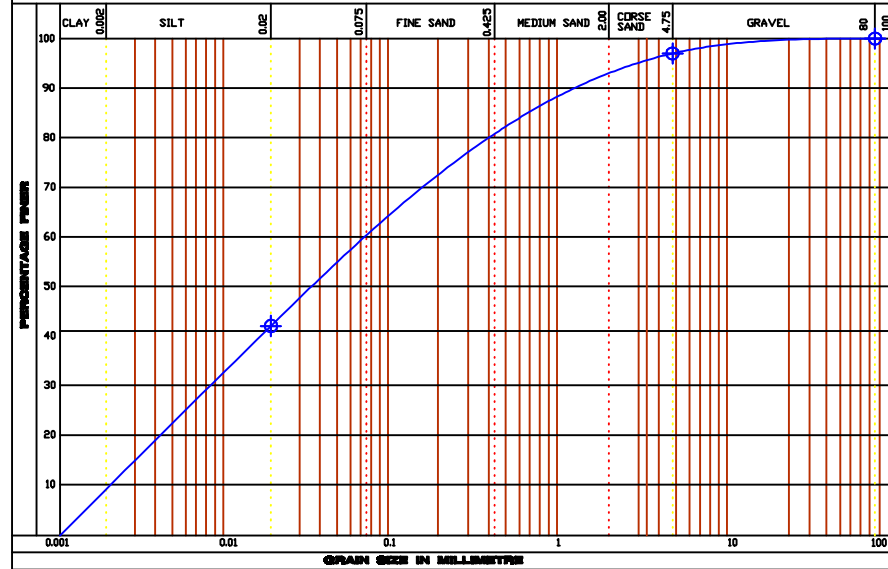


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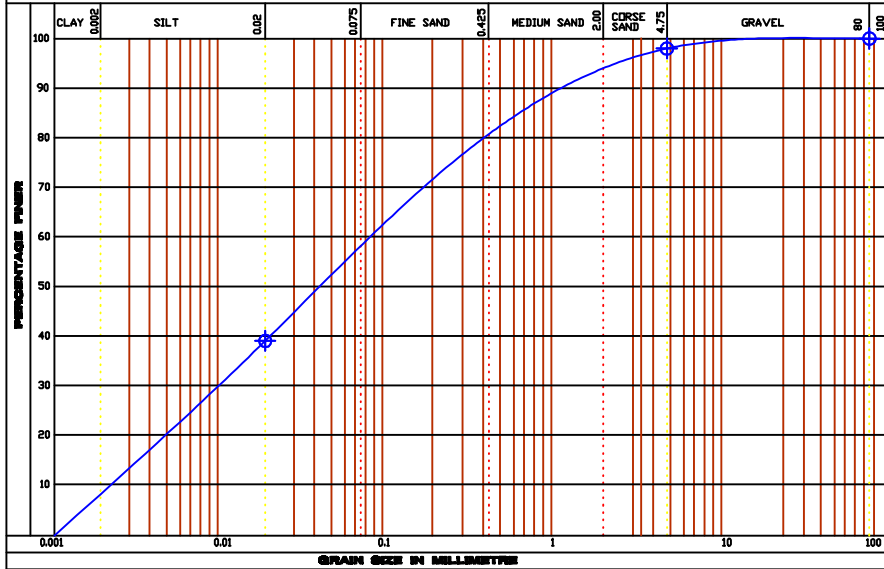
LOCATION - COAL STORAGE B.H NO- 68
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**



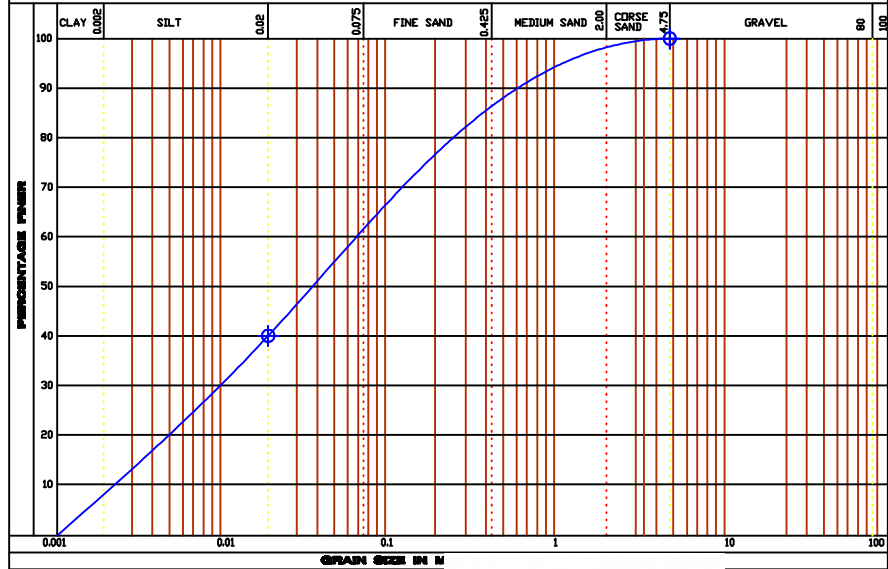
LOCATION - COAL STORAGE B.H NO- 68
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 68
DEPTH-10.50M **GRAIN SIZE DISTRIBUTION CURVE**

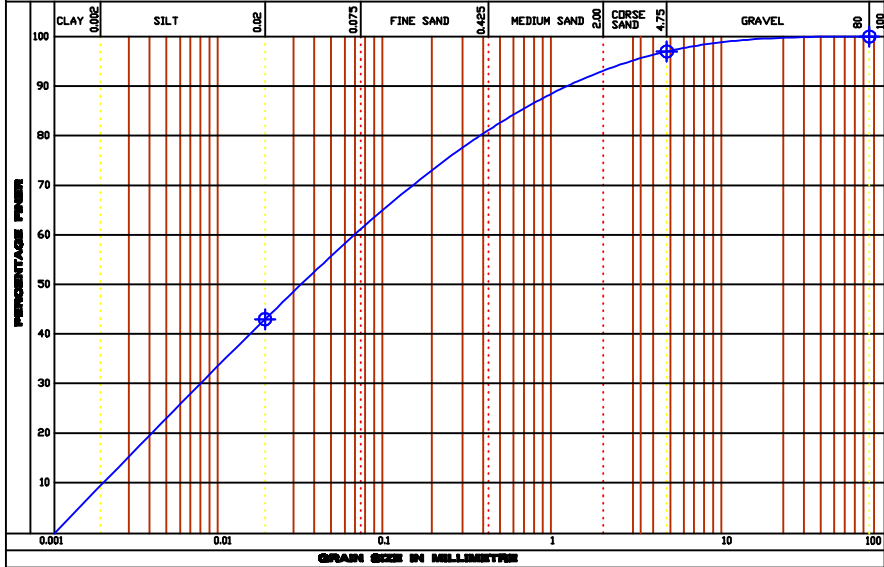


LOCATION - COAL STORAGE B.H NO- 68
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**

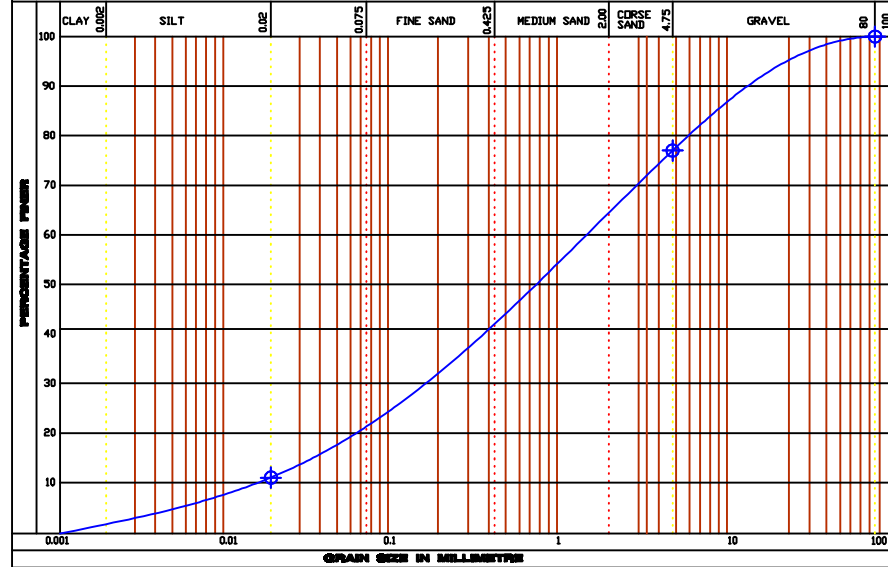



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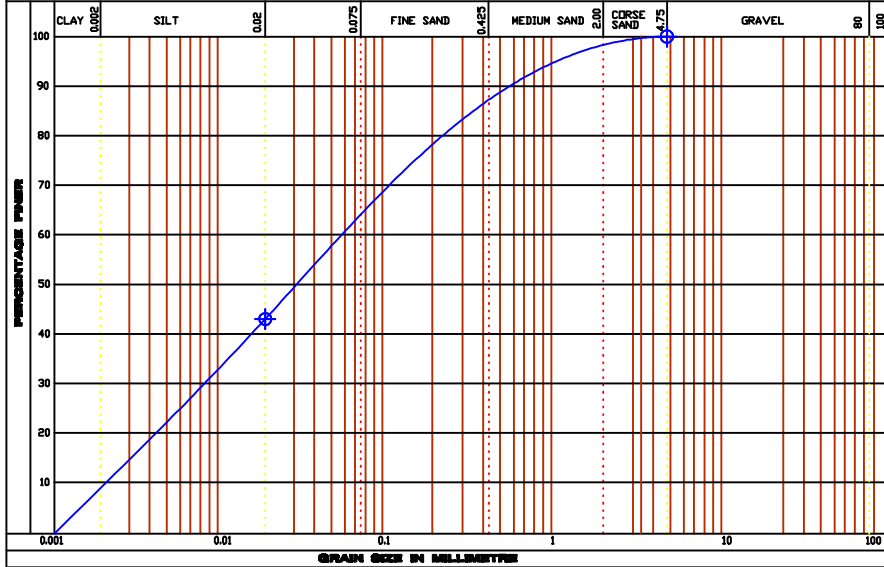
LOCATION - COAL STORAGE **B.H NO- 70**
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**



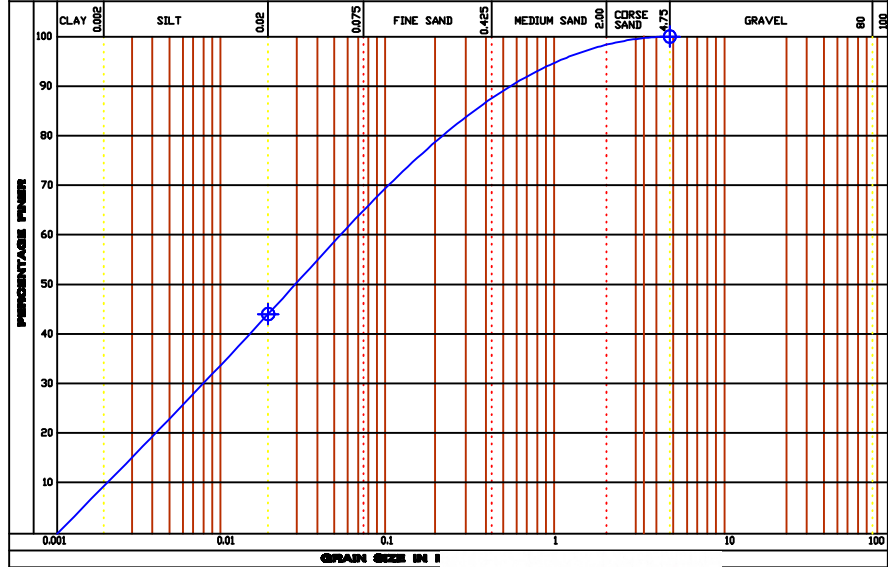
LOCATION - COAL STORAGE **B.H NO- 71**
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

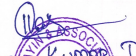



LOCATION - COAL STORAGE **B.H NO- 71**
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**

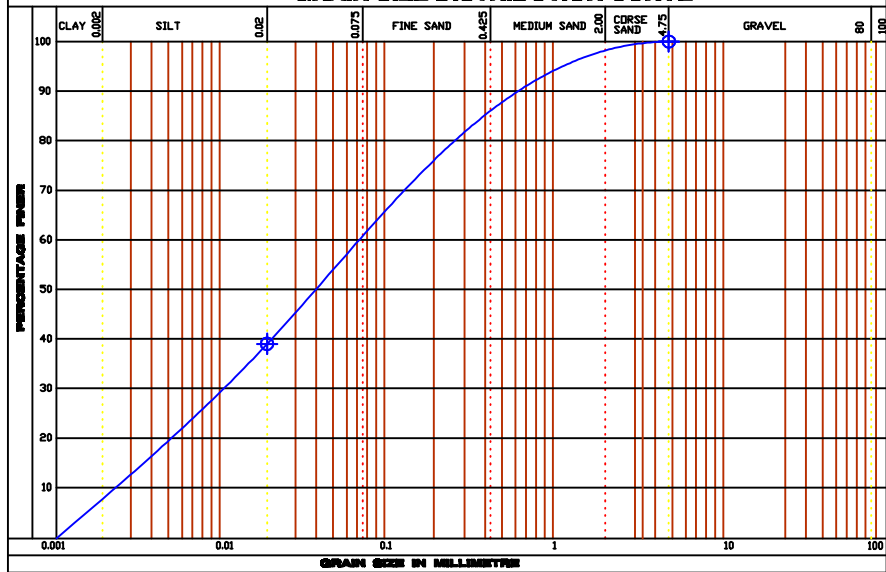


LOCATION - COAL STORAGE **B.H NO- 70**
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

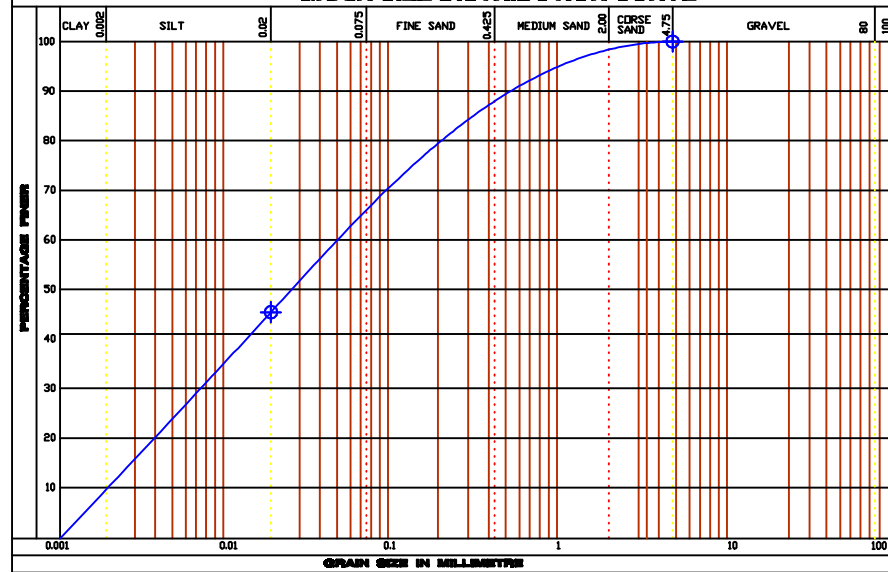



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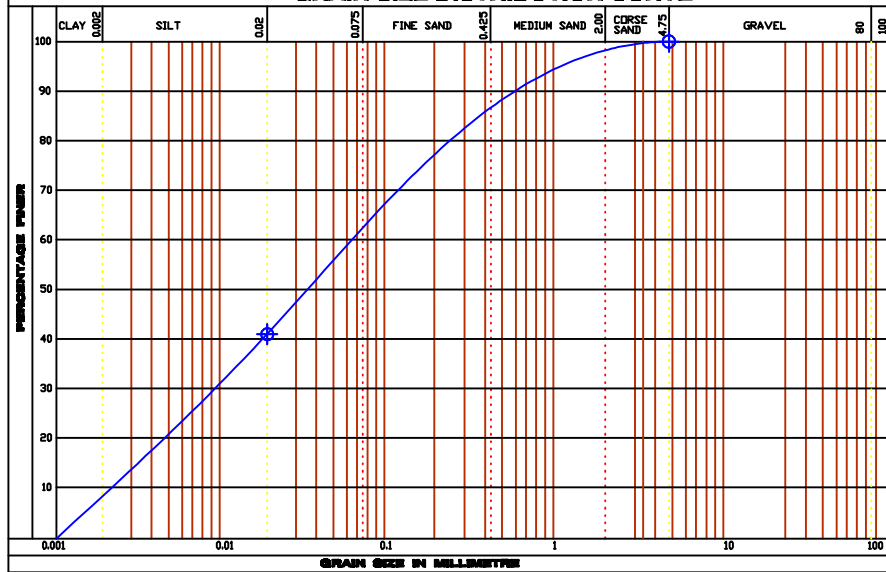
LOCATION - COAL STORAGE B.H NO- 73
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**



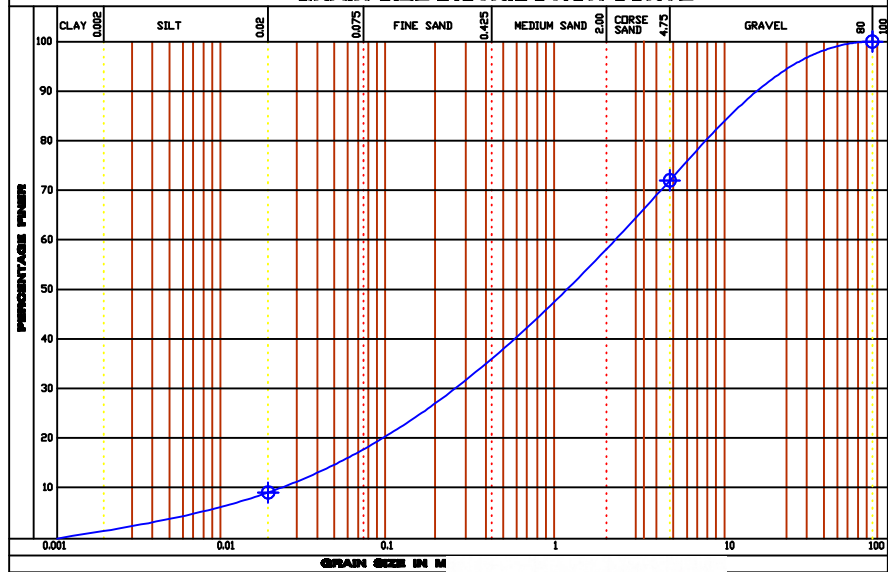
LOCATION - COAL STORAGE B.H NO- 73
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 73
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**

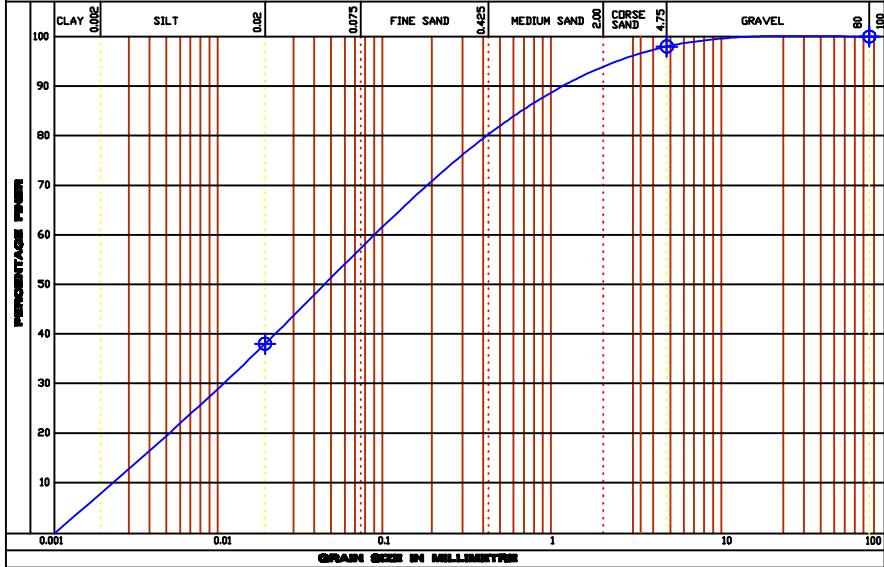


LOCATION - COAL STORAGE B.H NO- 74
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

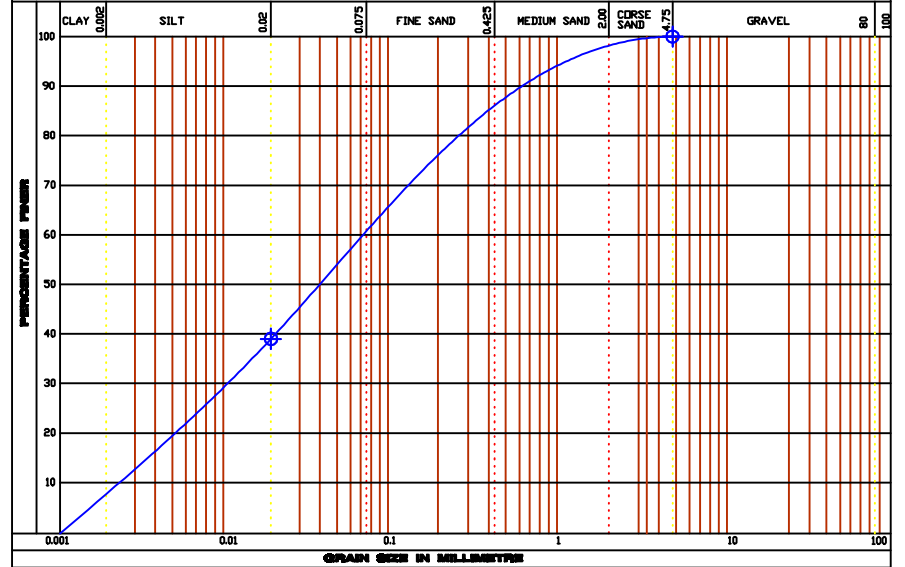



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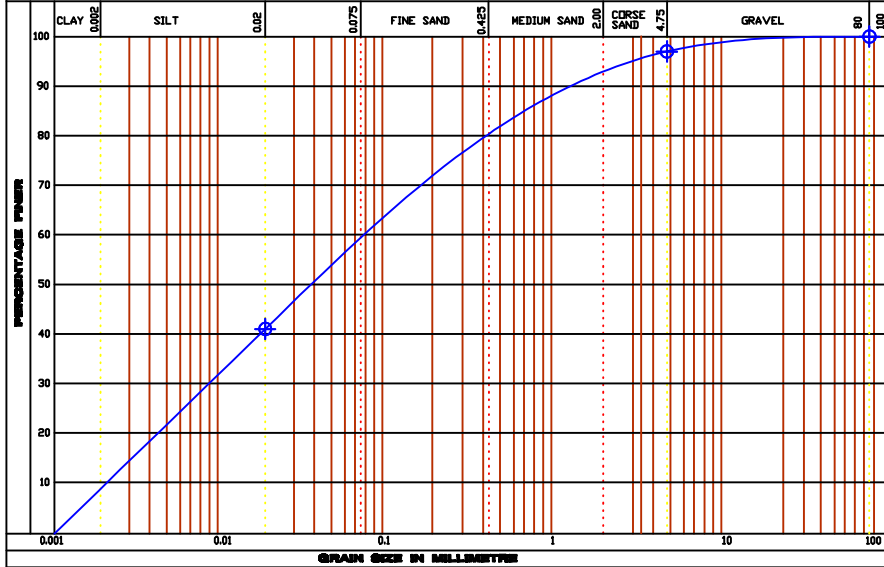
LOCATION - COAL STORAGE B.H NO- 74
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**



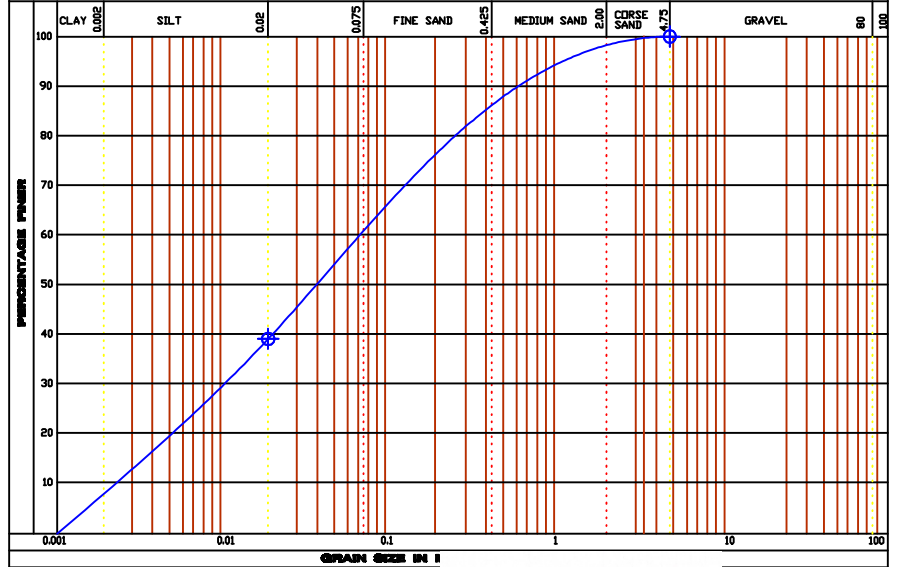
LOCATION - COAL STORAGE B.H NO- 74
DEPTH-7.50M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 75
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**

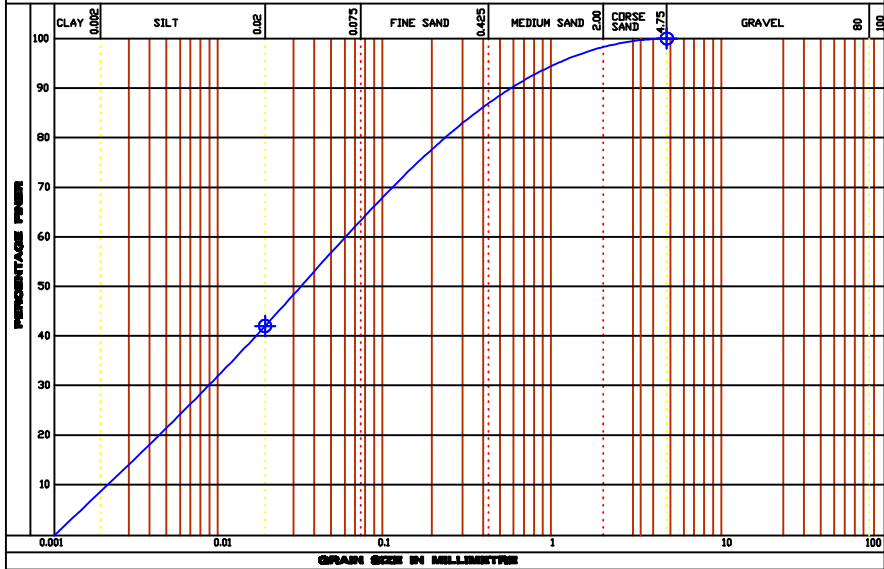


LOCATION - COAL STORAGE B.H NO- 75
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**

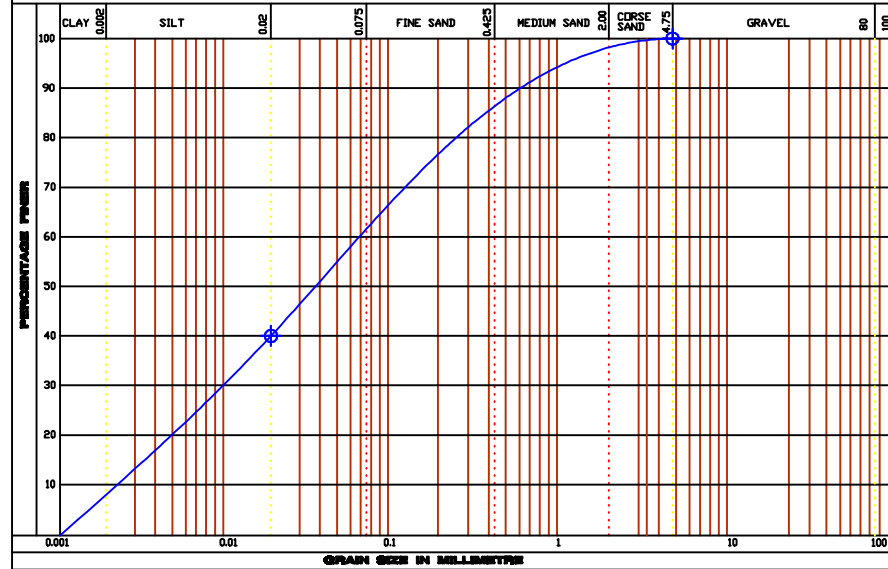



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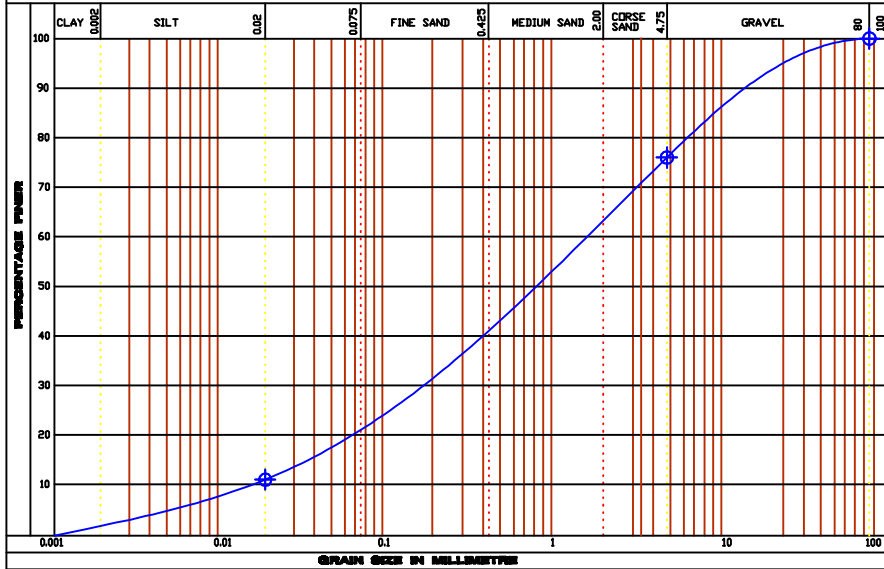

LOCATION - COAL STORAGE B.H NO- 76
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**



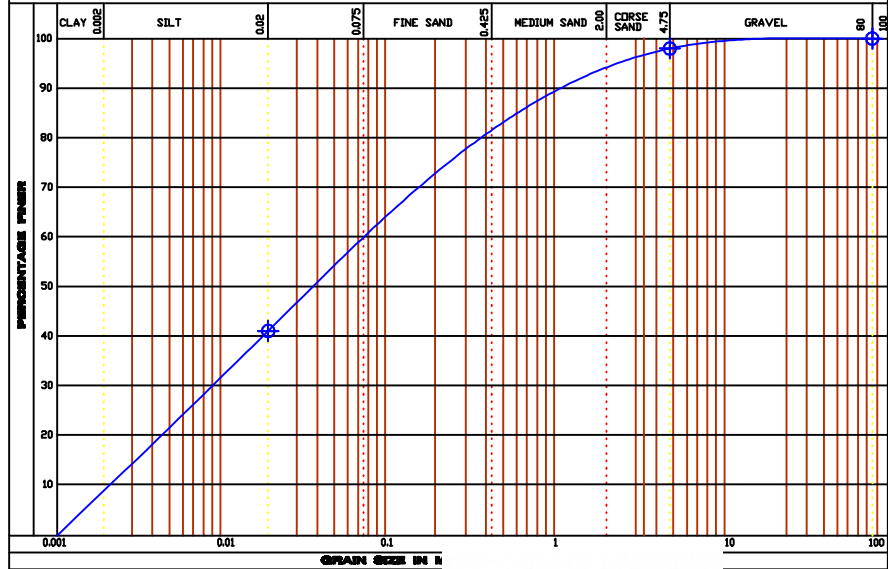
LOCATION - COAL STORAGE B.H NO- 76
DEPTH-7.50M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 77
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

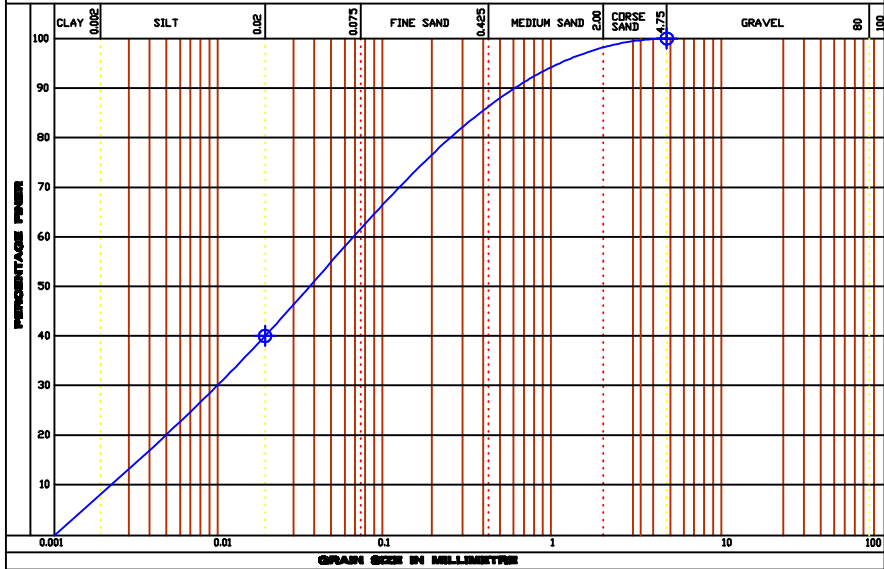


LOCATION - COAL STORAGE B.H NO- 77
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**

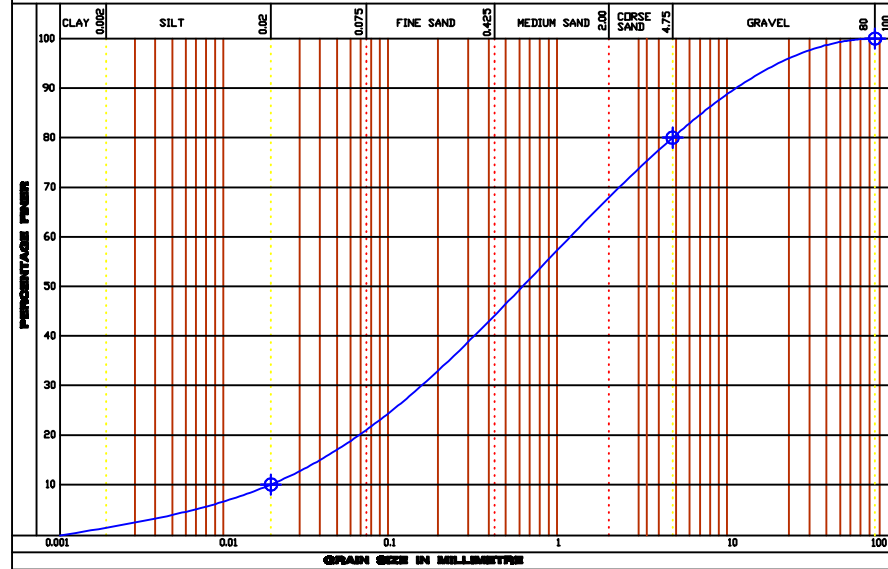



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 M.TECH (GEO TECH)

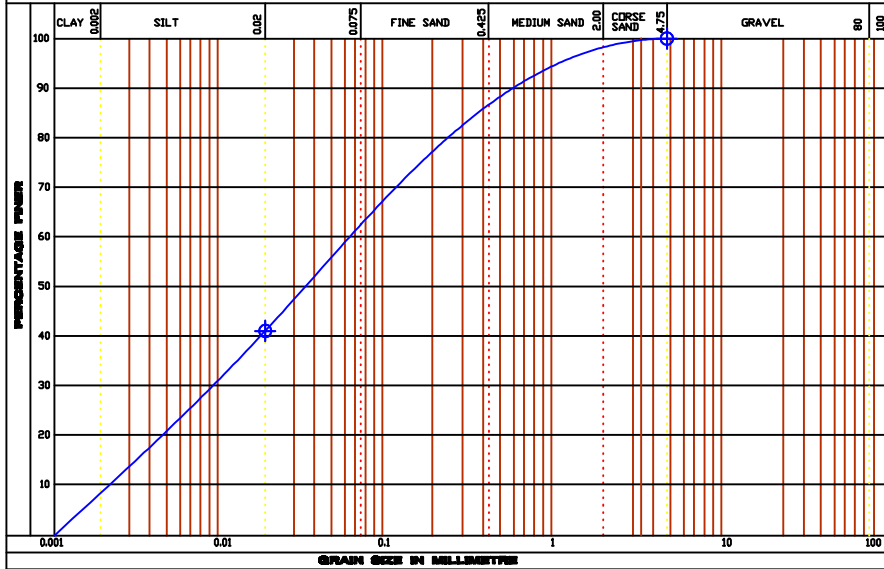

LOCATION - COAL STORAGE **B.H NO- 78**
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**



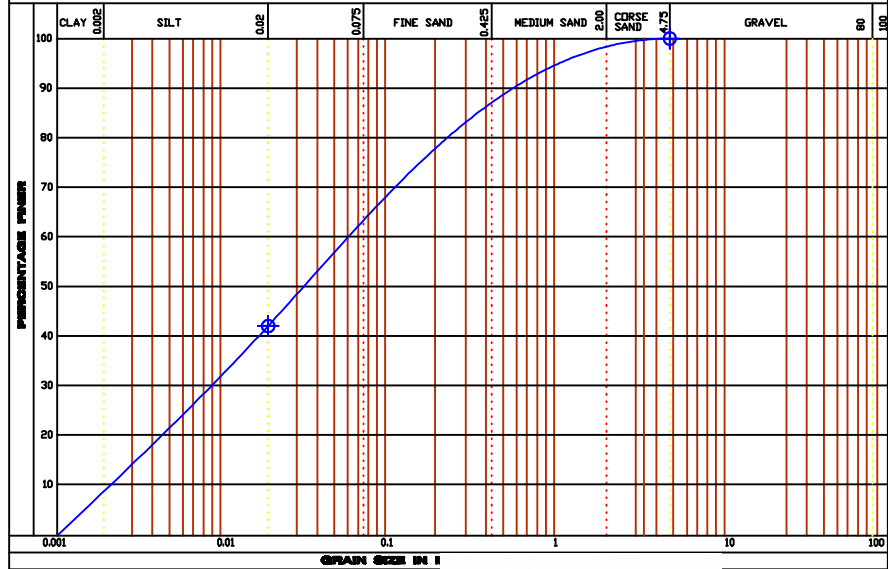
LOCATION - COAL STORAGE **B.H NO- 78**
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE **B.H NO- 78**
DEPTH-4.50M **GRAIN SIZE DISTRIBUTION CURVE**

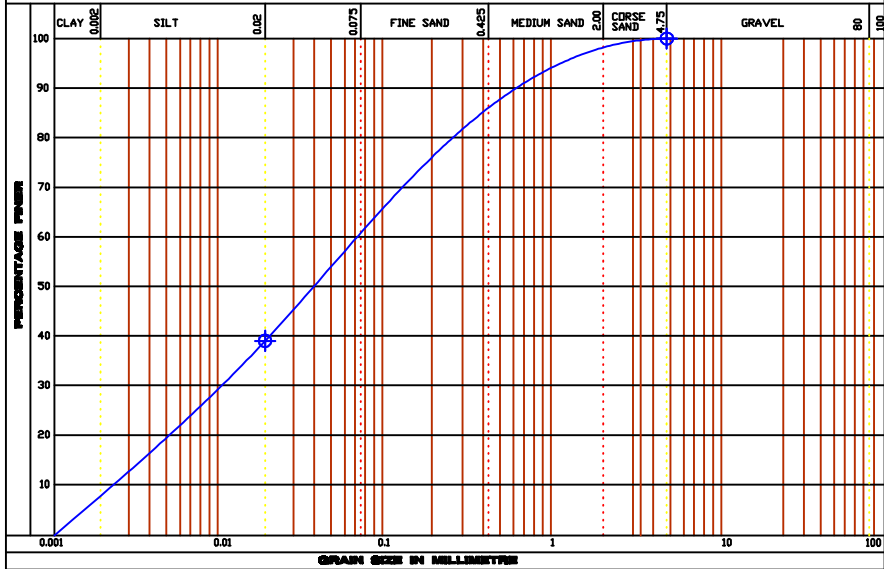


LOCATION - COAL STORAGE **B.H NO- 80**
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

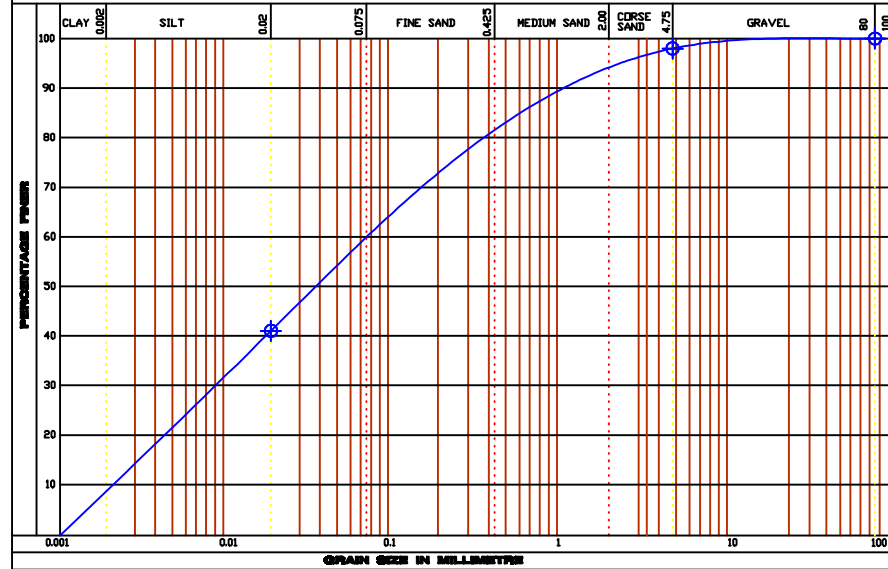


(Signature)
BISHWANT KUMAR DAS,
M.TECH (GEOTECH)
 SATYANAGAR

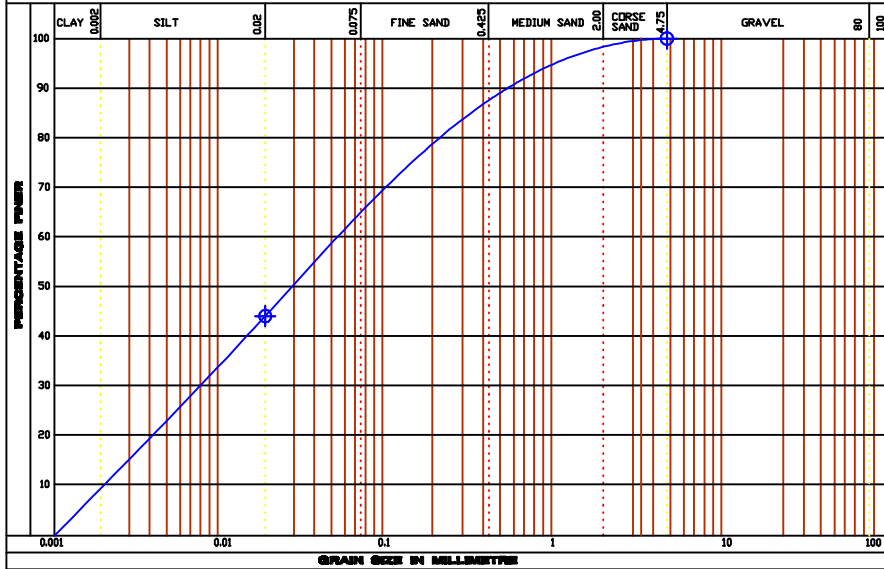
LOCATION - COAL STORAGE B.H NO- 80
DEPTH-6.00M **GRAIN SIZE DISTRIBUTION CURVE**



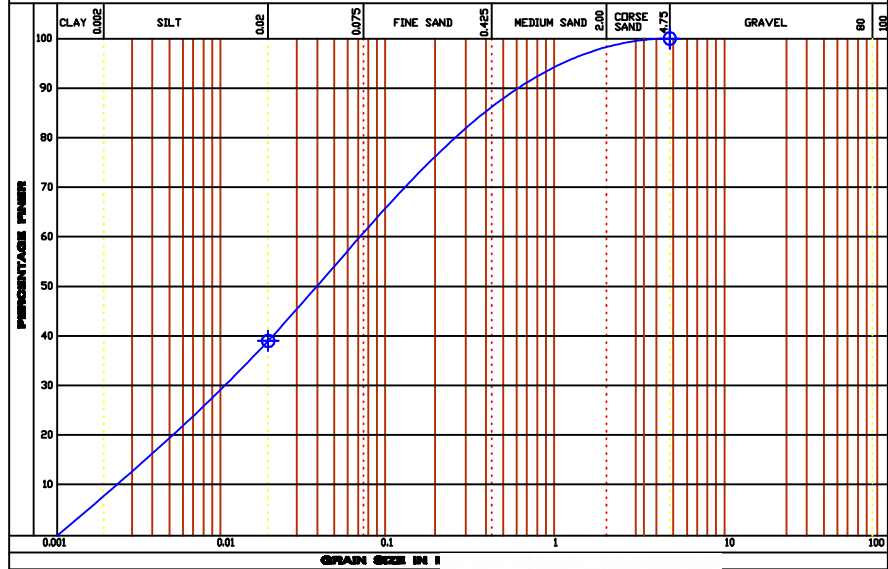
LOCATION - COAL STORAGE B.H NO- 81
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**





LOCATION - COAL STORAGE B.H NO- 82
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

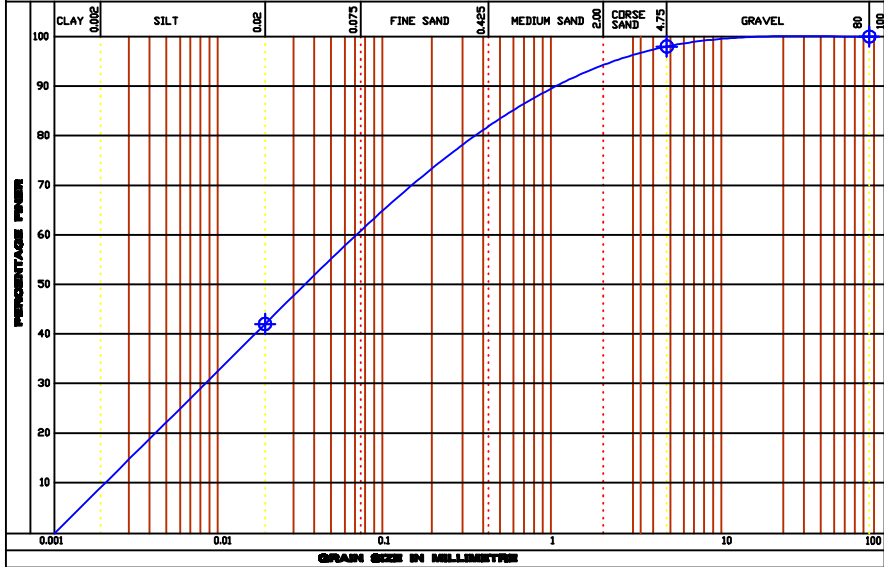


LOCATION - COAL STORAGE B.H NO- 83
DEPTH-7.50M **GRAIN SIZE DISTRIBUTION CURVE**

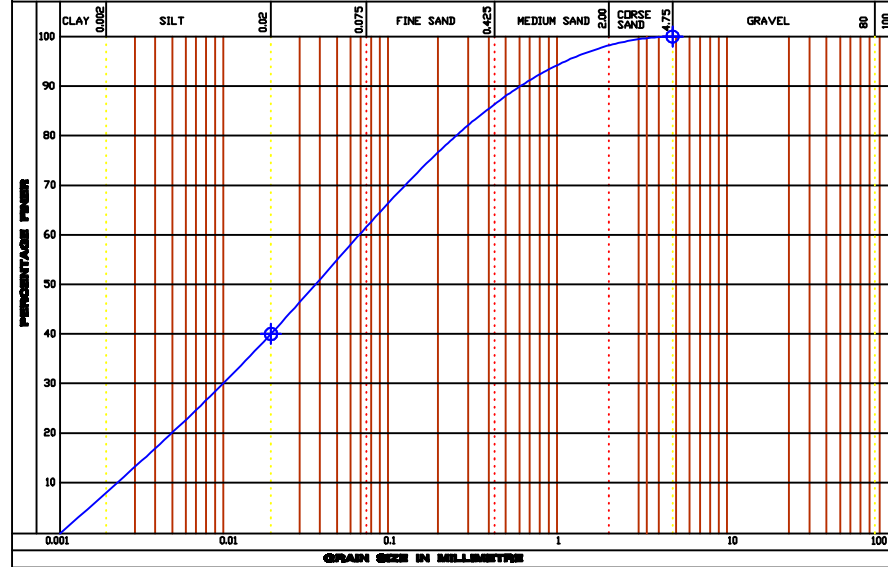



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 M.TECH (P&EOT&CH)


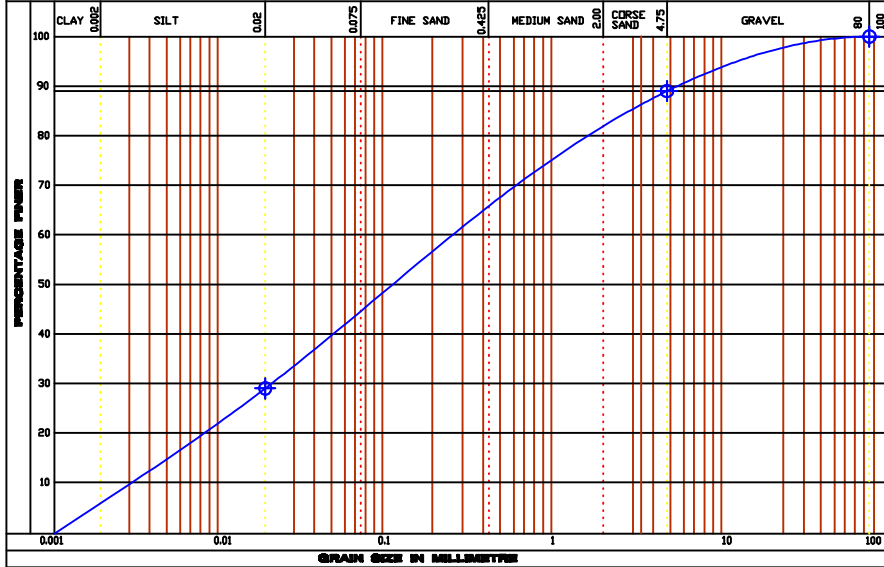
LOCATION - COAL STORAGE B.H NO- 83
DEPTH-3.00M
GRAIN SIZE DISTRIBUTION CURVE



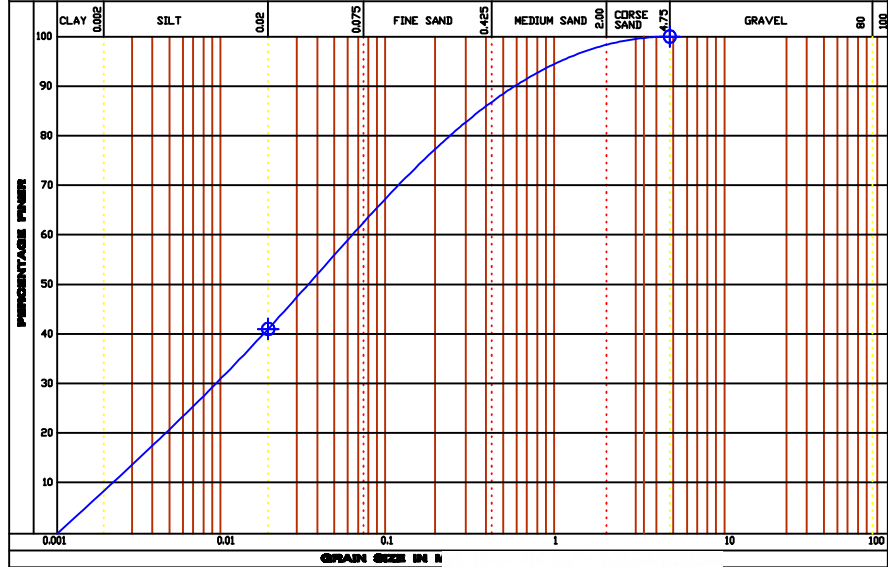
LOCATION - COAL STORAGE B.H NO- 83
DEPTH-7.50M
GRAIN SIZE DISTRIBUTION CURVE



LOCATION - COAL STORAGE B.H NO- 84
DEPTH-1.50M
GRAIN SIZE DISTRIBUTION CURVE

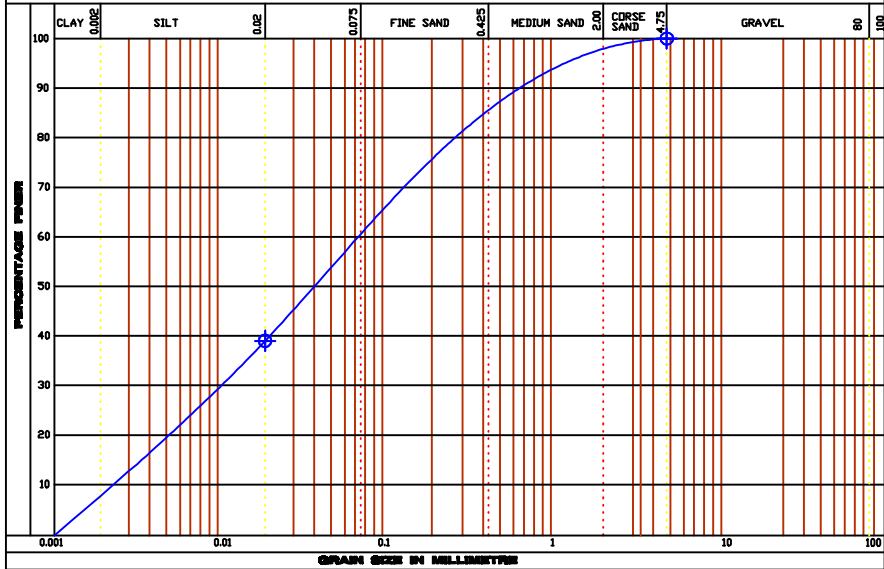


LOCATION - COAL STORAGE B.H NO- 84
DEPTH-6.00M
GRAIN SIZE DISTRIBUTION CURVE

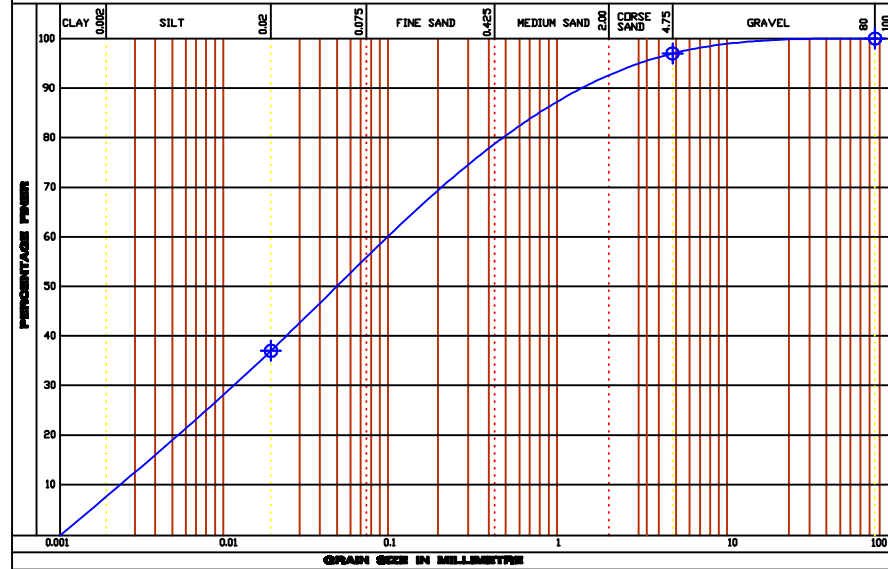


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 M.TECH (GEO TECH)
 SATYANAGAR

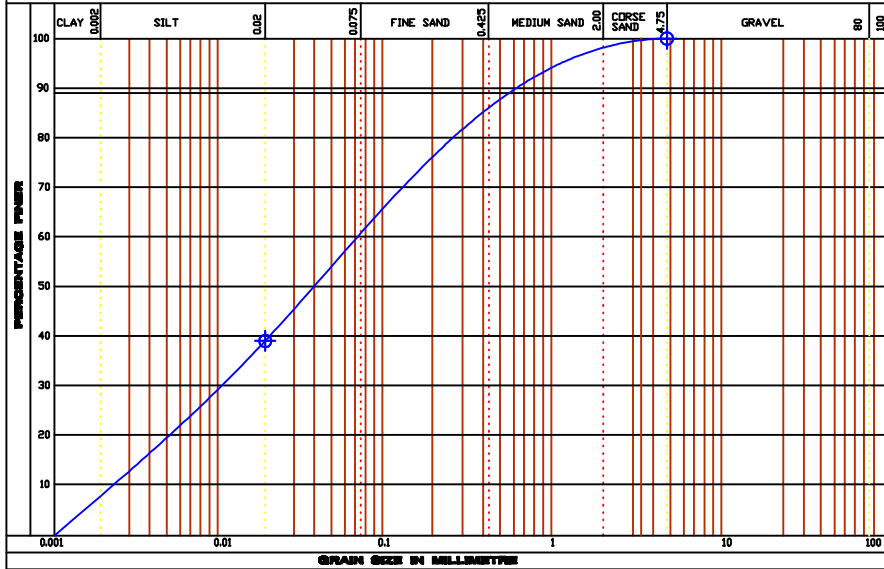
LOCATION - COAL STORAGE B.H NO- 84
DEPTH-10.00M **GRAIN SIZE DISTRIBUTION CURVE**



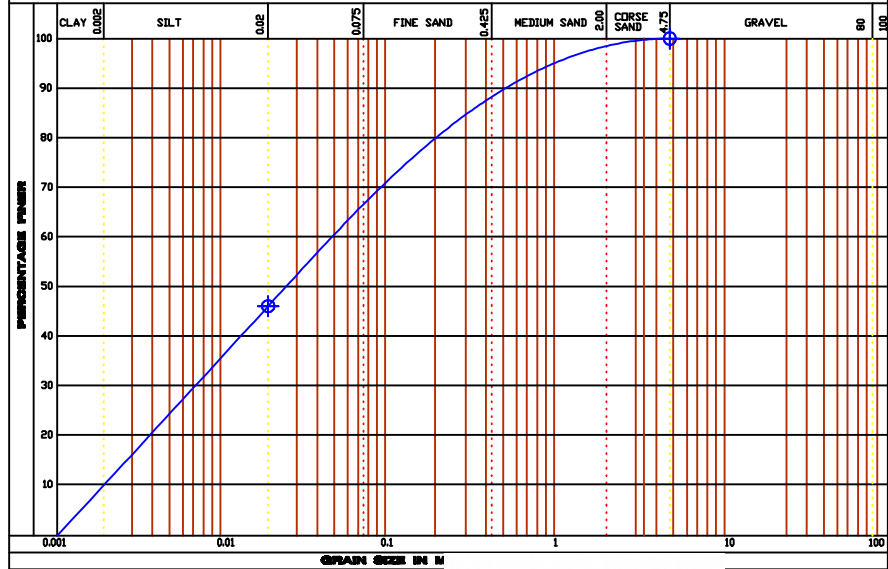
LOCATION - COAL STORAGE B.H NO- 85
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**



LOCATION - COAL STORAGE B.H NO- 86
DEPTH-10.50M **GRAIN SIZE DISTRIBUTION CURVE**

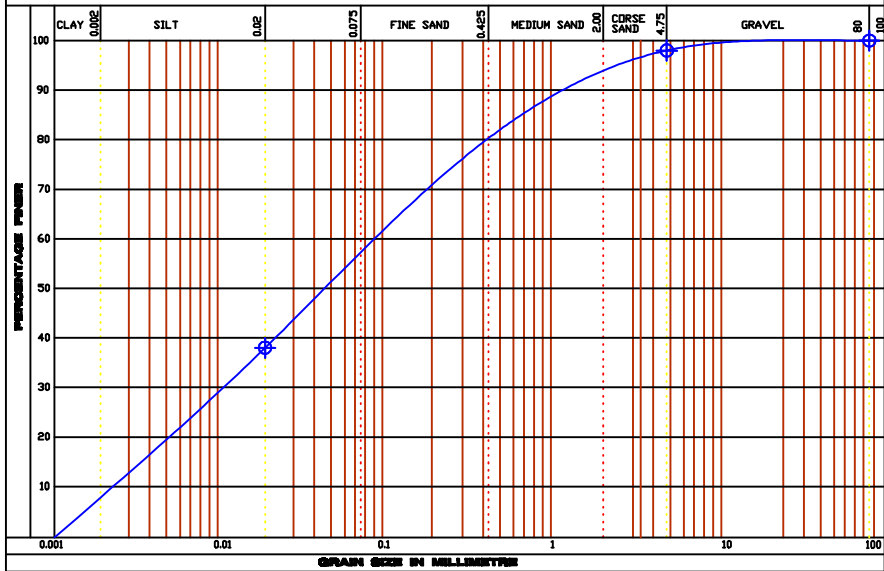


LOCATION - COAL STORAGE B.H NO- 88
DEPTH-1.50M **GRAIN SIZE DISTRIBUTION CURVE**

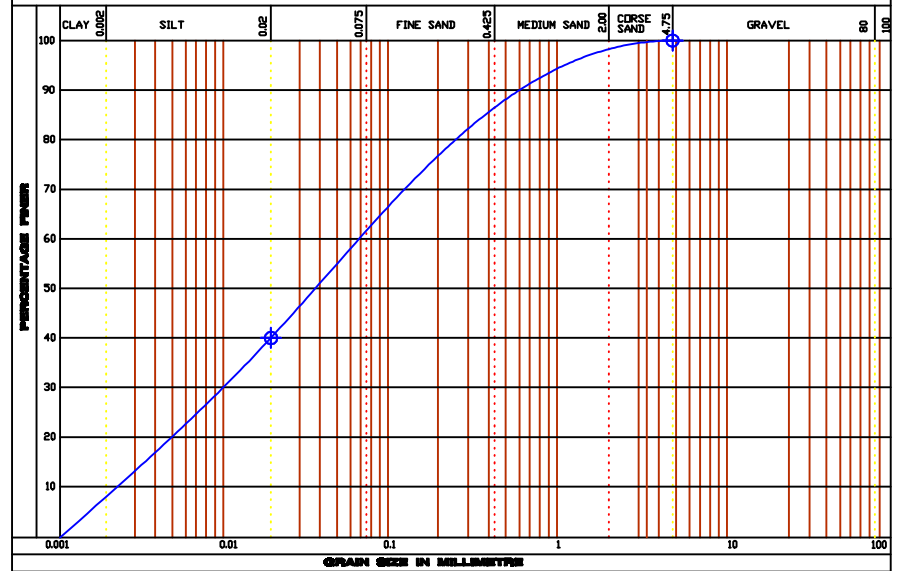



BISHWANATH KUMAR DAS.
 M.TECH (GEO TECH)
 SWAYIN & ASSOCIATES

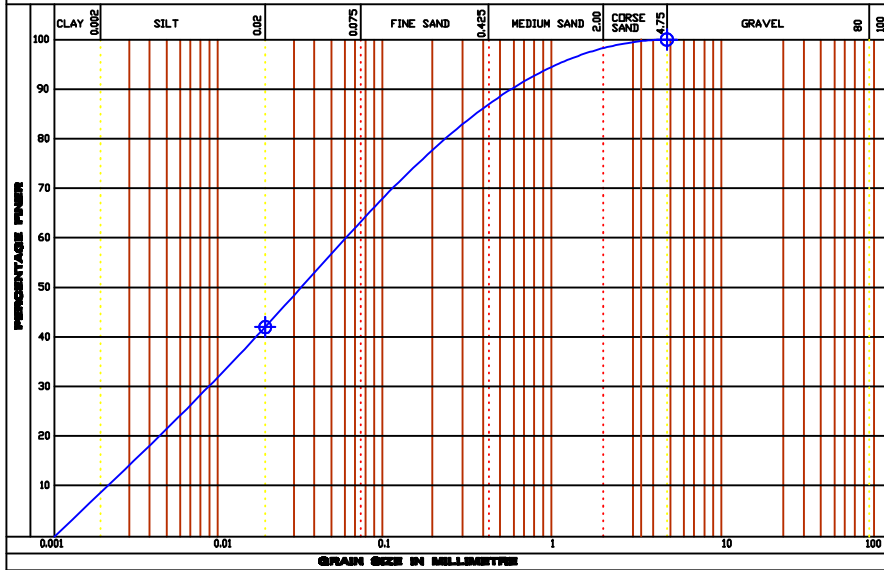
LOCATION - COAL STORAGE B.H NO- 86
DEPTH-10.50M **GRAIN SIZE DISTRIBUTION CURVE**



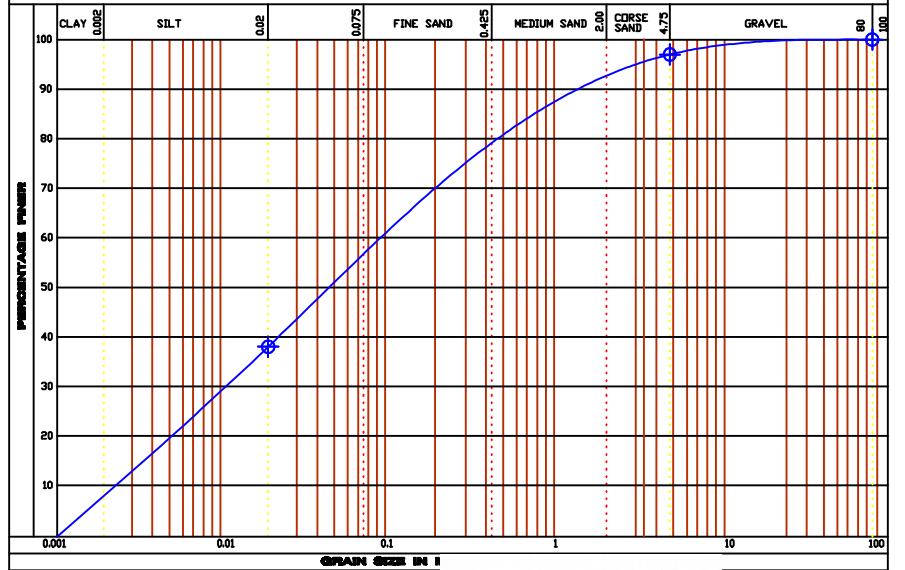
LOCATION - COAL STORAGE B.H NO- 87
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**





LOCATION - COAL STORAGE B.H NO- 87
DEPTH-10.00M **GRAIN SIZE DISTRIBUTION CURVE**

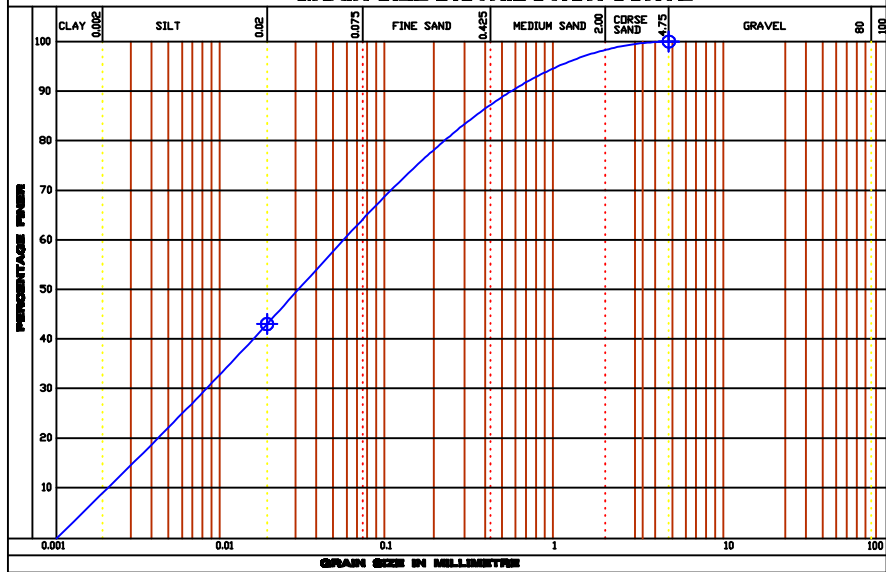


LOCATION - COAL STORAGE B.H NO- 86
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**

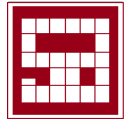



 BISHWAJIT KUMAR DAS
 M.TECH (P&OT) (ECH)


LOCATION - COAL STORAGE **S.N NO- 88**
DEPTH-3.00M **GRAIN SIZE DISTRIBUTION CURVE**




 BISWAJIT KUMAR DAS.
 M.TECH (GEOTECH)

CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

NET SAFE BEARING CAPACITY

LOCATION:-ASU Area

BH No:- 34 to 42 & 45 to 48

SQUARE

Shape of Footing:-

Size of footing :- 3 X 3

CLAYEY SAND

Founding stratum:- 6

C	φ
1.2	24
5.3	6
0	35
0	32
0	0

THICKNESS OF 1st LAYER = 1.72 M
 THICKNESS OF 2nd LAYER = 1.84 M
 THICKNESS OF 3rd LAYER = 2.01 M
 THICKNESS OF 4th LAYER = 10.43 M
 THICKNESS OF 5th LAYER = 0 M
 FOUNDATION DEPTH = 3 M
 WIDTH OF FOOTING = 3 M

SHEAR CRITERIA:

Based on Lab. Test results -

Considering sub - stratum as cohesive

$D_f = 3 \text{ m}$
Cohesion (c) = 5.3 t/sqm
 Angle of shearing Resistance (ϕ) = 6

$N_c = 6.862$ $N_q = 1.75$ $N_\gamma = 0.604$
 $S_c = 1.3$ $S_q = 1.2$ $S_\gamma = 0.8$
 $d_c = 1.199841$ $d_q = 1$ $d_\gamma = 1$
 $i_c = 1$ $i_q = 1$ $i_\gamma = 1$
 $B = 3 \text{ m}$
 $\gamma_{sub} = 1.9 \text{ t/m}^2$
 $F = 2.5$
 $W' = 0.5$

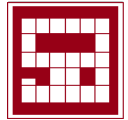
$$q_d = cN_c S_c d_c i_c + q(N_q - 1)S_q d_q i_q + .5B\gamma' N_\gamma S_\gamma d_\gamma i_\gamma W'$$

$q_d = 62.54605$

$q_s = (1/F)q_d = 25.02 \text{ t/m}^2$

where, F=Factor of safety


 BISHWANATH KUMAR DAS.
 M.TECH (PHDOTECH)
 T.L. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

SETTLEMENT CRITERIA -

Settlement of 1st layer $S1 = \lambda_1 \Delta p_1 m_{v1} H1$

$\lambda_1 = 0.7$

$\Delta p_1 = 0 \text{ T/m}^2$

$m_{v1} = 0.00095 \text{ SQ.M/T}$

$H1 = 0 \text{ m}$

$S1 = 0 \text{ mm}$

Settlement of 2nd layer $S2 = \lambda_2 \Delta p_2 m_{v2} H2 I_{F2}$

$\lambda_2 = 0.7$

$\Delta p_2 = 22.69129662 \text{ T/m}^2$

$m_{v2} = 0.002 \text{ SQ.M/T}$

$H2 = 0.56 \text{ m}$

$S2 = 17.78997655 \text{ mm}$

Settlement of 3rd layer $S3 = \Delta p_3 H3 (1 - \mu_3) / E$

$E = 3000 \text{ T/m}^2$

$\Delta p_3 = 4.164959277 \text{ T/m}^2$

$\mu_3 = 0.3$

$H3 = 2.01 \text{ m}$

$S3 = 3.790112942 \text{ mm}$

Settlement of 4th layer $S4 = \Delta p_4 H4 (1 - \mu_4) / E$

$E = 5000 \text{ T/m}^2$

$\Delta p_4 = 0.635990106 \text{ T/m}^2$

$\mu_4 = 0.3$

$H4 = 3.43 \text{ m}$

$S4 = 0.347250598 \text{ mm}$

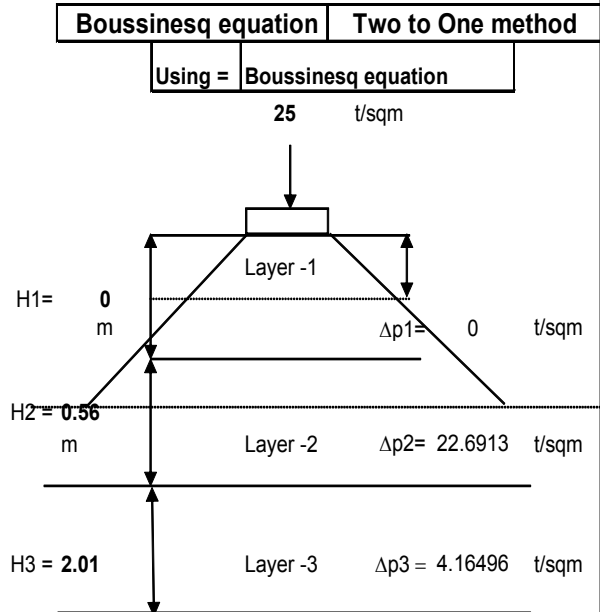
Total settlement S = $S1 + S2 + S3 + S4 + S5 = 21.92734009 \text{ mm}$

Depth correction factor = 0.74

Rigidity Factor = 1

Final Settlement Sf = 16.22623166

16.22623 mm settlement is for 25 t/sqm
 so, for 25 mm settlement ABP is = 38.52 t/sqm
 40 mm settlement ABP is = 61.63 t/sqm
 75 mm settlement ABP is = 115.55 t/sqm



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 M.TECH (GEOTECH)



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 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

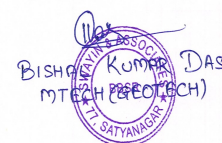
152 Design Aids in Soil Mechanics and foundation Engineering

Table 9.14 Typical Range of Values for the static Stress-strain Modulus E for Selected Soils (Field Values Depend on Stress History, Water Content,, Density, etc.)

Soil	E Kg/cm ²
Clay:	
Very soft	20-150
Soft	50-250
Medium	150-500
Hard	500-1000
Sandy	250-2500
Glacial till:	
Loose	100-1600
Dense	1500-7250
Very dense	4800-15000
Loose	150-600
Sand:	
Silty	75-250
Loose	100-250
Dense	500-850
Sand and gravel:	
Loose	500-1500
Dense	1000-2000
Shale	1500-150000
Silt	20-200

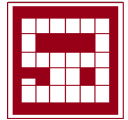
Table 9.15 Typical Range of Values for Poisson's Ratio, μ

Type of soil	μ
Clay, saturated	0.4-0.5
Clay, Unsaturated	0.1-0.3
Sandy clay	0.2-0.3
Silt	0.3-0.35
Sand (dense)	
Coarse (void ratio = 0.4-0.7)	0.2-0.4
Fine grained (void ratio =0.4-0.7)	0.15
Rock	0.25
	0.1-0.4 (depends somewhat on type of rock)
Loose	0.1-0.3
Ice	0.36
Concrete	0.15


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REFERENCE:-

* Modulus of Elastic 'E' & Poisson's Ratio are taken from the textbook 'Design Aids in Soil Mechanics and Foundation Engineering-Shenbaga R Kaniraj' pg no.152.



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SAMPLE CALCULATION OF SAFE BEARING CAPACITY (IS-6403:1981)
(FROM SHEAR PARAMETER)

BH No:-34 to 42 & 45 to 48

Zone-01

Shape of footing:-Square

Size of footing: 3 x 3m

Depth of footing: 3.00m

Founding Stratum: - Clayey sand

Average Thickness of 1st Layer:-1.72 m

Average Thickness of 2nd Layer:-1.88 m

Average Thickness of 3rd Layer:-2.01 m

Average Thickness of 4th Layer:-10.43 m

C = Cohesion

ϕ = Angle of shear Resistance

D_f = Depth of foundation

B = Width of footing

N_c, N_q, N_γ = Bearing Capacity Factor

S_c, S_q, S_γ = Shape Factor

d_c, d_q, d_γ = Depth Factor

I_c, I_q, I_γ = Inclination Factor

γ = Bulk density

W' = Correction factor for location of water table

SHEAR CRITERIA AS PER IS 6403:

BASED ON LAB TEST RESULTS :

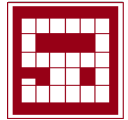
Considering sub - stratum as cohesive

Depth of Foundation D_f = 3.00 m

Cohesion (c) = 1.20 t/sqm (from shear parameter)

Angle of Shearing Resistance (ϕ) = 24 (from shear parameter)


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JOB No: TLD/2020-03

BEARING CAPACITY FACTOR

(As per IS 6403-1981 Class 5.1.2.2 page no 8)

$$So, Nc= 6.862 \quad Nq= 1.75 \quad N\gamma= 0.604$$

SHAPE FACTOR

(As per IS 6403-1981 Table No-02 page no 8)

For Square Footing

$$Sc= 1.30 \quad Sq= 1.2 \quad S\gamma= 0.80$$

DEPTH FACTOR

As per IS 6403-1981 page no 9)

$$dc = 1+0.2 \times (\text{depth of foundation/width of footing}) \times \tan \left(\left(\frac{\pi}{180} \right) \times (45 + (\phi/2)) \right) = 1.20$$

$$dq = dy$$

For ' ϕ ' Value > 10

$$dq = dy = 1 + 0.1 \left(\frac{Df}{B} \right) \times \left(\sqrt{\tan \left(\frac{\pi}{180} + \phi \right) \times 3.14 / 2 \times 180} \right) = 1.00$$

INCLINATION FACTOR

$$Ic = Iq = I\gamma = 1$$

(γ_{bulk}) 1.90 t/sqm (As per lab test data)

Factor of Safety taken as = 2.5

$$W' = 0.50 \quad \text{Due to water table likely to rise have taken as } 0.5$$

ULTIMATE NET BEARING CAPACITY (As Per IS 6403: clause 5.1.2

(GENERAL SHEAR FAILURE)

$$q_d = cN_c S_c d_{c_i} + q(N_q - 1) S_q d_{q_i} + 0.5 B \gamma' N_\gamma S_\gamma d_{\gamma_i} W'$$

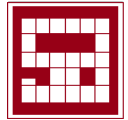
$$= 62.54 \text{ t/m}^2$$

$$q_s = (1/F) q_d$$

$$= 62.54 / 2.5$$

$$= 25.02 \text{ t/m}^2$$

(Signature)
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 M.TECH (GEOTECH)
 SATYANAGAR



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JOB No: TLD/2020-03

LOAD CARRYING CAPACITY OF PILE IN ROCK
AS PER IS 2911 (Part 1/Sec 2) : 2010

Location: ASU Area (Zone-1)

Borehole No: BH-34 to42 & 45 to48

Cut-off Level of Pile, $L_c =$ 2.0 Mtr.

After Cut-off Length of Pile, $L_p =$ 8.0 Mtr. Total Length of Pile from NGL = 10.00 Mtr.

Dia. of Pile, $B =$ 0.45 Mtr.

Length of Socket, $L =$ 3.65 Mtr. (i.e., from Weathered Rock Layer)

Safe load carrying of pile, in tones

$$Q_s = C_{u1} \cdot N_c \cdot (\pi \cdot B^2 / 4 \cdot F_s) + \alpha \cdot C_{u2} \cdot (\pi \cdot B \cdot L / F_s) \quad \text{- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)}$$

C_{u1} = Shear strength of rock below the base of the pile

C_{u2} = Average shear strength of rock along socketed length of Pile

L = Length of Socket in 'm'

Q_s = Allowable capacity of Pile

$C_{u1} = 14.00$ MPa = 1372.93 KN/m²

$C_{u2} = 16.62$ MPa = 1629.87 KN/m²

F_s = Factor of Safety taken as 3

$N_c = 9$

$\alpha = 0.9$

- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)

- Please refer Fig.3 of IS 2911 (Part 1/Sec 2)

- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)

Details of Layer I & II as per IS 2911 (Part 1/Sec 2) :

Layer No.	Thickness of Stratum (m)	Cohesion (t/m ²)	Angle of friction (ϕ°)	Density (γ)	Alpha (α)	K_f	P_{Di}	A_{si} (m ²)	Q_s
1 (NGL to 1.88m)	1.72	1.20	21	1.82	0	1	1.57	2.43	1.46 T
2 (1.88m to 3.70m)	1.84	5.30	2	1.77	1	0	5.17	2.60	13.79 T
3 (3.70m to 5.680m)	2.01	0.00	35	1.00	0	1	8.16	2.84	16.23 T
4 (5.68m to 10.00m)	4.43	0.00	35	1.00	0	1	11.97	6.26	52.47 T

Skin Friction Resistance, $Q_s =$ 53.93 T

Note: * Since the Cut-Off length of Pile has been considered as 4.00m, the thickness of stratum has been considered accordingly.

* For Cohesiveless Soils, $Q_s = K_f \cdot P_{Di} \cdot \tan \delta \cdot A_{si}$ - As per Appendix-A of IS 2911 (Part 1/Sec 2)

* For Cohesive Soils, $Q_s = \alpha \cdot C \cdot A_{si}$ - As per Appendix-B of IS 2911 (Part 1/Sec 2)

Allowable End Bearing Component = $C_{u1} \cdot N_c \cdot (\pi \cdot B^2 / 4 \cdot F_s)$
 = 655.07 KN

Allowable Shear Component = $\alpha \cdot C_{u2} \cdot (\pi \cdot B \cdot L / F_s)$
 = 2523.06 KN

Allowable Capacity of Pile, Q_s in Compr. = **374.92 T**

Ultimate Uplift Load Carrying capacity = (Shear Comp. + Skin Friction + Weight of Pile) - As per clause no.6.3.2 of IS 2911 (Part 1/Sec 2)

Allowable Uplift Load Carrying capacity = **122.01 T** - (Unit wt. of pile as 15KN/m³)

Allowable Load Carrying capacity in Lateral = Modulus of Sub Grade Reaction = 10.00 MN/m³ - From Table-3 of IS 2911 (Part 1/Sec 2)

Length of pile above GL $L_1 =$ 0.00 m

Grade of concrete $f_{ck} =$ 35.00 N/mm²

Modulus of Elasticity of Concrete, $E =$ $5000 \sqrt{f_{ck}}$
 = 29580 N/mm²
 = 29580 MN/m²

Moment of Inertia of Pile, $I =$ $\pi D^4 / 64$
 = 0.0020 m⁴

Pile Stiffness, $T =$ $(EI / \eta h)^{1/5}$ - From Clause C-2.3.2 of IS 2911 (Part 1/Sec 2)
 = 1.562 m

$L_1 / T =$ 0.00 m

$L_f / T =$ 2.20

Length of Fixity $L_f =$ 343.66 cm - From Fig 4 - IS 2911 (Part 1/Sec 2)

$Y =$ $Q(L_1 + L_f)^3 / 12EI$ - (For Fixed Head) as per IS 2911 (Part 1/Sec 2)

$Y =$ 0.50 cm = 0.005 m

$L_1 =$ 0.00 cm = 0.00 m

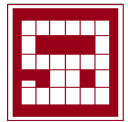
$L_f =$ 343.66 cm = 3.437 m

$0.005 =$ $Q(0 + 6.110)^3 / (12 \cdot 29580 \cdot 0.0201)$

$Q =$ 0.08802 MN

Allowable Load Carrying capacity in Lateral = **8.80 T**


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 SATYANAGAR



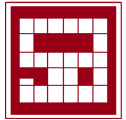
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CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES**

JOB No: TLD/2020-03

SITE PHOTOGRAPHS



Biswajit Kumar Das
BISHWAJIT KUMAR DAS.
M.TECH (P&OT/TECH)
SAYANAGAR



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 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
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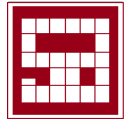
JOB No: TLD/2020-03



BISHW KUMAR DAS
 M.TECH (GEOTECH)
 T.L. SATYANAGAR

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CLIENT: M/S TALCHER FERTILIZERS LIMITED.
CONTRACTOR: M/S WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: M/S SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

INTRODUCTION


M/s Swayin & Associates has awarded to conduct the Soil Investigation Works, Survey works of coal gasification & ammonia urea plant, Talcher, Odisha, India for M/s Talcher Fertilizers Limited for the proposed construction structures, Industrial plant, Building, Boundary wall etc. located at Talcher in Odisha. This report provides the results of the geotechnical investigation conducted at Gas cleaning unit area Location of Talcher for TFL.

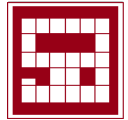
The geotechnical Investigation was completed and provides accurate detailed data of soil conditions of Proposed Area at Talcher under Talcher Fertilizers limited.

Through correspondence with the WUHUAN ENGINEERING CO.,LTD. The investigation was intended to assist in determining the most appropriate method for the development of construction structures, Industrial plant, Building, Boundary wall etc.

The work was completed in accordance with the proposal as per LOI No: WUHUAN/SWAYIN/SOIL/TFL/2020: DTD.03.01.2020.

This report has been prepared specifically and solely for the project described herein. It contains the Geotechnical Investigation and provides the observations and Recommendations for the proposed Gas cleaning unit at Talcher, Odisha under M/s Talcher Fertilizers limited.


BISWAJIT KUMAR DAS.
MTECH (GEOTECH)

CLIENT: M/S TALCHER FERTILIZERS LIMITED.
CONTRACTOR: M/S WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: M/S SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

1. **GENERAL INFORMATION ABOUT THE FIELD INVESTIGATION, INCLUDING EQUIPMENTS, METHODS, PERSONNEL, COMMENTS:**

a) **General Data:**

Name of Owner: M/s Talcher Fertilizers Limited.

Name of Contractor: Wuhan Engineering Co., Ltd.

Name of Sub-Contractor: M/s Swayin & Associates.

Name of Project: Detailed soil Investigation Works, Survey works of coal gasification & ammonia urea plant, Talcher, Odisha, India.

LOI No: WUHUAN/SWAYIN/SOIL/TFL/2020: DTD.03.01.2020

Description of Work: To execute/ providing services for soil investigation & allied works at TFL's Coal gasification, Ammonia & Urea unit for Gas cleaning unit in Talcher.


BISHWAJIT KUMAR DAS.
MTECH (GEOTECH)
SWAYIN & ASSOCIATES
P.L. SATYANAGAR



CLIENT: M/S TALCHER FERTILIZERS LIMITED.
CONTRACTOR: M/S WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: M/S SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

LIST OF EQUIPMENTS / PERSONNEL

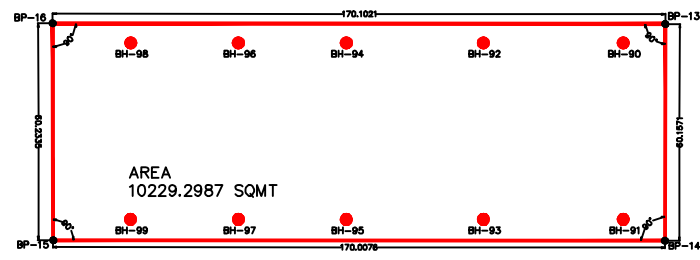
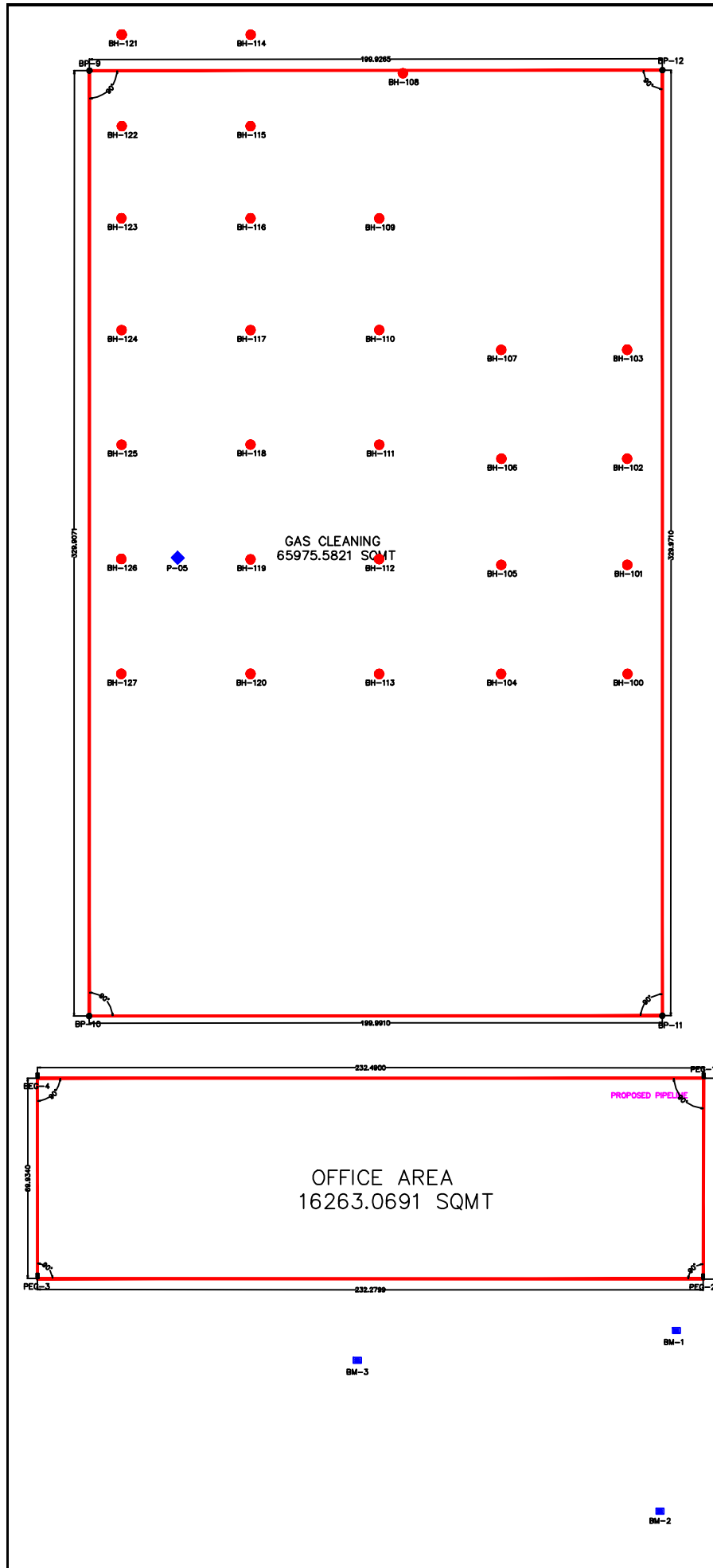
List of Equipments:

S No.	Name of the Equipments	Quantity
1.	8 HP Engine (Kirloskar)	03 no's
2.	8 HP Engine (Mahaveer)	01 no
3.	Tractor-Mounted Boring Rig	01 no
4.	Core Barrel (0.5, 1.0, 1.5mtr) NX-size Double tube	Each 05 no's
5.	Casing 4" dia.	15 no's
6.	Drilling Rod	200mtr
7.	Split Spoon Sampler	05 no's & extra 3 no's Available at site.
8.	UDS Tube	As per required
9.	UDS Lifter	05 no's
10.	Core Box	As per required
11.	SPT Hammer (63.5 kg)	05 no's
12.	Diamond Bit (NX Size)	As required
13.	TC Bit (NX Size)	As required
14.	Guide Rod	05 no's
15.	Water Pump	05 no's
16.	Hose pipe with football	05 no's
17.	Delivery pipe	05 set's
18.	Chhuri	08 no's
19.	Tool Kits	05 no's

List of Responsible Person for the Project:

S No.	Name of Personnel	Designation
1.	Shri.SambhunathSwayin	Managing Partner
2.	Mr.DharmaTeja Annam	Technical Manager
3.	Mr.Sukant Swain	Project Manager
4.	Mr.BibhuRanjanBaliarsingh	Asst. Technical Manager
5.	Mr.Deepak Kumar Sahoo	Civil Engineer
6.	Mr.SashankarDhali	Site Engineer
7.	Mr.BiswajitSahoo	Site Engineer
8.	Mr.BhabhenHalder	Site Engineer
9.	Mr.Sudev Pal	Surveyor
10.	Mr.Rajesh Das	Asst. Surveyor
11.	Duryodhan Pradhan	Site Supervisor
12.	Vijay Kumar	Site Supervisor
13.	Mr.Bijay Kumar Behera	Lab. Technician
14.	Mr.Sudhir Kumar Rout	Lab. Technician
15.	Ms.ManjulataNayak	Draftsman
16.	Mrs.Lija Rani Sethy	Draftsman


 BISHWANATH KUMAR DAS
 MTECH (METEOROL) (IIT, SATYANAGAR)

BH No.	Type	Easting	Northing	RL "M"
BH-90	Type-B	896.9385	1181.9811	94.873
BH-91	Type-D	896.9469	1132.9931	94.863
BH-92	Type-D	858.1320	1181.9811	94.897
BH-93	Type-D	858.1429	1132.9931	94.777
BH-94	Type-D	820.1120	1181.9811	95.111
BH-95	Type-B	820.1092	1132.9690	94.569
BH-96	Type-D	790.1271	1181.9811	94.396
BH-97	Type-D	790.1417	1132.9931	94.314
BH-98	Type-D	760.2183	1181.9811	94.642
BH-99	Type-D	760.1571	1132.9931	94.506
BH-100	Type-D	681.3126	1044.2179	95.23
BH-101	Type-B	681.2493	1082.2574	95.138
BH-102	Type-D	681.2251	1119.2915	95.293
BH-103	Type-D	681.2221	1157.3483	95.6
BH-104	Type-D	637.2071	1044.2223	95.039
BH-105	Type-D	637.2842	1082.2633	95.148
BH-106	Type-D	637.3187	1119.3118	95.112
BH-107	Type-B	637.2671	1157.3227	95.317
BH-108	Type-B	602.9597	1253.8046	95.969
BH-109	Type-D	594.6864	1203.1335	95.582
BH-110	Type-B	594.7218	1164.2071	95.241
BH-111	Type-D	594.6999	1124.2039	95.095
BH-112	Type-D	594.6639	1084.2441	95.201
BH-113	Type-D	594.6746	1044.2245	95.033
BH-114	Type-D	549.8461	1267.2866	96.611
BH-115	Type-B	549.7791	1235.3504	95.843
BH-116	Type-D	549.8184	1203.2156	95.469
BH-117	Type-D	549.8027	1164.1960	95.363
BH-118	Type-B	549.8088	1124.2715	95.198
BH-119	Type-D	549.7990	1084.2046	95.221
BH-120	Type-D	549.7785	1044.2433	95.137
BH-121	Type-D	504.8427	1267.3083	96.827
BH-122	Type-D	504.8560	1235.3561	96.306
BH-123	Type-D	504.7799	1203.2273	95.378
BH-124	Type-D	504.8141	1164.1957	95.213
BH-125	Type-D	504.8098	1124.1918	95.163
BH-126	Type-B	504.7000	1084.3108	95.237
BH-127	Type-D	504.6934	1044.2419	95.151
P-05	PLT	523.8867	1084.2155	95.187

KEY PLAN

NTB

LEGEND

GRID LINE	=====
CONTOUR LINE	-----
PROPOSED BOUNDARY	-----
BOUNDARY POINT	●
ROAD	====
LIGHT POLE	⊥
OFFICE PILLAR	⊥
BUILDING	▭
TREE	⊕
BENCH MARK PILLAR	⊕
TBM (TEMPORARY BENCH)	⊕
BORE HOLE	●
BOUNDARY WALL	-----
POND/WATER LOGGED AREA	~~~~~
HEAP AREA	⊕

SURVEYED AREA: 287735.5671 Sqm. 71.1010 Acres
 1) AIR SEPARATION : 25799.9970 Sqmt. 6.375 Acres
 2) CMD & COAL GASIFICATION: 59704.2737 Sqmt. 14.753 Acres
 3) GAS CLEANING: 65975.5821 Sqmt. 16.3029 Acres
 4) AREA 10229.2987 Sqmt. 2.5277 Acres
TOTAL AREA 161709.151 Sqmt. 39.9586 Acres

CO-ORDINATES OF BOUNDARY POINT			
BP NO.	EASTING	NORTHING	R.L "m"
BP-1	83.4800	1165.5930	95.111
BP-2	83.4800	1050.5930	94.904
BP-3	203.4800	1050.5930	95.088
BP-4	203.4800	1265.4800	94.917
BP-5	248.4800	1145.5670	95.074
BP-6	248.4800	1045.5670	95.484
BP-7	448.4800	1045.5670	95.556
BP-8	448.4800	1145.5670	95.260
BP-9	493.4800	1124.9230	95.964
BP-10	493.4800	924.9230	95.030
BP-11	693.4800	924.9230	95.241
BP-12	693.4800	1124.9230	96.413
BP-13	908.7329	1187.2063	94.861
BP-14	908.5584	1127.0494	94.904
BP-15	738.6139	1127.1239	94.786
BP-16	738.5684	1187.4219	95.164

CO-ORDINATES OF TBM			
BM NO.	EASTING	NORTHING	R.L "m"
TBM-1	416.209	616.772	94.447

CO-ORDINATES OF BM			
BM NO.	EASTING	NORTHING	R.L "m"
BM-1	692.339	813.02	94.682
BM-2	692.619	731.991	94.532
BM-3	537.023	804.648	93.445

NOTES:-
 1. All the dimensions are in Meter unless other wise mentioned.
 2. Spot Levels and Grids are Marked at distance of 5.0mX5.0m.
 3. Contour Interval is 0.5m
 4. Survey was carried-out Bench Mark

DATE	Asst		FINAL SUBMISSION	
	INITIAL	SIGN	INITIAL	SIGN
SURVEYED BY	SURVEYED BY		SUBJECT OF REVISION	
	UP	TRM	REV	DIS
DRAWN BY	INITIAL	SIGN	INITIAL	SIGN
	CHECKED BY	APPROVED BY		

CLIENT WUHUAN ENGINEERING CO., LTD

TITLE TOPOGRAPHICAL SURVEY DRAWING

LOCATION FERTILIZER CORPORATION OF INDIA LTD, TALCHER, ANGUL DISTRICT, ORISSA

PROJECT SOIL INVESTIGATION AND TOPOGRAPHICAL SURVEY WORKS FOR CONSTRUCTION WORKS OF COAL GASIFICATION PLANT, TALCHER

SURVEYED & PREPARED BY SWAYIN & ASSOCIATES
 17, BASTI WARDHA, P.O. - ANGUL, DISTRICT - ANGUL, ORISSA

SCALE DRAWING NO. REV

1:1000 SWAYIN & ASSOCIATES TOPOGRAPHICAL SURVEY DWG-01 0

BISHWANATH KUMAR DAS

 MTECH (GEOTECH)



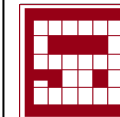
CLIENT: M/S TALCHER FERTILIZERS LIMITED.
CONTRACTOR: M/S WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: M/S SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

LOCATION DETAILS

SL No.	Location	Type of BH	BH No.	DOS	DOC	Depth of BH (mtr.)	UTM Coordinates		RL (mtr.)	GWT (mtr.)
							Easting	Northing		
1.	Gas cleaning Unit	B	BH-90	29.04.20	30.04.20	15.14	896.93	1181.98	94.873	2.10
2.		D	BH-91	29.04.20	30.04.20	11.88	896.94	1132.99	94.863	3.14
3.		D	BH-92	29.04.20	30.04.20	12.02	858.13	1181.98	94.897	2.10
4.		D	BH-93	30.04.20	01.05.20	11.17	858.14	1132.99	94.777	2.90
5.		D	BH-94	30.04.20	01.05.20	11.90	820.11	1181.98	95.111	2.95
6.		B	BH-95	30.04.20	01.05.20	15.53	820.10	1132.96	94.569	3.50
7.		D	BH-96	01.05.20	02.05.20	10.10	790.12	1181.98	94.396	3.10
8.		D	BH-97	01.05.20	02.05.20	9.95	790.14	1132.99	94.314	3.45
9.		D	BH-98	01.05.20	02.05.20	10.11	760.21	1181.98	94.642	2.90
10.		D	BH-99	02.05.20	03.05.20	10.16	760.15	1132.99	94.506	2.10
11.		D	BH-100	28.04.20	29.04.20	11.94	681.31	1044.21	95.230	2.60
12.		B	BH-101	27.04.20	28.04.20	15.20	681.24	1082.25	95.138	2.60
13.		D	BH-102	27.04.20	28.04.20	11.90	681.22	1119.29	95.293	2.50
14.		D	BH-103	27.04.20	28.04.20	11.95	681.22	1157.34	95.600	2.50
15.		D	BH-104	22.04.20	23.04.20	14.80	637.20	1044.22	95.039	2.50
16.		D	BH-105	28.04.20	29.04.20	12.03	637.28	1082.26	95.148	2.60
17.		D	BH-106	28.04.20	29.04.20	11.85	637.31	1119.31	95.112	2.60
18.		B	BH-107	26.04.20	27.04.20	15.04	637.26	1157.32	95.317	2.40
19.		B	BH-108	23.04.20	24.04.20	15.25	602.95	1253.80	95.969	2.60
20.		D	BH-109	21.04.20	22.04.20	14.05	594.68	1203.13	95.582	2.60

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T.L. SATYANAGAR



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SUB - CONTRACTOR: M/S SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

LOCATION DETAILS

SL No.	Location	Type of BH	BH No.	DOS	DOC	Depth of BH (mtr.)	UTM Coordinates		RL (mtr.)	GWT (mtr.)
							Easting	Northing		
21.	Gas cleaning Unit	B	BH-110	20.04.20	21.04.20	18.44	594.72	1164.20	95.241	2.60
22.		D	BH-111	26.03.20	26.03.20	15.69	594.69	1124.20	95.095	2.70
23.		D	BH-112	25.03.20	25.03.20	16.47	594.66	1084.24	95.201	2.10
24.		D	BH-113	22.04.20	23.04.20	15.00	594.67	1044.22	95.033	2.50
25.		D	BH-114	26.04.20	27.04.20	13.25	549.84	1267.28	96.611	2.60
26.		B	BH-115	24.04.20	25.04.20	12.00	549.77	1235.35	95.843	2.40
27.		D	BH-116	21.04.20	22.04.20	13.86	549.81	1203.21	95.469	2.60
28.		D	BH-117	20.04.20	21.04.20	14.38	549.80	1164.19	95.363	2.50
29.		B	BH-118	26.03.20	26.03.20	18.71	549.80	1124.27	95.198	2.70
30.		D	BH-119	25.03.20	25.03.20	16.21	549.79	1084.20	95.221	2.60
31.		D	BH-120	23.04.20	24.04.20	11.10	549.77	1044.24	95.137	2.70
32.		D	BH-121	26.04.20	27.04.20	12.12	504.84	1267.30	96.827	2.60
33.		D	BH-122	25.04.20	26.04.20	10.37	504.85	1235.35	96.306	2.40
34.		D	BH-123	25.04.20	26.04.20	11.90	504.77	1203.22	95.378	2.35
35.		D	BH-124	25.04.20	26.04.20	11.75	504.81	1164.19	95.213	2.40
36.		D	BH-125	24.04.20	25.04.20	10.00	504.80	1124.19	95.163	2.40
37.		B	BH-126	25.03.20	25.03.20	18.78	504.70	1084.31	95.237	2.80
38.		D	BH-127	23.04.20	24.04.20	12.00	504.69	1044.24	95.151	2.70
39.0		-	PLT-01	05.05.20	06.05.20	1.80	523.88	1084.21	95.187	2.60

* RL – Reduced Level, which also refers Natural Ground Level (NGL) of particular position?

*GWT–Ground Water Table.

* DOS – Date of Start.

* DOC – Date of Completion.

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JOB No: TLD/2020-03

Geological Information:

Talcher also named as City of Black Diamond or Coal City of Odisha is one of the fastest growing industrial and coal hubs in the state. Because of its huge coal reserves, the city has been ranked among the highest in terms of GDP in Odisha. It is also one of the 4 sub-divisions of Angul district in the Indian state of Odisha. Situated on the right bank of the river Brahmani, it is one of the fastest growing industrial and mining complexes of the country. The city is surrounded by the coalfields under MCL (Mahanadi Coalfields Limited) and has three Mega Power plants like NTPC, TTPS. Jindal power plant (FCIL), set up **Talcher** Unit over an area of 902 acre in the district of Angul, **Odisha** which is located about 126 km away from **Bhubaneswar** to produce urea using coal as feed stock. ... 1980 with Ammonia and Urea production capacity of 900 and 1500 Tons per day respectively. The "Talcher Fertilizers Limited" (TFL), a consortium of four state-run companies GAIL, CIL, RCF and FCIL was established in December 2014 to revive the Talcher unit. Joint Venture Company was incorporated on 27.10.2015 with contributing equity of GAIL, CIL and RCF being 29.67% each while FCIL retaining 10.99% equity. Projects & Development India Limited (PDIL) is the PMC for the project.

History:

A legend states that Talcher was founded in the 12th century by one of four brothers belonging to the Kachwaha Rajput dynasty of Jaipur who were on a pilgrimage to Puri; during the same journey another brother became the ruler of Bonai State and two others were killed. At the time of the British Raj Talcher was one among the 26 feudatory states of Odisha. The state's accession to the Indian Union was signed by its last ruler Hrudaya Chandra Dev Birabar on 1 January 1948.

Population Density:

As of 2011 India census, Talcher had a population of 40,841 . Males constitute 55% of the population and females 45%. Talcher has an average literacy rate of 75%, higher than the national average of 59.5%: male literacy is 80%, and female literacy is 62%. In Talcher, 12% of the population is under 6 years of age.

Climate:

The Talcher lies on 92m above sea level Talcher's climate is classified as tropical. The summers are much rainier than the winters in Talcher. According to Köppen and Geiger, this climate is classified as Aw. The average annual temperature is 27.0 °C | 80.7 °F in Talcher. About 1307 mm | 51.5 inch of precipitation falls annually.


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	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature (°C)	20.9	23.4	27.9	31.8	33.5	31.4	28.4	28.2	28.5	26.9	23.3	20.3
Min. Temperature (°C)	14	16.4	20.6	24.9	27	26.6	25.4	25.3	25.2	22.8	17.6	13.6
Max. Temperature (°C)	27.8	30.5	35.2	38.8	40	36.3	31.4	31.2	31.8	31.1	29	27.1
Avg. Temperature (°F)	69.6	74.1	82.2	89.2	92.3	88.5	83.1	82.8	83.3	80.4	73.9	68.5
Min. Temperature (°F)	57.2	61.5	69.1	76.8	80.6	79.9	77.7	77.5	77.4	73.0	63.7	56.5
Max. Temperature (°F)	82.0	86.9	95.4	101.8	104.0	97.3	88.5	88.2	89.2	88.0	84.2	80.8
Precipitation / Rainfall (mm)	10	31	32	33	50	195	293	327	224	90	19	3

Potential geology Hazards

The Project site dose not posses any type of Potential geological hazards.

Site Surface Description:

- According to the Topography of site location (Gas cleaning unit) the terrain was observed to be Sub-undulated to flat terrain.
- Due to the recent rain fall, the site location posses some patches of water logging with the depth of water 30 cm around.

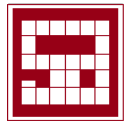
Description of above ground Obstructions:

- Since the above ground surface was leveled, there is no presence of above ground obstacles except some patches of water logging due to difference in ground levels.

b) Subsurface Conditions:

- As per the scope and contract conditions 38 no's of Boreholes were executed in this Gas cleaning unit and corresponding RL (in mtr) were recorded and tabulated in location details and log sheets.
- Center to Center distance between proposed BH positions was around 20-25m and since the BH'S were executed at closely spaced, there is no difference in soil strata inside boreholes.

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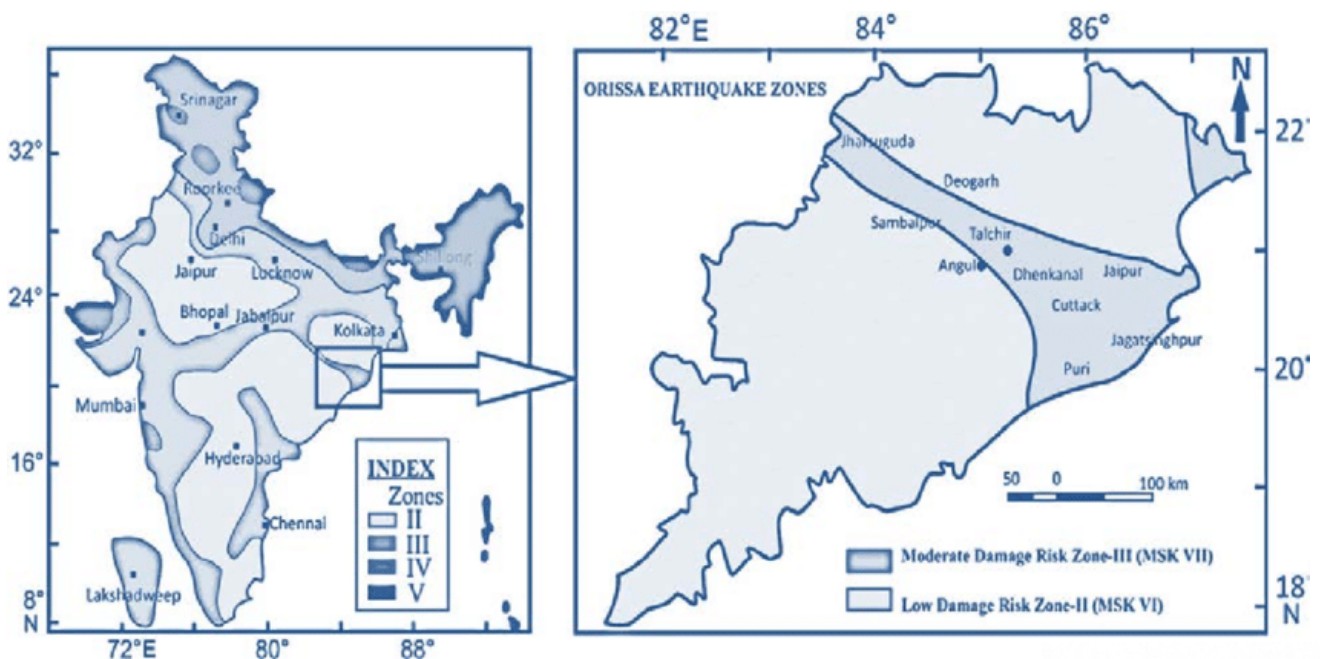
- The top surface layer consists of clayey sand which is dense to very dense in condition upto an average depth of 3.60. Mostly the ground water table was encountered in the top surface layer.
- Underlain the top layer followed by Sandstone.
- Difference in soil strata w.r. to ground levels and water table has been represented in a profile manner (please refer sub-soil profile)

Analysis & Discussion of Chemical Nature:

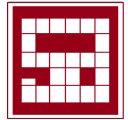
- Ground water quality is accessed on the basis of water samples collected from site. As per analysis of Ground water from the test results sulphate content is less than 400 mg/l and chloride content is less than 500 mg/l, hence the ground water may be used for construction purpose.
- The chemical analysis test result reveals that the sub-soil/ground water is not aggressive against chemical attack on sub-structures. Hence, no special precautions/remedial measures are required for underground reinforced concrete structure, steel or any other building material.

Seismic Hazard:

- As per seismic hazard map of India (refer figure below), the project site (Talcher, Odisha) lies in Moderate Damage Risk Zone-III.
- As per IS:1893 the type of soil encountered in project site is Type-I (Rock or Hard Soil Strata) as per Figure-2.



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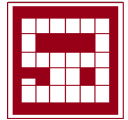
SCOPE OF WORK

The Geo-Technical Investigation consists of advancement of 38 boreholes at proposed Gas cleaning area. The boreholes were drilled up to required depths as per contract requirement and based on the level of the founding in which the foundations for the proposed structures & sub-structures, leading to their economical and safe design.

The Scope of work for the Field Investigation was as follows:

1. Advancement of 38 boreholes at the specified locations as per the tender terms & conditions.
2. Record the soil conditions encountered in the boreholes.
3. Conducting Standard Penetration test (SPT) Undisturbed sample (UDS) & disturbed (DS) soil samples from boreholes.
4. Conducting other allied activities of Soil Investigation as per tender requirement.
5. Conducting laboratory test on collected soil samples as per Bill of Quantities proposed.
6. Analysis of Field and laboratory tests data and provide geotechnical characterization of the soils encountered.
7. Preparation & Submission of the Geotechnical Investigation report, with appropriate descriptions of the existing Soil encountered in the boreholes advanced for the investigation and provide recommendations with respect to the implications for construction of Buildings and Structures etc., in Gas cleaning unit area.


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EXPLORATION TECHNIQUE

- i. Soil exploration was conducted with 150mm dia. boreholes. The bore were done with Rotary calyx technique as per IS 1892-1962. The top of the borehole is taken from the actual bed level at the time of boring. Standard Penetration tests were conducted at every required interval using Standard split spoon sampler driven by a 63.5 kg hammer with free fall height of 750 mm as per IS 2131-1963. The results are recorded and represented graphically in logs of boreholes. Disturbed sample was collected in plastic bags for visual inspection and classification of strata from all the layers as recorded in log sheets of boreholes.
- ii. Collection representative undisturbed/disturbed soil samples from the exploratory boreholes for carrying out detailed laboratory analysis, which would help finalization of design soil parameters and foundation type.
- iii. Carrying out standard penetration tests as per the provisions laid down in IS:2131-1981 in the holes and subsequently maintaining penetration chart depth-wise up to the test depth in each of the 1 nos. Exploratory bore holes at locations.

BORING METHOD

Boreholes were dug in Gas cleaning Areas as per direction of Engineer-in-charge.

The boreholes of 150mm dia. in soil & rocky strata up to the desired depth are indicating in borelog data sheet.

The boring was done by using Rotary calyx core drilling 04 no's & Tractor mount 01 no.

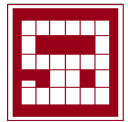
The drilling was stopped on reaching the specified depth within the layer.

CORE DRILLING (as per IS 6926:1996)

Core drilling was done where the formation encountered is too hard to be sampled by any soil sampling methods. The switching over from soil sampling method to core drilling should be normally done in accordance with the guidelines given in IS-2131:1981 and IS-2132:1986. However, the final decision should be taken by the geologist and engineer-in-charge of the site.

Casing was seated on bedrock or in a firm formation to prevent travelling of the borehole and to prevent loss of drilling fluid. Surface of the rock or hard formation at the bottom of the casing, was leveled, when necessary, using the appropriate bits. The core drilling may be carried out by an NX-size double-


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tube swivel-type core barrel approved by the engineer-in-charge. Core drilling was continued until core blockage occurs or until the net length of the core barrel has been drilled in.

The recovered core was placed in the core box with the upper (surface) end of the core. at the upper-left corner of the core box. The cores with proper markings is placed into core boxes at appropriate spacing's, with blocks. Soft or friable cores, or those which change materially upon drying, was wrapped in plastic film or seal in wax, or both as required by the engineer. Spacer blocks or slug properly marked are used to indicate any noticeable gap in recovered cores which might indicate a change or void in the formation. The fractured, bedded and/or jointed pieces of the core should be reassembled in the sequential order of their recovery before keeping the same in the core box.

Core drilling was stopped when soft materials are encountered that produce less than 50 percent recovery. If necessary, samples of soft materials were taken as per IS-2131:1981 and IS-2132:1986 in consultation with geologist or engineer-in-charge. Diamond core drilling was resumed when hard formation is again encountered.

Sub-surface structures, including the dip of strata, the occurrence of seams, fissures, cavities and broken areas are among the most important items to be detected and described. Special care was taken to obtain and record information about these features. The core samples was properly logged into the cores boxes as per IS 1892:1979.


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FIELD TEST

1. Standard Penetration Tests (as per IS.2131)

These tests were conducted by using split spoon sampler, which consists of a driving shoe, a split-barrel of circular cross-section which is longitudinally split into two parts and a coupling. IS: 2131-1981 gives the standard for carrying out the test.

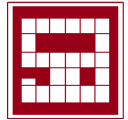
Procedure:

1. The borehole is advanced to the required depth and the bottom cleaned.
2. The split-spoon sampler, attached to standard drill rods of required length is lowered into the borehole and rested at the bottom
3. The split-spoon sampler is driven into the soil for a distance of 750mm by blows of a drop hammer (monkey) of 63.5 kg falling vertically and freely from a height of 750 mm. The number of blows required to penetrate every 150 mm is recorded while driving the sampler. The number of blows required for the last 300 mm of penetration is added together and recorded as the N value at that particular depth of the borehole. The number of blows required to effect the first 150mm of penetration, called the seating drive, is disregarded.
4. The split-spoon sampler is then withdrawn and is detached from the drill rods. The split-barrel is disconnected from the cutting shoe and the coupling. The soil sample collected inside the split barrel is carefully collected so as to preserve the natural moisture content and transported to the laboratory for tests. Sometimes, a thin liner is inserted within the split-barrel so that at the end of the SPT, the liner containing the soil sample is sealed with molten wax at both its ends before it is taken away to the laboratory.
5. The SPT is carried out at every 0.75 m vertical intervals in a borehole. This can be increased to 1.50 m if the depth of borehole is large. Due to the presence of boulders or rocks, it may not be possible to drive the sampler to a distance of 450 mm. In such a case, the N value can be recorded for the first 300 mm penetration. The boring log shows refusal and the test is halted if
 - a) 50 blows are required for any 150mm penetration
 - b) 100 blows are required for 300m penetration
 - c) 10 successive blows produce no advance.

2. Undisturbed Sample (AS PER IS - 2132)

In each borehole undisturbed sample(UDS) shall be collected at regular intervals of 3m .The starting depth of collecting UDS shall be either 2.5m (where starting depth of SPT is 1m) or 1m (where starting depth of SPT is 2.5m) depth below ground level. The starting depth shall be staggered in alternate bore-holes. Undisturbed samples shall be of 100mm diameter and 450mm length. Samples shall be collected in such a manner that the structure of soil and its moisture content do not get altered. The


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specification for the accessories required for sampling and the sampling procedure shall conform to IS: 1892 and IS:2132.

3. Disturbed Samples

Representative disturbed sample obtained from boring at every 1.5m interval in depth or change in stratum shall be placed in suitable sampling covers labeled properly for onward transmission to the laboratory. This sample shall be sent to the laboratory immediately after the boring is completed. All SPT samples shall also be similarly preserved.

4. Plate Load Test Procedure (AS PER IS 1888-1982)

Two no's of Electrical Resistivity test were conducted in the field at CMD Area to determine the resistance to flow of an electric current through the sub surface material at interval of ground surface.

LABORATORY TESTING TECHNIQUE (AS PER IS)

The soil samples collected from the boreholes were tested in the laboratory and the field tests conducted at the site. The following tests were conducted.

a. Moisture content (IS - 2720 Pt. II)

Natural Moisture contents were obtained by oven drying method and the results are tabulated in Annexure-A.

b. Bulk and dry density

The bulk and dry density with saturated and buoyant density of samples are tabulated.

c. Grain Size Distribution (IS - 2720 Pt. IV)

Both sieve size analysis and hydrometer analysis were conducted on different samples and the findings are tabulated. Grain size classification scale confirms Indian Bureau of Standards (IS:1498).

d. Specific Gravity (IS-2720 Pt.III-2)



Specific gravity values were obtained by pycnometer method/Density Bottle method and the results are tabulated.

e. Atterberg's Limits (IS - 2720 Pt. V)

The consistency limits are the water contents at which the soil mass passes from one state to another. The soil mass interaction has four states of consistency limits. The Atterberg's limits useful for engineering purposes are Liquid Limit & Plastic Limit, which are tabulated along with other index properties.

f. Direct Shear Tests - IS 2720 (Part XIII)

These tests were done on identical sandy samples by shear box apparatus which was an undrained test. Shearing force was applied by increasing the successive load until the failure takes place. The plane of shear failure was determined & the graph is attached.


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g. Tri-axial Shear Test (IS - 2720 Pt.XI)

This test was done by triaxial apparatus on all undisturbed & remolded soil samples of cylindrical shape, subjected to direct stress acting in three mutually perpendicular direction viz. Major principal stress in vertical direction and minor principal stress failure is determined. This test gives more accurate & precise result of C & Φ due to uniform stress distribution of fluid from the empirical formula ($\sigma_1 = \sigma_3 \tan^2 \Phi + 2c \tan \Phi$).

h. Void Ratio (IS-2386 Pt.III-1963)

The percentage of voids shall be calculated as follows:

$$\text{Percentage of voids} = (V_v/V_s)$$

where, V_v = Volume of Void Space ; V_s = Volume of Solids.

i. Unconfined Compression Tests (IS-2720 Pt.-X)

This was generally performed on selected cohesive soil depends on shear characteristic of the soil which can be determined from the unconfined compression test result. Effective stress parameters (C & Φ) were determined from the failure envelope.

j. Permeability Test (IS-2720 Pt.-17)

This test is to determine the permeability (hydraulic conductivity) of a sandy soil by the constant head test method.

Permeability (or hydraulic conductivity) refers to the ease with which water can flow through a soil. This property is necessary for the calculation of seepage through earth dams or under- sheet pile walls, the calculation of the seepage rate from waste storage facilities (landfills, ponds, etc.), and the calculation of the rate of settlement of clayey soil deposits.

k. Water content of Rock (IS-13030-1991)

Water contents of rock test were obtained in our laboratory by oven drying method and the results are tabulated.

l. Density of Rock (IS-13030-1991)

The density test of rock was obtained in our laboratory and the results are tabulated.

m. Porosity of Rock (IS-13030-1991)

The Porosity test of rock was obtained in our laboratory and the results are tabulated.

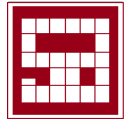
n. Permeability of Rock (IS-5229-1-1985)

The Permeability test of rock was obtained in our laboratory and the results are tabulated.

o. UCS Test of Rock (IS-9143-1-1979)

The Unconfined Compressive Strength test of rock was obtained in our laboratory and the results are tabulated.

(Signature)
 BISHWANATH DAS.
 M.TECH (GEOTECH)
 SWAYIN & ASSOCIATES
 SATYANAGAR



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CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

p. Mohr's Scale of hardness Test of Rock (IS-13630-13-2006)

The Mohr's Scale of hardness test of rock was obtained in our laboratory and the results are tabulated.

q. Shear Strength Test of Rock (IS-1121-IV-1974)

The Shear Strength test of rock was obtained in our laboratory and the results are tabulated.

r. Mineralogical & Petro logical Test of Rock (IS-2386-8-1963)

The Mineralogical & Petro logical Test rock was obtained in our laboratory and the results are tabulated.

CHEMICAL ANALYSIS OF WATER

a. pH Tests- IS 3025 (Pt.-11)

The pH value of water was determined as per IS code 3025 Part-11 and results are tabulated.

b. Chloride Tests- IS 3025 (Pt.-32)

The chloride content was tested in our laboratory as per IS code 3025 Part-32 and results are tabulated.

c. Sulphate Tests- IS 3025 (Pt.-24)

The sulphate content was tested in our laboratory as per IS code 3025 Part-24 and results are tabulated.

d. Carbonate Tests- IS 3025 (Pt.-51)

The Carbonate content was tested in our laboratory as per IS code 3025 Part-51 and results are tabulated.

e. Magnesium Test-IS 3025 (Pt.-46)

The Magnesium content was tested in our laboratory as per IS code 3025 Part-46 and results are tabulated.

f. Ammonium Test-IS 3025 (Pt.-34)

The Ammonium content was tested in our laboratory as per IS code 3025 Part-34 and results are tabulated.


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SWAYIN & ASSOCIATES
SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

DESIGN PARAMETERS

- Since the project site is having uniform Sub-Soil stratification, for Gas cleaning area boreholes has been grouped in three zones viz., Zone-01 (BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126), Zone-02 (BH-95, BH-97 to 98) & Zone-03 (BH-104, 113, 120 & 127). Based on bore logs, Field & Laboratory Test results, the following Design Soil Profile has been used for the analysis of Open Foundation and Pile Foundations:

Zone-01 (BH-90 to 94, 96, 99 to 103, 105 to 112, 114 to 119 & BH-121 to 126)

Layer No.	Stratum Description	Depth in (m)	Average 'N' Value	Thickness of Stratum (m)	Shear Parameters		Liquid Limit	Density Y_b (gm/cc)
					C (kg/cm ²)	ϕ (°)		
1	Clayey Sand	NGL to 6.15	68 to >100	6.15	0.12	25	31	1.88
2	Sandstone	6.15 to 13.40	>100	7.25	Completely to Highly Weathered – Sedimentary Rock			

* Table 1.1

Zone-02 (BH-95 & BH-97 to 98)

Layer No.	Stratum Description	Depth in (m)	Average 'N' Value	Thickness of Stratum (m)	Shear Parameters		Liquid Limit	Density Y_b (gm/cc)
					C (kg/cm ²)	ϕ (°)		
1	Filled up soil mix Boulder	NGL to 2.27	100	2.27	-	-	-	1.99
2	Clayey Sand	2.27 to 6.00	72 to > 100	3.73	0.11	26	31	1.88
3	Sandstone	6.00 to 11.86	>100	5.86	Completely to Highly Weathered – Sedimentary Rock			

* Table 1.2

Zone-03 (BH-104, 113, 120 & 127)

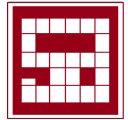
Layer No.	Stratum Description	Depth in (m)	Average 'N' Value	Thickness of Stratum (m)	Shear Parameters		Liquid Limit	Density Y_b (gm/cc)
					C (kg/cm ²)	ϕ (°)		
1	Clayey sand mix Boulder	NGL to 2.38	82	2.38	0.08	31	29	1.95
2	Clayey Sand	2.38 to 7.61	>100	5.23	0.13	26	30	1.89
3	Sandstone	7.61 to 13.23	>100	6.93	Completely to Highly Weathered – Sedimentary Rock			

* Table 1.3

Note:

Rock classification is based on RQD % of rock.

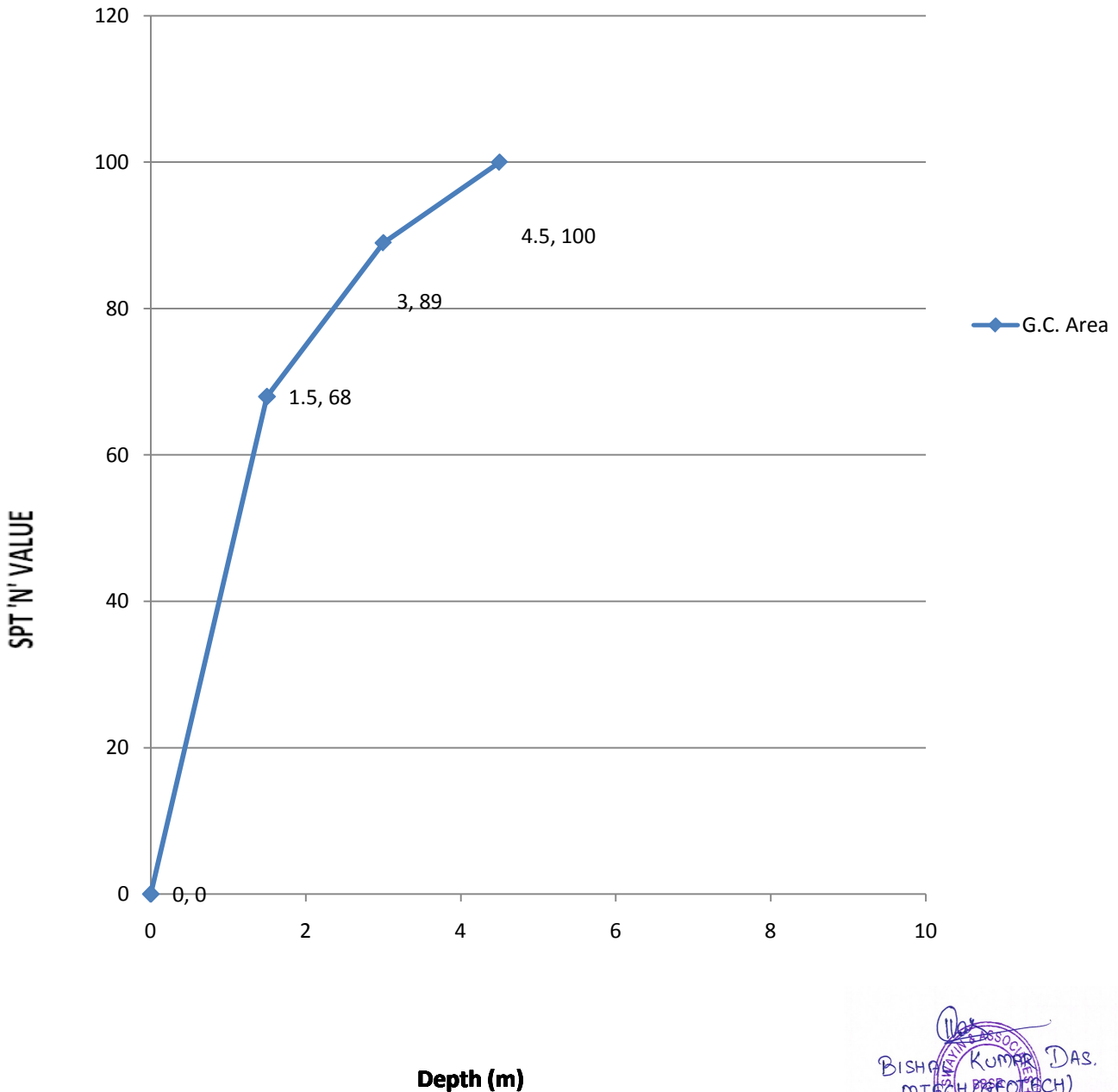

 BISHWANATH KUMAR DAS.
 M.TECH (P&E) (IIT)

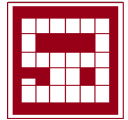
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 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Average SPT 'N' Vs Depth Gas Cleaning Area (Zone-1)



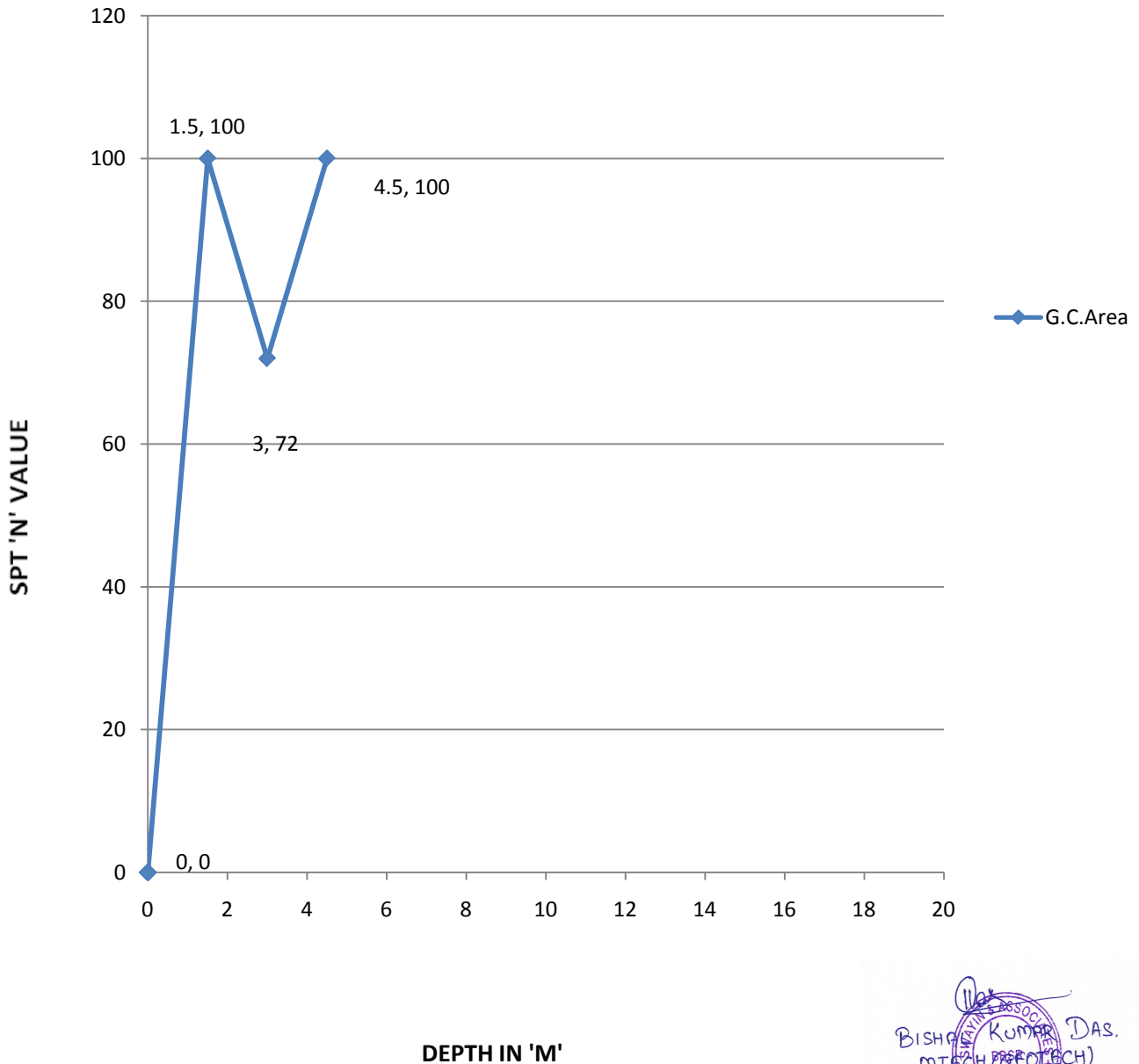
(Signature)
 BISHWANATH KUMAR DAS.
 MTECH (GEOTECH)
 SWAYIN & ASSOCIATES
 SATYANAGAR



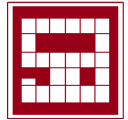
CLIENT: TALCHER FERTILIZERS LIMITED.
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Average SPT 'N' Vs Depth Gas Cleaning Area Zone-02



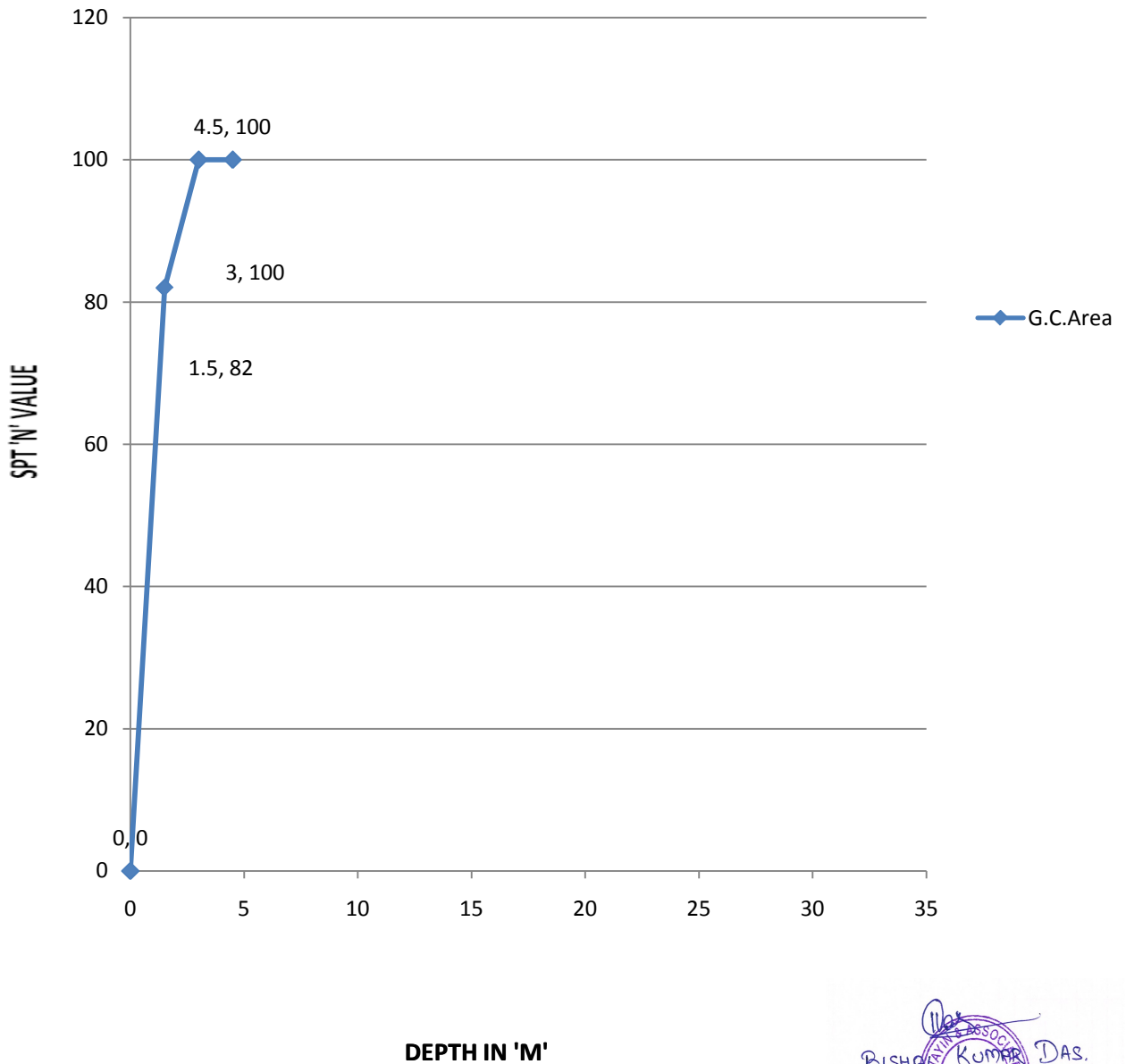
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 T.T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

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Average SPT 'N' vs Depth Gas Cleaning Area Zone-3



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CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ANALYSIS OF STRATUM

LOCATION: (Gas cleaning Area)

Zone-01(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)


Stratum	Average Depth Range (max13.40m)	'N' Value	Type of soil	State
I	0.00-6.15	68 to >100	Clayey sand	Very Dense
II	6.15-13.40	>100	Sand stone	Sedimentary Rock

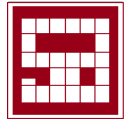
Zone-02 (BH-95, BH-97 to BH-98)

Stratum	Average Depth Range (max11.86m)	'N' Value	Type of soil	State
I	0.00-2.27	100	Filled up soil mix Boulder	Very Dense
II	2.77-6.00	72 to >100	Clayey Sand	Very Dense
III	6.00-11.86	>100	Sandstone	Sedimentary Rock

Zone-03 (BH-104, 113, 120 & 127)

Stratum	Average Depth Range (max13.23m)	'N' Value	Type of soil	State
I	0.00-2.38	82	Clayey sand mix Boulder	Very Dense
II	2.38-7.61	>100	Clayey Sand	Very Dense
III	7.61-13.23	>100	Sandstone	Sedimentary Rock


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 SWAYIN & ASSOCIATES
 TAL SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

COEFFICIENT FRICTION BETWEEN SOIL AND CONCRETE FOUNDATION:

Location-Gas cleaning Area

Zone-01

(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Description	Coefficient of friction (μ)	
	Minimum	Maximum
Clayey sand	0.35	0.45
Sand stone	0.65	0.70

Zone-02

(BH-95, BH-97 to BH-98)

Description	Coefficient of friction (μ)	
	Minimum	Maximum
Filled up soil mix Boulder	0.55	0.60
Clayey sand	0.35	0.45
Sand stone	0.65	0.70

Zone-03

(BH-104, 113, 120 & 127)

Description	Coefficient of friction (μ)	
	Minimum	Maximum
Clayey sand soil mix Boulder	0.55	0.60
Clayey sand	0.35	0.45
Sand stone	0.65	0.70


 BISHWAJIT KUMAR DAS.
 M.TECH (GEOTECH)




CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF SQUARE FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.1 the following are the analysis of safe bearing capacity in open foundation:

Zone-01(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Location	Depth in 'm'	Width of Footing in 'm'	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-1)	1.50	Up to 3.0	33.11	68.74	109.98	206.22
		>3.0 to <6.0	35.60	63.97	102.35	191.92
	2.00	Up to 3.0	38.49	66.11	105.77	198.32
		>3.0 to <6.0	40.61	60.87	97.40	182.62
	3.00	Up to 3.0	49.68	58.06	92.90	174.18
		>3.0 to <6.0	50.88	52.38	83.80	157.13
	4.00	Up to 3.0	61.46	46.24	73.99	138.72
		>3.0 to <6.0	61.49	44.75	71.60	134.26
	5.00	Up to 3.0	73.81	41.21	65.94	123.64
		>3.0 to <6.0	72.46	41.24	65.99	123.73

* Table No. 1.4

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 BISHWANATH KUMAR DAS
 MTECH (GEO TECH)
 SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF STRIP FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.1, the following are the analysis of safe bearing capacity in open foundation:

Zone-01(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-1)	1.50	5 x 1	27.81	77.85	124.57	233.56
		10 x 2	27.55	68.90	110.24	206.71
		15 x 3	28.83	61.97	99.15	185.90
		20 x 4	30.49	61.08	97.73	183.25
		25 x 5	32.30	60.69	97.10	182.07
		30 x 6	34.20	75.20	120.32	225.60
	2.00	5 x 1	33.81	75.52	120.83	226.56
		10 x 2	32.42	65.51	104.82	196.54
		15 x 3	33.32	57.69	92.30	173.07
		20 x 4	34.79	56.56	90.49	169.67
		25 x 5	36.49	56.02	89.63	168.05
		30 x 6	38.31	69.05	110.48	207.15
	3.00	5 x 1	46.90	61.98	99.17	185.95
		10 x 2	42.70	53.33	85.33	159.99
		15 x 3	42.66	49.62	79.39	148.87
		20 x 4	43.66	47.72	76.35	143.16
		25 x 5	45.08	46.77	74.83	140.31
		30 x 6	46.71	56.99	91.19	170.98
	4.00	5 x 1	61.43	49.36	78.98	148.08
		10 x 2	53.70	45.13	72.21	135.39
		15 x 3	52.48	41.19	65.90	123.57
		20 x 4	52.90	39.86	63.77	119.57
		25 x 5	53.97	38.42	61.47	115.26
		30 x 6	55.36	46.27	74.03	138.80
5.00	5 x 1	77.42	39.72	63.55	119.15	
	10 x 2	65.43	40.48	64.77	121.44	
	15 x 3	62.79	39.05	62.48	117.16	
	20 x 4	62.50	36.85	58.97	110.56	
	25 x 5	63.14	35.25	56.40	105.75	
	30 x 6	64.25	42.22	67.54	126.65	

* Table No. 1.5

(Signature)
 BISHU KUMAR DAS.
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 TILSAYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

Mat Foundation:

Zone-01(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-1)	1.50	6 x 6	37.05	78.53	125.66
		10 x 10	43.20	73.22	117.16
		15 x 15	51.19	68.86	110.17
		20 x 20	59.27	65.55	104.89
		25 x 25	67.40	62.66	100.25
		30 x 30	75.54	60.05	96.08
		12 x 6	33.49	76.73	122.77
		20 x 10	38.03	72.24	115.58
		30 x 15	43.98	68.45	109.51
		40 x 20	50.02	65.26	104.42
	2.00	50 x 25	56.10	62.43	99.89
		60 x 30	62.20	59.87	95.79
		6 x 6	41.96	73.51	117.62
		10 x 10	47.92	67.46	107.94
		15 x 15	55.82	63.04	100.87
		20 x 20	63.86	59.66	95.46
		25 x 25	71.95	56.92	91.08
		30 x 30	80.07	54.48	87.17
		12 x 6	38.36	70.96	113.54
		20 x 10	42.72	66.24	105.98
	3.00	30 x 15	48.58	62.33	99.72
		40 x 20	54.58	59.31	94.89
		50 x 25	60.63	56.65	90.65
		60 x 30	66.71	54.27	86.83
		6 x 6	51.99	63.22	101.16
		10 x 10	57.50	56.07	89.72
		15 x 15	65.16	51.71	82.74
		20 x 20	73.08	48.59	77.74
		25 x 25	81.11	46.04	73.67
		30 x 30	89.19	43.85	70.16
3.00	12 x 6	48.32	59.81	95.69	
	20 x 10	52.23	54.51	87.22	
	30 x 15	57.87	50.77	81.23	
	40 x 20	63.75	47.93	76.69	
	50 x 25	69.74	45.62	72.99	
	60 x 30	75.78	43.59	69.74	

* Table No. 1.6

(Signature)
 BISHWAIN & ASSOCIATES
 BISHWAIN KUMAR DAS.
 M.TECH (GEO TECH)
 T.L. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

Mat Foundation:

Zone-01(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-1)	4.00	6 x 6	62.32	53.02	84.83
		10 x 10	67.25	46.33	74.12
		15 x 15	74.62	41.61	66.57
		20 x 20	82.40	38.76	62.02
		25 x 25	90.34	36.51	58.42
		30 x 30	98.36	34.61	55.38
		12 x 6	58.58	49.61	79.37
		20 x 10	61.92	44.07	70.51
		30 x 15	67.27	40.58	64.94
		40 x 20	73.02	38.06	60.89
	5.00	50 x 25	78.92	35.99	57.58
		60 x 30	84.90	34.22	54.75
		6 x 6	72.94	49.27	78.83
		10 x 10	77.17	41.87	67.00
		15 x 15	84.20	36.79	58.86
		20 x 20	91.80	33.56	53.70
		25 x 25	99.63	31.19	49.90
		30 x 30	107.58	29.23	46.77
		12 x 6	69.12	45.20	72.32
		20 x 10	71.78	39.61	63.38
30 x 15	76.79	35.51	56.82		
40 x 20	82.37	32.79	52.47		
50 x 25	88.17	30.62	49.00		
60 x 30	94.08	28.79	46.07		

* Table No. 1.7


 BISHWANATH KUMER DAS.
 MTECH (P&E) (E.C.H.)




CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03


ALLOWABLE BEARING CAPACITY OF SQUARE FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.2 the following are the analysis of safe bearing capacity in open foundation:

Zone-02(BH-95 & BH-97 to98)

Location	Depth in 'm'	Width of Footing in 'm'	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-2)	1.50	Up to 3.0	44.47	58.09	92.94	174.26
		>3.0 to <6.0	52.65	53.88	86.21	161.65
	2.00	Up to 3.0	55.55	66.36	106.18	199.09
		>3.0 to <6.0	63.28	60.75	97.19	182.24
	3.00	Up to 3.0	55.44	63.38	101.40	190.13
		>3.0 to <6.0	57.15	56.46	90.34	169.39
	4.00	Up to 3.0	68.97	50.60	80.96	151.80
		>3.0 to <6.0	69.40	48.32	77.31	144.96
	5.00	Up to 3.0	83.17	48.03	76.84	144.08
		>3.0 to <6.0	82.05	47.12	75.39	141.35

* Table No. 1.8

(Signature)
 BISHWANKAR KUMAR DAS.
 MTECH (GEOTECH)




CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF STRIP FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.2 the following are the analysis of safe bearing capacity in open foundation:

Zone-02(BH-95 & BH-97 to 98)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-2)	1.50	5 x 1	34.28	62.58	100.12	187.73
		10 x 2	37.94	55.24	88.39	165.73
		15 x 3	42.81	52.36	83.78	157.09
		20 x 4	47.98	51.54	82.47	154.63
		25 x 5	53.28	51.12	81.79	153.36
		30 x 6	58.63	63.04	100.86	189.12
	2.00	5 x 1	45.51	58.41	93.45	175.22
		10 x 2	47.74	64.11	102.58	192.33
		15 x 3	52.14	57.91	92.66	173.73
		20 x 4	57.08	56.69	90.71	170.08
		25 x 5	62.23	55.90	89.44	167.69
		30 x 6	67.49	68.72	109.95	206.15
	3.00	5 x 1	52.00	52.88	84.60	158.63
		10 x 2	47.71	58.28	93.25	174.85
		15 x 3	47.93	54.17	86.67	162.50
		20 x 4	49.28	52.00	83.20	156.00
		25 x 5	51.08	50.42	80.67	151.26
		30 x 6	53.11	61.59	98.54	184.77
	4.00	5 x 1	68.56	52.88	84.60	158.63
		10 x 2	60.32	49.50	79.21	148.51
		15 x 3	59.23	45.07	72.12	135.22
		20 x 4	59.93	43.40	69.44	130.19
		25 x 5	61.33	41.48	66.37	124.45
		30 x 6	63.10	50.03	80.05	150.09
5.00	5 x 1	86.80	46.59	74.54	139.77	
	10 x 2	73.78	47.36	75.77	142.07	
	15 x 3	71.10	45.51	72.82	136.53	
	20 x 4	70.99	42.19	67.51	126.58	
	25 x 5	71.92	40.27	64.43	120.80	
	30 x 6	73.37	48.23	77.17	144.70	

* Table No. 1.9

BISHWANKAR & ASSOCIATES
 BISHWANKAR KUMAR DAS.
 M.TECH (GEO TECH)
 171 SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

Mat Foundation:

Zone-02(BH-95 & BH-97 to 98)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-2)	1.50	6 x 6	56.88	65.84	105.34
		10 x 10	74.12	62.30	99.68
		15 x 15	95.89	59.61	95.37
		20 x 20	117.72	57.67	92.27
		25 x 25	139.59	55.95	89.53
		30 x 30	161.47	54.38	87.01
		12 x 6	50.15	64.32	102.92
		20 x 10	63.00	61.46	98.34
		30 x 15	79.29	59.25	94.81
		40 x 20	95.65	57.41	91.86
	2.00	50 x 25	112.04	55.75	89.21
		60 x 30	128.44	54.22	86.75
		6 x 6	67.40	73.16	117.05
		10 x 10	84.41	67.83	108.53
		15 x 15	106.07	64.14	102.63
		20 x 20	127.85	61.38	98.20
		25 x 25	149.68	59.16	94.65
		30 x 30	171.54	57.16	91.45
		12 x 6	60.61	70.62	112.99
		20 x 10	73.24	66.60	106.56
	3.00	30 x 15	89.41	63.42	101.46
		40 x 20	105.72	61.01	97.62
		50 x 25	122.07	58.88	94.20
		60 x 30	138.45	56.93	91.09
		6 x 6	58.58	68.32	109.32
		10 x 10	65.38	61.02	97.63
		15 x 15	74.74	56.72	90.76
		20 x 20	84.37	53.69	85.91
		25 x 25	94.12	51.22	81.96
		30 x 30	103.92	49.09	78.54
3.00	12 x 6	54.36	64.63	103.41	
	20 x 10	59.22	59.32	94.91	
	30 x 15	66.12	55.69	89.11	
	40 x 20	73.28	52.97	84.75	
	50 x 25	80.56	50.75	81.21	
	60 x 30	87.88	48.80	78.08	

* Table No. 1.10

(Signature)
 BISHA KUMAR DAS.
 M.TECH (P&E) (IIT)
 SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

Mat Foundation:

Zone-02(BH-95 & BH-97 to 98)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-2)	4.00	6 x 6	70.50	57.33	91.73
		10 x 10	76.66	50.37	80.60
		15 x 15	85.69	45.53	72.86
		20 x 20	95.17	42.67	68.27
		25 x 25	104.82	40.41	64.65
		30 x 30	114.55	38.49	61.59
		12 x 6	66.20	53.64	85.83
		20 x 10	70.43	47.92	76.67
		30 x 15	77.01	44.42	71.06
		40 x 20	84.02	41.89	67.03
	5.00	50 x 25	91.20	39.82	63.72
		60 x 30	98.46	38.05	60.89
		6 x 6	82.76	56.30	90.07
		10 x 10	88.14	47.88	76.60
		15 x 15	96.78	42.10	67.35
		20 x 20	106.06	38.43	61.49
		25 x 25	115.59	35.74	57.18
		30 x 30	125.25	33.51	53.62
		12 x 6	78.37	51.64	82.62
		20 x 10	81.84	45.29	72.46
30 x 15	88.04	40.63	65.02		
40 x 20	94.86	37.55	60.08		
50 x 25	101.92	35.09	56.14		
60 x 30	109.11	33.01	52.81		

* Table No. 1.11


 BISHWANATH KUMAR DAS.
 MTECH (P&E) (IIT)
 T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF SQUARE FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.3 the following are the analysis of safe bearing capacity in open foundation:

Zone-03 (BH-104, 113, 120, 127)

Location	Depth in 'm'	Width of Footing in 'm'	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-3)	1.50	Up to 3.0	58.83	93.37	149.39	280.10
		>3.0 to <6.0	66.29	83.41	133.46	250.24
	2.00	Up to 3.0	76.99	96.96	155.14	290.89
		>3.0 to <6.0	76.99	96.96	155.14	290.89
	3.00	Up to 3.0	58.47	120.59	192.94	361.76
		>3.0 to <6.0	60.01	108.25	173.19	324.74
	4.00	Up to 3.0	72.22	98.81	158.09	296.42
		>3.0 to <6.0	72.41	95.00	152.00	285.00
	5.00	Up to 3.0	86.66	78.94	126.30	236.81
		>3.0 to <6.0	85.22	78.46	125.54	235.38

* Table No. 1.12



 BISHWANATH KUMAR DAS.

 MTECH (GEOTECH)

 SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF STRIP FOOTING FROM SHEAR PARAMETER

* Based on the design parameters tabulated in Table 1.3 the following are the analysis of safe bearing capacity in open foundation:

Zone-03 (BH-104, 113, 120, 127)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)			
			Shear Consideration	Allowable Settlement		
				25mm	40mm	75mm
Gas cleaning Area (Zone-3)	1.50	5 x 1	47.46	95.86	153.37	287.57
		10 x 2	49.44	81.52	130.44	244.57
		15 x 3	53.68	84.17	134.67	252.50
		20 x 4	58.48	79.84	127.75	239.53
		25 x 5	63.51	79.13	126.61	237.40
		30 x 6	68.66	97.99	156.78	293.96
	2.00	5 x 1	59.52	86.04	137.67	258.13
		10 x 2	59.58	88.81	142.09	266.42
		15 x 3	63.18	92.37	147.80	277.12
		20 x 4	67.66	90.29	144.47	270.88
		25 x 5	72.50	89.22	142.76	267.67
		30 x 6	77.51	109.92	175.88	329.77
	3.00	5 x 1	56.24	73.22	117.16	219.67
		10 x 2	51.35	105.10	168.15	315.29
		15 x 3	51.44	103.06	164.90	309.19
		20 x 4	52.77	98.81	158.10	296.44
		25 x 5	54.59	96.66	154.65	289.97
		30 x 6	56.67	117.60	188.16	352.79
	4.00	5 x 1	73.7	73.22	117.16	219.67
		10 x 2	64.58	97.05	155.28	291.15
		15 x 3	63.26	88.01	140.82	264.04
		20 x 4	63.88	84.85	135.76	254.56
		25 x 5	65.28	81.56	130.49	244.67
		30 x 6	67.08	98.18	157.09	294.55
5.00	5 x 1	90.77	73.22	117.16	219.67	
	10 x 2	76.81	78.42	125.47	235.25	
	15 x 3	73.82	74.80	119.68	224.40	
	20 x 4	73.57	70.16	112.26	210.48	
	25 x 5	74.41	67.06	107.29	201.17	
	30 x 6	75.81	80.43	128.69	241.30	

* Table No. 1.13

11/04
 BISHWANTHA KUMAR DAS.
 M.TECH (GEOTECH)
 T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

Mat Foundation:

Zone-03 (BH-104, 113, 120, 127)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-3)	1.50	6 x 6	70.30	102.33	163.73
		10 x 10	86.92	96.61	154.58
		15 x 15	108.10	92.18	147.49
		20 x 20	129.43	88.95	142.32
		25 x 25	150.82	86.09	137.75
		30 x 30	172.23	83.48	133.57
		12 x 6	62.58	99.98	159.97
		20 x 10	74.92	95.31	152.49
		30 x 15	90.75	91.63	146.61
		40 x 20	106.72	88.56	141.69
	2.00	50 x 25	122.74	85.79	137.26
		60 x 30	138.79	83.23	133.17
		6 x 6	80.84	117.03	187.25
		10 x 10	97.14	108.18	173.09
		15 x 15	118.17	101.94	163.11
		20 x 20	139.42	97.22	155.56
		25 x 25	160.76	93.42	149.48
		30 x 30	182.14	90.01	144.01
		12 x 6	73.05	112.97	180.75
		20 x 10	85.08	106.22	169.94
	3.00	30 x 15	100.76	100.78	161.25
		40 x 20	116.65	96.65	154.63
		50 x 25	132.62	92.98	148.77
		60 x 30	148.64	89.65	143.44
		6 x 6	61.40	130.45	208.72
		10 x 10	68.15	115.55	184.89
		15 x 15	77.51	106.42	170.27
		20 x 20	87.17	99.87	159.79
		25 x 25	96.95	94.53	151.24
		30 x 30	106.8	89.93	143.89
	12 x 6	56.97	123.40	197.44	
	20 x 10	61.77	112.34	179.74	
	30 x 15	68.66	104.49	167.18	
	40 x 20	75.84	98.52	157.63	
	50 x 25	83.14	93.66	149.85	
	60 x 30	90.5	89.40	143.03	

* Table No. 1.14


 BISHWANATH KUMAR DAS
 M.TECH (GEO TECH)
 SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY OF MAT FOOTING FROM SHEAR PARAMETER

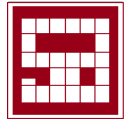
Mat Foundation:

Zone-03 (BH-104, 113, 120, 127)

Location	Depth in 'm'	Width of Footing in 'm' (L x B)	Net Safe Bearing Capacity (t/m ²)		
			Shear Consideration	Allowable Settlement	
				25mm	40mm
Gas cleaning Area (Zone-3)	4.00	6 x 6	73.46	112.51	180.01
		10 x 10	79.53	98.18	157.09
		15 x 15	88.55	88.05	140.88
		20 x 20	98.05	81.92	131.07
		25 x 25	107.73	77.07	123.31
		30 x 30	117.51	72.98	116.77
		12 x 6	68.94	105.27	168.43
		20 x 10	73.08	93.39	149.42
		30 x 15	79.64	85.89	137.42
		40 x 20	86.66	80.43	128.69
		50 x 25	93.86	75.96	121.54
		60 x 30	101.15	72.16	115.45
	5.00	6 x 6	85.86	93.88	150.20
		10 x 10	91.12	80.26	128.41
		15 x 15	99.73	70.98	113.57
		20 x 20	109.02	65.14	104.22
		25 x 25	118.58	60.85	97.36
		30 x 30	128.28	57.30	91.68
		12 x 6	81.25	86.11	137.78
		20 x 10	84.60	75.92	121.47
		30 x 15	90.76	68.51	109.62
		40 x 20	97.57	63.64	101.83
		50 x 25	104.65	59.74	95.59
		60 x 30	111.86	56.44	90.30

* Table No. 1.15

(Signature)
 BISHWAKUMAR DAS.
 M.TECH (P&E) (IIT)
 T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ALLOWABLE BEARING CAPACITY FROM PLATE LOAD TEST

Location:- Coal Gas Cleaning Area

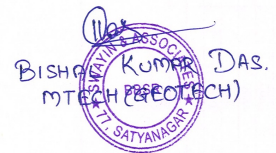
Location	PLT No	Depth in (m)	Plate Size (m)	Footing size (m)	Allowable pressure from PLT graph(when st=25mm)	Allowable pressure from PLT graph(when st=40mm)
					For 25mm	For 40mm
Coal Gas Cleaning	05	1.80	0.50	1	76.25	162.43
				2	58.34	158.81
				3	44.16	131.39
				4	32.47	101.15
				5	27.85	89.23

* Table No. 1.16

- ❖ The Recommended value for the foundation at a depth 1.80 m depth footing size 3 x 3 is 44.16 T/m² for 25 mm settlement.

As per Client required

- 2.00 m depth footing size 3 x 3 is 49.07 T/m² for 25 mm settlement
- 2.50 m depth footing size 3 x 3 is 61.33 T/m² for 25 mm settlement


 BISHU KUMAR DAS.
 MTECH (GEOTECH)
 SWAYIN & ASSOCIATES
 T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

ANALYSIS OF LOAD CAPACITIES IN PILE FOUNDATION

BORED CAST IN-SITU PILE:

- The recommended Pile Capacity of bored cast-in-situ RCC Piles for different length and diameters shall be as follows:
- Pile cut-off level is considered as 2.00m below Natural Ground Level (NGL).
- Since the soil strata in this location (Gas cleaning Area) has been possess the top soil as Clayey Sand, Filled up sand mix boulder & clayey sand mix boulder (Dense in Nature) followed by Sedimentary Rock composition, the Safe load carrying capacity of pile foundation has been tabulated as below .

Zone-01

(BH-90 to 94, BH-96, BH-99 to 103, BH-105 to 112, BH-114 to 119, BH-121 to 126)

Pile Diameter (m)	Length of Pile below Cut-Off Level (m)	Safe Load Carrying Capacity of Pile (MT)		
		Compression	Uplift / Tension	Lateral Capacity
0.45	10.00	261.45	95.25	8.80
0.50		296.33	108.78	9.78
0.60		369.60	137.61	11.74
0.75		488.26	185.26	14.67
0.80		530.14	202.33	15.65

* Table No. 1.17

Zone-02

(BH-95 & BH-97 to 98)

Pile Diameter (m)	Length of Pile below Cut-Off Level (m)	Safe Load Carrying Capacity of Pile (MT)		
		Compression	Uplift / Tension	Lateral Capacity
0.45	8.00	217.60	77.44	8.80
0.50		247.02	88.40	9.78
0.60		309.03	111.74	11.74
0.75		409.92	150.27	14.67
0.80		445.65	164.06	15.65


* Table No. 1.18

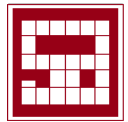
Zone-03

(BH-104, 113, 120, 127)

Pile Diameter (m)	Length of Pile below Cut-Off Level (m)	Safe Load Carrying Capacity of Pile (MT)		
		Compression	Uplift / Tension	Lateral Capacity
0.45	10.00	241.49	90.17	8.80
0.50		273.57	103.14	9.78
0.60		340.89	130.84	11.74
0.75		449.74	176.80	14.67
0.80		488.12	193.30	15.65

*Table No.1.19


 BISWANATH KUMAR DAS
 M.TECH (GEOTECH)
 T. SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

DISCUSSION AND CONCLUSION

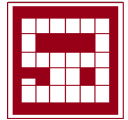
Based on the field and laboratory test results and the given recommendations the following are summarized:

Since the project Gas cleaning site is having uniform Sub-Soil stratification, boreholes has been grouped into three zones viz., Zone-1 (BH-90 to BH-94, BH-96, BH-99 to BH-103, BH-105 to BH-112, BH-114 to BH-119, BH-121 to BH-126), Zone-2 (BH-95, BH-97 to BH-98), Zone-3 (BH-104, BH-113, BH-120 & BH-127) Based on bore logs, Field & Laboratory Test results, the following Design Soil Profile has been used for the analysis of Open Foundation and Pile Foundations.

General Observation opinion:

- For Gas Cleaning area in Zone-01 the top surface layer consists of clayey sand which is very dense in condition upto an average depth of 6.15m, Undulation followed by Sand stone Rock.
- For Gas Cleaning area in Zone-02 the top surface layer consists of Filled up soil mix boulder which is very dense in condition upto an average depth of 2.27m, Undulation the top layer, there is a presence of Clayey sand with 'N' value greater than 100. The condition of soil strata is very dense upto an average depth of 6.00m followed by Sand stone.
- For Gas Cleaning area in Zone-03 the top surface layer consists of Clay sand mix boulder which is very dense in condition upto an average depth of 2.38m, Undulation the top layer, there is a presence of Clayey sand with 'N' value greater than 100. The condition of soil strata is very dense upto an average depth of 7.61m followed by Sand stone.
- Difference in soil strata w.r.to ground levels and water table has been represented in a profile manner (please refer sub-soil profile).
- At project site, it is observed that Sedimentary Rocks composition of Sandstone at deeper depths was present.
- From the analysis of rock tests, it is noted that moderate weathering is formed at entire area with sandstone (fine grained).
- Details of rock test details have been given in Annexure-B of the report.


BISHAL KUMAR DAS.
M.TECH (P&EOT) (IIT, SATYANAGAR)



CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Recommendations for Foundation consideration:

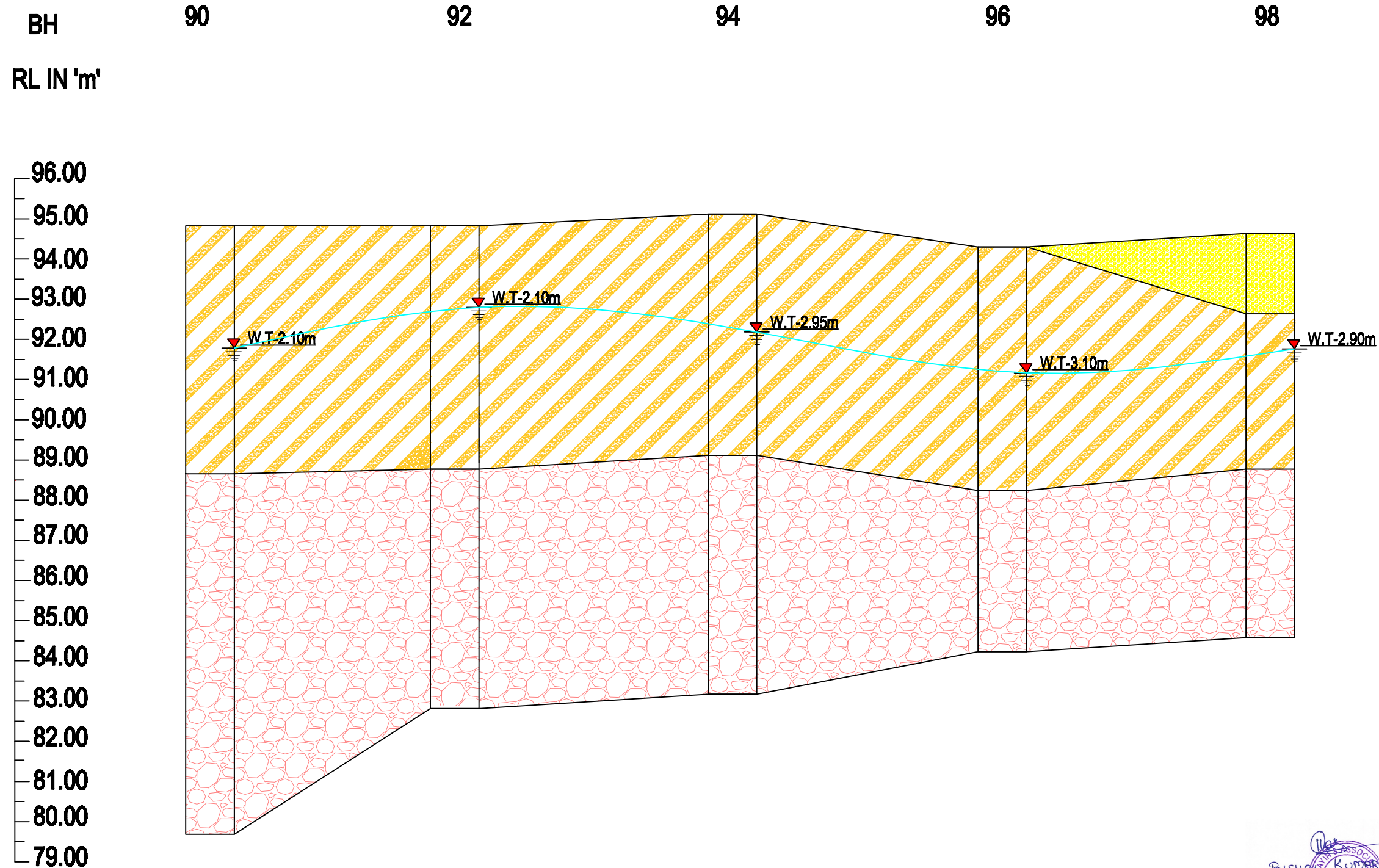
- For lightly loaded structures in Zone-01(i.e., for structure loading upto 49 t/m²) Shallow/Open foundation of footing size 3.0 x 3.0 m upto 3.00m depth may be considered, please refer TABLE:-1.4
- For lightly loaded structures in Zone-02(i.e., for structure loading upto 55 t/m²) Shallow/Open foundation of footing size 3.0 x 3.0 m upto 3.00m depth may be considered, please refer TABLE:-1.8
- For lightly loaded structures in Zone-03(i.e., for structure loading upto 58 t/m²) Shallow/Open foundation of footing size 3.0 x 3.0 m upto 3.00m depth may be considered, please refer TABLE:-1.12
- For heavy loaded structures i.e. Pile foundation please refer TABLE:- 1.17 to 1.19
- From the test results being performed (in-situ and laboratory), it is clear that there is no requirement of soil improvement in the site location. Moreover, the project site is not prone to liquefaction zone.

Suitability of the soils to be used as fill material:

- As per the laboratory test results the soil present at site location is clayey sand with slight plasticity. So it is recommended to use excavated soil as back filling material followed with layer to layer compaction up to maximum density.
- Since they will exhibit slight to no plasticity the soils can be compacted to fairly good compaction and provides good backfill and foundation support.
- For Coal Gas Cleaning Area in Zone-I the natural ground water table is available at minimum depth of 2.00m to maximum 3.00m.
- For Coal Gas Cleaning Area in Zone-II the natural ground water table is available at minimum depth of 3.00m to maximum 4.00m.
- For Coal Gas Cleaning Area in Zone-III the natural ground water table is available at minimum depth of 2.00m to maximum 1.50m.


BISHWANATH KUMAR DAS.
MTECH (GEOTECH)
SWAYIN & ASSOCIATES
SATYANAGAR

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	FILLEDUP SOIL MIX BOULDER	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-

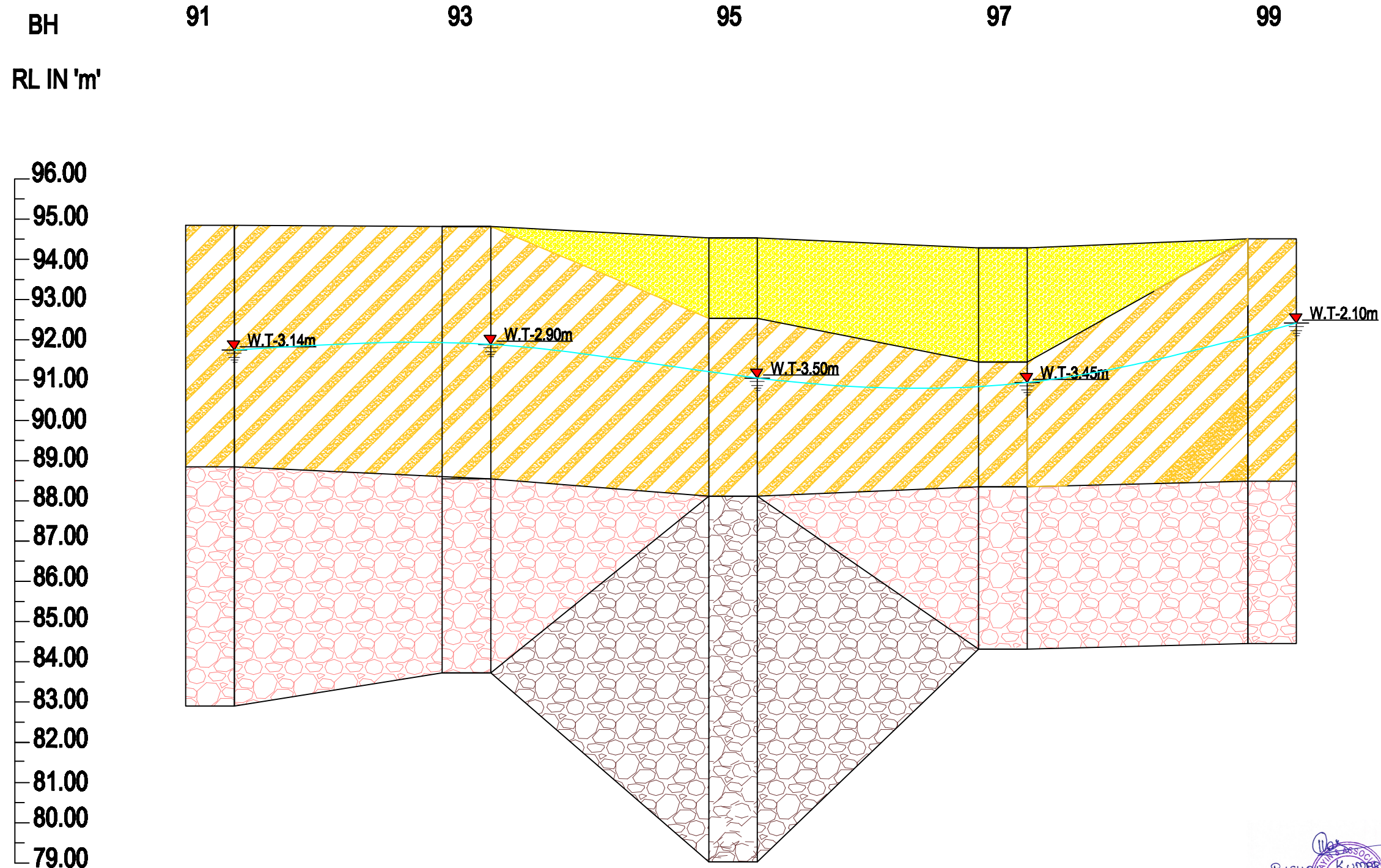
SWAYIN & ASSOCIATES .
77, SATYA NAGAR, BHUBANESWAR
PH-(0674) 2570016, 2572871

LOCATION GAS CLEANING AREA

TITLE SUB-SOIL & CROSS PROFILE

BISHWANATH KUMAR DAS
M.TECH (GEOTECH)
TALCHER, SATYANAGAR

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	FILLEDUP SOIL MIX BOULDER	
3	SAND STONE	
4	HARD SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-

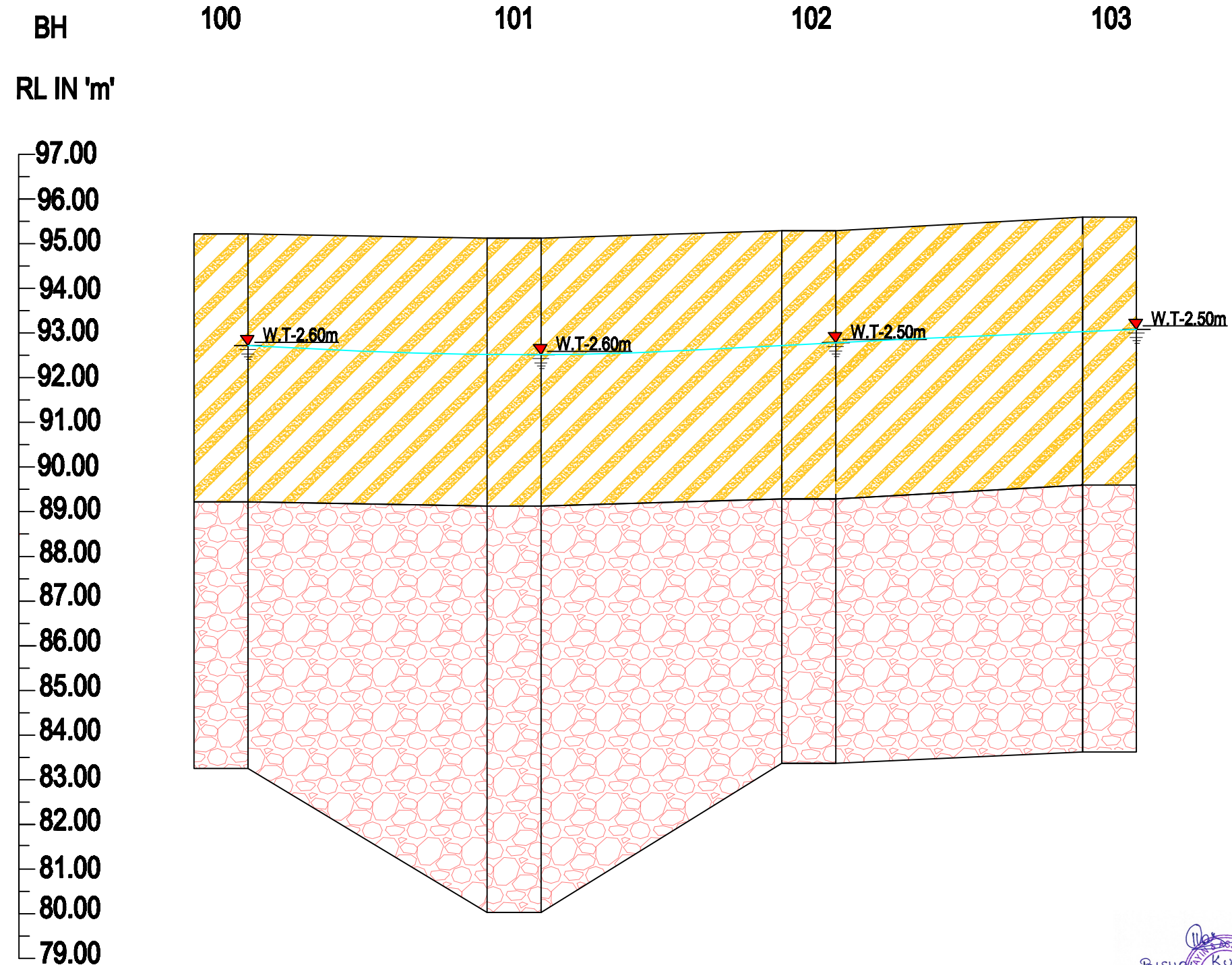
SWAYIN & ASSOCIATES .
77, SATYA NAGAR, BHUBANESWAR
PH-(0674) 2570016, 2572871

LOCATION : GAS CLEANING AREA

TITLE : SUB-SOIL & CROSS PROFILE

BISHNU KUMAR DAS
M.TECH (GEOTECH)
TALCHER, SATYANAGAR

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT :  TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-

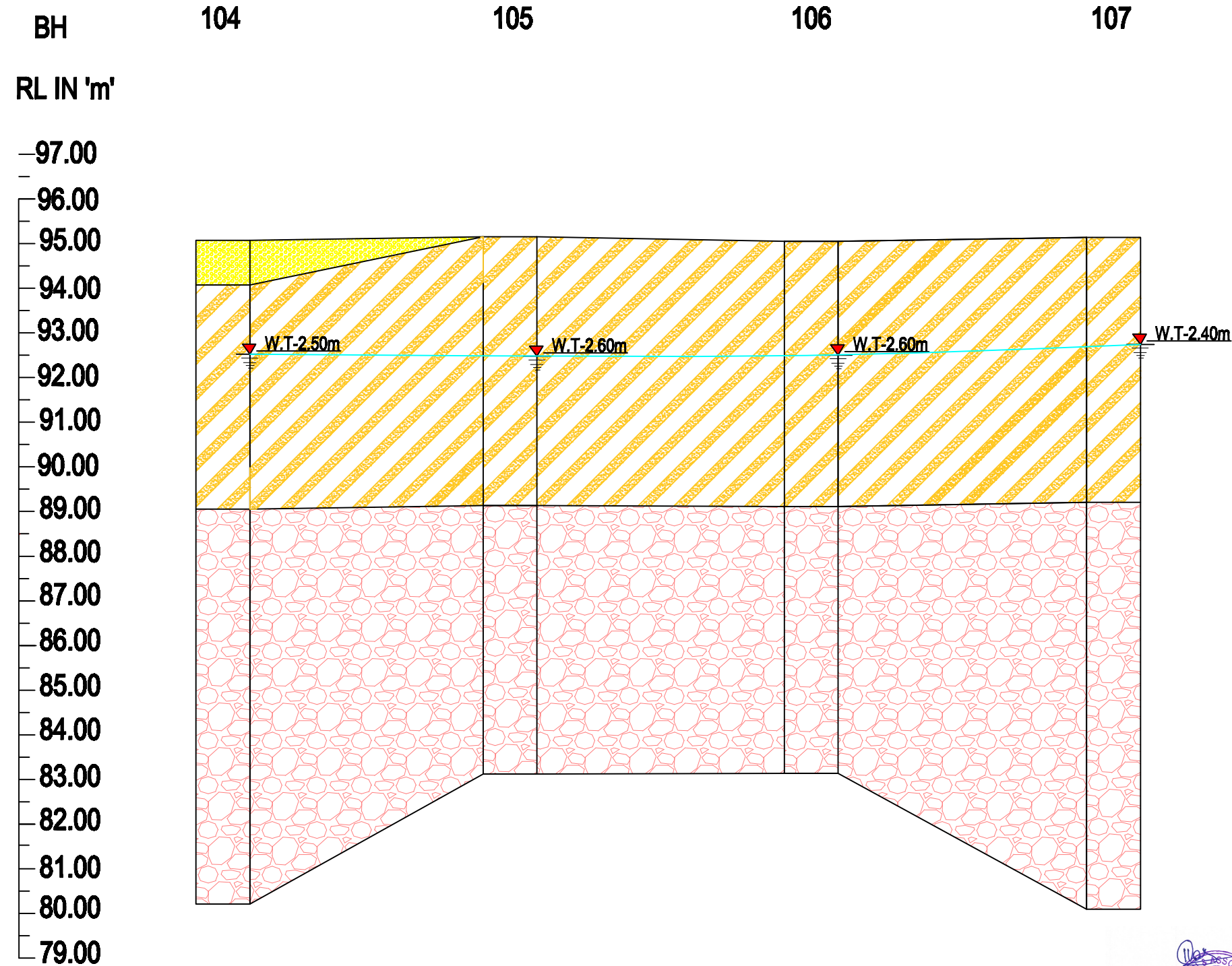
 **SWAYIN & ASSOCIATES .**
77, SATYA NAGAR, BHUBANESWAR
PH-(0674) 2570015, 2572871

LOCATION GAS CLEANING AREA

TITLE SUB-SOIL & CROSS PROFILE


BISHWANATH KUMAR DAS.
 M.TECH (P&E) (E.C.H.)


SUB-SOIL & CROSS PROFILE



LEGEND:

1	FILLEDUP SOIL MIX BOULDER	
2	CLAYEY SAND	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

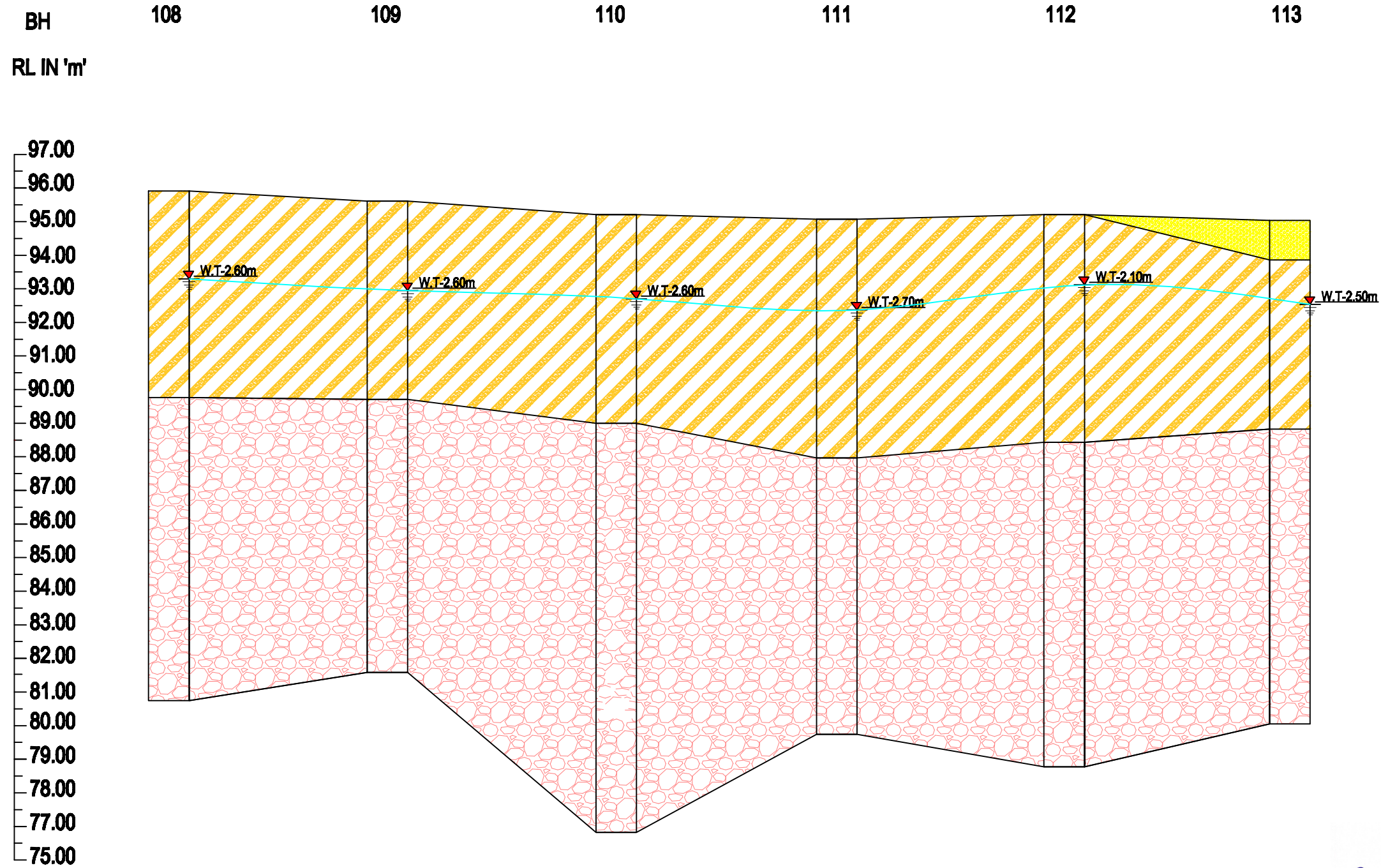
CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-
SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESWAR
 PH-(0674) 2570015, 2572871

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

BISHWANATH KUMAR DAS.
 M.TECH (P&E) (IIT, SATYANAGAR)

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	FILLEDUP SOIL MIX BOULDER	
3	SAND STONE	

NOTE: ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT: TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR: WUHUAN ENGG. CO., LTD.

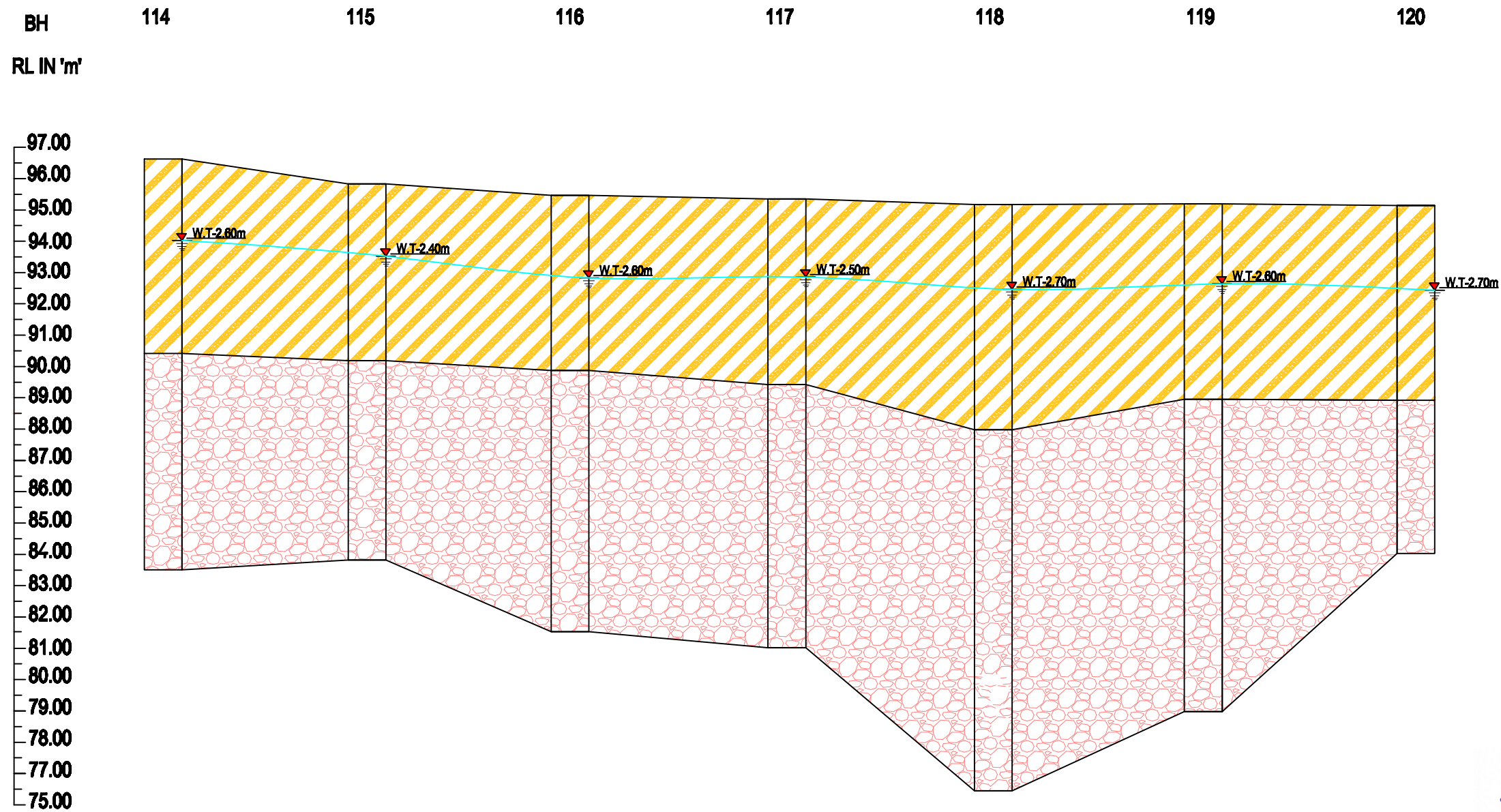
INVESTIGATED AND PREPARED BY :-

SWAYIN & ASSOCIATES.
77, SATYA NAGAR, BHUBANESHWAR
PH-(0674) 2576015, 2572871

LOCATION: GAS CLEANING AREA
TITLE: SUB-SOIL & CROSS PROFILE

BISHAL KUMAR DAS.
M.TECH (GEO TECH)
TFL, SATYANAGAR

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

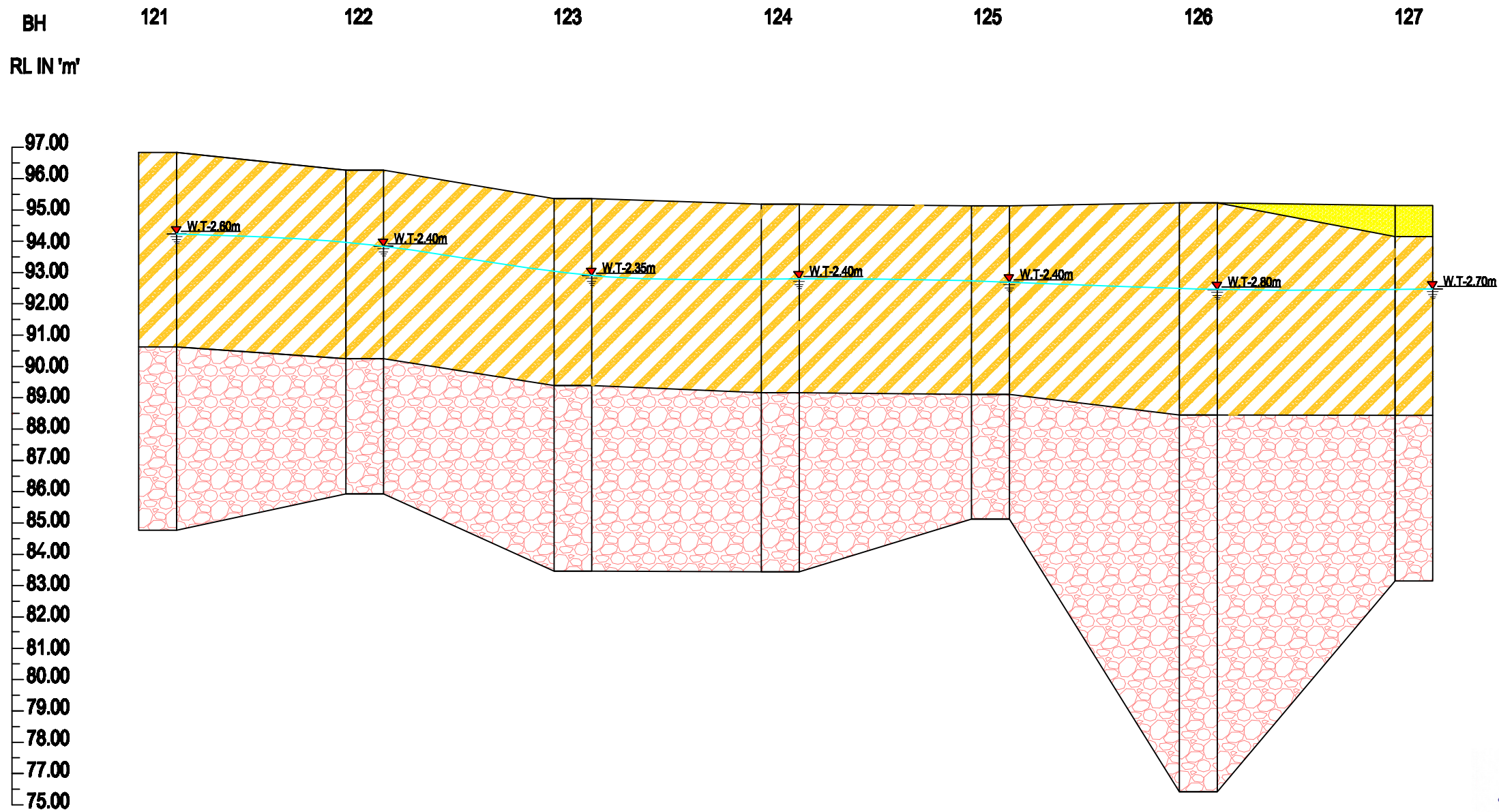
CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-
 SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESHWAR
 PH-(0674) 2570014, 2572871

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	FILLEDUP SOIL MIX BOULDER	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-

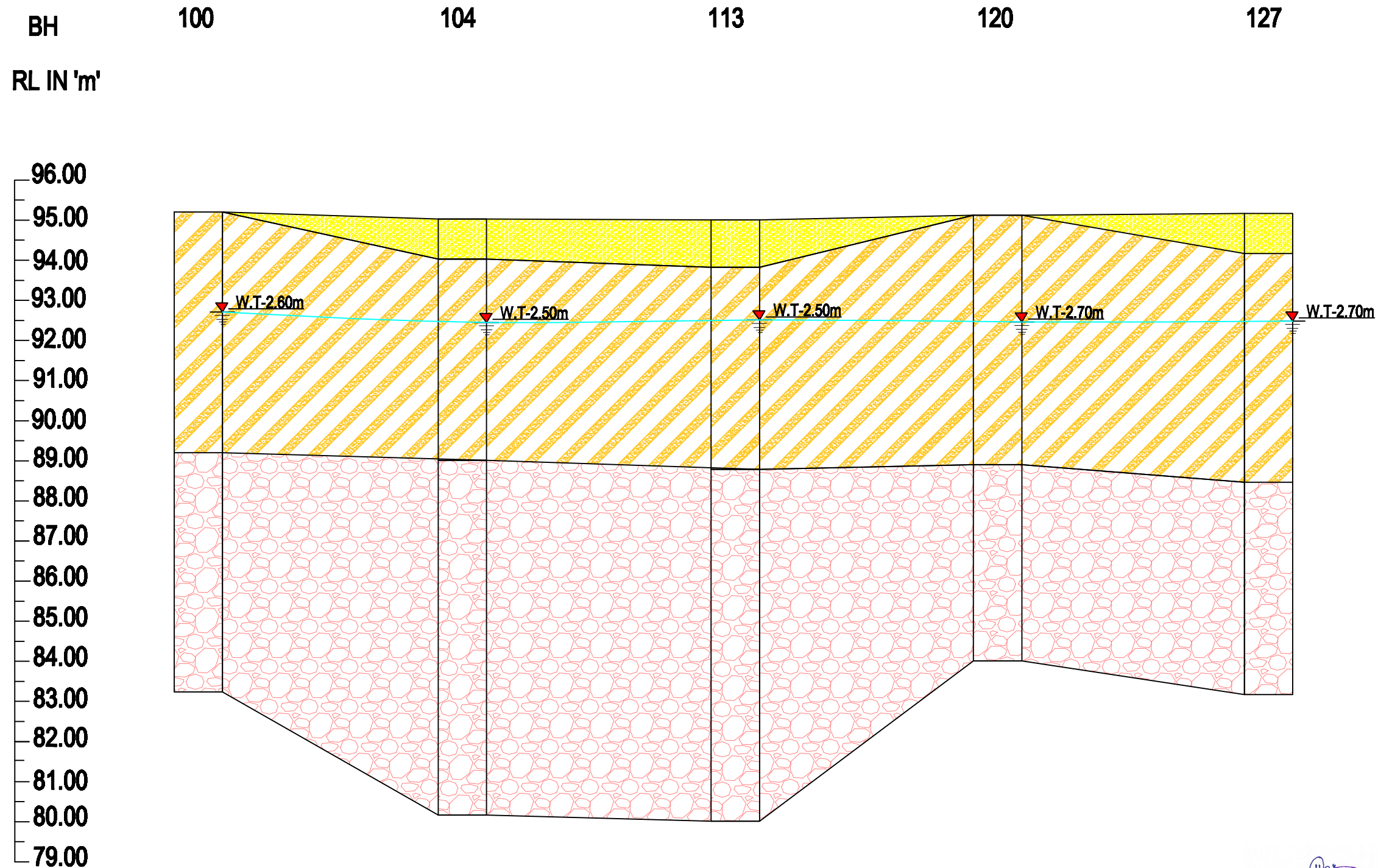
SWAYIN & ASSOCIATES .
77, SATYA NAGAR, BHUBANESHWAR
PH-(0674) 2570014, 2572871

LOCATION : GAS CLEANING AREA

TITLE : SUB-SOIL & CROSS PROFILE

BISHWANATH KUMAR DAS.
 M.TECH (P&OT, IIT KGP)

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
2	FILLEDUP SOIL MIX BOULDER	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

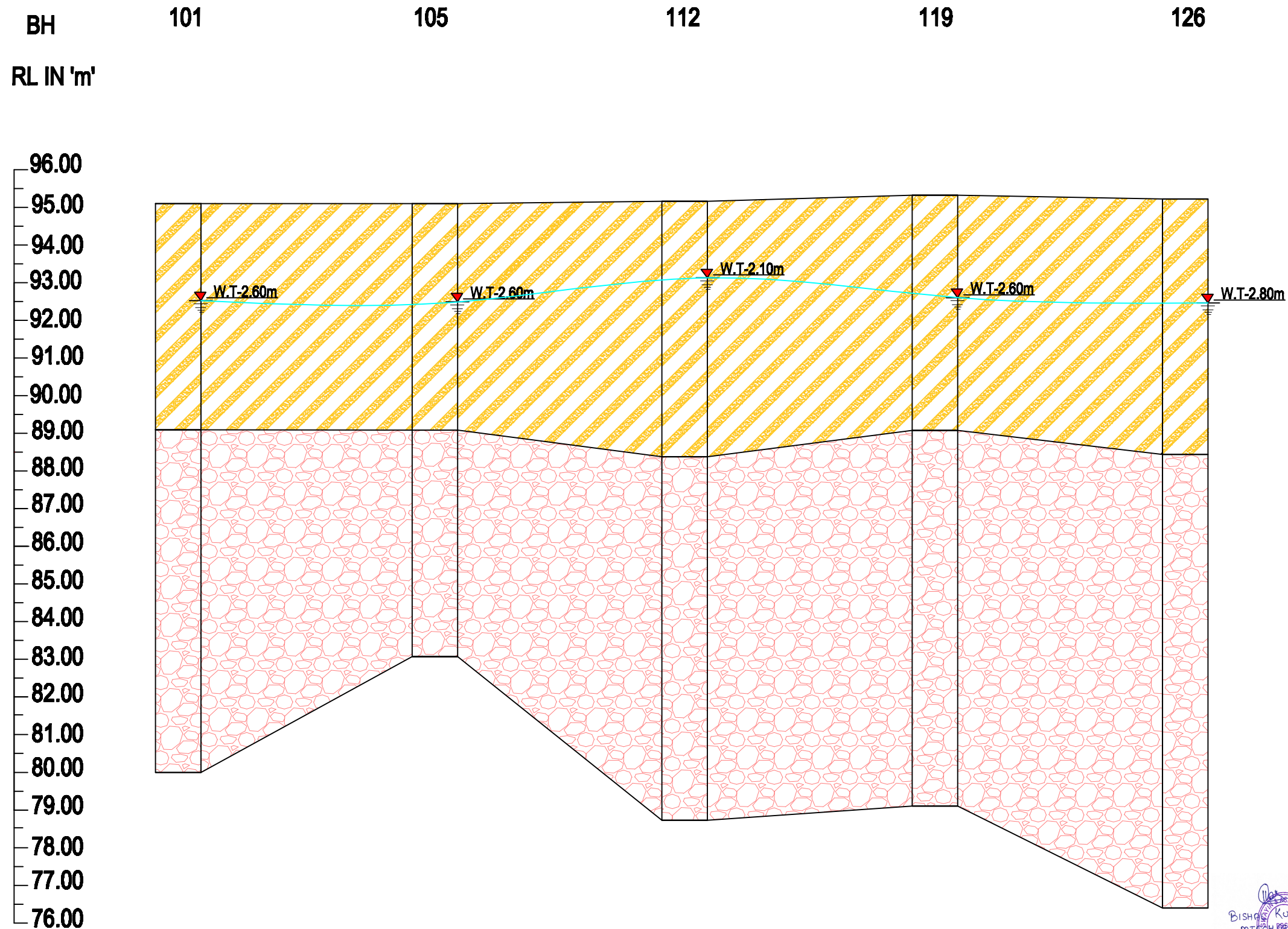
CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-
SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESWAR
 PH-(0674) 2570016, 2572871

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

BISHWANATH KUMAR DAS,
 M.TECH (PRACTICAL)
 77, SATYA NAGAR

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

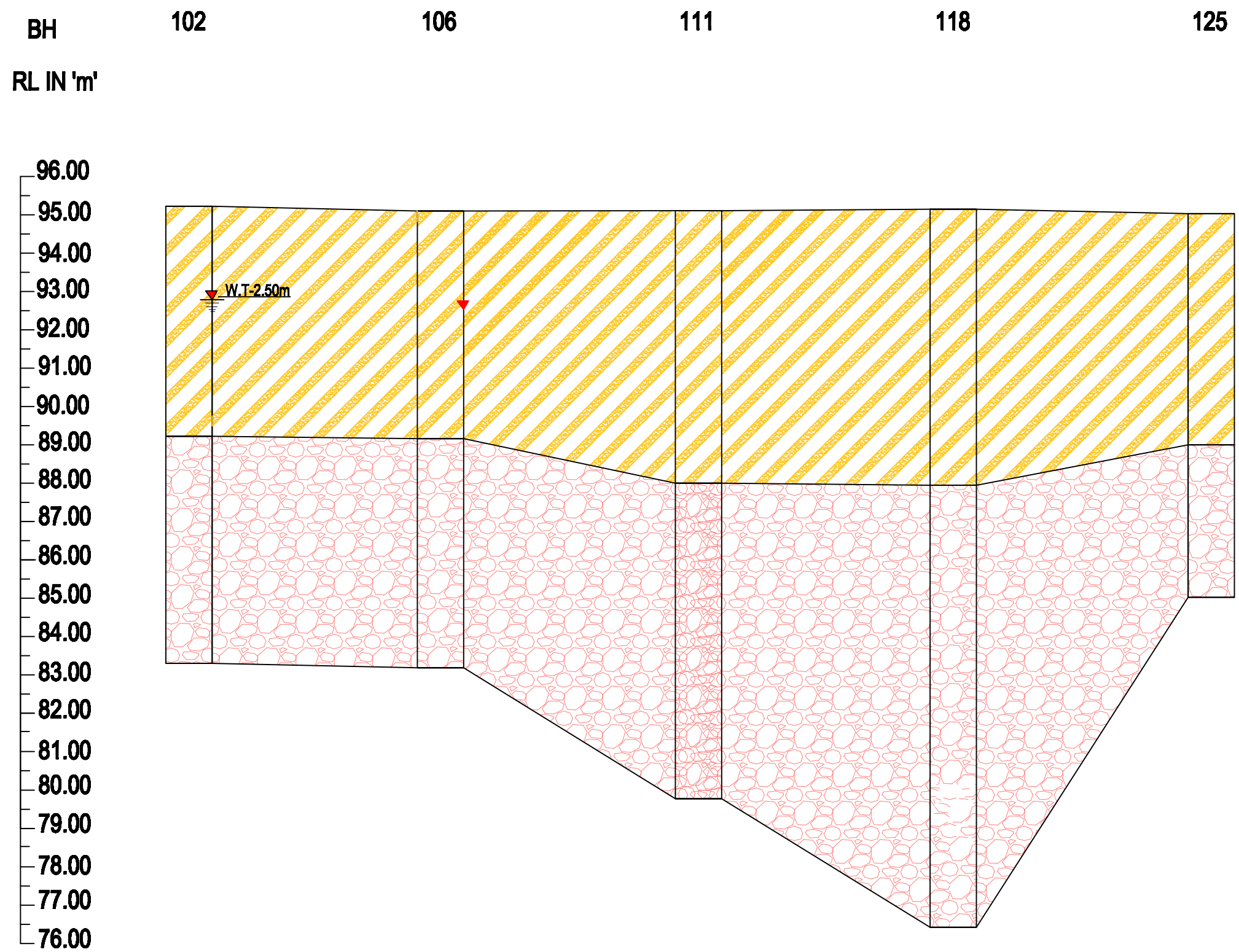
CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-
 SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESWAR
 PH-(0674) 2570015, 2572871

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

Bishwajit Kumar Das
 M.TECH (GEOTECH)

SUB-SOIL & CROSS PROFILE



LEGEND:

1	CLAYEY SAND	
3	SAND STONE	

NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT : TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.



INVESTIGATED AND PREPARED BY :-
 SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESWAR
 PH-(0674) 2570015, 2572871

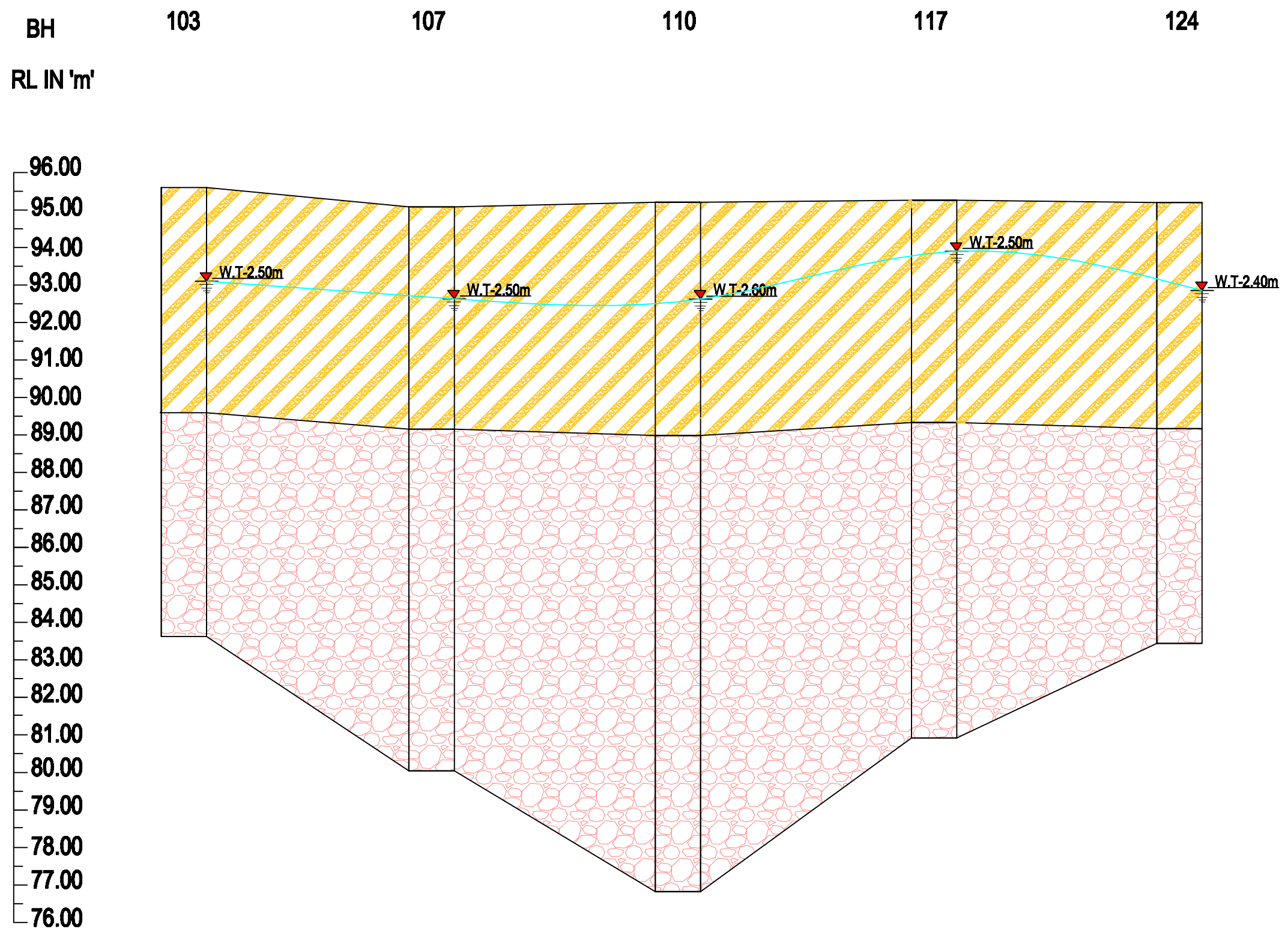
BISHNU KUMAR DAS
 M.TECH (GEOTECH)
 I.I.T. SATYANAGAR

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

SUB-SOIL & CROSS PROFILE

LEGEND:

1	CLAYEY SAND	
3	SAND STONE	




NOTE : ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.

PROJECT : DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

CLIENT :  TALCHER FERTILIZERS LIMITED (TFL)

CONTRACTOR : WUHUAN ENGG. CO., LTD.

INVESTIGATED AND PREPARED BY :-
 SWAYIN & ASSOCIATES .
 77, SATYA NAGAR, BHUBANESWAR
 PH-(0674) 2570015, 2572871

LOCATION	GAS CLEANING AREA
TITLE	SUB-SOIL & CROSS PROFILE

BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -90	SHEET NO: -01
DEPTH: 15.14 m	CO-ORDINATES: E : 896.93 m N : 1181.98 m	GROUND LEVEL: RL- 94.873 M
COMMMENCED ON: 29.04.2020	COMPLETED ON: 30.04.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.10m		TYPE : - B

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			1.50								58	SPT	01					
			2.00									UDS	01					
			3.00								76	SPT	02					
			4.50								>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	6.20	6.00															
			7.50									CS	01	18	NIL			
			9.00										CS	02	34	10		
			10.50										CS	03	42	18		
			12.00										CS	04	58	24		
			13.50										CS	05	60	25		
			15.00										CS	06	62	26		

BH TERMINATED AT DEPTH 15.14M

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: 01 No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 06 No. of Water Sample : 01
No. of SPT: 04

BISHAL KUMAR DAS.
MTECH (P&T) (IIT KANPUR)

BORELOG DATA SHEET

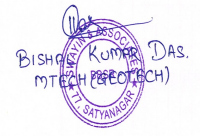
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -91	SHEET NO: -01
DEPTH:	11.88 m	CO-ORDINATES: E : 896.94 m N : 1132.99 m	GROUND LEVEL: RL- 94.863 M
COMMMENCED ON: 29.04.2020	COMPLETED ON: 30.04.2020	LOCATION : -GAS CLEANING	TYPE : - D
WATER TABLE : 3.14m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00		1.50						55	SPT	01					
			3.00		3.00						89	SPT	02					
			4.00		4.50						>100	SPT	03					
			5.00		6.00													
SAND STONE	SEDIMENTARY ROCK	6.00	6.00															
			7.00		7.50													
			8.00		9.00													
			9.00		10.50													
			10.00		11.88													
BH TERMINATED AT DEPTH 11.88M		11.88	12.00															
			13.00															
			14.00															
			15.00															

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 05	No. of Water Sample : 01
	No. of SPT: 03	



BORELOG DATA SHEET

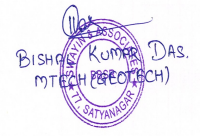
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -92	SHEET NO: -01
DEPTH: 12.02 m	CO-ORDINATES: E : 858.13 m N : 1181.98 m	GROUND LEVEL: RL- 94.897 M
COMMENCED ON: 29.04.2020	COMPLETED ON: 30.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.10m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			1.50								54	SPT	01					
			2.00															
			3.00								66	SPT	02					
SAND STONE	SEDIMENTARY ROCK	6.10	6.00															
			7.00															
			7.50															
			8.00															
			9.00															
			9.00															
			10.50															
	10.50																	
	11.00																	
BH TERMINATED AT DEPTH 12.02M		12.02	12.00															
			12.00															
			13.00															
			14.00															
			15.00															

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL
No. of Undisturbed sample: NIL
No. of CORE: 04
No. of SPT: 04
No. of Vane Shear Test : NIL
No. of Water Sample : 01



BORELOG DATA SHEET

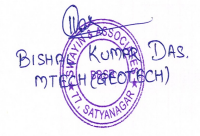
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -93	SHEET NO: -01
DEPTH:	11.17 m	COMPLETED ON: 01.05.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 30.04.2020		CO-ORDINATES: E : 858.14 m N : 1132.99 m	GROUND LEVEL: RL- 94.777 M
WATER TABLE :2.90m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50							54	SPT	01						
			3.00							62	SPT	02						
			4.50							93	SPT	03						
SAND STONE	SEDIMENTARY ROCK	6.30	6.00															
			7.50															
			9.00															
			10.50															
BH TERMINATED AT DEPTH 11.17M		11.17	11.00															
			11.17															
			12.00															
			13.00															
			14.00															
			15.00															

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 04	No. of Water Sample : 01
	No. of SPT: 04	



BORELOG DATA SHEET

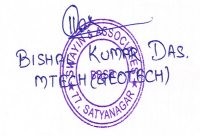
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -94	SHEET NO: -01
DEPTH: 11.90 m	CO-ORDINATES: E : 820.11 m N : 1181.98 m	GROUND LEVEL: RL- 95.111 M
COMMENCED ON: 30.04.2020	COMPLETED ON: 01.05.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.95m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00															
			3.00				1.50					56	SPT	01				
			4.00				3.00					99	SPT	02				
SAND STONE	SEDIMENTARY ROCK	6.00	6.00															
			7.00															
			8.00															
			9.00				4.50					>100	SPT	03				
			10.00				6.00						CS	01	23	NIL		
BH TERMINATED AT DEPTH 11.90M			7.00															
			7.50															
			8.00															
			9.00				7.50						CS	02	26	NIL		
			10.50				9.00						CS	03	29	15		
	11.00				10.50						CS	04	22	10				
	12.00				11.90						CS	05	18	12				

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 05 No. of Water Sample : 01
 No. of SPT: 03



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -95	SHEET NO: -01
DEPTH:	15.53 m	COMPLETED ON: 01.05.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 30.04.2020	COMPLETED ON: 01.05.2020	CO-ORDINATES: E : 820.10 m N : 1132.96 m	GROUND LEVEL: RL- 94.569 M
WATER TABLE : 3.50m		LOCATION : -GAS CLEANING	TYPE : - B

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
FILLED UP SOIL MIX BOULDER		0.00	0.00														
CLAYEY SAND	SC	2.00	2.00		1.50						>100	SPT	01				
			2.00		2.00								UDS	01			
			3.00		3.00							70	SPT	02			
			4.00		4.50							>100	SPT	03			
HARD SANDY STONE	SEDIMENTARY ROCK	6.40	6.00		6.00						>100	SPT	04				
			7.00		7.50								CS	01	17	NIL	
			8.00		9.00									CS	02	28	NIL
			10.00		10.50									CS	03	36	12
			11.00		12.00									CS	04	38	14
	12.00		13.50									CS	05	52	19		

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 -WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: 01 No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 06 No. of Water Sample : 01
 No. of SPT: 04

Bishal Kumar Das
MTECH (P&T) (SPECIALIZED)
S.WAYIN & ASSOCIATES

SWAYIN & ASSOCIATES

77, SATYANAGAR, BHUBANESWAR
Web Site : www.swayinassociates.com

BORELOG DATA SHEET

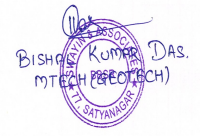
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -95	SHEET NO: -02
DEPTH:	15.53 m	COMPLETED ON: 01.05.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 30.04.2020	CO-ORDINATES: E : 820.10 m N : 1132.96 m	GROUND LEVEL: RL- 94.569 M	LOCATION : -GAS CLEANING TYPE : - B
WATER TABLE : 3.50m			

DESCRIPTION OF STRATA	CLASSIFICATION	CHANGE OF STRATA IN METERS	DEPTH IN METERS	SYMBOL	SAMPLE DEPTH IN METERS	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
HARD SANDY STONE BH TERMINATED AT DEPTH 15.53M	SEDIMENTATION	15.53	15.00 15.53 16.00 17.00 18.00 19.00 20.00 21.00 22.00 23.00 24.00 25.00 26.00 27.00 28.00 29.00 30.00		15.53							CS	06	58	26	

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ∇-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: 01	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 06	No. of Water Sample : 01
	No. of SPT: 04	



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -96	SHEET NO: -01
DEPTH: 10.10 m	CO-ORDINATES: E : 790.12 m N : 1181.98 m	GROUND LEVEL: RL- 94.396 M
COMMMENCED ON: 01.05.2020	COMPLETED ON: 02.05.2020	LOCATION : -GAS CLEANING
WATER TABLE : 3.10m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00				1.50				53	SPT	01				
			3.00				3.00				86	SPT	02				
			4.00				4.50				>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	6.10	6.00		6.00							CS	01	25	NIL		
			7.00			7.50						CS	02	21	NIL		
			8.00			9.00							CS	03	28	15	
			9.00			10.00							CS	04	20	11	
BH TERMINATED AT DEPTH 10.10M		10.10	10.00		10.10												

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
No. of SPT: 03

Biswas Kumar Das
MTECH (P&T) (IIT KGP)
SWAYIN & ASSOCIATES

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -97	SHEET NO: -01
DEPTH: 9.95 m	CO-ORDINATES: E : 790.14 m N : 1132.99 m	GROUND LEVEL: RL- 94.314 M
COMMENCED ON: 01.05.2020	COMPLETED ON: 02.05.2020	LOCATION : -GAS CLEANING
WATER TABLE : 3.45m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
FILLED UP SOIL MIX BOULDER		0.00	0.00		1.50						>100	SPT	01				
CLAYEY SAND	SC	2.80	3.00		3.00						62	SPT	02				
			4.50	4.50		4.50						>100	SPT	03			
SAND STONE	SEDIMENTARY ROCK	5.90	6.00		6.00						>100	SPT	04				
			7.50	7.50		7.50							CS	01	25	12	
			9.00	9.00		9.00							CS	02	28	13	
BH TERMINATED AT DEPTH 9.95M		9.95	10.00														

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL
No. of Undisturbed sample: NIL
No. of CORE: 02
No. of SPT: 04
No. of Vane Shear Test : NIL
No. of Water Sample : 01

BISHOP KUMAR DAS.
MTECH (P&T)
SWAYIN & ASSOCIATES

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -98	SHEET NO: -01
DEPTH: 10.11 m	CO-ORDINATES: E : 760.21 m N : 1181.98 m	GROUND LEVEL: RL- 94.642 M
COMMENCED ON: 01.05.2020	COMPLETED ON: 02.05.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.90m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
FILLED UP SOIL MIX BOULDER		0.00	0.00													
			1.00													
			2.00		1.50						>100	SPT	01			
CLAYEY SAND	SC		3.00		3.00						84	SPT	02			
			4.00													
			5.00		4.50						>100	SPT	03			
			5.80		6.00						>100	SPT	04			
SAND STONE	SEDIMENTARY ROCK		7.00		7.50							CS	01	18	NIL	
			8.00													
			9.00		9.00							CS	02	28	12	
BH TERMINATED AT DEPTH 10.11M		10.11	10.00		10.11							CS	03	42	14	
			11.00													
			12.00													
			13.00													
			14.00													
			15.00													

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL
No. of Undisturbed sample: NIL
No. of CORE: 03
No. of SPT: 04
No. of Vane Shear Test : NIL
No. of Water Sample : 01

Bishal Kumar Das
MTECH (P&T) (IIT KGP)
SWAYIN & ASSOCIATES

BORELOG DATA SHEET

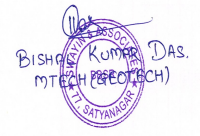
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -99	SHEET NO: -01
DEPTH:	10.16 m	COMPLETED ON: 03.05.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 02.05.2020		CO-ORDINATES: E : 760.15 m N : 1132.99 m	GROUND LEVEL: RL- 94.506 M
WATER TABLE :2.10m			LOCATION : -GAS CLEANING TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50		1.50					64	SPT	01						
			3.00		3.00					88	SPT	02						
SAND STONE	SEDIMENTARY ROCK	6.05	6.00		6.00													
			7.50		7.50													
			9.00		9.00													
			10.16		10.16													
BH TERMINATED AT DEPTH 10.16M																		

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
No. of SPT: 03





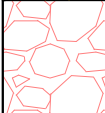
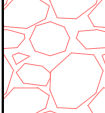
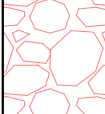
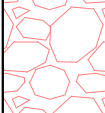
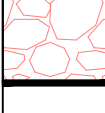


SWAYIN & ASSOCIATES
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BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -100	SHEET NO: -01
DEPTH:	11.94 m	COMPLETED ON: 29.04.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 28.04.2020	COMPLETED ON: 29.04.2020	CO-ORDINATES: E : 681.31 m N : 1044.210 m	GROUND LEVEL: RL- 95.230 M
WATER TABLE :2.60m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50							67	SPT	01						
			3.00							77	SPT	02						
			4.50							>100	SPT	03						
SAND STONE	SEDIMENTARY ROCK	6.00	6.00															
			7.50															
			9.00															
			10.50															
			11.94															
BH TERMINATED AT DEPTH 11.94M																		

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
No. of SPT: 04


BISHAL KUMAR DAS.
MTECH (P&T) (S.W.A.)

BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -101	SHEET NO: -01
DEPTH:	15.20 m	CO-ORDINATES: E : 681.24 m N : 1082.25 m	GROUND LEVEL: RL- 95.138 M
COMMENCED ON: 27.04.2020	COMPLETED ON: 28.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00								62	SPT	01					
			3.00								>100	SPT	02					
			4.00															
			5.00															
SANDY STONE	SEDIMENTARY ROCK	6.00	6.00															
			7.00															
			8.00															
			9.00															
			10.00															
			10.50															
			11.00															
			12.00															
			12.00															
			13.50															
	14.00																	
	15.00																	
BH TERMINATED AT DEPTH 15.20M																		

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY











No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 06 No. of Water Sample : 01
No. of SPT: 04



BORELOG DATA SHEET

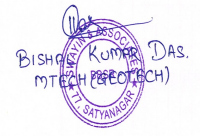
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -102	SHEET NO: -01
DEPTH:	11.90 m	COMPLETED ON: 28.04.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 27.04.2020	COMPLETED ON: 28.04.2020	CO-ORDINATES: E : 681.22 m N : 1119.29 m	GROUND LEVEL: RL- 95.293 M
WATER TABLE :2.50m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50								59	SPT	01					
			3.00								90	SPT	02					
			4.50								>100	SPT	03					
			6.00								>100	SPT	04					
SAND STONE	SEDIMENTARY ROCK	6.00	6.00															
			7.50									CS	01	19	NIL			
			9.00										CS	02	24	NIL		
			10.50										CS	03	42	20		
			11.90										CS	04	30	13		
BH TERMINATED AT DEPTH 11.90M																		

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY



No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -103	SHEET NO: -01
DEPTH: 11.95 m	CO-ORDINATES: E : 681.220 m N : 1157.340 m	GROUND LEVEL: RL- 95.600 M
COMMENCED ON: 27.04.2020	COMPLETED ON: 28.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.50m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00			1.50					59	SPT	01				
			3.00			2.00						UDS	01				
SANDY STONE	SEDIMENTARY ROCK	6.00	6.00														
			7.00														
			8.00														
			9.00														
			10.00														
			11.00														
			12.00														
			11.95														
BH TERMINATED AT DEPTH 11.95M																	

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

BISHAL KUMAR DAS.
MTECH (P&T) (IIT KGP)
SWAYIN & ASSOCIATES

No. of disturbed sample: NIL	No. of Undisturbed sample: 01	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 04	No. of Water Sample : 01
	No. of SPT: 04	

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BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -104	SHEET NO: -01
DEPTH:	14.80 m	COMPLETED ON: 23.04.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 22.04.2020	COMPLETED ON: 23.04.2020	CO-ORDINATES: E : 637.200 m N : 1044.220 m	GROUND LEVEL: RL- 95.039 M
WATER TABLE :2.50m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
CLAYEY SAND MIX BOULDER		0.00	0.00													
CLAYEY SAND	SC	1.00	1.00		1.50					92	SPT	01				
		3.00	3.00		3.00					>100	SPT	02				
		4.50	4.50		4.50					>100	SPT	03				
		6.00	6.00		6.00					>100	SPT	04				
SAND STONE	SEDIMENTARY ROCK	9.00	9.00		9.00						CS	01	33	12		
		12.00	12.00		12.00						CS	02	52	23		
		14.80	14.80		14.80						CS	03	68	25		
		BH TERMINATED AT DEPTH 14.80M														

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ∇-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 03	No. of Water Sample : 01
	No. of SPT: 04	

BISHWAS KUMAR DAS.
MTECH (P&T)
SWAYIN & ASSOCIATES

BORELOG DATA SHEET

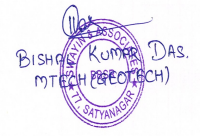
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -105	SHEET NO: -01
DEPTH:	12.03 m	COMPLETED ON: 29.04.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 28.04.2020	COMPLETED ON: 29.04.2020	CO-ORDINATES: E : 637.280 m N : 1082.260 m	GROUND LEVEL: RL- 95.148 M
WATER TABLE :2.60m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00		1.50						55	SPT	01					
			3.00		3.00						90	SPT	02					
			4.00		4.50						>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	6.00	6.00		6.00					>100	SPT	04						
			7.00		7.50						CS	01	21	NIL				
			8.00		9.00							CS	02	28	NIL			
			10.00		10.50							CS	03	35	16			
			11.00		12.03		12.03					CS	04	41	24			
BH TERMINATED AT DEPTH 12.03M		12.03	12.03															

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -106	SHEET NO: -01
DEPTH:	11.85 m	CO-ORDINATES: E : 637.310 m N : 1119.310 m	GROUND LEVEL: RL- 95.112 M
COMMENCED ON: 28.04.2020	COMPLETED ON: 29.04.2020	LOCATION : -GAS CLEANING	TYPE : - D
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00		1.50						62	SPT	01				
			3.00		3.00						95	SPT	02				
			4.00		4.50						>100	SPT	03				
SANDY STONE	SEDIMENTARY ROCK	5.90	6.00		6.00					>100	SPT	04					
			7.00		7.50						CS	01	18	NIL			
			8.00		9.00						CS	02	26	NIL			
			9.00		10.50						CS	03	43	21			
			10.00		11.85						CS	04	30	14			
			11.00														
			12.00														
			13.00														
BH TERMINATED AT DEPTH 11.85M																	

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
No. of SPT: 04

BISHOP KUMAR DAS.
MTECH (P&T) (S.WAYIN)

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BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -107	SHEET NO: -01
DEPTH:	15.04 m	CO-ORDINATES: E : 637.260 m N : 1157.320 m	GROUND LEVEL: RL- 95.317 M
COMMMENCED ON: 26.04.2020	COMPLETED ON: 27.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.40m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00									67	SPT	01			
			3.00									97	SPT	02			
			4.00									>100	SPT	03			
SANDY STONE	SEDIMENTARY ROCK	5.90	6.00														
			7.00														
			8.00														
			9.00														
			10.00														
			11.00														
			12.00														
			13.00														
			14.00														
			15.00														
			15.04														

BH TERMINATED AT DEPTH 15.04M

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL

No. of Undisturbed sample: NIL
No. of CORE: 06
No. of SPT: 04

No. of Vane Shear Test : NIL
No. of Water Sample : 01

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BORELOG DATA SHEET

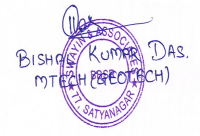
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -108	SHEET NO: -01
DEPTH:	15.25 m	CO-ORDINATES: E : 602.950 m N : 1253.800 m	GROUND LEVEL: RL- 95.969 M
COMMMENCED ON: 23.04.2020	COMPLETED ON: 24.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			1.50								55	SPT	01				
			2.00									UDS	01				
			3.00														
			3.00									68	SPT	02			
SANDY STONE	SEDIMENTARY ROCK	6.20	6.00														
			7.00														
			7.50														
			8.00														
			9.00														
			9.00														
			10.00														
			10.50														
			12.00														
			12.00														
	13.00																
	13.50																
	14.00																
	15.00																
BH TERMINATED AT DEPTH 15.25M			15.25														
		15.25	15.25														

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: 01	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 06	No. of Water Sample : 01
	No. of SPT: 04	



BORELOG DATA SHEET

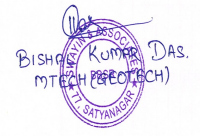
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -109	SHEET NO: -01
DEPTH: 14.05 m	CO-ORDINATES: E : 594.686 m N : 1203.133 m	GROUND LEVEL: RL- 95.582 M
COMMMENCED ON: 21.04.2020	COMPLETED ON: 22.04.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.60m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								81	SPT	01				
			3.00								>100	SPT	02				
			4.00								>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	5.90	6.00														
			7.00														
			8.00														
			9.00														
			10.00														
			10.50														
			11.00														
			12.00														
			13.00														
			14.00														
BH TERMINATED AT DEPTH 14.05M		14.05	14.05														

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 05	No. of Water Sample : 01
	No. of SPT: 04	



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -110	SHEET NO: -01
DEPTH:	18.44 m	CO-ORDINATES: E : 594.721 m N : 1164.207 m	GROUND LEVEL: RL- 95.241 M
COMMENCED ON: 20.04.2020	COMPLETED ON: 21.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								84	SPT	01				
			3.00								>100	SPT	02				
			4.00								>100	SPT	03				
			5.00								>100	SPT	04				
SAND STONE	SEDIMENTARY ROCK	6.30	6.00														
			7.00														
			7.50									CS	01	25	NIL		
			8.00														
			9.00									CS	02	38	12		
			10.00									CS	03	44	20		
			11.00														
			12.00									CS	04	42	18		
			13.00														
			14.00									CS	05	45	21		
	15.00		15.00								CS	06	43	22			

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 08 No. of Water Sample : 01
 No. of SPT: 04

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BORELOG DATA SHEET

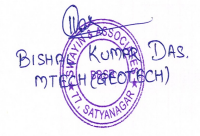
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -110	SHEET NO: -02
DEPTH:	18.44 m	CO-ORDINATES: E : 594.721 m N : 1164.207 m	GROUND LEVEL: RL- 95.241 M
COMMENCED ON: 20.04.2020	COMPLETED ON: 21.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
SAND STONE	SEDIMENTARY ROCK	15.00	15.00		15.00							CS	06	43	22	
			16.00		16.50							CS	07	58	25	
			17.00		18.44		18.44							CS	08	59	25
BH TERMINATED AT DEPTH 18.44M		18.44														
			19.00													
			20.00													
			21.00													
			22.00													
			23.00													
			24.00													
			25.00													
			26.00													
			27.00													
			28.00													
			29.00													
			30.00													

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ∇-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 08 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

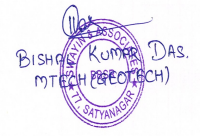
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -111	SHEET NO: -01
DEPTH: 15.69 m	CO-ORDINATES: E : 594.699 m N : 1124.203 m	GROUND LEVEL: RL- 95.095 M
COMMMENCED ON: 26.03.2020	COMPLETED ON: 26.03.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.70m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00		1.50						82	SPT	01				
			3.00		3.00						>100	SPT	02				
			4.00		4.50						>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	7.10	7.00		7.50												
			8.00														
			9.00		9.00							CS	01	19	NIL		
			10.00		10.50							CS	02	25	NIL		
			11.00		12.00							CS	03	34	12		
			12.00		13.50							CS	04	43	25		
			13.00		14.00												
			14.00		15.00												
			15.00		15.69												
				15.69									CS	05	58	26	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 05 No. of Water Sample : 01
 No. of SPT: 05



BORELOG DATA SHEET

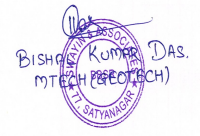
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -112	SHEET NO: -01
DEPTH:	16.47 m	CO-ORDINATES: E : 594.663 m N : 1084.244 m	GROUND LEVEL: RL- 95.201 M
COMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	LOCATION : -GAS CLEANING	TYPE : - D
WATER TABLE : 2.10 m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								81	SPT	01				
			3.00								>100	SPT	02				
			4.00								>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	6.80	6.80														
			7.00														
			7.50								>100	SPT	04				
			8.00														
			9.00														
			9.50														
			10.00														
			10.50														
			11.00														
			12.00														
	13.00																
	14.00																
	15.00		15.00														

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 06	No. of Water Sample : 01
	No. of SPT: 05	



SWAYIN & ASSOCIATES

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BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -112	SHEET NO: -02
DEPTH:	16.47 m	COMPLETED ON: 25.03.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	CO-ORDINATES: E : 594.663 m N : 1084.244 m	GROUND LEVEL: RL- 95.201 M
WATER TABLE : 2.10 m		LOCATION : -GAS CLEANING	TYPE : -D

DESCRIPTION OF STRATA	CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
SAND STONE BH TERMINATED AT DEPTH 16.47M	SEDIMENTARY	15.00	15.00		15.00							CS	05	48	22	
		16.47	16.47		16.47							CS	06	54	26	
			17.00													
			18.00													
			19.00													
			20.00													
			21.00													
			22.00													
			23.00													
			24.00													
			25.00													
			26.00													
			27.00													
			28.00													
			29.00													
			30.00													

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ∇-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 06 No. of Water Sample : 01
 No. of SPT: 05

BISHAL KUMAR DAS.
 MTECH (P&T) (IIT KANPUR)
 (IIT KANPUR)

BORELOG DATA SHEET

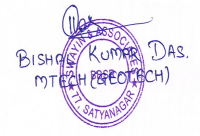
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -113	SHEET NO: -01
DEPTH: 15.00 m	CO-ORDINATES: E : 594.674 m N : 1044.224 m	GROUND LEVEL: RL- 95.033 M
COMMMENCED ON: 22.04.2020	COMPLETED ON: 23.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.50m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND MIX BOULDER	SC	0.00	0.00														
		1.20	1.50							87	SPT	01					
CLAYEY SAND		3.00	3.00							>100	SPT	02					
		4.50	4.50							>100	SPT	03					
	SEDIMENTARY ROCK	6.20	6.00							>100	SPT	04					
		9.00	9.00								CS	01	28	13			
SAND STONE		12.00	12.00								CS	02	54	22			
		15.00	15.00								CS	03	56	22			
BH TERMINATED AT DEPTH 15.00M																	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 03 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

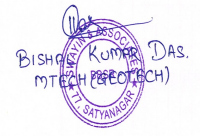
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -114	SHEET NO: -01
DEPTH: 13.25 m	CO-ORDINATES: E : 549.846 m N : 1267.286 m	GROUND LEVEL: RL- 96.611 M
COMMMENCED ON: 26.04.2020	COMPLETED ON: 27.04.2020	LOCATION : -GAS CLEANING TYPE : - D
WATER TABLE :2.60m		

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.50							72	SPT	01					
			3.00							82	SPT	02					
			4.50							>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	6.20	6.00														
			7.50									CS	01	16	NIL		
			9.00										CS	02	19	NIL	
			10.50										CS	03	24	10	
			12.00										CS	04	42	20	
			13.25										CS	05	49	25	
			13.25														

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 05 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

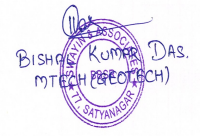
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -115	SHEET NO: -01
DEPTH:	12.00 m	CO-ORDINATES: E : 549.779 m N : 1235.350 m	GROUND LEVEL: RL- 95.843 M
COMMMENCED ON: 24.04.2020	COMPLETED ON: 25.04.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.40m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50							78	SPT	01						
			3.00								85	SPT	02					
			4.50								>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	5.70	6.00															
			6.00								>100	SPT	04					
			7.50									CS	01	18	NIL			
			9.00									CS	02	25	NIL			
			10.50									CS	03	36	10			
			12.00									CS	04	48	20			
			13.00															
			14.00															
BH TERMINATED AT DEPTH 12.00M																		

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
No. of SPT: 04



BORELOG DATA SHEET

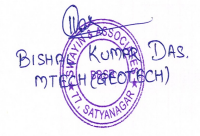
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -116	SHEET NO: -01
DEPTH: 13.86 m	CO-ORDINATES: E : 549.818 m N : 1203.215 m	GROUND LEVEL: RL- 95.469 M
COMMMENCED ON: 21.04.2020	COMPLETED ON: 22.04.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.60m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								88	SPT	01				
			3.00								>100	SPT	02				
			4.00								>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	5.60	5.60														
			6.00								>100	SPT	04				
			7.00									CS	01	23	NIL		
			8.00														
			9.00									CS	02	28	10		
			10.00									CS	03	34	20		
			11.00														
			12.00									CS	04	58	25		
			13.00														
			14.00									CS	05	60	28		
BH TERMINATED AT DEPTH 13.86M		13.86	13.86														

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 05	No. of Water Sample : 01
	No. of SPT: 04	



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -117	SHEET NO: -01
DEPTH: 14.38 m	CO-ORDINATES: E : 549.802 m N : 1164.196 m	GROUND LEVEL: RL- 95.363 M
COMMENCED ON: 20.04.2020	COMPLETED ON: 21.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.50m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00									77	SPT	01				
			3.00									>100	SPT	02				
			4.00									>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	5.90	6.00															
			7.00															
			7.50										CS	01	24	NIL		
			8.00															
			9.00										CS	02	38	13		
			10.00										CS	03	42	15		
			11.00															
			12.00										CS	04	43	18		
			13.00															
			14.00															
BH TERMINATED AT DEPTH 14.38M		14.38	14.38								CS	05	45	22				

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL
No. of Undisturbed sample: NIL
No. of CORE: 05
No. of SPT: 04
No. of Vane Shear Test : NIL
No. of Water Sample : 01

BISHOP KUMAR DAS.
MTECH (PRACTICE)
77, SATYANAGAR

BORELOG DATA SHEET

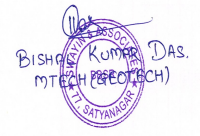
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -118	SHEET NO: -01
DEPTH: 18.71 m	CO-ORDINATES: E : 549.808 m N : 1124.271 m	GROUND LEVEL: RL- 95.198 M
COMMENCED ON: 26.03.2020	COMPLETED ON: 26.03.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.70m		TYPE : - B

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00		1.50						73	SPT	01				
			3.00		3.00						>100	SPT	02				
			4.00		4.50						>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	7.20	7.00														
			8.00		7.50						>100	SPT	05				
			9.00		9.00							CS	01	18	NIL		
			10.00		10.50							CS	02	24	NIL		
			11.00		12.00							CS	03	38	20		
			12.00		13.50							CS	04	49	22		
			13.00		14.00												
			14.00		15.00												
			15.00		15.00							>100	SPT	05	54	23	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 07	No. of Water Sample : 01
	No. of SPT: 05	



SWAYIN & ASSOCIATES

77, SATYANAGAR, BHUBANESWAR
Web Site : www.swayinassociates.com

BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -118	SHEET NO: -02
DEPTH:	18.71 m	COMPLETED ON: 26.03.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 26.03.2020	COMPLETED ON: 26.03.2020	CO-ORDINATES: E : 549.808 m N : 1124.271 m	GROUND LEVEL: RL- 95.198 M
WATER TABLE :2.70m		LOCATION : -GAS CLEANING	TYPE : - B

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
SAND STONE	SEDIMENTARY ROCK	15.00	15.00		15.00							CS	05	54	23	
			16.00		16.50							CS	06	56	25	
			17.00		18.71							CS	07	59	25	
BH TERMINATED AT DEPTH 18.71M		18.71														
			19.00													
			20.00													
			21.00													
			22.00													
			23.00													
			24.00													
			25.00													
			26.00													
			27.00													
			28.00													
			29.00													
			30.00													

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 07 No. of Water Sample : 01
No. of SPT: 05



BORELOG DATA SHEET

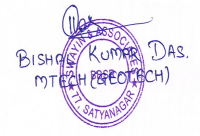
NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -119	SHEET NO: -01
DEPTH:	16.21 m	CO-ORDINATES: E : 549.799 m N : 1084.204 m	GROUND LEVEL: RL- 95.221 M
COMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	LOCATION : -GAS CLEANING	TYPE : - D
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.00															
			2.00									80	SPT	01				
			3.00									>100	SPT	02				
			4.00									>100	SPT	03				
			5.00									>100	SPT	04				
SAND STONE	SEDIMENTARY ROCK	6.30	6.00								>100	SPT	04					
			7.00															
			7.50															
			8.00															
			9.00															
			9.00															
			10.00															
			10.50															
			12.00															
			12.00															
	13.00																	
	13.50																	
	14.00																	
	15.00		15.00															

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 07	No. of Water Sample : 01
	No. of SPT: 04	



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -119	SHEET NO: -02
DEPTH:	16.21 m	COMPLETED ON: 25.03.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	CO-ORDINATES: E : 549.799 m N : 1084.204 m	GROUND LEVEL: RL- 95.221 M
WATER TABLE : 2.60m		LOCATION : -GAS CLEANING TYPE : - D	

DESCRIPTION OF STRATA	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
					20	40	60	80	100		TYPE	REF NO.			
SAND STONE BH TERMINATED AT DEPTH 16.21M	15.00	15.00		15.00							CS	06	58	26	
	16.21	16.21		16.21							CS	07	60	27	
		17.00													
		18.00													
		19.00													
		20.00													
		21.00													
		22.00													
		23.00													
		24.00													
		25.00													
		26.00													
		27.00													
		28.00													
		29.00													
		30.00													

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ∇-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 07 No. of Water Sample : 01
 No. of SPT: 04



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -120	SHEET NO: -01
DEPTH: 11.10 m	CO-ORDINATES: E : 549.778 m N : 1044.243 m	GROUND LEVEL: RL- 95.137 M
COMMMENCED ON: 23.04.2020	COMPLETED ON: 24.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.70m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								75	SPT	01				
			3.00								>100	SPT	02				
			4.00								>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	6.30	6.00														
			7.00														
			7.50									CS	01	22	NIL		
			8.00									CS	02	38	14		
			9.00									CS	03	48	21		
BH TERMINATED AT DEPTH 11.10M		11.10	11.00														

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, ∇ -WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL	No. of Undisturbed sample: NIL	No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL	No. of CORE: 03	No. of Water Sample : 01
	No. of SPT: 04	



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -121	SHEET NO: -01
DEPTH:	12.12 m	CO-ORDINATES: E : 504.842 m N : 1267.308 m	GROUND LEVEL: RL- 96.827 M
COMMMENCED ON: 26.04.2020	COMPLETED ON: 27.04.2020	LOCATION : -GAS CLEANING	TYPE : - D
WATER TABLE : 2.60m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50							67	SPT	01						
			3.00								90	SPT	02					
			4.50								>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	6.30	6.00															
			7.50															
			9.00															
			10.50															
			12.00															
			12.12															
			13.00															
			14.00															
BH TERMINATED AT DEPTH 12.12M																		

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
 No. of SPT: 04



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -122	SHEET NO: -01
DEPTH:	10.37 m	COMPLETED ON: 26.04.2020	JOB NO: -TLD/2020-03
COMMENCED ON: 25.04.2020	COMPLETED ON: 26.04.2020	CO-ORDINATES: E : 504.856 m N : 1235.356 m	GROUND LEVEL: RL- 96.306 M
WATER TABLE :2.40m		LOCATION : -GAS CLEANING	TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00		1.50						67	SPT	01				
			3.00		3.00						78	SPT	02				
			4.00		4.50						>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	6.10	6.00		6.00					>100	SPT	04					
			7.00		7.50						CS	01	25	10			
			8.00		9.00							CS	02	36	18		
			9.00		10.00							CS	03	48	21		
BH TERMINATED AT DEPTH 10.37M		10.37	10.37		10.37						CS	03	48	21			

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
No. of Large diameter sample: NIL No. of CORE: 03 No. of Water Sample : 01
No. of SPT: 04



BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -123	SHEET NO: -01
DEPTH: 11.90 m	CO-ORDINATES: E : 504.779 m N : 1203.227 m	GROUND LEVEL: RL- 95.378 M
COMMMENCED ON: 25.04.2020	COMPLETED ON: 26.04.2020	LOCATION : -GAS CLEANING TYPE : - D
WATER TABLE : 2.35m		

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00								68	SPT	01				
			3.00								80	SPT	02				
			4.00								>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	5.90	6.00														
			7.00														
			8.00														
			9.00														
			10.00														
			10.50														
			11.00														
			11.90														
BH TERMINATED AT DEPTH 11.90M																	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
 No. of SPT: 04



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -124	SHEET NO: -01
DEPTH: 11.75 m	CO-ORDINATES: E : 504.814 m N : 1164.195 m	GROUND LEVEL: RL- 95.213 M
COMMMENCED ON: 25.04.2020	COMPLETED ON: 26.04.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.40m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.50							74	SPT	01					
			3.00							84	SPT	02					
			4.50							>100	SPT	03					
SAND STONE	SEDIMENTARY ROCK	6.05	6.00														
			7.50									CS	01	21	10		
			9.00										CS	02	17	8	
			10.50										CS	03	26	15	
BH TERMINATED AT DEPTH 11.75M		11.75	11.75														
			12.00														
			13.00														
			14.00														
			15.00														

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 04 No. of Water Sample : 01
 No. of SPT: 04



SWAYIN & ASSOCIATES
77, SATYANAGAR, BHUBANESWAR
Web Site : www.swayinassociates.com

BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -125	SHEET NO: -01
DEPTH: 10.00 m	CO-ORDINATES: E : 504.809 m N : 1124.191 m	GROUND LEVEL: RL- 95.163 M
COMMMENCED ON: 24.04.2020	COMPLETED ON: 25.04.2020	LOCATION : -GAS CLEANING
WATER TABLE :2.40m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER	
						20	40	60	80	100		TYPE	REF NO.				
CLAYEY SAND	SC	0.00	0.00														
			1.00														
			2.00		1.50						81	SPT	01				
			3.00		3.00						>100	SPT	02				
			4.00		4.50						>100	SPT	03				
SAND STONE	SEDIMENTARY ROCK	5.90	6.00		6.00					>100	SPT	04					
			7.00		7.50						CS	01	24	NIL			
			8.00		9.00						CS	02	35	12			
			9.00		10.00		10.00				CS	03	44	18			
BH TERMINATED AT DEPTH 10.00M																	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 03 No. of Water Sample : 01
 No. of SPT: 04



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -126	SHEET NO: -01
DEPTH:	18.78 m	CO-ORDINATES: E : 504.70 m N : 1084.310 m	GROUND LEVEL: RL- 95.237 M
COMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.80m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER		
						20	40	60	80	100		TYPE	REF NO.					
CLAYEY SAND	SC	0.00	0.00															
			1.50							67	SPT	01						
			3.00								90	SPT	02					
			4.50								>100	SPT	03					
			6.00								>100	SPT	04					
SAND STONE	SEDIMENTARY ROCK	6.80	7.00															
			7.50															
			9.00															
			10.50															
			12.00															
	13.50																	
	15.00																	

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 07 No. of Water Sample : 01
 No. of SPT: 05



SWAYIN & ASSOCIATES

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Web Site : www.swayinassociates.com

BORELOG DATA SHEET

NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING:	ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE:	150 mm	BORE HOLE NO: -126	SHEET NO: -02
DEPTH:	18.78 m	CO-ORDINATES: E : 504.70 m N : 1084.310 m	GROUND LEVEL: RL- 95.237 M
COMMMENCED ON: 25.03.2020	COMPLETED ON: 25.03.2020	LOCATION : -GAS CLEANING	TYPE : - B
WATER TABLE : 2.80m			

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRES	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
SAND STONE	SEDIMENTARY ROCK	15.00	15.00		15.00							CS	05	45	21	
			16.00		16.50							CS	06	56	27	
			17.00		18.78							CS	07	61	29	
BH TERMINATED AT DEPTH 18.78M		18.78	19.00													
			20.00													
			21.00													
			22.00													
			23.00													
			24.00													
			25.00													
			26.00													
			27.00													
			28.00													
			29.00													
			30.00													

LEGEND: -
 UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST W- WATER SAMPLE,
 ▽-WATER LEVEL P-PENETROMETRE TEST, V- VANE SHEAR TEST C-CORE RECOVERY

No. of disturbed sample: NIL No. of Undisturbed sample: NIL No. of Vane Shear Test : NIL
 No. of Large diameter sample: NIL No. of CORE: 07 No. of Water Sample : 01
 No. of SPT: 05



NAME OF PROJECT: DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER.

TYPE OF BORING: ROTARY CALYX DRILLING	CLIENT: TALCHER FERTILIZERS LIMITED (TFL)	CONTRACTOR: WUHUAN ENGG. CO., LTD.
DIA OF HOLE: 150 mm	BORE HOLE NO: -127	SHEET NO: -01
DEPTH: 12.00 m	CO-ORDINATES: E : 504.693 m N : 1044.241 m	GROUND LEVEL: RL- 95.151 M
COMMENCED ON: 23.04.2020	COMPLETED ON: 24.04.2020	LOCATION : -GAS CLEANING
WATER TABLE : 2.70m		TYPE : - D

DESCRIPTION OF STRATA	IS CLASSIFICATION	CHANGE OF STRATA IN METRS.	DEPTH IN METRS.	SYMBOL	SAMPLE DEPTH IN METRS.	GRAPHICAL REPRESENTATION OF 'N' VALUES					'N' VALUES	SAMPLE		CORE RECOVERY %	RQD %	G.W.L OBSER
						20	40	60	80	100		TYPE	REF NO.			
CLAYEY SAND MIX BOULDER		0.00	0.00													
		1.00	1.00		1.50					74	SPT	01				
		2.00	2.00													
		3.00	3.00		3.00					>100	SPT	02				
		4.00	4.00													
		5.00	5.00		4.50					>100	SPT	03				
		6.00	6.00		6.00					>100	SPT	04				
		6.70	6.70													
		7.00	7.00		7.50						CS	01	19	NIL		
		8.00	8.00													
		9.00	9.00		9.00						CS	02	30	10		
		10.00	10.00													
		11.00	11.00		10.50						CS	03	38	20		
		12.00	12.00		12.00						CS	04	52	26		
BH TERMINATED AT DEPTH 12.10M		12.10	12.10													
		13.00	13.00													
		14.00	14.00													
		15.00	15.00													

LEGEND: - UDS-UNDISTURBED SAMPLE, DS- DISTURBED SAMPLE, SPT-STANDARD PENETRATION TEST, W- WATER SAMPLE, -W- WATER LEVEL, P-PENETROMETRE TEST, V- VANE SHEAR TEST, C-CORE RECOVERY

No. of disturbed sample: NIL
No. of Large diameter sample: NIL
No. of Undisturbed sample: NIL
No. of CORE: 04
No. of SPT: 04
No. of Vane Shear Test : NIL
No. of Water Sample : 01





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77, SATYANAGAR,
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TRIAL PIT-05

LOCATION :- CMD AREA

CO-ORDINATE :- E-523.880 N-1084.21

PROJECT:- DETAILED SOIL INVESTIGATION WORKS, SURVEY WORKS OF COAL GASIFICATION & AMMONIA UREA PLANT, TALCHER, ODISHA, INDIA.

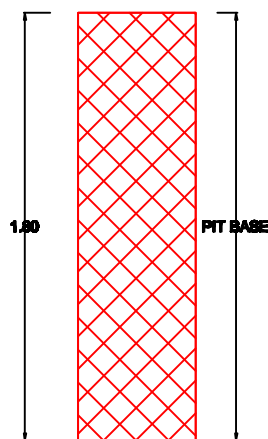
TP:-05

TOTAL DEPTH:1.80M
R.L:-95.187

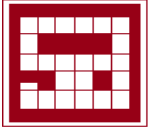
DATE OF START :-05.05.2020

DATE OF COMP. :- 06.05.2020

SCALE IN METRES	STRATA				SAMPLE			LEGEND:-				
	DEPTH	SYMBOL			DEPTH (M)	TYPE	No.					
0.00	0.00	3.00 S	3.00 W	3.00 N	3.00 E							
						1.00	UDS	01	1) CLAYEY SAND			
									1.60	DS	01	2) WATER TABLE-2.60 M
						3.00	3.00	3.00	3.00			



BISHAL KUMAR DAS.
MTECH (GEOTECH)
77, SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED

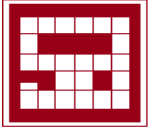
CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.

SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm ² (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)		
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)					
GAS CLEANING	BH-90	2.0	UDS	SC	1.90	1.48	28	0	68	32	34	21	13	-	-	-	0.11	28	0.058	0.000105	-	-	0.908 x 10 ⁻⁴		
		4.5	SPT	SC	1.88	1.52	24	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	0.75	13.33	-	
	BH-91	1.5	SPT	SC	-	-	-	4	65	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		3.0	SPT	SC	1.90	1.51	26	-	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.76	11.87	-
		4.5	SPT	SC	-	-	-	-	-	-	-	30	20	10	-	-	-	0.09	30	-	-	-	-	-	
	BH-92	1.5	SPT	SC	1.87	1.50	25	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.77	-	0.889 x 10 ⁻⁴
		3.0	SPT	SC	-	-	-	0	63	37	-	-	-	-	-	-	-	0.13	26	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	-	31	22	9	-	-	-	-	-	-	-	-	-	-	
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.062	0.000103	-	13.18	-	
	BH-93	1.5	SPT	SC	1.88	1.48	27	-	-	-	-	-	-	-	2.65	-	-	-	-	0.057	0.000106	0.79	-	-	
		3.0	SPT	SC	-	-	-	-	-	-	-	33	22	11	-	-	-	-	-	-	-	-	8.27	-	
		4.5	SPT	SC	-	-	-	0	60	40	-	-	-	-	-	-	-	-	-	-	-	-	-	0.864 x 10 ⁻⁴	
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	29	-	-	-	-	-	
	BH-94	1.5	SPT	SC	-	-	-	3	58	39	-	-	-	-	-	-	-	-	-	0.061	0.000104	-	7.47	-	
		3.0	SPT	SC	1.89	1.49	27	-	-	-	-	-	-	-	2.66	-	-	0.13	25	-	-	0.79	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	-	29	19	10	-	-	-	-	-	-	-	-	-	-	
	BH-95	1.5	SPT	SM	2.00	1.71	17	21	68	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2.0	UDS	SC	1.87	1.48	26	-	-	-	-	-	-	-	2.64	-	-	0.11	29	-	-	0.78	-	-	
		3.0	SPT	SC	-	-	-	0	63	37	-	-	-	-	-	-	-	-	-	-	-	-	9.33	-	
		4.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.0		SPT	SC	-	-	-	-	-	-	-	31	20	11	-	-	-	-	-	-	-	-	-	-	0.908 x 10 ⁻⁴	



CLIENT: TALCHER FERTILIZERS LIMITED

CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.

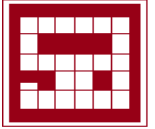
SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm2 (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)		
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)					
GAS CLEANING	BH-96	1.5	SPT	SC	1.87	1.48	26	-	-	-	-	-	-	2.65	-	-	-	-	0.091	0.000105	0.79	-	-		
		3.0	SPT	SC	-	-	-	0	61	39	-	-	-	-	-	-	0.09	30	-	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	33	23	10	-	-	-	-	-	-	-	-	-	12.96	-	
	BH-97	1.5	SPT	SM	1.98	1.68	18	19	70	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	-	-	-	2	66	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-
	BH-98	1.5	SPT	SM	-	-	-	21	68	11	-	-	-	2.68	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	1.89	1.48	28	-	-	-	-	-	-	2.64	-	-	0.12	27	-	-	0.79	-	-	-	
		4.5	SPT	SC	-	-	-	0	63	37	-	-	-	-	-	-	-	-	-	-	-	12.13	-	-	
	BH-99	1.5	SPT	SC	1.87	1.48	26	-	-	-	-	-	-	2.65	-	-	-	-	0.060	0.000107	0.79	8.53	-	-	
		3.0	SPT	SC	-	-	-	3	62	35	-	-	-	-	-	-	0.11	29	-	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	31	20	11	-	-	-	-	-	-	-	-	-	-	0.835 x 10 ⁻⁴	
	BH-100	1.5	SPT	SC	-	-	-	0	61	39	-	-	-	-	-	-	-	-	-	-	-	-	8.93	-	
		3.0	SPT	SC	1.85	1.49	24	-	-	-	-	-	-	2.66	-	-	-	-	-	-	0.78	-	-	0.799 x 10 ⁻⁴	
		4.5	SPT	SC	-	-	-	-	-	-	33	22	11	-	-	-	-	-	-	-	-	-	-	-	
	BH-101	1.5	SPT	SC	1.88	1.48	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.27	-	
		3.0	SPT	SC	-	-	-	4	58	38	-	-	-	-	-	-	0.14	25	-	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-	

Bishwan Kumar Das
M.TECH (GEOTECH)
SWAYIN & ASSOCIATES



CLIENT: TALCHER FERTILIZERS LIMITED

CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.

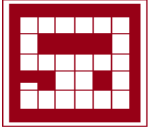
SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm ² (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)		
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)					
GAS CLEANING	BH-102	1.5	SPT	SC	-	-	-	-	-	-	32	21	11	-	-	-	-	-	-	0.062	0.000103	-	7.87	-	
		3.0	SPT	SC	1.86	1.49	25	-	-	-	-	-	-	-	-	-	0.11	28	-	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	2	60	38	-	-	-	-	-	-	-	-	-	-	-	-	-	0.812 x 10 ⁻⁴	-
	BH-103	1.5	SPT	SC	1.88	1.48	27	-	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.80	-	-
		3.0	SPT	SC	-	-	-	0	58	42	-	-	-	-	-	-	-	0.14	25	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	33	21	12	-	-	-	-	-	-	-	-	-	-	-	-
	BH-104	1.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.27	-
		3.0	SPT	SC	-	-	-	0	61	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	0.12	27	-	-	-	-	-	-	-
	BH-105	1.5	SPT	SC	-	-	-	-	-	-	-	31	20	11	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	1.86	1.49	25	-	-	-	-	-	-	-	2.64	-	-	-	-	-	-	-	0.77	-	-
		4.5	SPT	SC	-	-	-	2	63	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BH-106	1.5	SPT	SC	1.88	1.50	25	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.76	-	0.874 x 10 ⁻⁴
		3.0	SPT	SC	-	-	-	-	-	-	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	0	60	40	-	-	-	-	-	-	0.13	26	-	-	-	-	-	-	-
	BH-107	1.5	SPT	SC	-	-	-	0	58	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	1.86	1.48	26	-	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.80	12.93	-
		4.5	SPT	SC	-	-	-	-	-	-	33	21	12	-	-	-	-	-	-	-	-	-	-	-	-

(Signature)
Bishnu Kumar Das
M.TECH (GEOTECH)
SWAYIN & ASSOCIATES



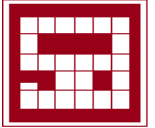
CLIENT: TALCHER FERTILIZERS LIMITED
 CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.
 SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm2 (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)	
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)				
GAS CLEANING	BH-108	1.5	SPT	SC	-	-	-	0	63	37	-	-	-	-	-	-	-	-	0.058	0.000107	-	-	-	
		2.0	UDS	SC	1.89	1.49	27	-	-	-	-	-	-	2.65	-	-	0.11	29	-	-	0.78	-	0.932 x 10 ⁻⁴	
		4.5	SPT	SC	-	-	-	-	-	-	31	19	12	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.33	-	-
	BH-109	1.5	SPT	SC	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	-	-	-	0	60	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	1.88	1.49	26	-	-	-	-	-	-	2.65	-	-	0.12	27	-	-	0.78	-	-	-
	BH-110	1.5	SPT	SC	1.90	1.48	28	-	-	-	-	-	-	2.64	-	-	0.10	29	-	-	0.78	-	-	-
		3.0	SPT	SC	-	-	-	3	59	38	-	-	-	-	-	-	-	-	-	-	-	12.13	-	-
		4.5	SPT	SC	-	-	-	-	-	-	32	21	11	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.846 x 10 ⁻⁴
	BH-111	1.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.063	0.000105	-	10.93	-	-
		3.0	SPT	SC	1.87	1.48	26	-	-	-	-	-	-	2.66	-	-	0.13	27	-	-	0.79	-	-	-
		4.5	SPT	SC	-	-	-	0	62	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	31	20	11	-	-	-	-	-	-	-	-	-	-	-
	BH-112	1.5	SPT	SC	1.89	1.48	28	-	-	-	-	-	-	2.65	-	-	-	-	-	-	0.79	-	-	-
3.0		SPT	SC	-	-	-	0	57	43	-	-	-	-	-	-	0.11	28	-	-	-	-	-	-	
4.5		SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.33	-	-	
6.0		SPT	SC	-	-	-	-	-	-	33	23	10	-	-	-	-	-	-	-	-	-	-	-	





CLIENT: TALCHER FERTILIZERS LIMITED

CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.

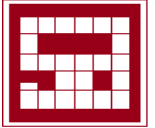
SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm ² (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)		
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)					
GAS CLEANING	BH-113	1.5	SPT	SC	-	-	-	0	60	40	-	-	-	-	-	-	-	-	-	0.060	0.000104	-	11.60	-	
		3.0	SPT	SC	-	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	1.88	1.49	26	-	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.78	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	25	-	-	-	-	-	-
	BH-114	1.5	SPT	SC	-	-	-	0	59	41	-	-	-	-	-	-	-	-	-	0.057	0.000106	-	9.60	-	
		3.0	SPT	SC	1.90	1.48	28	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.79	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	31	21	10	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	26	-	-	-	-	-	-
	BH-115	1.5	SPT	SC	1.87	1.50	25	-	-	-	-	-	-	-	2.66	-	-	0.10	29	-	-	-	0.78	-	-
		3.0	SPT	SC	-	-	-	2	60	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	32	22	10	-	-	-	-	-	-	-	-	-	-	-
	BH-116	1.5	SPT	SC	1.86	1.48	26	-	-	-	-	-	-	-	2.64	-	-	-	-	-	-	-	0.79	11.73	-
		3.0	SPT	SC	-	-	-	0	61	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	29	20	9	-	-	-	-	-	-	-	-	-	-	-
	BH-117	1.5	SPT	SC	-	-	-	0	58	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	1.89	1.49	27	-	-	-	-	-	-	-	2.64	-	-	0.13	26	-	-	-	0.77	-	-
			4.5	SPT	SC	-	-	-	-	-	-	31	20	11	-	-	-	-	-	-	-	-	-	-	-





CLIENT: TALCHER FERTILIZERS LIMITED

CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.

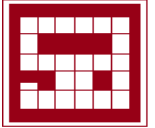
SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm2 (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)		
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)					
GAS CLEANING	BH-118	1.5	SPT	SC	-	-	-	-	-	-	32	20	12	-	-	-	-	-	-	-	-	-	0.887 x 10 ⁻⁴		
		3.0	SPT	SC	1.87	1.50	25	-	-	-	-	-	-	-	2.66	-	-	0.11	29	-	-	0.78	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.33	-	
		6.0	SPT	SC	-	-	-	0	60	40	-	-	-	-	-	-	-	-	-	0.060	0.000107	-	-	-	
	BH-119	1.5	SPT	SC	1.90	1.48	28	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.79	10.67	-
		3.0	SPT	SC	-	-	-	0	63	37	-	-	-	-	-	-	-	0.14	24	-	-	-	-	-	
		4.5	SPT	SC	-	-	-	-	-	-	30	21	9	-	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.913 x 10 ⁻⁴	
	BH-120	1.5	SPT	SC	-	-	-	0	59	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3.0	SPT	SC	1.89	1.49	27	-	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.78	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	29	19	10	-	-	-	-	-	0.059	0.000108	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	27	-	-	-	-	-	-
	BH-121	1.5	SPT	SC	-	-	-	0	58	42	-	-	-	-	-	-	-	-	-	-	-	-	-	8.93	-
		3.0	SPT	SC	1.87	1.48	26	-	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.79	-	-
		4.5	SPT	SC	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-	-
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14	25	-	-	-	-	-	-
BH-122	1.5	SPT	SC	1.90	1.50	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.93	-	
	3.0	SPT	SC	-	-	-	2	59	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	4.5	SPT	SC	-	-	-	-	-	-	32	21	11	-	-	-	-	-	-	-	-	-	-	-	-	
	6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	29	-	-	-	-	-	-	

BISHU KUMAR DAS.
M.TECH (GEO TECH)
SATYANAGAR



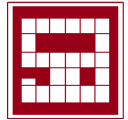
CLIENT: TALCHER FERTILIZERS LIMITED
 CONTRACTOR: VWUHUAN ENGINEERING CO., LTD.
 SUB CONTRACTOR: SWAYIN & ASSOCIATES.

JOB No. TLD/2020-03

ANNEXURE - A SUMMARY OF LABORATORY TEST RESULTS ON SOIL SAMPLES

Location	Borehole No	Depth in Mtrs	Type of Sample	IS Classification (IS:1498-1970)	Density in gm/cc		Water Content (%) (IS:2720 Pt-II)	Particle Size (%) (IS:2720 Pt-IV)			Atterberg's Limits (IS:2720 Pt-V)			Specific gravity (IS:2720 Pt-III_2)	Triaxial Shear Test (UU) (IS:2720 Pt-12)		Direct Shear Test (IS:2720 Pt-13)		Consolidation Test (IS:2720 Pt-15)		Void Ratio	UCS in kg/cm ² (IS:2720 Pt-10)	Permeability Test (IS:2720 Pt-17)	
					Bulk	Dry		Gravel	Sand	Silt & Clay	LL	PL	PI		C in kg/cm ²	φ in degree	C in kg/cm ²	φ in degree	Cc	Mv (cm ² /kg)				
GAS CLEANING	BH-123	1.5	SPT	SC	-	-	-	0	57	43	-	-	-	-	-	-	-	-	0.059	0.000106	-	-	-	
		3.0	SPT	SC	1.87	1.50	25	-	-	-	-	-	-	2.66	-	-	-	-	-	-	0.78	10.67	-	
		4.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	0.13	27	-	-	-	-	-	
	BH-124	1.5	SPT	SC	1.89	1.47	29	-	-	-	-	-	-	2.65	-	-	-	-	-	-	-	0.81	9.87	-
		3.0	SPT	SC	-	-	-	2	58	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	0.11	28	-	-	-	-	-	-
	BH-125	6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.902 x 10 ⁻⁴
		1.5	SPT	SC	1.88	1.49	26	-	-	-	-	-	-	2.66	-	-	-	-	-	-	-	0.78	-	-
		3.0	SPT	SC	-	-	-	-	-	-	33	22	11	-	-	-	-	-	-	-	-	-	-	-
	BH-126	4.5	SPT	SC	-	-	-	0	62	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1.5	SPT	SC	-	-	-	3	60	37	-	-	-	-	-	-	-	-	0.062	0.000106	-	8.93	-	-
		3.0	SPT	SC	1.87	1.47	27	-	-	-	-	-	-	2.64	-	-	-	-	-	-	0.79	-	-	-
		4.5	SPT	SC	-	-	-	-	-	-	30	19	11	-	-	-	-	-	-	-	-	-	-	-
	BH-127	6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	0.13	26	-	-	-	-	-	-
		1.5	SPT	SC	1.89	1.48	28	-	-	-	-	-	-	2.65	-	-	0.12	27	-	-	0.79	-	-	-
		3.0	SPT	SC	-	-	-	-	-	-	30	20	10	-	-	-	-	-	-	-	-	-	-	-
4.5		SPT	SC	-	-	-	0	59	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		6.0	SPT	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.33	-	

BISHU KUMAR DAS
 M.TECH (GEOTECH)

CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

CALCULATION FOR VOID RATIO

Example for some Boreholes

1) For BH-90

Depth:-4.50m

Specific gravity: 2.65

Dry Density: 1.52

$$\text{Void Ratio } (e_0) = (2.65/1.52)-1 \\ = 0.75$$

5) For BH-110

Depth:-1.50m

Specific gravity: 2.64

Dry Density: 1.48

$$\text{Void Ratio } (e_0) = (2.64/1.48)-1 \\ = 0.78$$

2) For BH-95

Depth:-2.00m

Specific gravity: 2.64

Dry Density: 1.48

$$\text{Void Ratio } (e_0) = (2.64/1.48)-1 \\ = 0.78$$

6) For BH-117

Depth:- 1.50m

Specific gravity: 2.64

Dry Density: 1.49

$$\text{Void Ratio } (e_0) = (2.64/1.49)-1 \\ = 0.77$$

3) For BH-100

Depth:-3.00m

Specific gravity: 2.66

Dry Density: 1.49

$$\text{Void Ratio } (e_0) = (2.66/1.49)-1 \\ = 0.78$$

7) For BH-123

Depth:- 3.00m

Specific gravity: 2.66

Dry Density: 1.50

$$\text{Void Ratio } (e_0) = (2.66/1.50)-1 \\ = 0.78$$

4) For BH-105

Depth:-3.00m

Specific gravity: 2.64

Dry Density: 1.49

$$\text{Void Ratio } (e_0) = (2.64/1.49)-1 \\ = 0.77$$


BISHNU KUMAR DAS.
M.TECH (PRACTICE)
SATYANAGAR

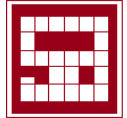


CLIENT: TALCHER FERTILIZERS LIMITED
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JOB No: TLD/2020-03

ANNEXURE-B (ANALYSIS OF ROCK PROPERTIES)

Borehole No.		90	91	92	93
Depth (in mtr)		15.14	9.00	12.02	11.17
Core Piece No		06	03	04	04
RQD (%)		26	15	22	19
Density (g/cc)		2.51	2.54	2.57	2.56
Water content		0.032	0.042	0.036	0.041
Porosity		10.25	9.85	10.25	10.59
Permeability		1.54×10^{-7}	1.72×10^{-7}	1.96×10^{-7}	1.82×10^{-7}
Unconfined Compressive Strength (kg/cm ²)		252.73	230.57	238.12	232.24
Point Load Test (kg/cm ²)		10.56	9.86	10.37	10.06
Weatherability		Highly Weathered (Grade-IV)	Completely Weathered(Grade-V)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)
Term		Weak to Strong	Weak	Weak	Weak
Mohr's Scale of Hardness		5	4	5	4
Cohesion and angle of internal friction	Shear Strength, C	19.15 kg/cm ²	15.65 kg/cm ²	21.52 kg/cm ²	14.35 kg/cm ²
	ϕ	27°	30°	30°	31°
Mineralogical and Petrological composition		Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 15° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip
Corrosivity		Mildly Corrosive	Moderately to Mildy Corrosive	Moderately Corrosive	Moderately to Mildy Corrosive
The rock deformability characteristics		Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor

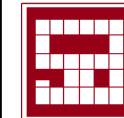


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JOB No: TLD/2020-03

Borehole No.	94	95	96	97
Depth (in mtr)	9	15.53	9	9.00
Core Piece No	3	06	3	2
RQD (%)	15	26	15	13
Density (g/cc)	2.55	2.59	2.56	2.58
Water content	0.042	0.031	0.043	0.036
Porosity	9.86	10.25	9.72	9.68
Permeability	1.82×10^{-7}	2.09×10^{-7}	1.80×10^{-7}	1.68×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	232.73	254.29	234.14	226.85
Point Load Test (kg/cm ²)	10.12	10.92	10.06	9.26
Weatherability	Completely Weathered(Grade-V)	Highly Weathered (Grade-IV)	Completely Weathered(Grade-V)	Completely Weathered(Grade-V)
Term	Weak	Weak to Strong	Weak	Weak
Mohr's Scale of Hardness	4	5	4	4
Cohesion and angle of internal friction	Shear Strength, C	14.47 kg/cm ²	18.54 kg/cm ²	13.22 kg/cm ²
	ϕ	31°	29°	32°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip
Corrosivity	Moderately Corrosive	Moderately to Mildly Corrosive	Moderately Corrosive	Moderately Corrosive
The rock deformability characteristics	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor


 BISHWANATH K. DAS.
 M.TECH (PRACTICAL)
 SWAYIN & ASSOCIATES



CLIENT: TALCHER FERTILIZERS LIMITED
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	98	99	100	101
Depth (in mtr)	10.11	9.00	11.94	15.20
Core Piece No	03	03	04	06
RQD (%)	14	16	21	20
Density (g/cc)	2.55	2.56	2.54	2.57
Water content	0.036	0.039	0.035	0.042
Porosity	10.95	10.43	10.82	10.75
Permeability	1.83×10^{-7}	1.66×10^{-7}	2.23×10^{-7}	1.75×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	229.54	227.12	234.67	231.46
Point Load Test (kg/cm ²)	10.04	9.82	10.24	10.16
Weatherability	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)
Term	Weak	Weak	Weak	Weak
Mohr's Scale of Hardness	4	4	4	4
Cohesion and angle of internal friction	Shear Strength, C	18.56 kg/cm ²	18.47 kg/cm ²	19.47 kg/cm ²
	ϕ	29°	29°	28°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip
Corrosivity	Moderately Corrosive	Moderately Corrosive	Moderately Corrosive	Moderately Corrosive
The rock deformability characteristics	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor


 Biswas Kumar Das.
 M.TECH (Petro. Engg.)
 SATYANISHA

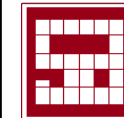


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 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	102	103	104	105
Depth (in mtr)	10.50	12.00	14.80	12.03
Core Piece No	3	4	03	04
RQD (%)	20	18	25	24
Density (g/cc)	2.58	2.57	2.56	2.56
Water content	0.039	0.038	0.037	0.042
Porosity	10.67	10.41	11.23	10.74
Permeability	1.76×10^{-7}	1.58×10^{-7}	1.94×10^{-7}	1.63×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	228.51	227.61	242.80	238.46
Point Load Test (kg/cm ²)	10.02	9.84	10.72	10.43
Weatherability	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)
Term	Weak	Weak	Weak to Strong	Weak
Mohr's Scale of Hardness	4	4	5	4
Cohesion and angle of internal friction	Shear Strength, C	18.53 kg/cm ²	13.35 kg/cm ²	12.89 kg/cm ²
	ϕ	26°	32°	33°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip
Corrosivity	Moderately Corrosive	Moderately Corrosive	Moderately to Mildly Corrosive	Moderately Corrosive
The rock deformability characteristics	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor


 BISHWANATH KUMAR DAS
 M.TECH (PRACTICE)
 T. SATYANARAYAN



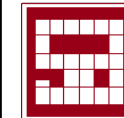
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 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	106	107	108	109
Depth (in mtr)	10.50	13.50	15.25	14.05
Core Piece No	3	06	06	05
RQD (%)	21	20	22	26
Density (g/cc)	2.56	2.54	2.56	2.57
Water content	0.042	0.038	0.037	0.039
Porosity	10.84	10.54	11.13	10.94
Permeability	2.03×10^{-7}	2.28×10^{-7}	2.35×10^{-7}	2.17×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	234.37	228.57	232.51	242.08
Point Load Test (kg/cm ²)	10.16	9.94	10.15	10.45
Weatherability	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)	Highly Weathered (Grade-IV)
Term	Weak	Weak	Weak	Weak to Strong
Mohr's Scale of Hardness	4	4	4	5
Cohesion and angle of internal friction	Shear Strength, C	12.41 kg/cm ²	18.67 kg/cm ²	13.48 kg/cm ²
	ϕ	32°	26°	33°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip
Corrosivity	Moderately Corrosive	Moderately Corrosive	Moderately to Mildly Corrosive	Moderately Corrosive
The rock deformability characteristics	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor



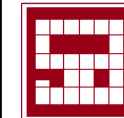
BISHWANATH KUMAR DAS.
 M.TECH (PROJECT TECH)
 T. SATYANARAYAN



CLIENT: TALCHER FERTILIZERS LIMITED
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	110	111	112	113
Depth (in mtr)	16.50	15.69	16.47	15
Core Piece No	07	05	06	03
RQD (%)	25	26	26	22
Density (g/cc)	2.56	2.58	2.57	2.54
Water content	0.038	0.036	0.041	0.039
Porosity	10.54	10.47	10.92	10.78
Permeability	2.24×10^{-7}	1.96×10^{-7}	2.18×10^{-7}	2.05×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	246.52	253.49	252.89	227.52
Point Load Test (kg/cm ²)	10.42	10.94	11.31	9.85
Weatherability	Highly Weathered (Grade-IV)	Highly Weathered (Grade-IV)	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)
Term	Weak to Strong	Weak to Strong	Weak to Strong	Weak
Mohr's Scale of Hardness	5	5	5	5
Cohesion and angle of internal friction	Shear Strength, C	17.21 kg/cm ²	18.52 kg/cm ²	15.69 kg/cm ²
	ϕ	29°	27°	31°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip
Corrosivity	Moderately Corrosive	Moderately Corrosive	Moderately Corrosive	Moderately to Mildly Corrosive
The rock deformability characteristics	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor



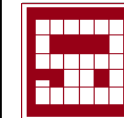
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JOB No: TLD/2020-03

Borehole No.	114	115	116	117
Depth (in mtr)	13.25	12.00	13.86	14.38
Core Piece No	5	4	05	05
RQD (%)	25	20	28	22
Density (g/cc)	2.56	2.59	2.53	2.56
Water content	0.041	0.034	0.039	0.041
Porosity	10.21	10.47	10.98	11.19
Permeability	2.35×10^{-7}	1.98×10^{-7}	1.93×10^{-7}	1.62×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	248.72	227.94	256.89	228.39
Point Load Test (kg/cm ²)	10.54	9.57	10.79	9.84
Weatherability	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)
Term	Weak to Strong	Weak	Weak to Strong	Weak
Mohr's Scale of Hardness	5	4	5	4
Cohesion and angle of internal friction	Shear Strength, C	14.23 kg/cm ²	17.28 kg/cm ²	16.74 kg/cm ²
	ϕ	30°	30°	29°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 15° dip
Corrosivity	Mildly Corrosive	Moderately to Mildly Corrosive	Mildly Corrosive	Mildly Corrosive
The rock deformability characteristics	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor



BISHWANATH KUMAR DAS
 M.TECH (GEO TECH)
 171 SATYANARAYAN



**CLIENT: TALCHER FERTILIZERS LIMITED
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES**

JOB No: TLD/2020-03

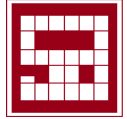
Borehole No.	118	119	120	121
Depth (in mtr)	16.50	16.21	10.50	12.12
Core Piece No	06	07	03	04
RQD (%)	25	27	21	24
Density (g/cc)	2.57	2.57	2.56	2.55
Water content	0.037	0.034	0.039	0.038
Porosity	11.82	10.53	11.25	11.42
Permeability	1.86×10^{-7}	1.64×10^{-7}	1.92×10^{-7}	2.12×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	236.56	245.69	227.28	234.65
Point Load Test (kg/cm ²)	10.23	10.32	9.85	9.54
Weatherability	Highly Weathered (Grade-IV)	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)
Term	Weak to Strong	Weak to Strong	Weak	Weak
Mohr's Scale of Hardness	5	5	4	4
Cohesion and angle of internal friction	Shear Strength, C	18.35 kg/cm ²	18.41 kg/cm ²	18.18 kg/cm ²
	ϕ	28°	32°	27°
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 15° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 15° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 15° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip
Corrosivity	Mildly Corrosive	Moderately Corrosive	Mildly Corrosive	Moderately to Mildly Corrosive
The rock deformability characteristics	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor



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 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	122	123	124	125
Depth (in mtr)	10.37	11.90	10.50	10.00
Core Piece No	03	04	03	03
RQD (%)	21	26	15	18
Density (g/cc)	2.56	2.54	2.57	2.56
Water content	0.038	0.041	0.039	0.038
Porosity	11.15	11.57	11.18	11.67
Permeability	2.42×10^{-7}	2.35×10^{-7}	2.21×10^{-7}	2.18×10^{-7}
Unconfined Compressive Strength (kg/cm ²)	228.82	231.35	224.82	226.34
Point Load Test (kg/cm ²)	10.02	10.14	9.52	11.51
Weatherability	Completely Weathered (Grade-V)	Highly Weathered (Grade-IV)	Completely Weathered (Grade-V)	Completely Weathered (Grade-V)
Term	Weak	Weak to Strong	Weak	Weak
Mohr's Scale of Hardness	4	5	4	4
Cohesion and angle of internal friction	Shear Strength, C	15.58	15.74 kg/cm ²	16.75 kg/cm ²
	ϕ	29 ⁰	29 ⁰	28 ⁰
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 25° dip
Corrosivity	Moderately to Mildly Corrosive	Mildly Corrosive	Moderately to Mildly Corrosive	Moderately to Mildly Corrosive
The rock deformability characteristics	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V Description of Rock : Very Poor	Quality of Deformation : V Description of Rock : Very Poor



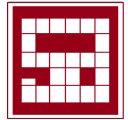
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 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Borehole No.	126	127		
Depth (in mtr)	18.78	12.00		
Core Piece No	07	04		
RQD (%)	29	26		
Density (g/cc)	2.57	2.55		
Water content	0.036	0.042		
Porosity	10.14	10.68		
Permeability	1.78×10^{-7}	1.85×10^{-7}		
Unconfined Compressive Strength (kg/cm ²)	240.64	232.42		
Point Load Test (kg/cm ²)	10.35	9.78		
Weatherability	Highly Weathered (Grade-IV)	Highly Weathered (Grade-IV)		
Term	Weak to Strong	Weak to Strong		
Mohr's Scale of Hardness	5	4		
Cohesion and angle of internal friction	Shear Strength, C	16.52 kg/cm ²	15.42 kg/cm ²	
	ϕ	28°	29°	
Mineralogical and Petrological composition	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip	Type of Rock: Sedimentary Rock Classification: Sandstone Group: Arenaceous (Sandy) Composition: Fine Grained Sands Moderate spaced Fractures with 35° dip		
Corrosivity	Mildly Corrosive	Mildly Corrosive		
The rock deformability characteristics	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor	Quality of Deformation : V to IV Description of Rock : Very Poor to Poor		



BISHNU KUMAR DAS.
 M.TECH (GEOTECH)
 T. PATANIGURU



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

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Table 12.5

Geomechanical classification of jointed rock masses

Class No. and its description	1	2	3	4	5
	Very good	good	Fair	Poor	Very Poor
Rock Quality R.Q.D.(%)	90-100	75-90	50-75	25-50	< 25
Weathering	Unweathered	Slightly Weathered	Moderately weathered	Highly weathered	Completely weathered

REFERENCE:-

* For Rock classification reference is taken from "ENGINEERING CLASSIFICATIONS OF ROCK MASS-Dr P. Verma.





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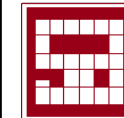
JOB No: TLD/2020-03

ANNEXURE-C (ANALYSIS OF CHEMICAL PROPERTIES OF WATER SAMPLES)

S No.	Borehole No.	pH	Chloride	Hardness	Sulphate	Carbondioxide	Ammonia	Magnesium
1	BH-92	7.25	92.68	261.23	132.15	0.86	0.21	6.42
2	BH-96	7.37	94.75	258.65	127.88	0.89	0.25	5.90
3	BH-100	7.13	91.24	262.58	130.73	0.92	0.33	6.34
4	BH-104	7.42	94.24	264.61	133.02	0.91	0.27	5.84
5	BH-109	7.23	92.38	262.75	131.29	0.89	0.24	5.82
6	BH-112	7.32	96.12	259.83	128.25	0.94	0.32	5.24
7	BH-116	7.17	92.28	252.61	132.32	0.97	0.36	5.96
8	BH-119	7.37	91.22	254.37	127.64	0.87	0.30	6.12
9	BH-120	7.21	94.24	250.12	129.96	0.91	0.29	5.98
10	BH-123	7.34	96.47	259.14	130.95	0.89	0.39	6.17
11	BH-125	7.26	95.41	254.92	129.16	0.96	0.35	5.79
12	BH-127	7.29	93.24	255.61	132.42	0.82	0.23	6.57

- All test results are mentioned in mg/l except for pH.
- Ground water quality is assessed on the basis of water samples collected from site. Since the test results are in permissible limits, ground water of project site can be used for construction.





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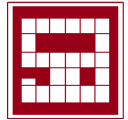
JOB No: TLD/2020-03

ANNEXURE-D (ANALYSIS OF CHEMICAL PROPERTIES OF SOIL SAMPLES)

S No.	Borehole No.	Depth in 'm'	Chloride (%)	Sulphate (%)
1	BH-90	1.50	0.17	0.13
2	BH-93	4.50	0.19	0.16
3	BH-97	1.50	0.21	0.14
4	BH-101	3.00	0.18	0.15
5	BH-105	3.00	0.20	0.14
6	BH-109	4.50	0.21	0.13
7	BH-111	1.50	0.23	0.15
8	BH-114	4.50	0.21	0.14
9	BH-117	1.50	0.17	0.17
10	BH-120	3.00	0.18	0.16
11	BH-123	4.50	0.18	0.12
12	BH-127	3.00	0.15	0.11

ANNEXURE-E (ANALYSIS OF CHEMICAL PROPERTIES OF ROCK SAMPLES)

S No.	Borehole No.	Depth in 'm'	Chloride (%)	Sulphate (%)
1	BH-91	10.50	0.043	0.026
2	BH-94	12.95	0.049	0.023
3	BH-99	12.00	0.051	0.030
4	BH-100	16.50	0.057	0.029
5	BH-103	13.15	0.053	0.033
6	BH-107	16.50	0.059	0.027
7	BH-110	10.50	0.047	0.024
8	BH-113	15.00	0.060	0.031
9	BH-115	16.50	0.054	0.029
10	BH-119	13.00	0.045	0.033
11	BH-124	15.00	0.055	0.028
12	BH-125	16.50	0.047	0.022



CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

PLATE LOAD TEST RESULTS & GRAPHS



Biswas Kumar Das.
M.TECH (PRACTICAL)
SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

PLATE LOAD TEST PROCEDURE (AS PER IS 1888-1982)

a) PLATE SIZE AND THICKNESS:

The square plates used are of 0.50m was used for the Test.

b) TEST PIT:

Test was conducted at depths of 1.80m Below Ground Level after proper leveling. The top surface was finished and leveled properly.

c) PLACING OF TEST PLATE:

The plate was bedded to the soil by spreading fine sand carefully leveled and set horizontally at the bottom of the pit. At the commencement of the test the seating load of 10.00 kg/cm² at the plate level was applied.

d) METHOD OF LISTING:

Loading is applied by the method consisting of a hydraulic jack. The loading system is adequate to ensure that the test can be carried up to the specified limit. A ball and socket arrangement was inserted suitably in the assembly so as to allow the plate to rotate while keeping the direction of the load vertical throughout. Hydraulic jack with a load gauge attachment applied the loading increment.

e) LOAD INCREMENTS:

The numbers of loading increments were decided on the basis of ultimate bearing capacity according to clause no. 4.6 of IS 1888.

f) SETTLEMENT AND OBSERVATION:

Settlement was recorded with two dial gauges of 30mm range and least count of 0.01 mm placed diagonally opposite on the test plate. Settlement was observed for each increment of load after an interval of 1, 2.25, 4, 6.25, 9, 16, 25min. the average of two dial-gauge readings were considered. The next load increment was applied when the rate of settlement is less than 0.02 mm/ min.



Bishal Kumar Das.
M.Tech (Geotech)
SATYANAGAR



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

PLATE LOAD TEST REPORT

Client: TALCHER FERTILIZERS LIMITED	DOS: 05.05.2020
Co-ordinate: E-523.88 N-1084.21	DOC: 06.05.2020
Size of the plate: 500 mm x 500 mm x 25mm	Location:-Gas Cleaning Area
Plate Loading Test No. 05	Depth of Testing: 1.80m
RL-95.187m	

SI No:	Date	Time	Pressure at plate level	Load Intensity	Dial Gauge Readings		Settlement in mm		Remarks.
					D1	D2	Average	Net	
1	2	3	4	5	6	7	8	9	10
1	0505.2020	2.00 PM	5.00 kg/cm ²	20.00 KN/m ²					
2		2.01 PM			0.05	0.10	0.08	0.08	
3		2.02 PM			0.09	0.12	0.11	0.11	
4		2.04 PM			0.12	0.20	0.16	0.16	
5		2.06 PM			0.23	0.28	0.26	0.26	
6		2.09 PM			0.38	0.42	0.40	0.40	
7		2.16 PM			0.62	0.76	0.69	0.69	
8		2.25 PM			0.67	0.84	0.76	0.76	
9	05.05.2020	3.00 PM	10.00 kg/cm ²	40.00 KN/m ²	0.68	0.85	0.77	0.77	
10		3.01 PM			1.27	1.40	1.34	1.34	
11		3.02 PM			1.28	1.44	1.36	1.36	
12		3.04 PM			1.29	1.47	1.38	1.38	
13		3.06 PM			1.29	1.55	1.42	1.42	
14		3.09 PM			1.29	1.55	1.42	1.42	
15		3.16 PM			1.30	1.58	1.44	1.44	
16		3.25 PM			1.32	1.61	1.47	1.47	
17		4.00 PM			1.39	1.61	1.50	1.50	
18	05.05.2020	4.05 PM	20 kg/cm ²	80.00 KN/m ²	1.75	2.08	1.92	1.92	
19		4.06 PM			1.85	2.11	1.98	1.98	
20		4.07 PM			1.96	2.14	2.05	2.05	
21		4.09 PM			1.96	2.14	2.05	2.05	
22		4.11 PM			2.01	2.15	2.08	2.08	
23		4.14 PM			2.02	2.16	2.09	2.09	
24		4.21 PM			2.03	2.18	2.11	2.11	
25		4.30 PM			2.05	2.23	2.14	2.14	
26		5.05 PM			1.75	2.08	1.92	1.92	


 BISHWAJIT KUMAR DAS
 MTECH (GEOTECH)




CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

PLATE LOAD TEST REPORT

Client: TALCHER FERTILIZERS LIMITED	DOS: 05.05.2020
Co-ordinate: E-523.88 N-1084.21	DOC: 06.05.2020
Size of the plate: 500 mm x 500 mm x 25mm	Location:-Gas Cleaning Area
Plate Loading Test No. 05	Depth of Testing: 1.80m
RL-95.187m	

SI No:	Date	Time	Pressure at plate level	Load Intensity	Dial Gauge Readings		Settlement in mm		Remarks.
					D1	D2	Average	Net	
1	2	3	4	5	6	7	8	9	10
27	05.05.2020	5.10 PM	40 kg/cm ²	160.00 KN/m ²	4.68	4.71	4.70	4.70	
28		5.11 PM			4.70	4.74	4.72	4.72	
29		5.12 PM			4.71	4.80	4.76	4.76	
30		5.14 PM			4.81	4.85	4.83	4.83	
31		5.16 PM			4.87	4.91	4.89	4.89	
32		5.19 PM			4.89	4.95	4.92	4.92	
33		5.26 PM			4.92	5.01	4.97	4.97	
34		5.35 PM			5.10	5.06	5.08	5.08	
35		6.10 PM			5.22	5.09	5.16	5.16	
36	05.05.2020	6.21 PM	60 kg/cm ²	240.00 KN/m ²	6.83	6.62	6.73	6.73	
37		6.22 PM			6.88	6.63	6.76	6.76	
38		6.24 PM			6.90	6.65	6.78	6.78	
39		6.26 PM			6.91	6.65	6.78	6.78	
40		6.29 PM			6.91	6.65	6.78	6.78	
41		6.36 PM			6.93	6.66	6.80	6.80	
42		6.45 PM			6.95	6.67	6.81	6.81	
43		7.20 PM			6.98	7.08	7.03	7.03	
44	05.05.2020	7.26 PM	80 kg/cm ²	320.00 KN/m ²	8.04	8.01	8.03	8.03	
45		7.27 PM			8.10	8.04	8.07	8.07	
46		7.29 PM			8.13	8.06	8.10	8.10	
47		7.31 PM			8.14	8.07	8.11	8.11	
48		7.34 PM			8.16	8.10	8.13	8.13	
49		7.41 PM			8.18	8.12	8.15	8.15	
50		7.50 PM			8.19	8.14	8.17	8.17	
51		8.25 PM			8.25	8.16	8.21	8.21	


 BISHWANATH KUMAR DAS.
 MTECH (GEOTECH)
 IIT PATNA



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

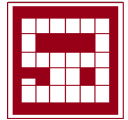
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PLATE LOAD TEST REPORT

Client: TALCHER FERTILIZERS LIMITED	DOS: 05.05.2020
Co-ordinate: E-523.88 N-1084.21	DOC: 06.05.2020
Size of the plate: 500 mm x 500 mm x 25mm	Location:-Gas Cleaning Area
Plate Loading Test No. 05	Depth of Testing: 1.80m
RL-95.187m	

Sl No:	Date	Time	Pressure at plate level	Load Intensity	Dial Gauge Readings		Settlement in mm		Remarks.
					D1	D2	Average	Net	
1	2	3	4	5	6	7	8	9	10
52	05.05.2020	8.31 PM	100 kg/cm ²	400.00 KN/m ²	8.88	9.06	8.97	8.97	
53		8.32 PM			8.96	9.08	9.02	9.02	
54		8.34 PM			9.02	9.10	9.06	9.06	
55		8.36 PM			9.04	9.12	9.08	9.08	
56		8.39 PM			9.07	9.14	9.11	9.11	
57		8.46 PM			9.12	9.18	9.15	9.15	
58		8.55 PM			9.30	9.38	9.34	9.34	
59		9.30 PM			9.40	9.68	9.54	9.54	
60	05.05.2020	9.36 PM	150 kg/cm ²	600.00 KN/m ²	11.06	11.09	11.08	11.08	
61		9.37 PM			11.08	11.11	11.10	11.10	
62		9.39 PM			11.09	11.14	11.12	11.12	
63		9.41 PM			11.11	11.14	11.13	11.13	
64		9.44 PM			11.24	11.28	11.26	11.26	
65		9.51 PM			11.35	11.41	11.38	11.38	
66		10.00 PM			11.68	11.52	11.60	11.60	
67	05.05.2020	10.05 PM	200 kg/cm ²	800.00KN/m ²	13.90	13.98	13.94	13.94	
68		10.06 PM			13.92	14.01	13.97	13.97	
69		10.07 PM			13.94	14.04	13.99	13.99	
70		10.09 PM			13.97	14.08	14.03	14.03	
71		10.11 PM			14.09	14.16	14.13	14.13	
72		10.14 PM			14.14	14.20	14.17	14.17	
73		10.21 PM			14.24	14.29	14.27	14.27	
74		10.30 PM			14.51	14.61	14.56	14.56	
75	REVERS								
76	06.05.20	5.30 AM	150 kg/cm ²	600.00KN/m ²	12.82	12.88	12.85	12.85	
77		6.00 AM	100 kg/cm ²	400.00KN/m ²	10.25	10.29	10.27	10.27	
78		6.30 AM	50 kg/cm ²	200.00 KN/m ²	9.01	9.12	9.07	9.07	
79		7.00 AM	20 kg/cm ²	80.00 KN/m ²	8.55	8.61	8.58	8.58	
80		7.15 AM	0 kg/cm ²	0 KN/m ²	8.03	8.00	8.02	8.02	


 BISHOY KUMAR DAS.
 MTECH (GEOTECH)

CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

Load Intensity calculation for PLT

Size of the Plate = (0.50 x 0.50) m
= 0.25 m²

Pressure applied on Plate in 1st stage = 5 kg/cm²

Load Intensity = Applied Pressure on plate / Size of the Plate
= (5/0.25) = 20 Kn/m²



Bishal Kumar Das.
M.TECH (PPEOT/TECH)
SWAYIN & ASSOCIATES
TALCHER, ODISHA

PLATE LOAD TEST NO - PLT-05

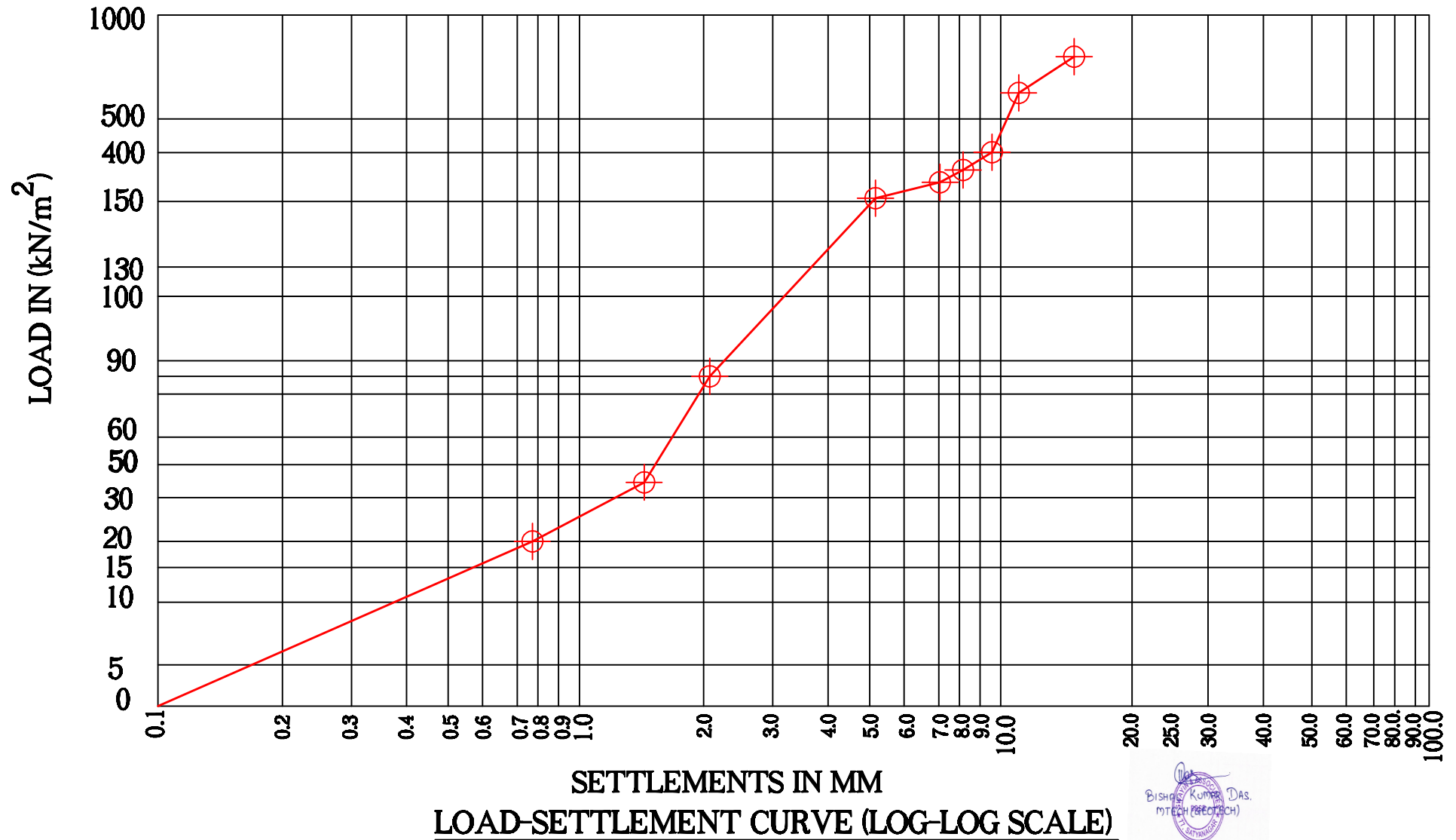
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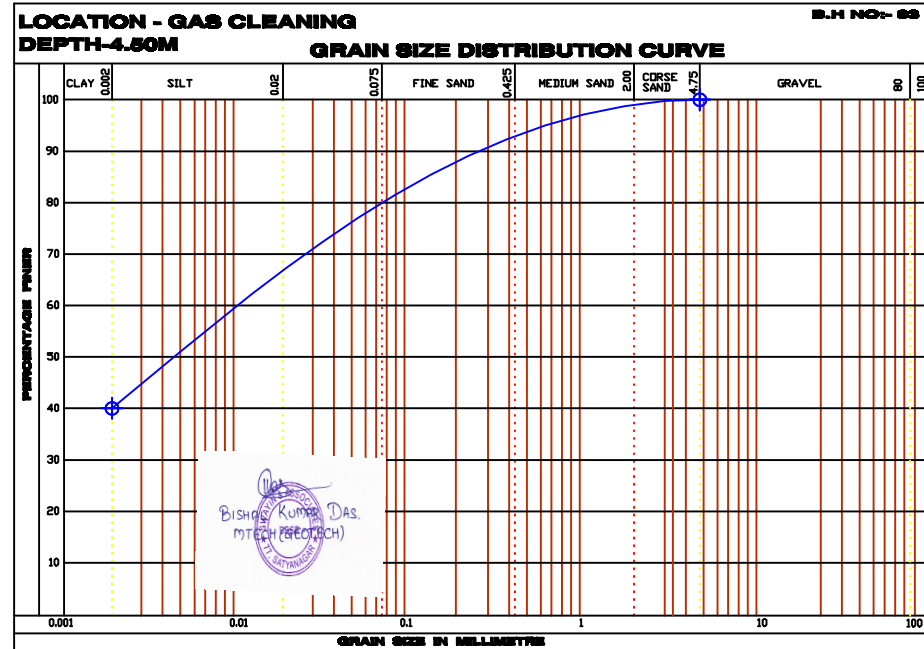
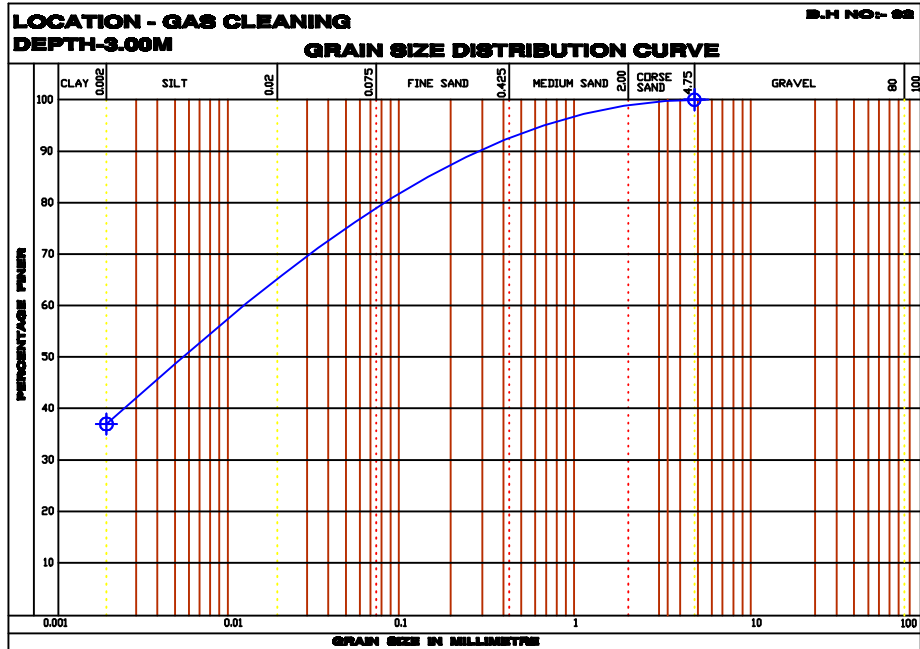
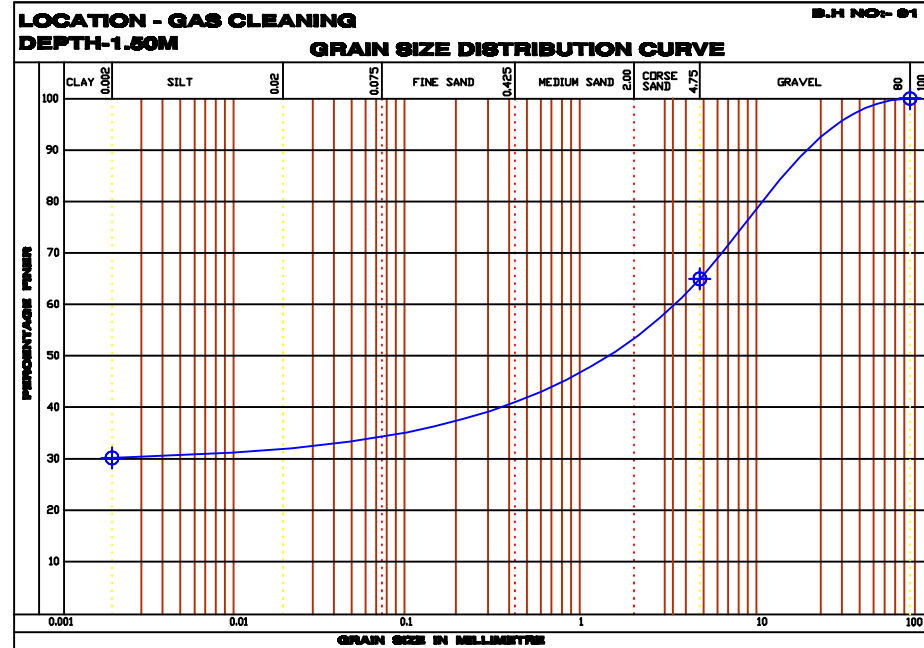
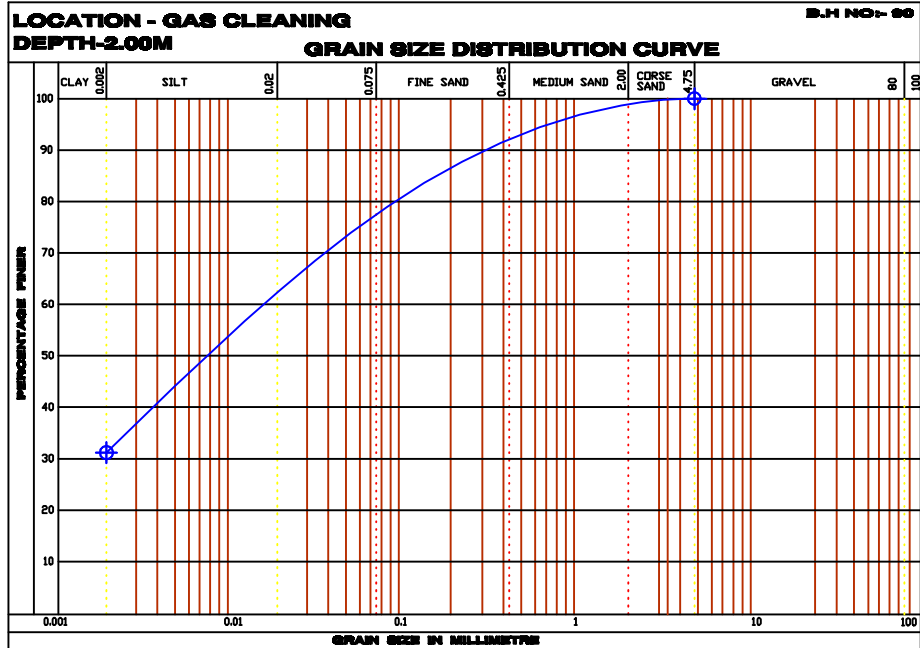
CLIENT : TFL (TALCHER FERTILIZERS LIMITED)

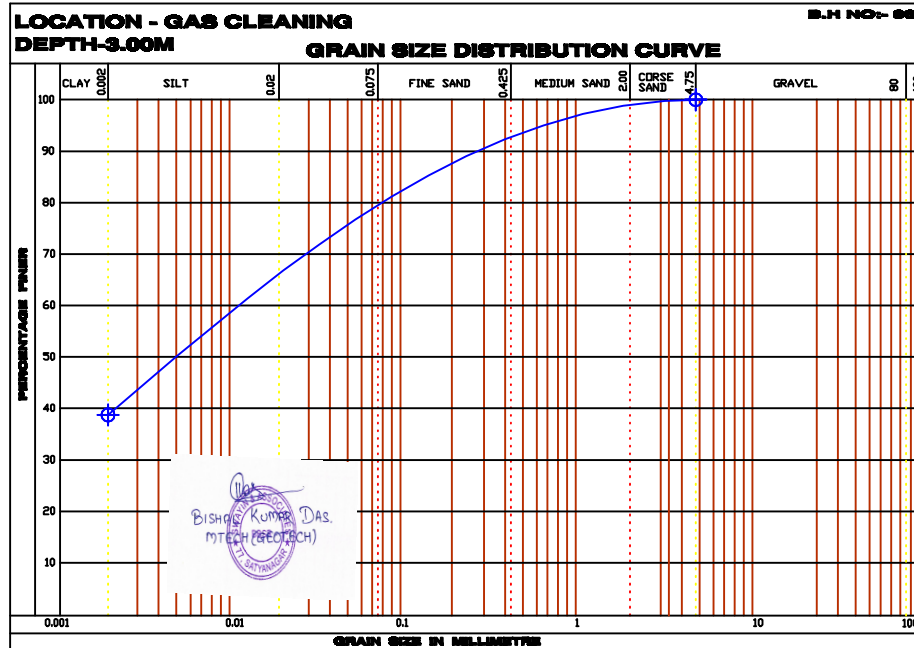
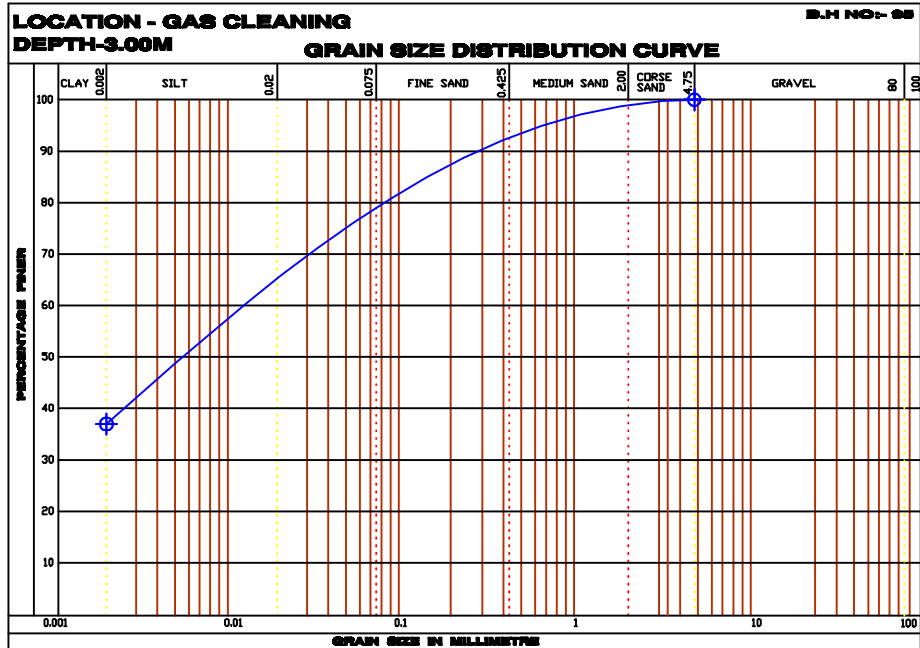
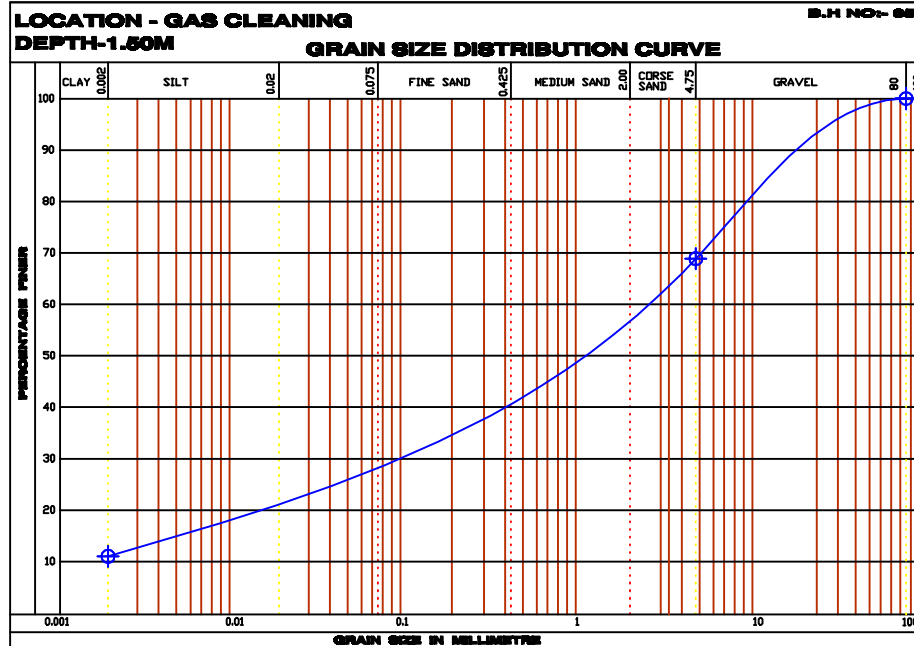
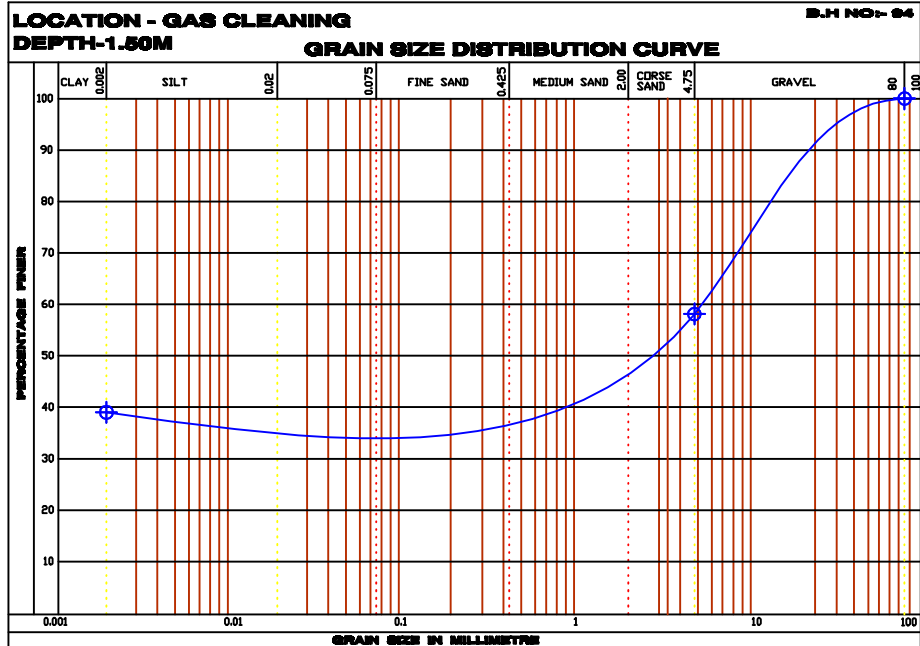
CO-ORDINATE: E-523.88, N- 1084.21

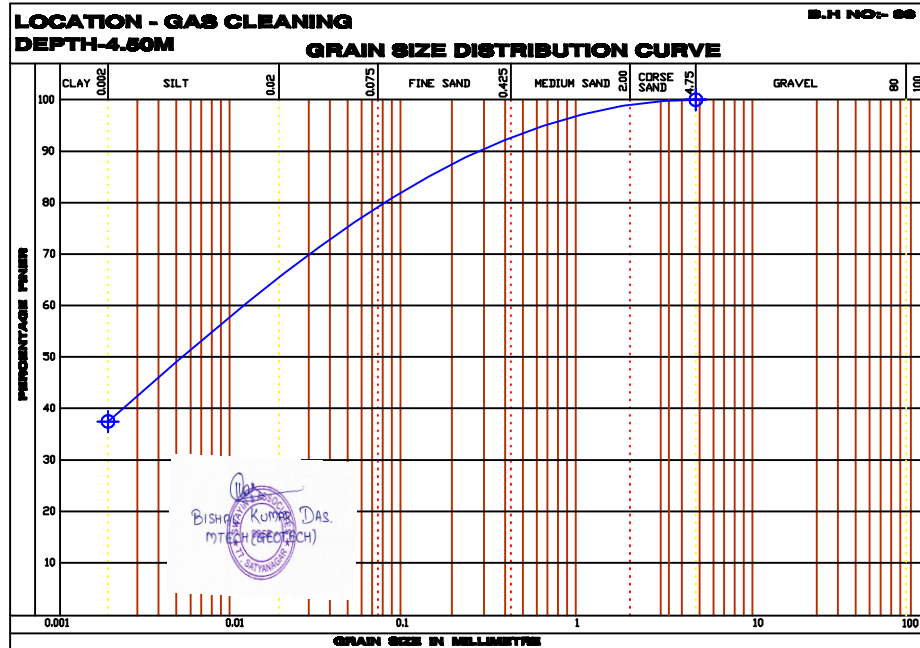
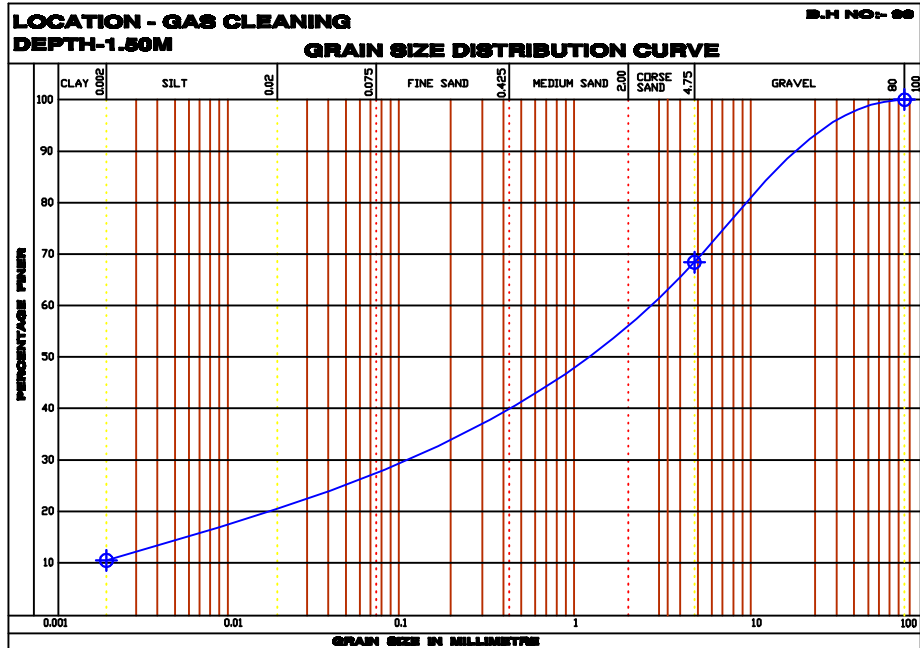
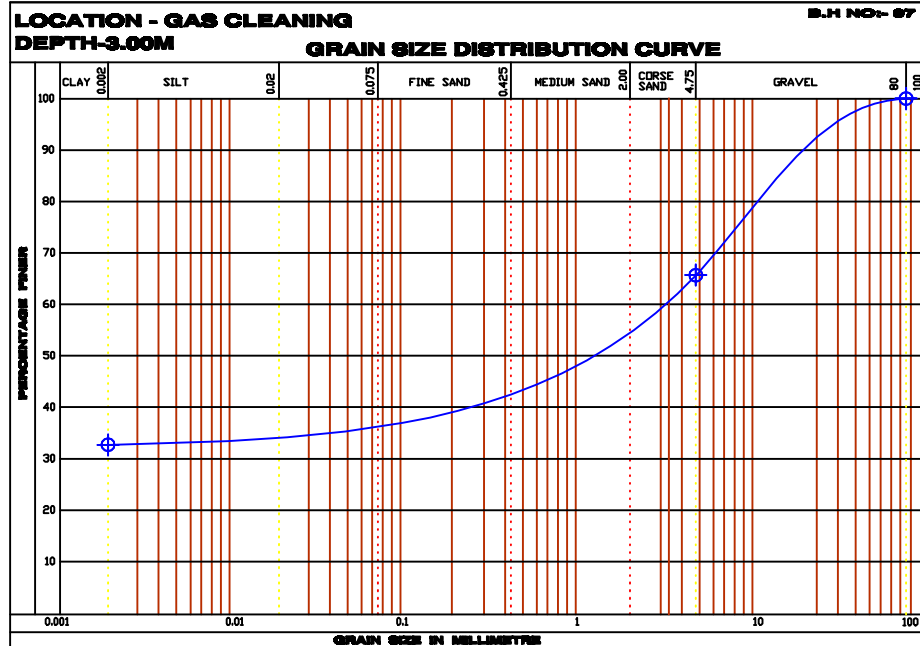
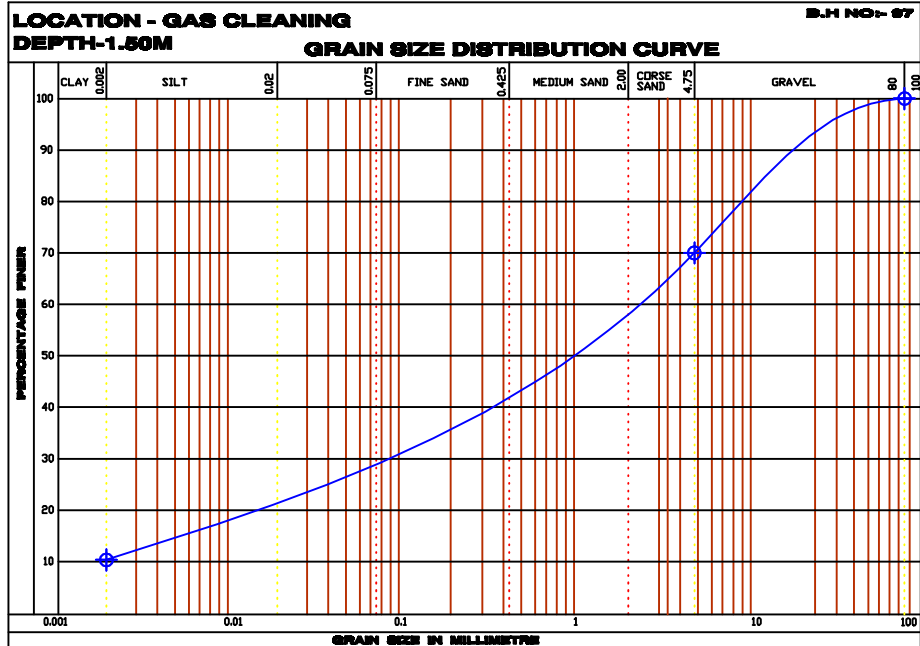
RL - 95.187M

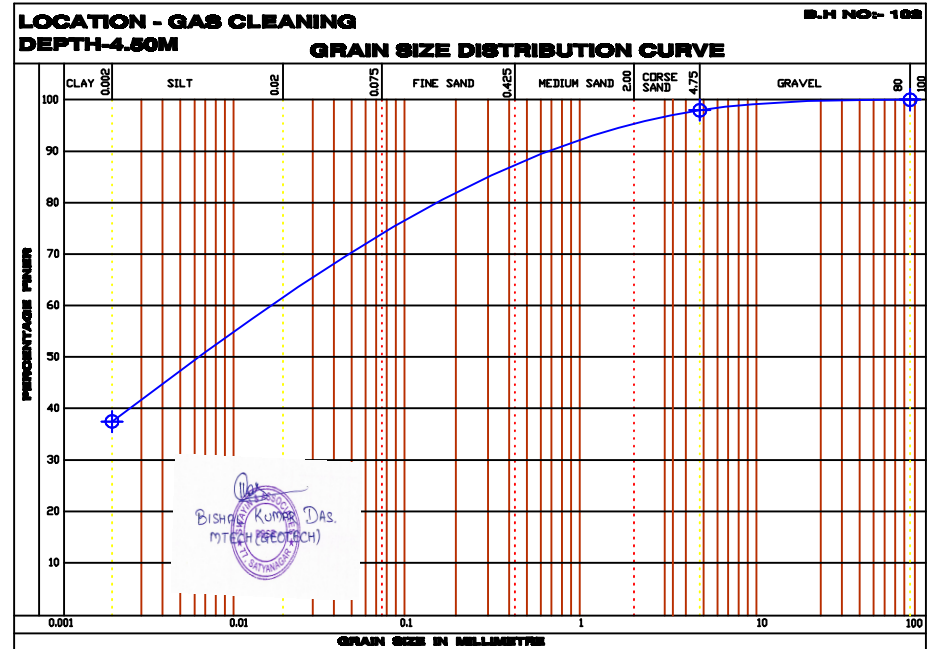
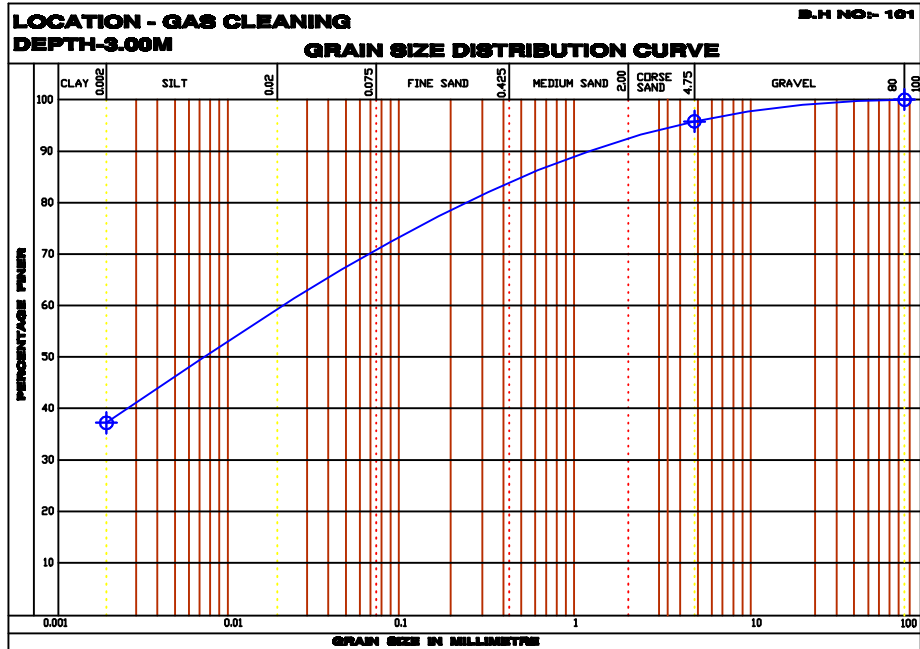
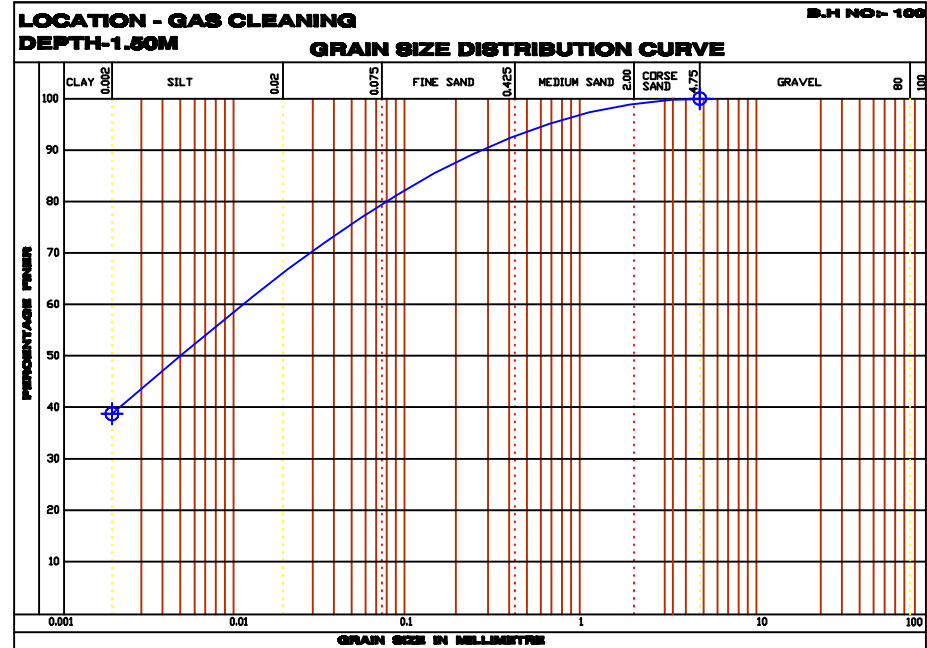
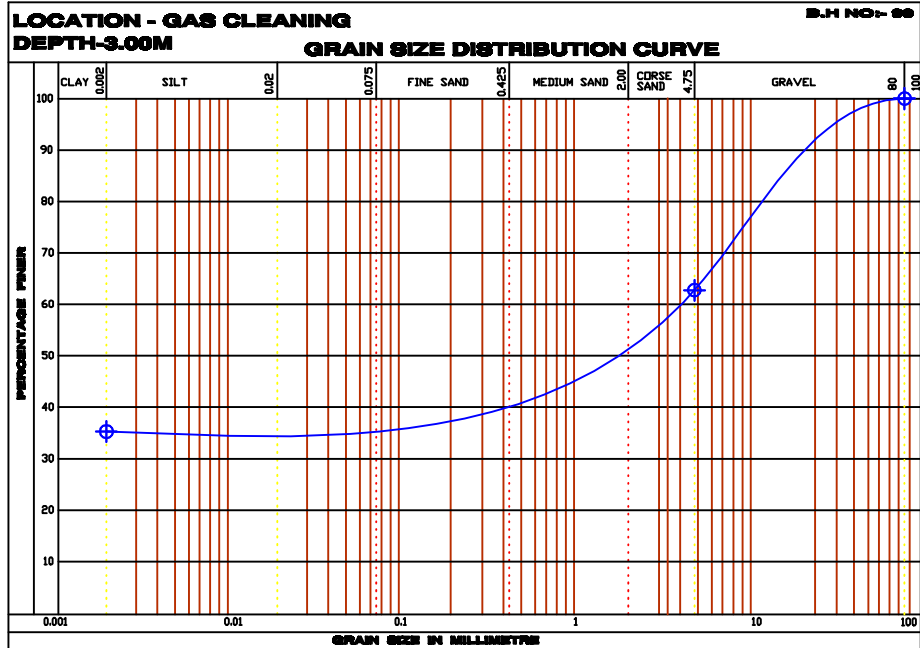
SIZE OF THE PLATE :- 500mm X 500mm

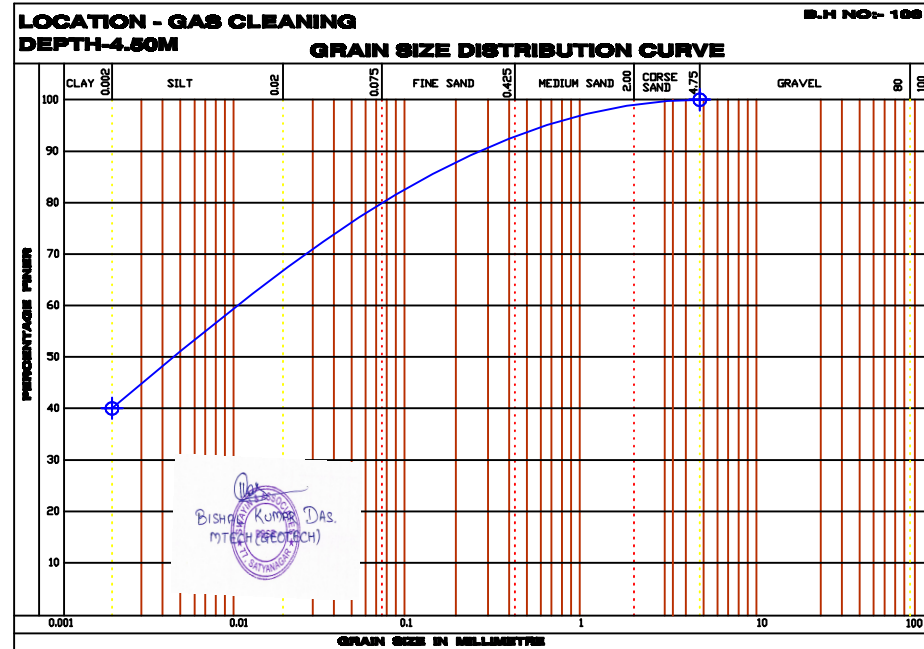
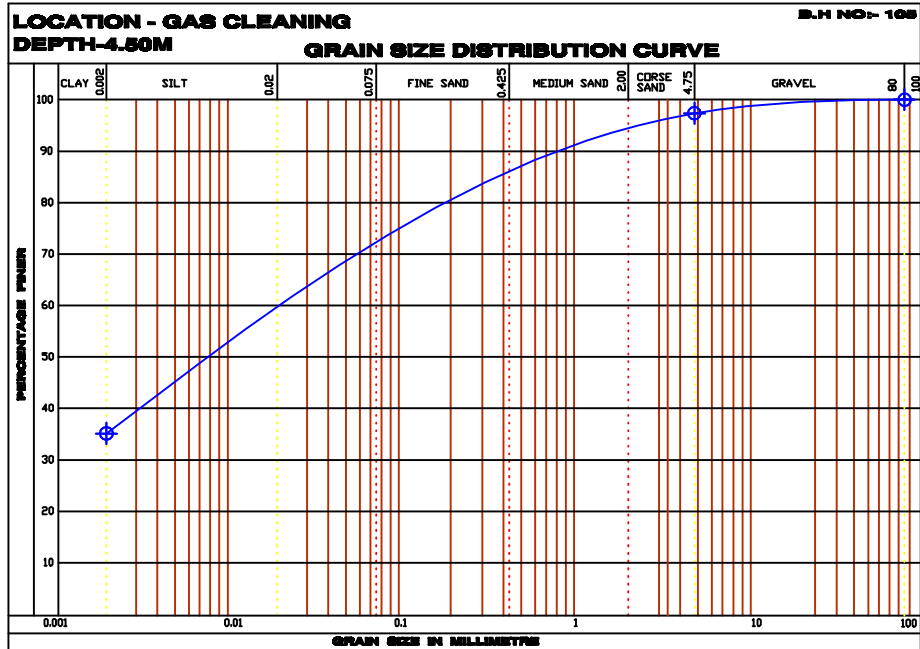
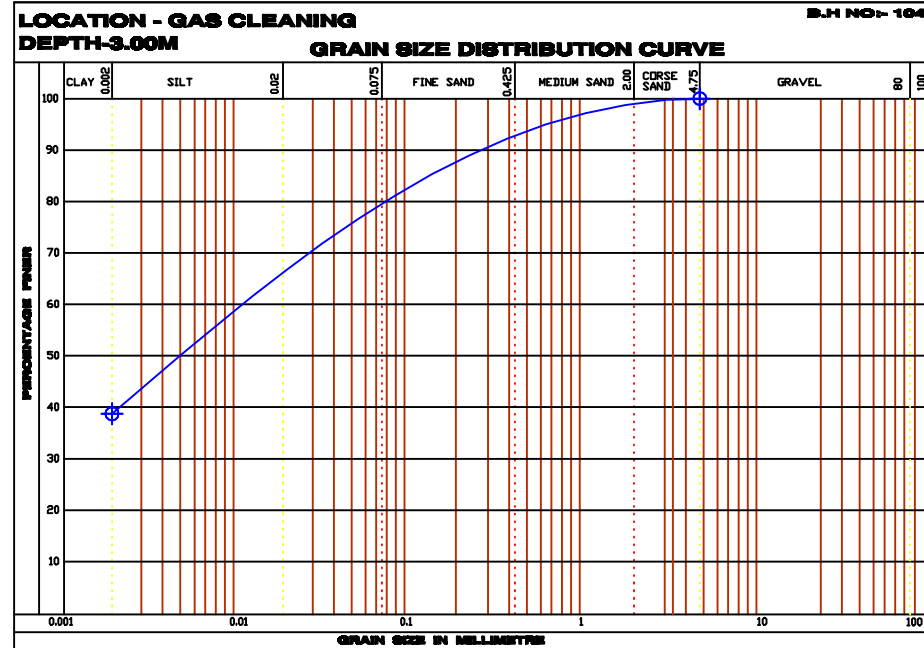
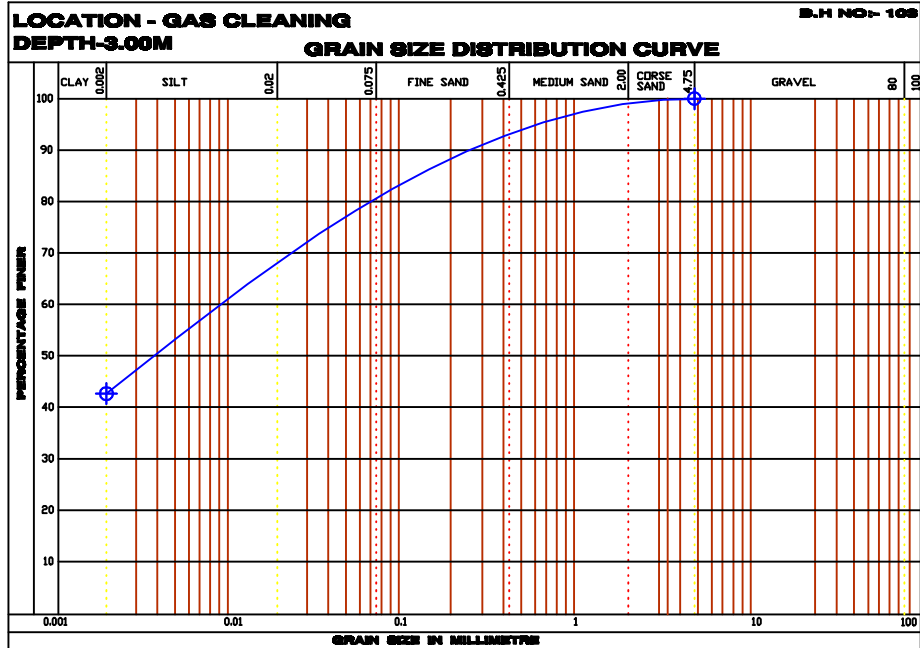


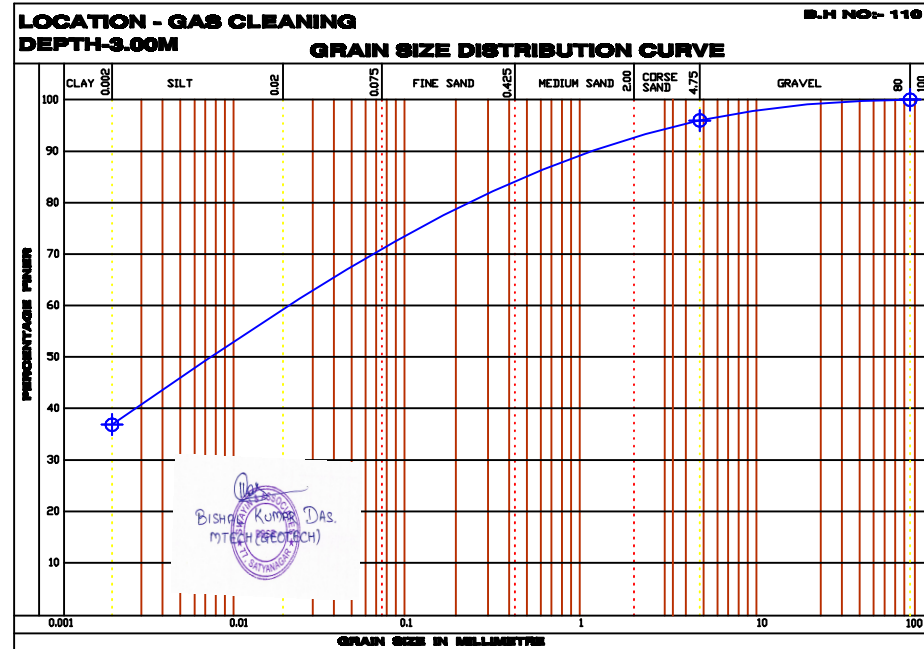
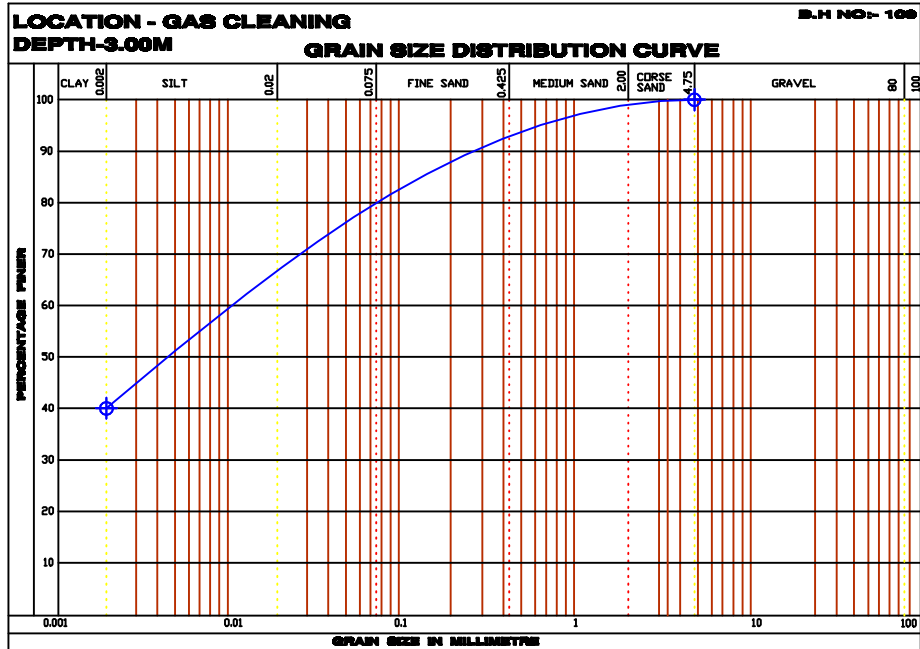
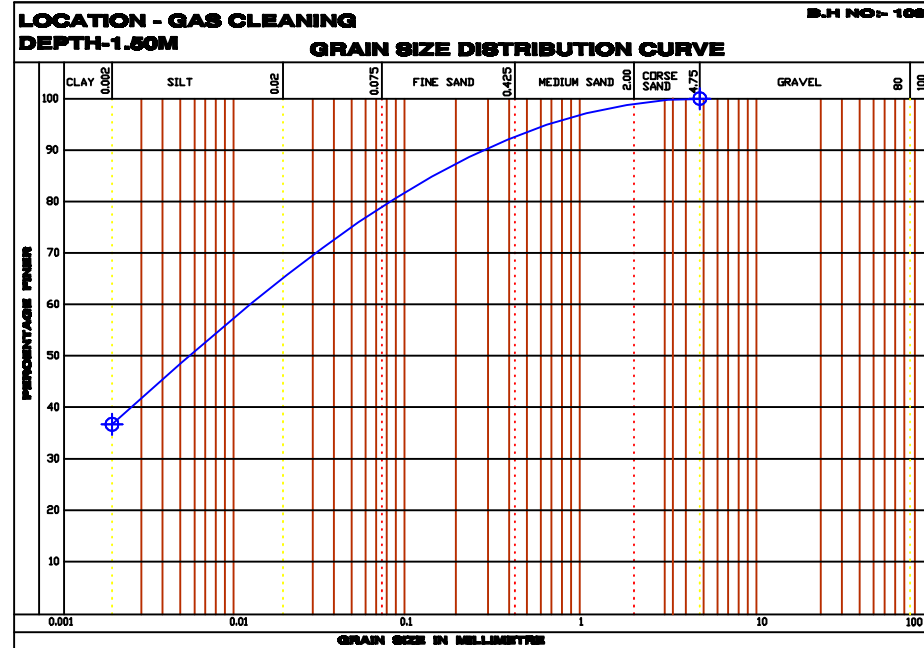
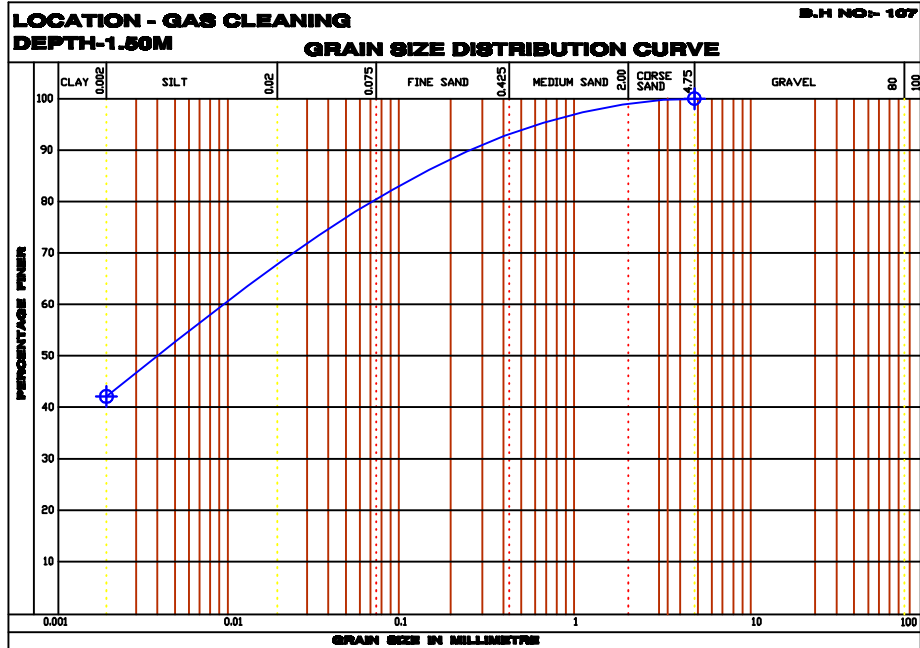


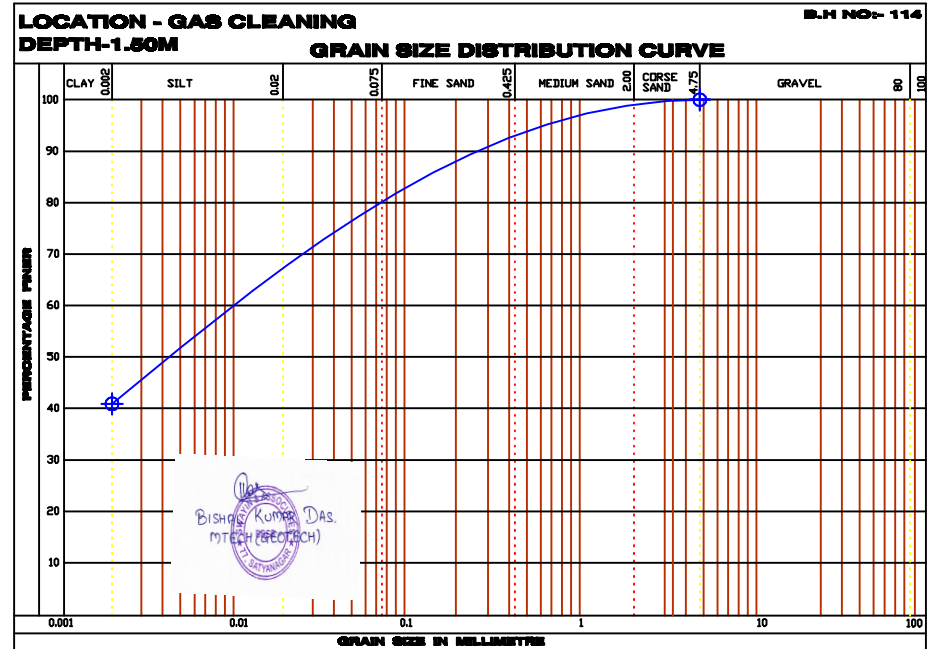
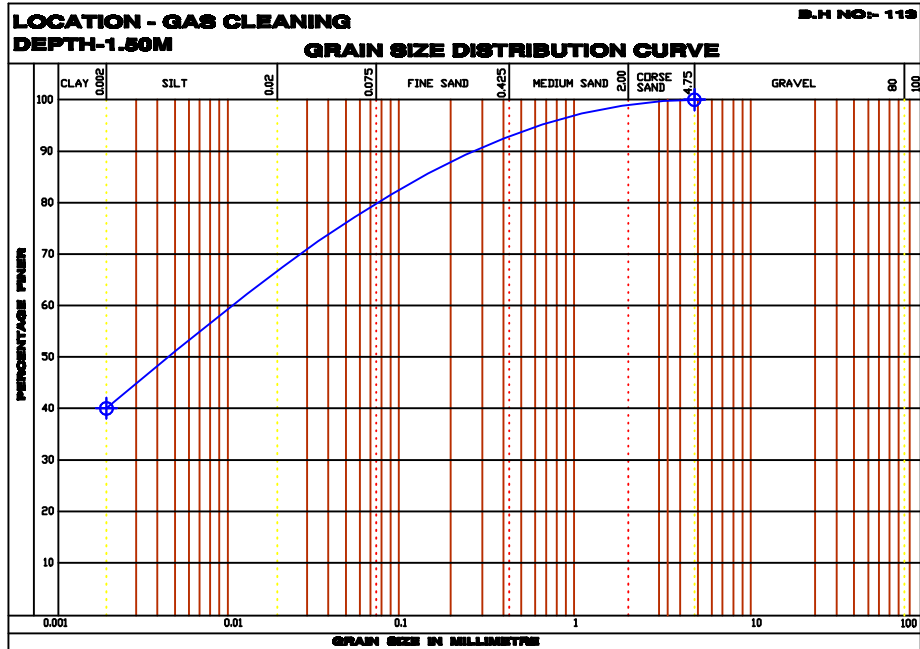
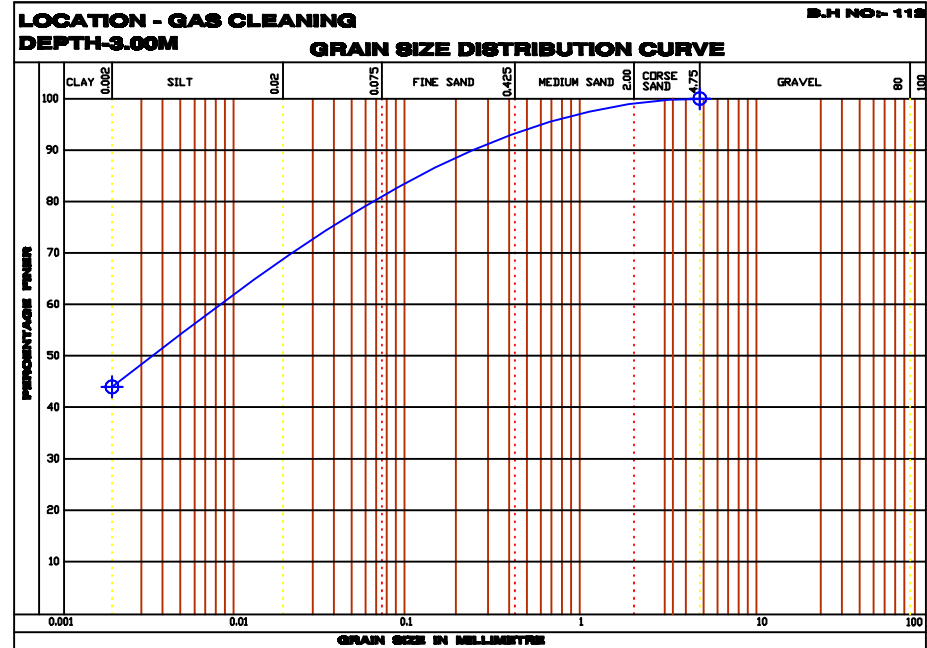
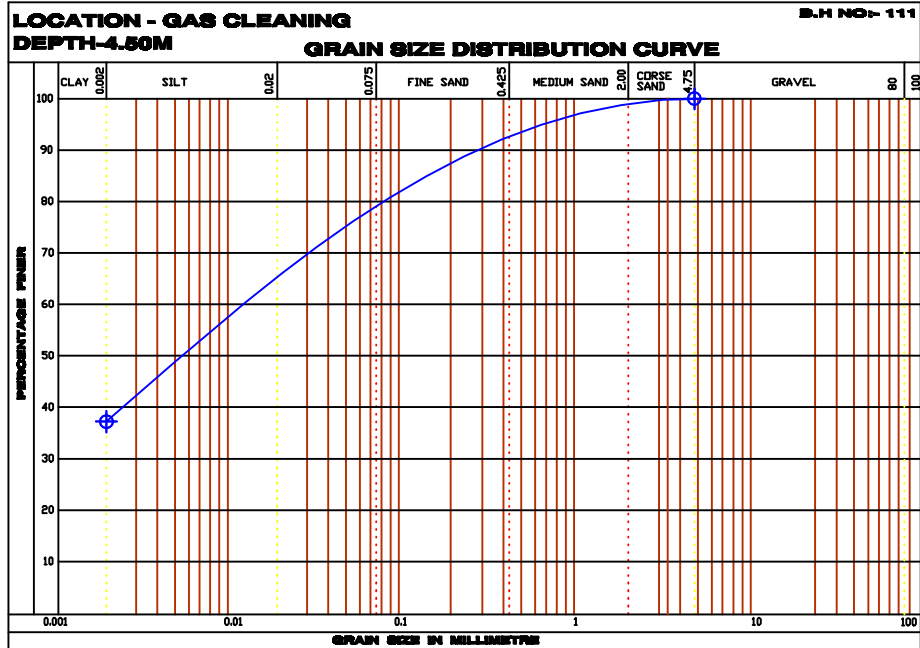


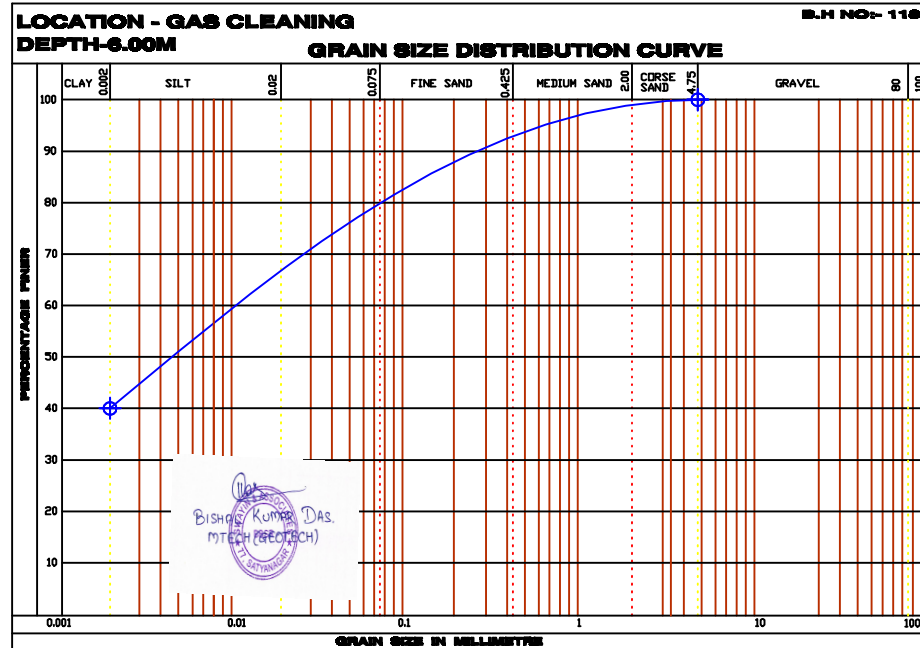
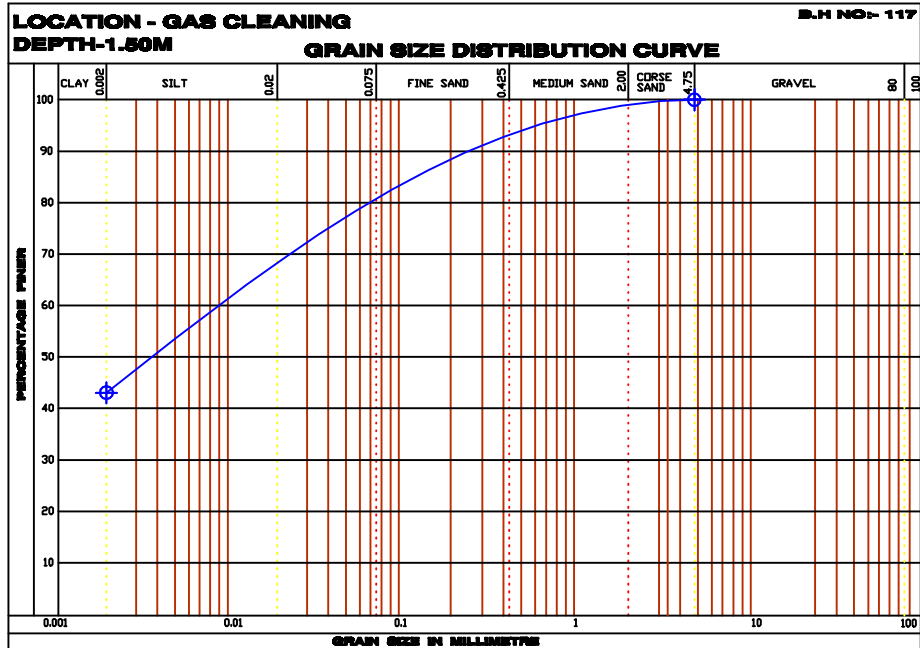
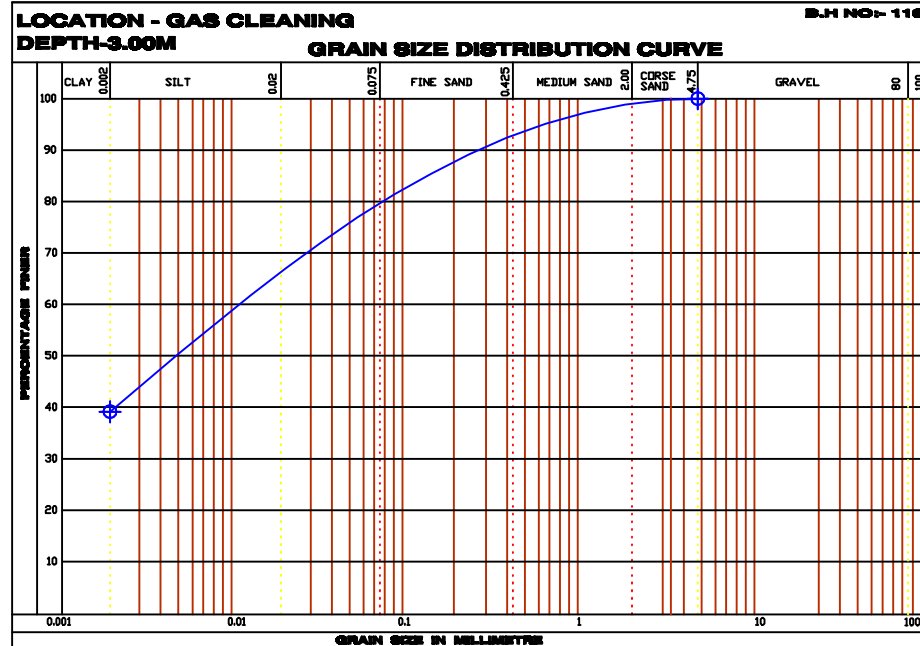
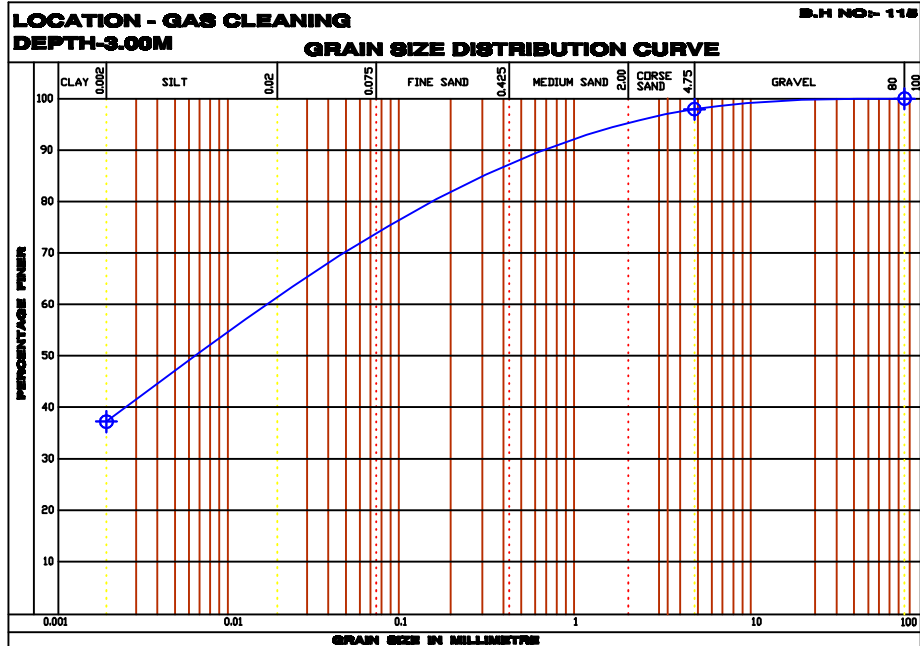


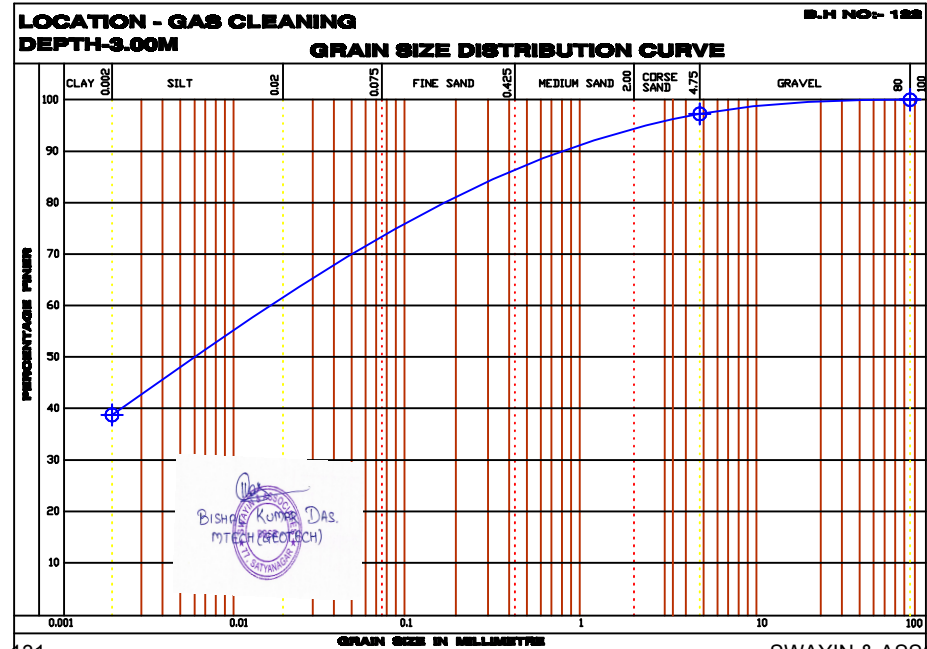
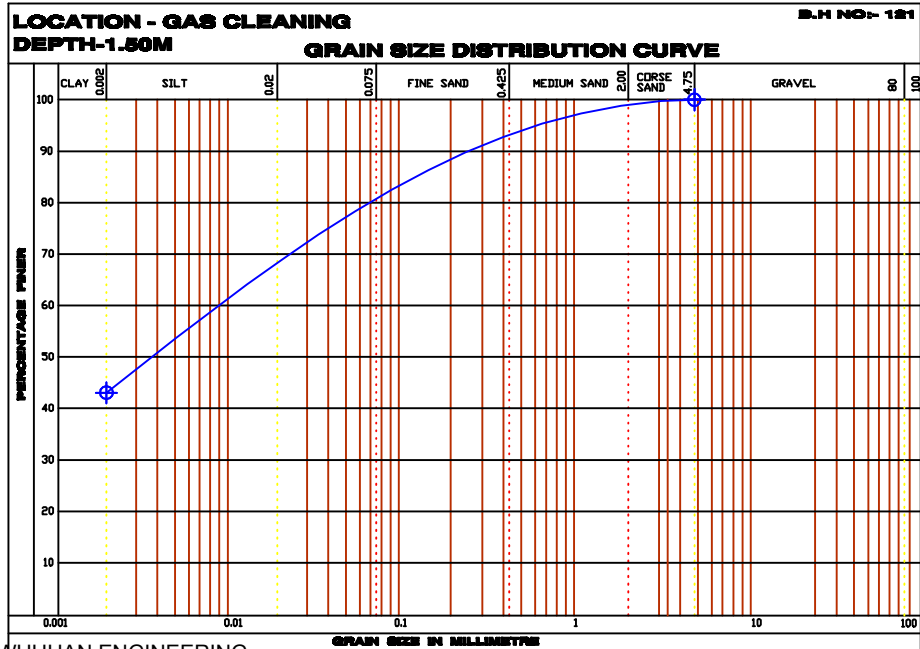
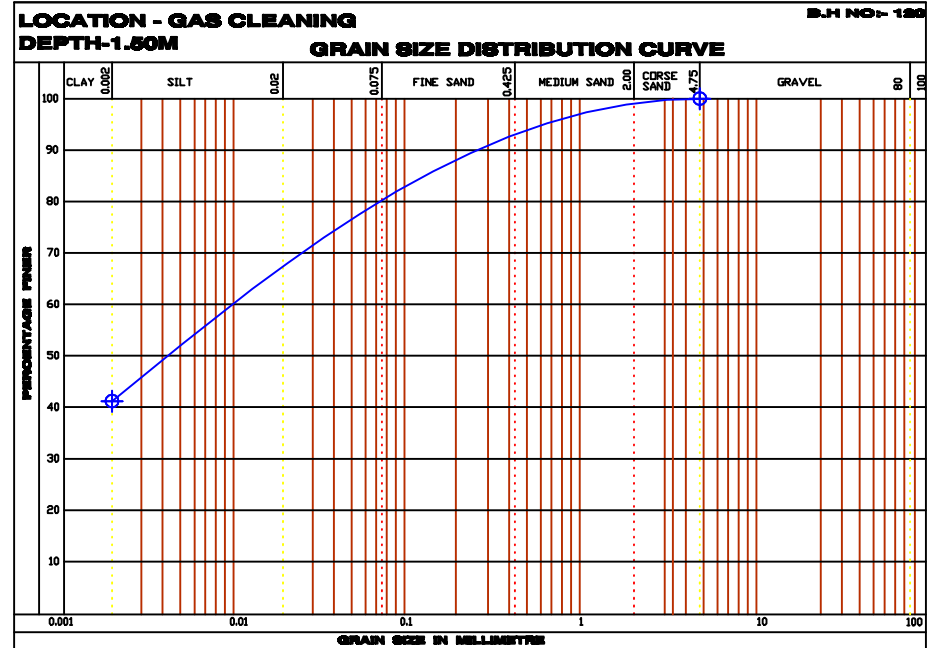
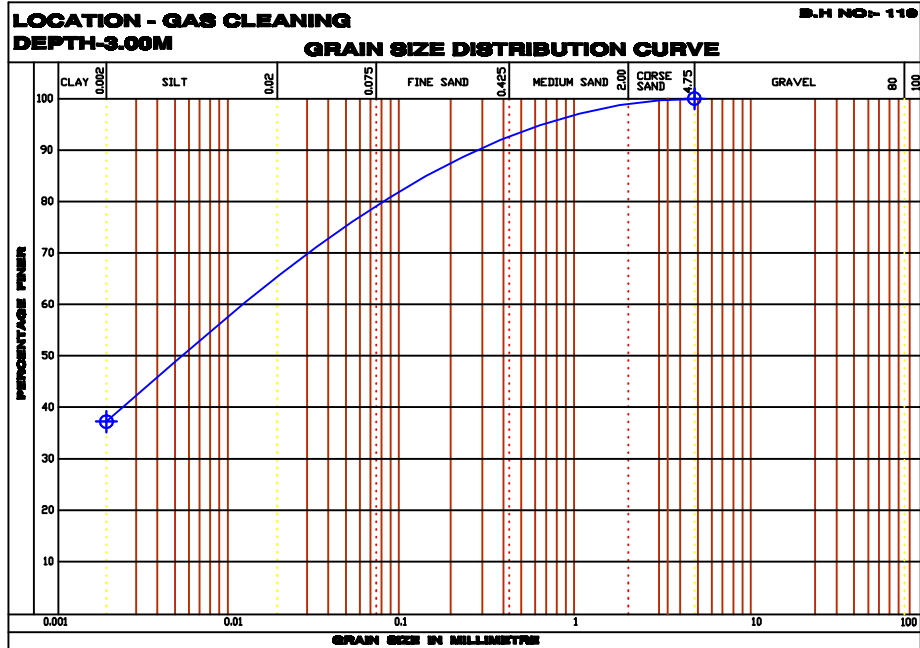


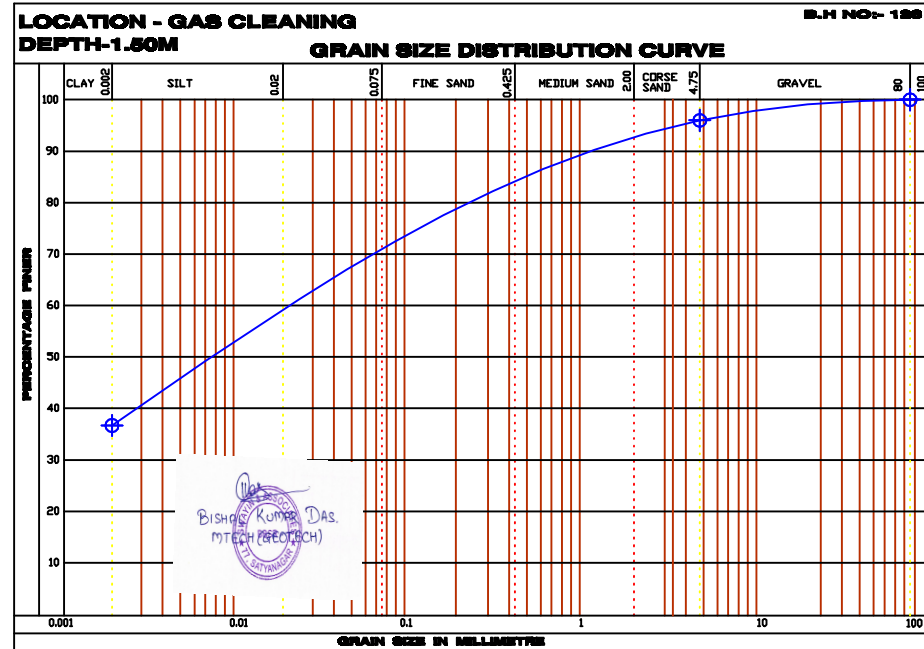
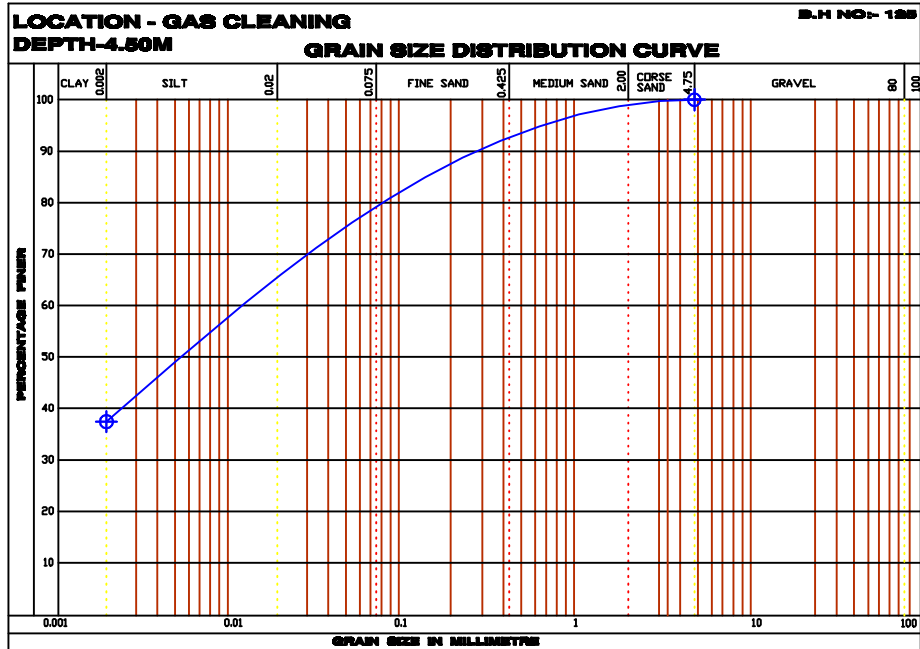
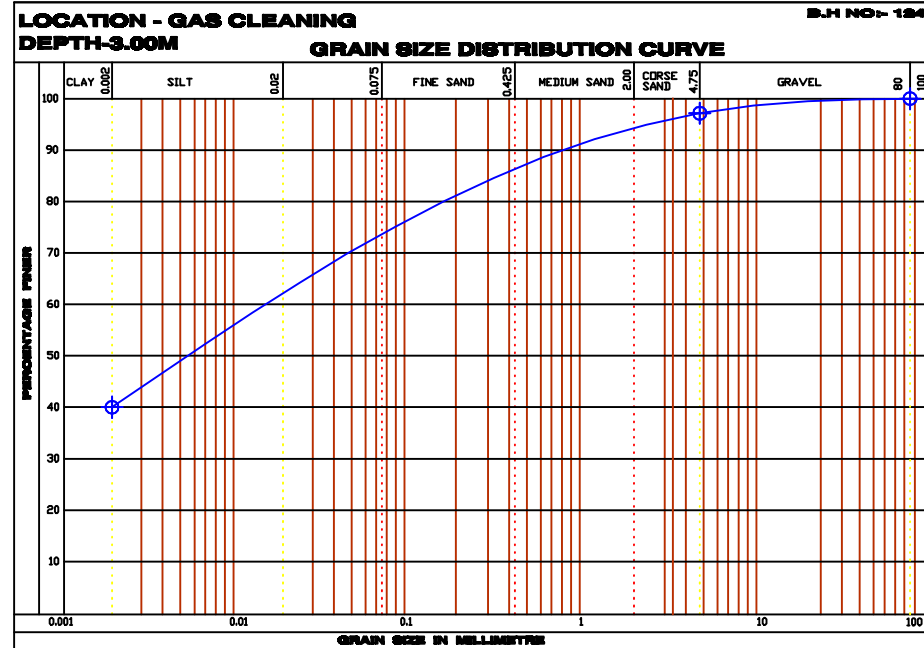
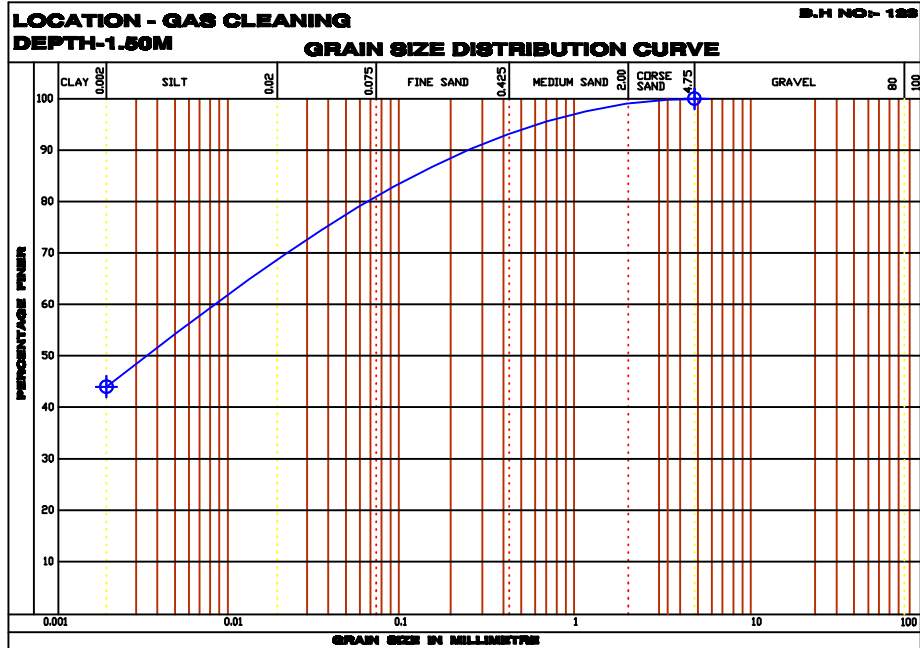


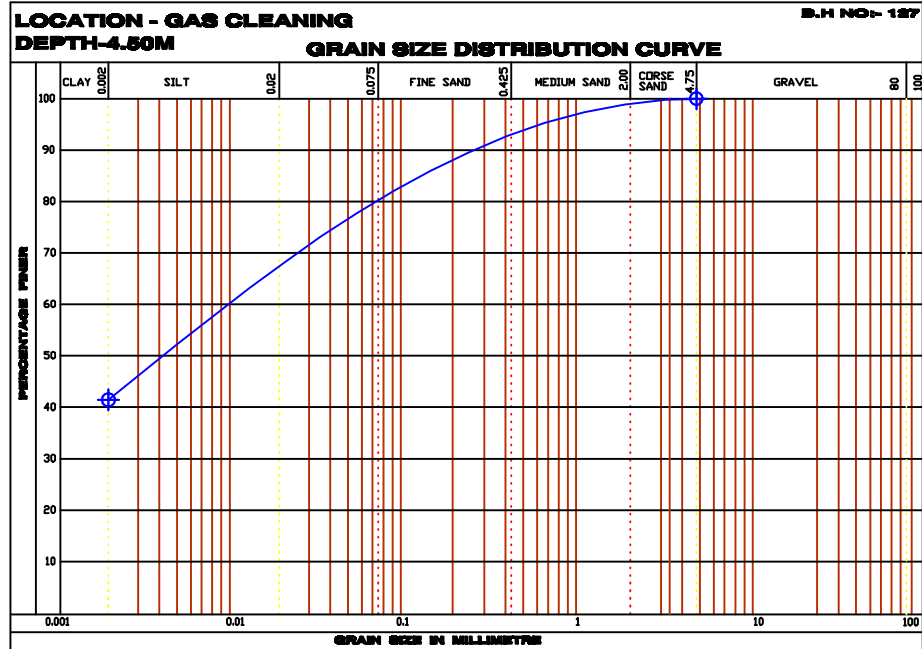




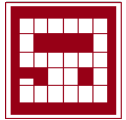









 Biswas Kumar Das
 M.TECH (GEOTECH)
 (SAYANIGURU)



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

NET SAFE BEARING CAPACITY

LOCATION:- GAS CLEANING AREA

BH NO:-90 to 94, 96, 99 to 103, 105 to 112, 114 to 119, 121 to 126

▾

Shape of Footing:-

Size of footing :- 3 X 3

▾

Founding stratum:-

THICKNESS OF 1st LAYER =	6.15	M
THICKNESS OF 2nd LAYER =	7.25	M
THICKNESS OF 3rd LAYER =	0	M
THICKNESS OF 4th LAYER =	0.00	M
THICKNESS OF 5th LAYER =	0	M
FOUNDATION DEPTH =	3	M
WIDTH OF FOOTING =	3	M

C	φ
1.2	25
0	35
0	0
0	0
0	0

SHEAR CRITERIA:

Based on Lab. Test results -

Considering sub - stratum as cohesive

D _f =	3	m	
Cohesion (c) =	1.2	t/sqm	
Angle of shearing Resistance (φ)=		25	
N _c =	20.72	N _q =	10.66
S _c =	1.3	S _q =	1.2
d _c =	1.199841	d _q =	1.099920399
i _c =	1	i _q =	1
B=	3	m	
γ _{sub} =	1.88	t/m ²	
F=	2.5		
W'=	0.5		
N _γ =		10.88	
S _γ =		0.8	
d _γ =		1.09992	
i _γ =		1	

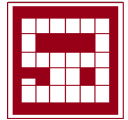
$$q_d = cN_c S_c d_{c,i_c} + q(N_q - 1) S_q d_{q,i_q} + 5B\gamma' N_\gamma S_\gamma d_{\gamma,i_\gamma} W'$$

q_d = 124.1932

q_s = (1/F) q_d 49.68 t/m²

where, F=Factor of safety





CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

SETTLEMENT CRITERIA -

Settlement of 1st layer $S1 = \lambda_1 \Delta p_1 m_{v1} H1$

$\lambda_1 = 1$
 $\Delta p_1 = 4.119873231 \text{ T/m}^2$
 $m_{v1} = 0.00105 \text{ SQ.M/T}$
 $H1 = 3.15 \text{ m}$

$S1 = 13.62648071 \text{ mm}$

Settlement of 2nd layer $S2 = \Delta p_2 H2 (1 - \mu_2) / E$

$E = 1600$
 $\Delta p_2 = 0.559442456 \text{ T/m}^2$
 $\mu_2 = 0.35$
 $H2 = 2.85 \text{ m}$

$S2 = 0.920457666 \text{ mm}$

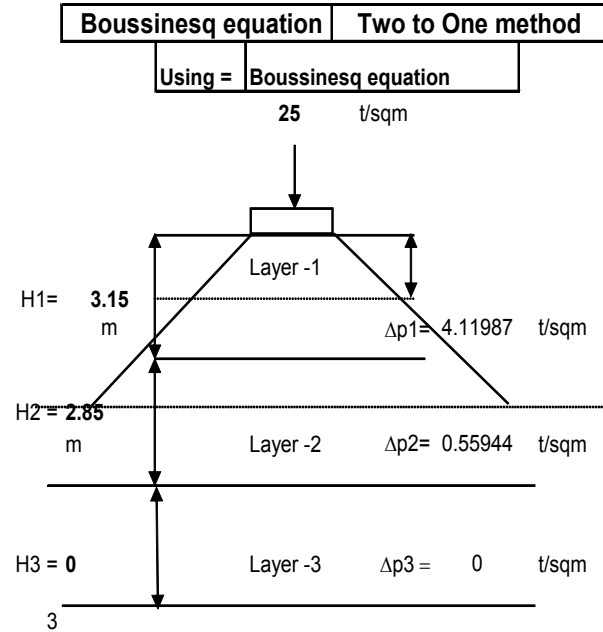
Total settlement $S = S1 + S2 = 14.55 \text{ mm}$

Depth correction factor = 0.74

Rigidity Factor = 1

Final Settlement $S_f = 10.765$

10.76473 mm settlement is for 25 t/sqm
 so, for 25 mm settlement ABP is = 58.06 t/sqm
 40 mm settlement ABP is = 92.90 t/sqm
 75 mm settlement ABP is = 174.18 t/sqm



BISHWAJIT KUMAR DAS
 M.TECH (PRACTICAL)
 (DATE: / /)



CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
 SUB - CONTRACTOR: SWAYIN & ASSOCIATES

JOB No: TLD/2020-03

152 Design Aids in Soil Mechanics and foundation Engineering

Table 9.14 Typical Range of Values for the static Stress-strain Modulus E for Selected Soils (Field Values Depend on Stress History, Water Content,, Density, etc.)

Soil	E Kg/cm ²
Clay:	
Very soft	20-150
Soft	50-250
Medium	150-500
Hard	500-1000
Sandy	250-2500
Glacial till:	
Loose	100-1600
Dense	1500-7250
Very dense	4800-15000
Loose	150-600
Sand:	
Silty	75-250
Loose	100-250
Dense	500-850
Sand and gravel:	
Loose	500-1500
Dense	1000-2000
Shale	1500-150000
Silt	20-200

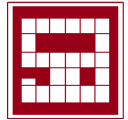
Table 9.15 Typical Range of Values for Poisson's Ratio, μ

Type of soil	μ
Clay, saturated	0.4-0.5
Clay, Unsaturated	0.1-0.3
Sandy clay	0.2-0.3
Silt	0.3-0.35
Sand (dense)	
Coarse (void ratio = 0.4-0.7)	0.2-0.4
Fine grained (void ratio =0.4-0.7)	0.15
Rock	0.25
	0.1-0.4 (depends somewhat on type of rock)
Loose	0.1-0.3
Ice	0.36
Concrete	0.15

REFERENCE:-

* Modulus of Elastic 'E' & Poisson's Ratio are taken from the textbook 'Design Aids in S and Foundation Engineering-Shenbaga R Kaniraj' pg no.152.





CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
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JOB No: TLD/2020-03

SAMPLE CALCULATION OF SAFE BEARING CAPACITY (IS-6403:1981)

(FROM SHEAR PARAMETER)

BH No:- 90 to 94, 96, 99 to 103, 105 to 112, 114 to 119, 121 to 126

Zone-01

Shape of footing:-Square

Size of footing: 3 x 3m

Depth of footing: 3.00m

Founding Stratum: - Clayey sand

Average Thickness of 1st Layer:-6.15 m

Average Thickness of 2nd Layer:-7.25 m

Average Thickness of 3rd Layer:-0.00 m

C = Cohesion

ϕ = Angle of shear Resistance

D_f = Depth of foundation

B = Width of footing

N_c, N_q, N_γ = Bearing Capacity Factor

S_c, S_q, S_γ = Shape Factor

d_c, d_q, d_γ = Depth Factor

I_c, I_q, I_γ = Inclination Factor

γ = Bulk density

W' = Correction factor for location of water table

SHEAR CRITERIA AS PER IS 6403:

BASED ON LAB TEST RESULTS :

Considering sub - stratum as cohesive

Depth of Foundation D_f = 3.00 m

Cohesion (c) = 1.20 t/sqm (from shear parameter)

Angle of Shearing Resistance (ϕ) = 25 (from shear parameter)





CLIENT: TALCHER FERTILIZERS LIMITED.
 CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
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JOB No: TLD/2020-03

BEARING CAPACITY FACTOR

(As per IS 6403-1981 Class 5.1.2.2 page no 8)

$$So, Nc= 20.72 \quad Nq= 10.66 \quad N\gamma= 10.88$$

SHAPE FACTOR

(As per IS 6403-1981 Table No-02 page no 8)

For Square Footing

$$Sc= 1.30 \quad Sq= 1.2 \quad S\gamma= 0.80$$

DEPTH FACTOR

As per IS 6403-1981 page no 9)

$$dc = 1+0.2 \times (\text{depth of foundation/width of footing}) \times \tan \left(\left(\frac{\pi}{180} \right) \times (45 + \left(\frac{\phi}{2} \right)) \right) = 1.20$$

$$dq = dy$$

For 'φ' Value > 10

$$dq = dy = 1 + 0.1 \left(\frac{Df}{B} \right) \times \left(\sqrt{\tan \left(\frac{\pi}{180} + \phi \right) \times 3.14 / 2 \times 180} \right) = 1.10$$

INCLINATION FACTOR

$$Ic = Iq = I\gamma = 1$$

(γ_{bulk}) 1.88 t/sqm (As per lab test data)

Factor of Safety taken as = 2.5

$$W' = 0.50 \quad \text{Due to water table likely to rise have taken as } 0.5$$

ULTIMATE NET BEARING CAPACITY (As Per IS 6403: clause 5.1.2

(GENERAL SHEAR FAILURE)

$$q_d = cN_c S_c d_{c_i} + q(N_q - 1) S_q d_{q_i} + 0.5 B \gamma' N_\gamma S_\gamma d_{\gamma_i} W'$$

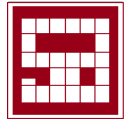
$$= 124.193 \text{ t/m}^2$$

$$q_s = (1/F) q_d$$

$$= 124.193 / 2.5$$

$$= 49.68 \text{ t/m}^2$$





**CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES**

JOB No: TLD/2020-03

**LOAD CARRYING CAPACITY OF PILE IN ROCK
AS PER IS 2911 (Part 1/Sec 2) : 2010**

Location: Gas Cleaning Area
Borehole No: BH-90 to 94, 96, 99 to 103, 105 to 112, 114 to 119, 121 to 126
Cut-off Level of Pile, L_c = 2.0 Mtr.
After Cut-off Length of Pile, L_p = 10.0 Mtr. **Total Length of Pile from NGL =** 12.00 Mtr.
Dia. of Pile, B = 0.45 Mtr.
Length of Socket, L = 1.40 Mtr. i.e from sand stone
Safe load carrying of pile, in tones

$$Q_a = C_{u1} \cdot N_c \cdot (\pi \cdot B^2 / 4 \cdot F_s) + \alpha \cdot C_{u2} \cdot (\pi \cdot B \cdot L / F_s) \quad \text{- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)}$$

C_{u1} = Shear strength of rock below the base of the pile

C_{u2} = Average shear strength of rock along socketed length of Pile

L = Length of Socket in 'm'

Q_s = Allowable capacity of Pile

$$C_{u1} = 10.00 \text{ MPa} = 980.67 \text{ KN/m}^2$$

$$C_{u2} = 15.29 \text{ MPa} = 1499.44 \text{ KN/m}^2$$

F_s = Factor of Safety taken as 3

$$\left. \begin{matrix} N_c = 9 \\ \alpha = 0.9 \end{matrix} \right\} \text{- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)}$$

- Please refer Fig.3 of IS 2911 (Part 1/Sec 2)

- As per B-8 of Annex-B of IS 2911 (Part 1/Sec 2)

Details of Layer I to IV as per IS 2911 (Part 1/Sec 2) :

Layer No.	Thickness of Stratum (m)	Cohesion (t/m ²)	Angle of friction (Ø°)	Density (γ)	Alpha (α)	K _i	P _{Di}	A _{si} (m ²)	Q _s
1 (NGL to 6.15m)	6.15	1.00	25	1.88	0	1	5.78	8.69	23.44 T
2 (6.15m to 12.00m)	5.85	0.00	35	2.00	0	1	17.41	8.27	100.83 T

Skin Friction Resistance, Q_s = 124.27 T

Note: * Since the Cut-Off length of Pile has been considered as 4.00m, the thickness of stratum has been considered accordingly.

* For Cohesiveless Soils, Q_s = K_i · P_{Di} · tanδ · A_{si} - As per Appendix-A of IS 2911 (Part 1/Sec 2)

* For Cohesive Soils, Q_s = α · C · A_{si} - As per Appendix-B of IS 2911 (Part 1/Sec 2)

Allowable End Bearing Component = C_{u1} · N_c · (π · B² / 4 · F_s) = 467.90 KN

Allowable Shear Component = α · C_{u2} · (π · B · L / F_s) = 890.31 KN

Allowable Capacity of Pile, Q_a in Compr. = 261.45 T

Ultimate Uplift Load Carrying capacity = (Shear Comp. + Skin Friction + Weight of Pile) - As per clause no.6.3.2 of IS 2911 (Part 1/Sec 2)

Allowable Uplift Load Carrying capacity = 95.25 T - (Unit wt. of pile as 15KN/m³)

Allowable Load Carrying capacity in Lateral = Modulus of Sub Grade Reaction = 10.00 MN/m³ - From Table-3 of IS 2911 (Part 1/Sec 2)

Length of pile above GL L₁ = 0.00 m
Grade of concrete f_{ck} = 35.00 N/mm²

Modulus of Elasticity of Concrete, E = 5000√f_{ck} = 29580 N/mm² = 29580 MN/m²

Moment of Inertia of Pile, I = π D⁴ / 64 = 0.0020 m⁴

Pile Stiffness, T = (EI / ηh)^{1/5} = 1.562 m - From Clause C-2.3.2 of IS 2911 (Part 1/Sec 2)

L₁ / T = 0.00 m
L_f / T = 2.20 - From Fig 4 - IS 2911 (Part 1/Sec 2)

Length of Fixity L_f = 343.66 cm

Y = Q(L₁+L_f)³ / 12EI - (For Fixed Head) as per IS 2911 (Part 1/Sec 2)

Y = 0.50 cm = 0.005 m

L₁ = 0.00 cm = 0.00 m

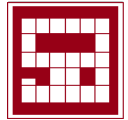
L_f = 343.66 cm = 3.437 m

0.005 = Q(0+6.110)³ / (12*29580*0.0201)

Q = 0.08802 MN

Allowable Load Carrying capacity in Lateral = 8.80 T


 BISHU KUMAR DAS
 MTECH (RECTECH)



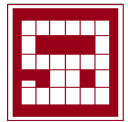
**CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES**

JOB No: TLD/2020-03

SITE PHOTOGRAPHS



Bishw Kumar Das
M.TECH (PRACTISE)
SWAYIN & ASSOCIATES





**CLIENT: TALCHER FERTILIZERS LIMITED.
CONTRACTOR: WUHUAN ENGINEERING CO., LTD.
SUB - CONTRACTOR: SWAYIN & ASSOCIATES**

JOB No: TLD/2020-03



Bishu Kumar Das
MTECH (METECH)
SATYRANG

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SECTION – VI - 4.0

CONSTRUCTION/ERECTION, PRE-COMMISSIONING, COMMISSIONING AND START-UP

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

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

0	14.03.2023	ISSUED FOR ENQUIRY	JKY	JKY	RRK
REV	REV ATE	PURPOSE	PREPD	REVWD	APPD



	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD AT TFL, ODISHA CONSTRUCTION/ERECTION, PRE- COMMISSIONING, COMMISSIONING AND START-UP	PNCN/PC0183/4018/Sec VI/4.0	0	
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SI. No.	DESCRIPTION	NUMBER OF SHEETS
1	General Scope of Works and Services-Construction / Erection	
2	General Scope of Works and Services -Pre-commissioning	
3	Basic Plan for Temporary Services	
4	Mechanical completion	
5	Commissioning	
6	Start up	

LIST OF ANNEXURES



ANNEXURE NUMBER	DESCRIPTION	NUMBER OF SHEETS
ANNEXURE-7-1	LSTK Contractor's Work Definition	
ANNEXURE-7-2	Detail Technical Scope	
ANNEXURE-7-3	Quality Control Procedures and Inspection Requirement	
ANNEXURE-7-4	Schedule Progress Evaluation and Progress Reporting	
ANNEXURE-7-5	Execution Plan	
ANNEXURE-7-6	Minimum Qualification & Exp. Of Key Supervisory Construction Personnel	
ANNEXURE-7-7	Deployment Schedule of Supervisory Personnel	
ANNEXURE-7-8	Deployment Schedule of Construction Equipment	
ANNEXURE-7-9	Details Of Equipment Proposed to be used for Tendered Work	

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD AT TFL, ODISHA CONSTRUCTION/ERECTION, PRE- COMMISSIONING, COMMISSIONING AND START-UP	PNCN/PC0183/4018/Sec VI/4.0	0	
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1 General scope of Work and services - Construction/Erection

LSTK CONTRACTOR shall be responsible for construction and erection of the Plant/ Unit including but not limited to the following:

- 1.1 Construction and erection of Plant/Unit and perform all other activities required to be performed for implementation of the WORK.
- 1.2 Provide and supply in due course all construction Equipment and Materials, tools, and temporary facilities necessary for implementation of the WORK.
- 1.3 Establish and operate adequate material control system in site for receipt, unloading, inspection, maintenance, handling, storage and utilization to ensure all Equipment and Materials are preserved and available as necessary for completion of the Plant/Unit.
- 1.4 Provide and supply all staff, tradesmen and labours for implementation of the WORK.
- 1.5 Establishment of overall construction policy and procedures for the Plant/Unit.
- 1.6 Provision of overall management and control of construction phase of the Plant/Unit.
- 1.7 Ensuring that all parts of the Plant/Unit are constructed and tested strictly in accordance with the specifications and applicable codes and standards asked for in the project documents.
- 1.8 Ensuring that construction is accomplished in accordance with the schedules.
- 1.9 Provide transportation of all Equipment and Materials to be provided and supplied by LSTK CONTRACTOR under the CONTRACT either from inside or outside to Site.
- 1.10 Construct, operate and maintain all temporary facilities required for its personnel involved in the WORK.
- 1.11 Provide transportation in the area of the Site and between Site and temporary facilities for all its personnel involved in the implementation of the WORK, including field labour, administrative staff, etc.
- 1.12 Recruit field and organize, manage and supervise its Sub Contractors and field labour for the WORK.
- 1.13 Provide liaison with OWNER, Sub Contractors, Licensors and Vendors to ensure that the Plant/Unit is constructed in accordance with the respective standard and specifications, set forth in the CONTRACT.

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD AT TFL, ODISHA CONSTRUCTION/ERECTION, PRE- COMMISSIONING, COMMISSIONING AND START-UP	PNCN/PC0183/4018/Sec VI/4.0	0	
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- 1.14 Establish with OWNER adequate procedures, control and reporting systems to provide close control of the progress of the WORK.
- 1.15 Provision of labour and facilities for loading, unloading and transportation of the Equipment within the site area.
- 1.16 Performance and/or provision of all other works and/or services required for performance of the WORK.
- 1.17 Execution of the whole civil, structural and building works of the Plant/Unit and/or utilities and off-site facilities.
- 1.18 Prefabrication of piping spools in a shop on the Site.
- 1.19 Erection and installation of EQUIPMENT and auxiliary facilities associated with the Plant/Unit.
- 1.20 Erection and field fabrication of structural steelwork, cladding ladders, handrails, stairs and platform of the Plant/Unit and/or utilities and off-site facilities.
- 1.21 Installation of pipe work including field fabrication at site.
- 1.22 Installation and testing of all instrumentation network and equipment of the Plant/Unit.
- 1.23 Installation and testing of electrical system and equipment of the Plant/Unit.
- 1.24 Installation of rubber lining, refractory brick lining & C-Brick lining, FRP/PVC/HDPE lining, as required for the Plant/Unit.
- 1.25 Painting of steelworks, piping, Equipment and building of the Plant/Unit.
- 1.26 Maintenance of construction equipment, vehicles and tackles of the Plant/Unit, during construction and erection period.
- 1.27 Pre-commissioning, Commissioning and Start-up of the Plant/Unit.
- 1.28 Carrying out Mechanical Completion.
- 1.29 Perform all material identification as per application codes and standards.
- 1.30 Provide winterization during construction.
- 1.31 Provide drawings and documents as required.
- 1.32 Supply to OWNER complete test records within three (3) days after completion of actual testing.
- 1.33 Installation and testing of all underground piping, if any.

	ROM COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD AT TFL, ODISHA CONSTRUCTION/ERECTION, PRE- COMMISSIONING, COMMISSIONING AND START-UP	PNCN/PC0183/4018/Sec VI/4.0	0	
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2.0 General scope of WORK and Services- Pre-commissioning

LSTK CONTRACTOR shall be responsible for the pre-commissioning phase of the Plant.



LSTK CONTRACTOR shall provide at SITE an adequate number of qualified pre-commissioning engineers to direct and control pre-commissioning activities.

LSTK CONTRACTOR shall also ensure that all special tools and test equipment required for pre-commissioning are available at its own cost.

LSTK CONTRACTOR shall provide adequate construction labour, construction tools and equipment for pre-commissioning.

Pre-commissioning which shall be performed by LSTK CONTRACTOR shall include, but not limited to the following:

- 2.1 Cleaning, flushing, draining blowing out, steaming out, drying and purging of Equipment and their linings and piping systems, including the installation and removal of temporary blinds, strainers, screens etc., and the replacement of all permanent items removed while the WORK is in progress.
- 2.2 Chemical cleaning wherever required, including but not limited to compressor suction piping and lube and seal oil piping, heaters, supply of chemical and disposal of wastes.
- 2.3 Chemical cleaning of feed water systems, and steam systems. Supply of chemical and disposal of wastes.
- 2.4 Chemical cleaning of any other parts, which have corroded to an extent, which, will detrimentally affect Plant/Unit performance or run length for such reasons as increased fouling due to rust. Supply of chemical and disposal of wastes.
- 2.5 Checking, Testing, calibration simulation test and adjustment of instruments, equipment and systems including control valves and safety devices, and installation and checking of orifices plates and other sensor devices in so far as this can be done before actual operation of the item concerns of complete system and loops.
- 2.6 Function test and checking out of electrical systems including substations, transformers, cables and switchgear, checking of all interlocks and setting of all relays. This shall include drying out operations, filtering of oil if required.
- 2.7 For motor driven equipment, amperage checking of motors and removal of temporary safety screens.

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- 2.8 Cleaning of screens and filters replacement and adjustment of packing and seals and tightening of flanges.
- 2.9 Introduction of fuels.
- 2.10 Introduction of lubricants and oil flushing for machinery.
- 2.11 Introduction of chemical into and initial operation of treatment plant.
- 2.12 Boiling out, bringing up to pressure and performing all required code tests on steam generation facilities and associated instrumentation.
- 2.13 Drying out of stacks and all refractory lined equipment.
- 2.14 For all piping systems, installation and removal of temporary blinds as required, circulation and commissioning of systems including process systems, services, effluent and drainage, utilities distribution, relief and blow down and interconnecting lines.
- 2.15 Test running of all other rotating equipment for 24 hours wherever possible.
- 2.16 Adjustment of all piping expansion and support devices.
- 2.17 Air-drying of Plant/Unit, which is required to be water-free.
- 2.18 Testing (including running, tightness and vacuum) of systems, as necessary to ensure that the sections and components of Plant/Unit are ready for operation.
- 2.19 All such further works which LSTK CONTRACTOR judges to be necessary or in the reasonable opinion of OWNER is necessary to bring the Plant/Unit to a state of readiness for the introduction of feedstock into Process Plant/Unit for processing requirements and for safe commencement of operation.

3.0 Basic Plan for Temporary Services

Temporary Construction Facilities

The LSTK shall arrange following facilities at his own cost for Construction/Erection purpose. Demolition and cleaning of temporary facilities developed for construction purpose shall also be under LSTK Contractor's scope.

1. Construction power shall be as per commercial part. Tapping of Construction Power 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

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termination etc. as well as underground cabling work) and further distribution shall be in LSTK Contractor's scope.

2. Construction Water shall be as per commercial part.
3. Construction sheds
4. Construction offices
5. Temporary Communication facilities
6. Office furniture
7. Labour colony during construction.

3.1 Sewage & Refuse Disposal

All temporary building like site office, canteen etc. shall be provided with individual septic tanks and soak pits for treatment and disposal of sanitary sewers. Construction site shall be provided with a network of temporary drain for disposal of rain water.

4.0 Mechanical Completion

Mechanical Completion means the time when all construction, erection & installation work per finally approved P&ID after HAZOP study and pre-commissioning related to the Plant is completed in accordance with the Project drawings and specifications, and all mechanical and pressure tests, including but not limited to hydro-testing, non-operating adjustments, cold alignment checks, final cleanup, hot bolting, refractory drying, field calibration of safety valves, calibration of all instruments, instrument loop checking and testing, monitoring / control / safety systems checking and testing, and all pre-commissioning activities have been completed, all incoming & outgoing services and utilities have been connected to each unit of the PLANT, interconnections of process lines and interconnection are completed and the Plant/Unit is ready in every respect for commissioning and for the first introduction of feed materials.



When OWNER is satisfied that Mechanical Completion of the plant has been achieved, OWNER shall issue certificate of Mechanical Completion to LSTK CONTRACTOR in accordance with the CONTRACT.

In order to meet this, LSTK CONTRACTOR shall perform all necessary mechanical works, tests and checks.

5.0 COMMISSIONING

5.1 Schedule for Commissioning

LSTK CONTRACTOR shall prepare a schedule for commissioning, start-up, and performance testing and initial operation in conjunction with OWNER. This shall be issued at least three months before pre commissioning of the first facility.

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This schedule shall include all activities as detailed herein and any other special activities, which require to be performed during commissioning.

5.2 Commissioning



LSTK CONTRACTOR shall be responsible to perform commissioning of the Plants and to provide necessary facilities during commissioning of the Plant including the Performance Tests. LSTK CONTRACTOR shall provide commissioning engineers and supporting staff and adequate commissioning labour. LSTK Contractor shall associate OWNER's engineers and operating staff with the commissioning work.

6.0 START UP

LSTK CONTRACTOR shall be responsible to perform start-up of the Plant/Unit. LSTK CONTRACTOR shall provide necessary facilities and for Start Up of the PLANT.

NOTE:

Detail CONTRACTOR'S scope of work in relation with the construction / erection, and pre-commissioning, commissioning and start-up from the point of scope of execution as well as performing way are described in detail in the following Sub-Annexes of Section-7.0.

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Sub-Annexure:



Annex 7 - 1 : LSTK Contractor's Work Definition

Annex 7 - 2 : Detail Technical Scope

Annex 7 - 3 : Quality Control Procedures and Inspection Requirement

Annex 7 - 4 : Schedule Progress Evaluation and Progress Reporting

Annex 7 - 5 : General Notes

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ANNEXURE-7-1

LSTK CONTRACTOR'S WORK DEFINITION

LSTK CONTRACTOR shall perform/provide the following activities but not limited to:



1. LSTK CONTRACTOR scope of work shall broadly consist of construction / erection, refurbishing, pre-commissioning, commissioning and Start Up of the Plant under the management of commissioning team it includes but not limited to civil works, fabrication & erection of structural steelwork, field assembly, mechanical erection and / or assembly and installation of all equipment and machinery, piping, electrical systems and network, instrumentation, insulation, painting, etc., except in so far as "Contract" otherwise provides, the provision of all temporary facilities, staff, tradesmen, labour, tools, tackle, construction equipment and materials, insurance, consumables and everything whether of temporary or permanent nature necessary and required in and for the work, so far as the necessity for providing the same is specified or reasonably inferred in or from the contract.
2. Perform all civil and building works as per Annex7 - 2A, titled civil and building works.
3. Perform all structural steel works as per Annex 7 - 2B, titled structural steelwork.
4. Perform all piping fabrication and erection works as per Annex7 - 2C, titled piping fabrication and erection work.
5. Perform all equipment erection works as per Annex 7 - 2D, titled equipment erection work.
6. Perform all electrical works as per Annex7 - 2E, titled electrical work.
7. Perform all instrumentation works as per Annex 7 - 2F, titled instrumentation works.
8. Perform all insulation works as per Annex 7 - 2G, titled insulation works.
9. Perform all painting works as per Annex 7 - 2H, titled painting Specification/work.

Supply the materials in order to execute WORK as per CONTRACT.
10. LSTK CONTRACTOR shall be responsible for providing services and materials for construction of all temporary facilities, which are essential for successful completion of construction and erection.



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The LSTK CONTRACTOR shall establish, operate and maintain all temporary facilities, such as, but not limits to:

- a) Labour camp/officers camps
 - b) Fabrication shops/yard
 - c) Workshop for maintenance of construction/testing equipment.
 - d) Field drawing office
 - e) Temporary warehouses, including open storage yards.
 - f) Construction offices (including facilities for photocopying, drawing reproduction, etc.)
 - g) First aid along with ambulance
 - h) Lab facilities, including NDT, for testing calibration, etc.
 - i) All temporary or approach roads for carrying out the WORK including temporary approach roads for access to LSTK CONTRACTOR'S site office/workshop/camp, etc. ground preparation for heavy lifts including approaches to cranes for heavy lifts. OWNER does not take any responsibility for making temporary roads.
 - j) Canteen & catering facilities for all LSTK CONTRACTOR'S work force.
 - k) All drainage around the facilities created for his WORK, and sewage disposal arrangements for labour camps/officers camps, site offices, etc.
 - l) Necessary transport for movement of its personnel, construction Equipment and Materials, consumables, etc.
 - n) Watering of roads through water tankers for dust suppression.
 - o) All temporary lighting for working during night.
 - p) All temporary hutments, sanitary & potable water and domestic sewerage requirements of LSTK Contractor's work force.
11. Supply to OWNER complete survey report within three (3) working days after completion of any survey.
 12. All excess soil shall be disposed of by LSTK CONTRACTOR outside the premises in a location designated by OWNER representative.

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13. Perform all nondestructive, hydrostatic and pre commissioning testing required.
14. Supply to OWNER complete test records within three (3) days after completion of actual testing.
15. Perform all welding including radiography required.
16. Provide drawings and documents as required.
17. Provide mobilization and demobilization, temporary material and temporary facilities and utilities required executing work.
18. Provide winterization during construction.
19. Provide scheduling, planning and reporting as per CONTRACT.
20. Keep complete administration and control of work, specified in CONTRACT.
21. Provide maintenance on all construction and permanent plant material as required during the CONTRACT period.
22. Perform all material identifications as per CONTRACT.
23. Perform all transportations as required.
24. Perform quality assurance, control and supply quality control documentation.
25. Perform all pre-commissioning activities as defined in the CONTRACT.
26. Provide and supply all procedures for execution of the work in accordance with drawings specifications, and applicable codes and standards.
27. Perform all other works and activities and supply all other materials which are required for completeness of the Work either mentioned in the CONTRACT or they are necessary for completeness of the work, in compliance with highest available standards and good quality.



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ANNEXURE- 7 - 2

DETAIL TECHNICAL SCOPE

See accompanying by discipline

Annexure-7 - 2A	Civil and Building work
Annexure-7 - 2B	Structural steel work
Annexure-7 - 2C	Pipe prefabrication and Erection
Annexure-7 - 2D	Equipment erection
Annexure-7 - 2E	Electrical work
Annexure-7 - 2F	Instrumentation work
Annexure-7 - 2G	Insulation work
Annexure-7- 2H	Painting work (For detail refer TS-2001)

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ANNEXURE- 7 - 2A

CIVIL AND BUILDING WORK

1.0 **SURVEYING**

1.1 Base line and base elevation will be furnished to LSTK CONTRACTOR. LSTK CONTRACTOR will furnish all surveys from this base line and elevation.

1.2 OWNER shall have the authority at anytime to determine, in accordance with the drawings or written directives, the correctness on completeness of the lines in use by LSTK CONTRACTOR.

1.3 Any erroneous WORK shall be corrected to OWNER'S satisfaction at LSTK CONTRACTOR'S expense.

2.0 **SITE**

Finish grading elevation to be as shown on drawing.

LSTK CONTRACTOR'S access to the WORK areas shall be via existing roads.

Any other roads required by LSTK CONTRACTOR are to be developed by LSTK CONTRACTOR.

3.0 **EXCAVATION AND BACKFILL**

3.1 **Excavation**



- Provide all excavation by machine or by hand according to the specifications.
- Excavation is to be executed by LSTK CONTRACTOR in a manner that will provide adequate space for performance, inspection and timely completion of the WORK. Supply dewatering as required. The method of dewatering shall be subject to Approval by OWNER.
- Temporary water drainage routing requires prior Approval by OWNER.

3.2 **Backfill**

All backfills shall be according to the specifications.

All excavations shall be kept dry and workable prior to and during backfiring and compacting.

Material that LSTK CONTRACTOR excavates in the course of WORK and which can be used for backfill, must be approved by OWNER prior to use. All other backfill material as required in this scope of work, drawings and specifications, shall be supplied by LSTK CONTRACTOR.

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Back filling shall be to ground level as shown on drawing. The placing of backfill may only start after approval by OWNER.

LSTK CONTRACTOR will inform OWNER to arrange for the required proctor tests. Tests shall be done by OWNER on his account.

4.0 **PILES AND CONCRETE FOUNDATIONS**

4.1 Install Piles and major and minor concrete foundations in accordance with the specification and drawings.

4.2 **Blinding to Underside Foundation Work**

Prior to placing a blinding layer of concrete, LSTK CONTRACTOR shall supply, place, compact and prepare the surface of excavated area. After this LSTK CONTRACTOR shall supply a blinding layer of concrete. Blinding layer to be in accordance with specifications and / or drawings.

4.3 **Reinforcement of Concrete**

Cut and bend to bar bending schedules, all type of reinforcing bars.

Store and protect all reinforcing bars against corrosion and any other deleterious effects prior to placing.

Installation of reinforcement including installation of spacers, supports, tying, wire in accordance with the specifications and drawings.

4.4 **Anchor Bolts**



Install all anchor bolts, in accordance with the specifications and drawings.

The following WORK is included but not limited to LSTK CONTRACTOR'S scope for installation of anchor bolts:

- Deliver of all templates.
- Store and protect against corrosion and any other deleterious effects.
- Place anchor bolts accurately in formwork or by templates, if required, or in pockets.
- Clean and grease anchor bolts threads after Concrete pour and protect bolts after greasing with plastic covers.

4.5 **Inserted and Embedded Item**

Install all concrete inserts and embedded items, including but not limited to the following items in accordance with the specifications and to the detail drawings to be furnished by LSTK CONTRACTOR.

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- Cement - In sockets.
- Cinch anchors.
- Steel sleeves, various size angle.
- Channel shapes with anchors. Curb angles and steel plates.
- Anchor rails.
- Pipe sleeves of heavy duty PVC pipe.

The WORK shall include but not limited to:

Store and protect against corrosion and damage place accurately in Formwork or by templates, if required, or by temporary bars for proper positioning.

4.6 The following WORK is included but not limited to LSTK CONTRACTOR'S scope for installation of major and minor foundations:

- All excavation, including sheet piling, if required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location, chosen by LSTK CONTRACTOR and approved by OWNER. The supply, installation and maintenance of a complete concrete batch plant, including concrete testing laboratory. Installation of selected backfill material, if required. Supply and delivery and installation of all formwork, assembly and disassembly of all reusable formwork, inclusive if any and all required supporting, bracing, pockets, cutouts, recesses, etc.
- Bending and installation of concrete reinforcement bars to the requirements and supply of items as defined in 4.3 above.
- Installation of all anchor bolts (including fabrication of templates), to the requirements and supply of items as defined in 4.4 above.
- Installation of embedded and inserted items, to the requirements and supply of items as defined in 4.5 above.
- Installation of construction and expansion joints where required.
- Mixing, delivery and pouring of concrete in accordance with specifications. Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.
- All temporary storage of formwork at SITE shall be of an orderly nature. In case storage does not comply with the above-mentioned rule, OWNER shall have the right to remove formwork from SITE within forty eight (48) hours after first warning and back charge LSTK CONTRACTOR for all related costs. OWNER shall not be held responsible for any of LSTK CONTRACTOR'S losses.
- The finishing of concrete, where required to a finish in compliance with the specifications.

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A copy of all-concrete mix truck delivery slips if applicable.

Concrete composition analysis of the concrete batch plant.

All scaffolding required.

All required dewatering to keep the excavations / backfill dry for the WORK.

5.0 CONCRETE STRUCTURES AND ELEVATED SLABS

Install concrete structures, in accordance with the specifications and drawings.

6.0 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of concrete elevated slabs:

See 4.6; however with -following exceptions: No-excavation, no backfill and- no dewater

7.0 YARD PAVING AND FINAL SURFACING



7.1 Excavation

Setting out and grading by machine and/or by hand for yard paving to the shape and depth in accordance with the specifications and drawings.

Disposal of all excavated material and neatly stock piling to a location chosen by LSTK CONTRACTOR and approved by OWNER.

7.2 Concrete Yard Paving

- Mix and install concrete for heavy duty paving areas, in accordance with the specifications and drawings.
- Mix and install concrete for light and medium duty paving areas in accordance with the specifications and drawings.
- The following work is included but not limited to LSTK CONTRACTORS scope for installation of concrete yard paving: See 4.6 above
- Surface preparation, including the supply and placing of waterproof building paper or similar waterproof material, well lapped at joints, laid on top of the well compacted sand layer and before pouring concrete.
- Reinforcement for heavy duty paving at top and bottom face and for light duty paving at top face only, with square mesh fabric reinforcement including protection against corrosion, the cutting, the bending and placement.
- Mixing and pouring of concrete in accordance with specifications, sufficient vibrating.

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Stopping clear from bases, plinths and piers and forming around surface and lay to give levels and falls.

- Installation of construction / expansion joints.

7.3 Unpaved Areas

Install gravel, tiles or crushed stone on leveled unpaved areas, all in accordance with the specifications and drawings.

7.4 Concrete Tiles for Walkways

Install well compacted sub-base layer and install the tiles on the sub-base all in accordance with specifications and drawings.

8.0 CONCRETE PIPE SLEEPERS

Fabricate and install reinforced concrete sleepers for pipe, complete with foundations in accordance with the specifications and drawings.

9.0 MANHOLES AND CATCH BASINS, TRENCHES

9.1 Fabricate and install pre-cast or formed and poured in situ concrete manholes and catch basins and trenches in accordance with the specifications and drawings.

9.2 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of manholes and catch basins. All excavation including sheet piling of required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location, designated by LSTK CONTRACTOR and approved by OWNER.



For Poured in Site

- Delivery and installation of all formwork, inclusive if any and all required supporting, bracings, pockets, cutouts recesses etc.
- Bending and installation of concrete reinforcement bars to the requirements and supply of items as defined in 4.3 above.
- Fabrication and installation of embedded and inserted items, if any, to the requirements and supply of items as defined in 4.5 above.
- Mixing and pouring of concrete in accordance with specifications.
- Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.
- All required dewatering to keep the excavations / backfill dry for installation work.
- Install cast - iron manhole frames and solid cover and fabricate and install steelwork catch basin grating and frames in accordance with specifications.



10.0 COLLECTION BASINS, PITS, SUMPS, RETAINING WALLS AND CULVERTS

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- 10.1 Fabricate and install concrete collecting basins in accordance with the specifications and drawings.
- 10.2 Fabricate and install concrete sumps and pits in accordance with the specifications and drawings.
- 10.3 Fabricate and install concrete walls around tanks and other retaining walls in accordance with the specifications and drawings.
- 10.4 Fabricate and install concrete pipe and bridge culverts including head walls in accordance with the specifications and drawings.
- 11.0 **DITCHES AND TRENCHES**
- 11.1 Fabricate and install earthen and concrete ditches and trenches including connection pipes and boxes in accordance with the specifications and drawings.
- 12.0 **STEEL SLIDING PLATES AND PTFE SLIDING PLATES**
- 12.1 **Steel Sliding Plates**
- Fabricate and install steel sliding plates in accordance with specifications and drawings.
 - The following work is included, but not limited to LSTK CONTRACTOR'S scope for fabrication and installation of steel sliding plates
 - Pick up materials, storage and protection against corrosion and any other deleterious effects.
 - Fabricate, place in pockets, level and grout, protect against possible damage and corrosion.
- 12.2 **PTFE Sliding Plates**
- Install sliding plates, in accordance with the specification and drawings.
- The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of sliding plates pick up materials, transport, store and protect
- Place in pockets, level and grout, protect against possible damage.
- 13.0 **GROUTING**
- 13.1 Mix and install grouting in accordance with the specifications and drawings.
- 13.2 LSTK CONTRACTOR shall grout under all structural steel columns and under all equipments, as specified.

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- 13.3 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of grouting:
- Prepare top surface of base and /or plinth, pockets, sleeves etc., prior to placing grout.
 - Mix and install grout mortar in accordance with specifications.
 - Grout mortar shall be used between steel base plate and concrete foundations.
 - Mix and install non-shrink grout between reciprocating rotary equipment base frame including the filling of the equipment steel frame, if required, and concrete foundation in accordance with manufacturer specifications and project specifications.
- 13.4 Grouting of equipment shall proceed only when equipment setting has been accepted by OWNER.
- 14.0 **ASPHALT PAVING**
- 14.1 Mix and install asphalt paving over base courses installed by LSTK CONTRACTOR, in accordance with the specifications and drawings.
- Roads/ Driveways/ Parking areas/ Sidewalks/ Tank pads
- 14.2 The following work is included but not limited CONTRACTOR'S scope for installation of asphalt paving to.
- Installation of all materials necessary to make a complete installation.
 - Installation of sub-grade, sub-base and base courses all properly compacted.
 - Delivery and installation of all formwork, inclusive if any and all required supporting, bracing, pockets, cutouts, recesses, etc.
 - Installation of expansion joints where required and/or construction joints
 - Stripping of formwork and removal of all surplus material to LSTK CONTRACTOR'S yard or locations designated by OWNER.
 - Mixing, delivery, installation, spreading and compaction of asphalt paving mixture in accordance with specifications.
 - Any and all measures for proper asphalt paving installation and curing.
- 15.0 **ROAD REPAIR AND MAINTENANCE**
- 15.1 Supply and deliver necessary materials, equipments and labour to repair and maintain all

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plant roads, as necessary.

- Repair work shall be in accordance with the specifications.
- LSTK CONTRACTOR shall be responsible for repair of roads, all on the indication of OWNER due to the damage to the roads, caused by LSTK CONTRACTOR'S activities and construction operations, or due to faulty construction by LSTK CONTRACTOR. LSTK CONTRACTOR is not entitled for compensation for such repair work.

16.0 REPAIR OF DYKES, SLOPES AND DITCHES

16.1 Supply and deliver necessary materials, equipment and labour to effect repairs on dykes, slopes and ditches as necessary.



- Repair WORK shall be in accordance with the specifications.
- LSTK CONTRACTOR shall be responsible for repair of dykes, slopes and ditches all on the indication of OWNER'S representative, due to damage to the dykes, slopes and ditches caused by LSTK CONTRACTOR'S activities and construction operations, or due to faulty construction by LSTK CONTRACTOR.
- LSTK CONTRACTOR is not entitled for compensation for such repair work.

17.0 UNDERGROUND SEWERS AND PIPING SYSTEMS

17.1 Install the underground piping systems, in accordance with the specifications and drawings.

17.2 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of underground piping systems.

- Excavation including sheet piling, if required, backfill, compacting and the transportation of surplus material, neatly stockpiled at a location designated by LSTK CONTRACTOR and approved by OWNER.
- Installation of sand backfill if required
- Receiving unload, inspect and transport LSTK CONTRACTOR'S supplied materials and store and protect.
- Installation of piping materials necessary for a complete installation.
- The installation of above ground fire hydrants, fire monitors and standpipe as well as the underground firewater system.
- The fabrication and installation of supports and thrust blocks for the piping as required.

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- Surface preparations and installation of coating and wrapping of the underground piping, if required as per Technical specification Mentioned in **Annexure- 7 - 2C**
- Installation of glass fiber reinforced epoxy piping in accordance with manufacturer's instructions as well as the specifications.
- Hydrostatic pressure testing of the underground piping systems including test apparatus, test piping, test blinds, bolts and gaskets in accordance with the specifications.



17.3 **Hydro Testing of Sewers and Underground Lines**

- Tests all sewers and underground piping systems as per test instructions. Testing is to be witnessed and approved by OWNER. A test schedule by test system shall be prepared by LSTK CONTRACTOR. Testing and completion shall be in accordance with project system priorities.
- Piping systems shall be tested with suitable water.
- Develop test system procedures and follow priorities established by OWNER. LSTK CONTRACTOR shall prepare detailed schedules based on this data for submittal to OWNER for his approval.
- The water for testing purposes is to be provided by LSTK CONTRACTOR.
- Inexpensive temporary gaskets shall be used in place of permanent gaskets where test blinds are located for hydrostatic testing. On successful completion of a test, the permanent gasket shall be installed when the blinds are removed.
- After hydro testing, LSTK CONTRACTOR shall perform the following activities:
 - Flushing
 - Remove temporary blinds
 - Install permanent gaskets.
 - Flange connection bolts tightened.
 - Coat and wrap welds.
 - Holiday testing and coating repairs.
 - Backfill and compaction.

18.0 **CIVIL PART FOR UNDERGROUND ELECTRICAL GROUNDING SYSTEM**



18.1 Excavation of the routing for the direct buried cables, for the road crossing and for the branch conduit and sleeves in accordance with layout and detail drawings.

18.2 Transport of the excavated soil, neatly stockpiled to location chosen by LSTK

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CONTRACTOR and approved by OWNER.

- 18.3 Installation of all protection conduits and installation materials in accordance with the specification, and design and detail drawings.
- 18.4 Transport of excavated soil and backfill including compacting of the round up to finished plant level.
- 19.0 **CIVIL PART FOR UNDERGROUND CABLE TRENCHES (AND CABLE) CIVIL PART**
- 19.1 Excavation of the routing for the concrete cable trenches for the direct buried cables, for the crossings and for the branch conduit and pipe sleeves by machine or by hand as dictated by local conditions.
- 19.2 Transport the excavated soil, properly stockpiled to a location off chosen by LSTK CONTRACTOR and approved by OWNER.
- 19.3 Installation of the concrete cable trenches in accordance with the specification and the design and detail drawings.
- 19.4 For scope of installation of concrete cable trenches see item 11.
- 19.5 Installation of the road culverts, protection sleeves and cable ducts at road crossing in accordance with layout and detail drawings. For scope of installation see item 10
- 19.6 Transport of the excavated soil and backfill of the surrounding area of the concrete trenches up to finished plant level.
- 19.7 Transport of the excavated soil and backfill of road crossing up to road including the supply and installation of the repair of the paving and / or asphalt road covering.
- 19.8 Transport and backfill of the trenches with a layer of clean sand, free from stones equalized up to the bottom level of the first (bottom) cable layer.
- 19.9 Transport and backfill of the layer of clean sand between cable. Layers and above top cable layer.
- 19.10 Transport of excavated soil and backfill including compacting of the ground up to the layer of concrete tiles or trench covers.
- 19.11 Installation of the cable protection covers and/or trench covers and /or cable routing colored marking tape.
- 19.12 Transport of the excavated soil and backfill including compacting of the ground above the layer of concrete tiles up to finished plant level.

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19.13 Installation of the cable route designated, trench markers.

20.0 STORAGE TANK PADS AND DYKES

20.1 Install tank pads as specified and as quantified on the specifications and drawings.

20.2 Install tank dykes and ramps as specified and as quantified on the specifications and drawings.

20.3 Install impervious clay layer inside the dyked tankage areas in accordance with specifications and drawings.

21.0 PERMANENT PLANT FENCING

21.1 Install permanent plant fencing, including personnel gates and truck gates as located, specified and quantified in the specifications and drawings.

22.0 SCAFFOLDING

22.1 Supply and erect all scaffolding for WORK.

22.2 Scaffolding shall be supplied, erected and maintained in strict accordance with local and governmental regulations as well as OWNER'S safety requirements. If there are conflicts, the more stringent shall prevail.

LSTK CONTRACTOR shall dismantle all its scaffolding at the completion of its WORK.

23.0 TESTING

23.1 All necessary tests in order to control the quality of the field works shall be done and all such test certificates should be kept in record, such as but not limited to



- Soil compaction tests.
- Concrete testing
- Asphalt testing
- Reinforcing bars testing

23.2 If any test fails LSTK CONTRACTOR shall replace those items, which do not meet the requirements.

All costs for replacements shall be borne by LSTK CONTRACTOR.

24.0 WELDING PROCEDURES SPECIFICATIONS AND WELDING PROCEDURE QUALIFICATION RECORDS

24.1 Provide within two months before starting the construction execution, its welding procedures

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(for A.G, U.G piping and any structural steel) for comment and approval. Approval of welding procedures by OWNER is required before the start of welding.

24.2 Prior to start of filed welding LSTK CONTRACTOR shall submit one (1) copy of all welders' qualification paper and applicable welding procedures approved and stamped by regulating authorities to OWNER.

25.0 DRAWINGS AND DOCUMENTS

25.1 LSTK CONTRACTOR will carry out all construction activities directly from the AFC construction drawings and specifications.

25.2 LSTK CONTRACTOR shall submit reports of each test or inspection within three (3) days after actual test or inspection. Failure to comply with the above rule may result in OWNER arranging for additional tests or inspections. Costs of which will be back charged to LSTK CONTRACTOR.

25.3 LSTK CONTRACTOR shall submit material certificates and quality records of the materials, as specified in previous sections and the applicable engineering specifications and standards.

25.4 LSTK CONTRACTOR shall also furnish a concrete installation record within two (2) weeks after completion of the WORK indicating, date of installation and quantity of concrete of each foundations, floor slab, elevated slab, frames, columns, etc.

This concrete installation record shall also show a reference with the concrete compression test certificates of the respective concrete pours and the concrete delivery slip numbers.



Failure to comply with the above time may result in the preparation of the documents by OWNER in which case all related costs will be back charged to LSTK CONTRACTOR.

26.0 MISCELLANEOUS

26.1 LSTK CONTRACTOR shall be fully responsible for the correct and accurate setting out of all elevations, positions, dimensions, alignments, profiles. etc, of all parts of the WORK and for the provision of all necessary instruments, appliances and labour in connection therewith The checking of any such matter by OWNER shall not relieve LSTK CONTRACTOR of its responsibility for the correctness thereof.



26.2 If during the construction or maintenance of WORK, any error is discovered in WORK, LSTK CONTRACTOR shall at its own cost rectify such error to the satisfaction of OWNER. LSTK CONTRACTOR shall in such case take all necessary actions such as overtime, etc. in order not to endanger the agreed upon time schedule.

26.3 All dimensions shown on the plans and drawings are given in the SI system, unless

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otherwise stated.

- 26.4 All costs for setting out the earthwork and for assisting OWNER in checking the various points, lines, levels, profiles, etc. shall be deemed to be included in the price.
- 26.5 LSTK CONTRACTOR shall under no circumstances extend its operations outside the limits of the area appropriated for WORK. LSTK CONTRACTOR will ensure that its operations shall not interfere in any way with properties of others.
- 26.6 No excavation work shall be started before the exact positions of the WORK have been marked by means of stakes controlled and approved by OWNER.
- 26.7 OWNER shall notify LSTK CONTRACTOR of all known existing underground pipes, cables, drains, manholes, etc. in current use, together with the approximate locations and hazards involved and LSTK CONTRACTOR shall ensure that they will not be broken or damaged in any way by the execution of WORK. Hand labour shall be used for excavation within a horizontal distance of 1.5 meters from existing utilities.
- 26.8 Any damage as referred to above shall be reported by LSTK CONTRACTOR. LSTK CONTRACTOR shall repair the damage.
- 26.9 The discovery of any unregistered pipes, drains, cables, etc., shall be promptly reported to and dealt with as directed by OWNER. Excavation, as required to determine the exact location of existing underground pipes, drains, cables etc. shall be considered as a part of WORK.
- 26.10 LSTK CONTRACTOR shall take precautions i.e. mats, lining with timber, etc. not to cause damage to permanent plant roads curbing and sidewalks with its construction equipment.
- 26.11 LSTK CONTRACTOR shall provide and be responsible for the construction of all temporary dewatering. Drainage, sheet piling, timbering etc. to ensure the stability of slopes, trenches, embankments, etc. during excavation work and that all areas are adequately drained to the satisfaction of OWNER.
- 26.12 LSTK CONTRACTOR is responsible for all soil slides that may occur during the execution of the WORK and for any detrimental effect of the same. LSTK CONTRACTOR shall as directed by OWNER either correct or repair the damage to the satisfaction of OWNER at its own expense or pay for the cost of repair by others of all damage caused to the WORK or adjacent property. No additional payments shall be made to LSTK CONTRACTOR to compensate the financial consequences of soil slides.
- 26.13 Collapse, cave-in, or movement of excavations, trenches, or the like shall be the responsibility of LSTK CONTRACTOR. LSTK CONTRACTOR acknowledges this responsibility and instructions of the OWNER.
- 26.14 Trenches, excavations, and the like shall be maintained in strict accordance with the

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requirements of the applicable national and local regulations.

- 26.15 LSTK CONTRACTOR shall be held entirely responsible for any effect or damage, which the execution of any of the earthwork may have upon, or which may be caused to any portion of WORK or any of the surrounding property.
- 26.16 Excavation will proceed until all unsuitable material is removed.
- 26.17 LSTK CONTRACTOR is responsible for the excavation required to installing bottom of footings at elevations as shown on drawings. The removal of a poor soil below the intended bottom of excavation is included in the CONTRACT. Any unnecessary over excavation will be in LSTK CONTRACTOR'S account.
- 26.18 Backfill shall be to the elevation shown on the approved drawings or as directed in writing by OWNER.
- 26.19 Special care must be taken in compaction operations over underground pipelines.
- 26.20 LSTK CONTRACTOR shall furnish all field engineering, surveying, layout, and checking to properly install all foundations to meet all requirements of the drawings and specifications, on completion of each foundation LSTK CONTRACTOR shall mark all foundations with a clear center line, locating both North, South, East and West and a bench elevation mark. LSTK CONTRACTOR shall stencil or by other means, paint equipment and column designation and coordinates, to all foundations installed by LSTK CONTRACTOR. All markings shall be located above high point of paving. These markings shall be preserved for use by others.
- 26.21 LSTK CONTRACTOR shall design concrete mix specification and furnish by means of reports from OWNER'S laboratory, proof that the materials and mixes for concrete conform to the specifications and codes prior to pouring the first concrete on SITE. LSTK CONTRACTOR shall furnish all field labour to make concrete tests and fill cubes quality of concrete aggregates and mix design will be checked by OWNER'S laboratory regularly.
- 26.22 All aboveground concrete for supports for steel structures must be smooth finished, and exposed edges of concrete to have a chamfer.
- The top of the foundations shall be poured so as to ensure true surfaces and designated slopes in all cases. LSTK CONTRACTOR is to avoid damage or movement of already installed reinforcement and/or other structures, formwork, etc., when pouring concrete.
- 26.23 All concrete pours for a given element must be monolithic, except where noted on the drawing or approved by OWNER.
- 25.24 If pouring cannot be finished within normal working hours, necessary actions shall be taken, sufficiently in advance for requesting permits for overtime. All pouring must be continued until the element is complete. OWNER shall be informed at least twenty-four (24) hours in

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advance.

- 26.25 Damaged formwork must be repaired in such a way as not to mark the concrete finish. All formwork must be braced adequately and be of a rigid construction. Gravel nests, surfaces crack, honeycombs, etc., and shall be repaired to the satisfaction of OWNER.
- 26.26 LSTK CONTRACTOR shall use immersion-vibrating equipment but it needs to be of a type approved by OWNER prior and also during use. Vibration of formwork and fresh concrete WORK is not allowed. OWNER will have the right to require replacement of inadequate during all phases of the WORK. A must condition shall be maintained after pouring as set forth in specifications. The WORK involved in this is to be included in the pricing.
- 26.27 OWNER reserve the rights to reject any WORK already poured which is not in accordance with drawing and specifications and of adequate quality.
- Serious inclusions appearing in concrete shall be reason for the rejection of WORK and LSTK CONTRACTOR requested to repair or replace at his own expense.
- 26.28 All costs involved in demolition, removal and replacement of rejected WORKS shall be the responsibility of LSTK CONTRACTOR all materials, equipment or auxiliaries not accepted by OWNER shall be removed immediately from the OWNER'S property.
- 26.29 Ready - mixed concrete shall be delivered without segregation. The concrete batch plant has to be approved by OWNER. Small quantities of concrete may be made at SITE after approval of OWNER.
- 26.30 The pouring of any reinforced concrete may only start after having obtained Approval of OWNER.
- 26.31 LSTK CONTRACTOR shall provide, during the period of this CONTRACT, temporary drainage ditches in WORK so that water will not be pended and so that all areas are adequately drained to the satisfaction of OWNER.
- 26.32 LSTK CONTRACTOR shall provide, during the period of this WORK, systems for the dewatering of all its WORK areas as required to properly execute the WORK. All dewatering methods shall be subject to the approval of OWNER.
- 26.33 All excavated boulders will be removed from SITE by LSTK CONTRACTOR.
- 26.34 Manholes are to be marked with M.H. Number.
- 26.35 Underground service lines have to be marked at their installation limits to aboveground piping, indicating line size, and service and line number.
- 26.36 Prefabricated concrete -items are to - be marked with date of fabrication, size, Length,



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identification code and installation north arrow.

27.0 BUILDINGS

27.1 LSTK CONTRACTOR shall do the construction of the buildings, including all activities and installations as specified, in drawing and specifications including the fabrication of all items that are not standard hardware components.

28.0 Quality of all civil and building materials shall be approved by OWNER before usage in the PLANT.

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ANNEXURE- 7-2B

STRUCTURAL STEELWORK



1. Delivery of all materials and fabricated structural steel to SITE, including all required transport, storage, intermediate storage, etc., including loading and unloading of materials.
2. LSTK CONTRACTOR will carry out all construction from the AFC construction / erection drawings and specifications.
3. LSTK CONTRACTOR shall be held entirely responsible for any effect or damage, which the erection of the structural steel may have upon, or which may be caused to any portion of WORK or any of the surrounding property.

4. **Erect Structural Steel-Structure Frames**

This item covers all activities required to erect prefabricated structural steel framing for single and multilevel structures.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Shimming of foundations and joints.
- ◆ Erecting.
- ◆ Cutting, drilling, welding and bolting to achieve fitment.
- ◆ Rectification required, if any.
- ◆ Final levelling, aligning and bolting (including torquing).
- ◆ Grouting of components and areas supplied unpainted or requiring finish coats, as per specifications.
- ◆ Touch up painting of damaged areas.
- ◆ Also included in this item are all clips plates, stiffeners, gussets, and connection material supplied loose for field installation.

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5. Fabricate and Erect Structural Steel-Structure

This item covers all activities required to fabricate and erect structural steel framing for single and multilevel structures, from raw steel, if any, sections, plates, rounds, etc. It including, but is not limited to the following:

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Preparation of detailed fabrication drawings and getting them approved from Owner.
- ◆ Shimming of foundations and joints.
- ◆ Measuring, cutting, bending, bolting and / or welding.
- ◆ Erecting.
- ◆ Cutting, drilling, welding and bolting to achieve fitment.
- ◆ Final levelling, aligning, bolting and /or welding (including torquing)
- ◆ Grouting of support piers.
- ◆ Painting as per specifications.

6. Fabricate and Erect Ladder and Safety Cages

This item covers all activities required to fabricate, assemble and erect ladders and safety cages in steel structures, from raw steel (unpainted) sections, plates rounds, etc.

It includes, but is not limited to, the following:



- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Preparation of detailed fabrication drawings and getting them approved from Owner.
- ◆ Measuring, cutting, bending, bolting and / or welding.
- ◆ Assembly and erecting including cutting, drilling, bolting, welding to achieve fitment.
- ◆ Cutting, drilling, welding and bolting to achieve fitment.
- ◆ Final Bolting and / or welding in position.
- ◆ Fabrication and installation of safety barrier rail and gate.
- ◆ Installation of raw bolts and forming of concrete pads, or connecting to a lower platform.
- ◆ Painting as per specifications.

7. Fabricate and Erect Platform and Walkways

This item covers all operations required to fabricate erect platforms and walkways on vessels, towers, structures, etc or on the ground from raw steel (unpainted) sections, plates, rounds, etc.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Preparation of detailed fabrication drawings and getting them approved from Owner.
- ◆ Measuring, cutting, bending, bolting and / or welding.

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- ◆ Erecting including any, cutting, drilling, welding for fitment.
- ◆ Final levelling, bolting and / or welding.
- ◆ Installing anchor bolts and grouting.
- ◆ Painting as per specifications.

Not including is the installation of flooring or the erection of handrail.

8. **Fabricate and Erect Welded Handrail**

This item covers all operations required to fabricate and erect double rail handrail and tope plate of all welded construction, from raw steel (unpainted) sections, plates rounds, etc.

It includes, but is not limited to, the following :



- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Preparation of detailed fabrication drawings and getting them approved from Owner.
- ◆ Fabrication including cutting, bending, welding, etc.
- ◆ Erecting of posts, top and middle rails toe plate including any cutting, trimming for fitment and welding.
- ◆ Grinding smooth of all cut edges and welds.
- ◆ Painting as per specifications.

9. **Fabricate and Erect Galvanized Tubular Handrails**

This item covers all operations required to fabricate and erect double rail tubular galvanized hand railing including all standards, fittings, bends, etc., from raw steel (unpainted) sections, plates, tubes, etc.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Fabrication including cutting, trimming edge stripping to required size & shape.
- ◆ Erecting into position.
- ◆ Bolting and/or welding.
- ◆ Trimming to suit platform structure and providing openings for pipe or cable, etc.
- ◆ Making good edges, and touch up painting including cold galvanizing of cut or welded parts.
- ◆ Painting of unpainted steel sections

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10. **Fabricate and Install Floor Grating**

This item covers all activities required to fabricate and install galvanized floor grating from large sheets ready for cutting, trimming, etc., to platform shapes.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Fabrication including cutting, trimming, edge stripping to required size & shape.
- ◆ Erecting into position.
- ◆ Bolting and/or welding.
- ◆ Trimming to suit platform structure and providing openings for pipe or cable, etc.
- ◆ Making good edges, and touch up painting including cold galvanizing of cut or welded parts.

11. **Fabricate and Install Chequer Plate Flooring**

This item covers all activities required to fabricate and erect chequer plate flooring, from sheets.

It includes, but is not limited to, the following:

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Fabrication including cutting, trimming edge stripping to required size & shape.
- ◆ Erecting into position.
- ◆ Bolting and/or welding.
- ◆ Cutting to suit platform structure and providing opening for pipe or cable, <etc.

12. **Erect Davits**

This item covers all activities required to erect fabricated davits on exchangers, vessels or in structures.

It includes, but is not limited to, the following :



- ◆ Delivery of davits and all other materials.
- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting up painting of damaged areas.

13. **Roof and Wall Sheeting**

This item covers all activities required to erect by bolting of roof and wall sheeting.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.

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- ◆ Cutting and fitting of sheeting including all shrilling, trimming and notching to facilitate openings.
- ◆ All flashing of ridges, corners gables, door jambs, etc.

14. **Down pipes and Gutters**

This item covers all activities required to install metal downpipes and gutters.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting including fitting, trimming supporting and jointing.

15. **Roof or Ridge Ventilator**

This items covers all activities required for the erection of roof or ridge ventilators on a steel clouded building.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting on roof including any trimming or figment.

16. **Install Gantry Crane Rails**

This item covers all activities required to install rails.

It includes, but is not limited to, the following :



- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting jointing levelling, aligning, and bolting or welding in passion.

17. **Install Gantry/Overhead Travelling Crane**

This item covers all activities required to erect and complete the installation of overhead cranes.

It includes, but is not limited to, the following :

- ◆ Provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting into rails.
- ◆ Installing all controls, both mechanical and electrical.
- ◆ Testing and running of crane.

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18. Install Travelling Trolleys



This item covers all activities required for the installation of beam mounted travelling trolley.

It includes, but is not limited to, the following :

- ◆ provision of all tools, equipment and consumables used in the course of the work.
- ◆ Erecting into position.
- ◆ All levelling and shimming of trolley beam as required.
- ◆ Marking of all beams and trolley with safe Working Load.
- ◆ All testing and running as required.

19. Inspection and Testing

- ◆ Inspection of steel structure shall be in accordance with the codes and standards.
- ◆ LSTK CONTRACTOR shall provide NDE services acceptable to OWNER. NDE inspection shall be carried out in accordance with standards, codes and specifications .
- ◆ LSTK CONTRACTOR shall be responsible for the repair of faulty welds and for all required extra radiography and inspection of the faulty welding work. In case of a faulty weld, 100% radiography on LSTK CONTRACTOR'S account can be done as per code.

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ANNEXURE- 7 – 2C

PIPE PREFABRICATION AND ERECTION

1.0 PIPING

1.1 Magnitude of Piping

LSTK CONTRACTOR shall prefabricate, install and test all piping as shown on the plan drawings and isometrics.

2.0 PIPING FABRICATION AND ERECTION

2.1 Piping systems and pipe supports shall be designed, fabricated, inspected, and tested in accordance with rules, codes, specifications and drawings.

2.2 Miscellaneous piping materials for vents, drains, instrument connections, etc. on equipment shall be installed using P & ID'S and equipment drawings.

2.3 The fabrication and erection of piping includes field welds. It is LSTK CONTRACTOR'S responsibility to choose the number and location of field welds to ensure efficient transportation and handling during erection. Furthermore LSTK CONTRACTOR shall locate the field welds in such a way that final adjustment for fit-up purposes will be possible.



For alloy piping that has to be stress relieved after welding the number of filed welds shall be kept to a bare minimum. LSTK CONTRACTOR shall thoroughly evaluate the need for each field weld in alloy piping he deems necessary.

2.4 LSTK CONTRACTOR will furnish OWNER with a marked up set of isometrics identifying all spool pieces, and weld numbers. All piping spools shall be clearly identified, per isometric by means of stainless steel tags affixed with wire.

2.5 LSTK CONTRACTOR shall erect all prefabricated and straight run piping as required by the drawings and specifications.

The erection and installation of the piping shall include but not be limited to the following

- Control valves.
- Safety valves
- Rapture disks.
- Level instrument and gauges.
- External level displacers.
- Special fittings.
- Breaching of vents, drains, instrument connections, etc.

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- Rota meters.
- Orifice flanges.
- Orifice plates.
- In - line instruments.
- Steam tracing.
- Steam traps.
- Extension stems. Valve operators.
- Bellows, expansion joints and similar specialty items.
- Thermowells (flanged, screwed and weld Ins.).
- Sample coolers.
- Instrument connections (up to and including the first block valve).
- Spring hangers and spring supports.
- Installation of miscellaneous piping and instrumentation supplied by equipment vendor.
- Temporary piping for drying, flushing and hydrostatic testing if necessary.
- Connection of piping to equipment.
- Connection of aboveground piping to underground piping.
- Pipe supports.

This shall include any necessary work to the piping to correct equipment misalignment.

2.6 Fastening of floor supports on concrete will be done with expansion type foundation bolts, if no anchor bolts are provided.



2.7 LSTK CONTRACTOR is responsible for the installation of steam tracing of piping, valves fittings and instruments where required, in accordance with the specifications and drawings. In general steam and condensate headers will be indicated on the piping plans. Lines to be traced will be indicated on P& ID'S and lines lists. Details of steam and condensate headers will be shown on separate drawings. Identification of steam tracers shall be by aluminum tag noting circuit number. Each end of system should be tagged.

A method of identification and tagging of the other various systems shall be established, subject to approval by OWNER and is for account of LSTK CONTRACTOR.

2.8 LSTK CONTRACTOR is responsible for the fabrication and erection of pipe supports, hangers, anchors and guides, as required by the drawings and specifications.

Spring pots and spring hangers, which shall be provided by LSTK CONTRACTOR as will be assembled, installed, adjusted and unlocked by LSTK CONTRACTOR after hydrostatic testing of the line. The required angle iron, will be decided in the field and supplied by LSTK CONTRACTOR.

2.9 LSTK CONTRACTOR shall install and remove all temporary strainers required for WORK defined herein. The removal of these items will be directed by OWNER. OWNER may decide to leave temporary strainers in during commissioning.

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- 2.10 LSTK CONTRACTOR shall be responsible for the fabrication, installation and dismantling of temporary spool pieces and blinds required for control valves, safety valves and in - line instruments during testing and cleaning. Requirements for these shall be minimized. Requirements for these will be prescribed by OWNER.

In general, in-line instruments, safety valves and control valves may be installed for fit-up purposes if available to avoid the use of temporary spool pieces. They shall be removed for flushing and testing and reinstalled as directed by OWNER. In the case of safety valves these must be installed for fit - up, taken down for calibration by LSTK CONTRACTOR, and reinstalled before mechanical completion. All open flanges and valves shall be blinded or plugged off.

- 2.11 LSTK CONTRACTOR is responsible for the installation and testing of all piping and steam, electrical tracing and all materials including all items necessary to completely close the systems in strict accordance with the established test system procedures and priorities as directed by OWNER.

- 2.12 **Wrapping & Coating:-** Surface preparations and installation of Wrapping & Coating of the underground piping with Cold tape (Materials for line coating and wrapping shall be of Tape coating system (Polyethylene backed tape with butyl rubber based adhesive system), if required

2.12.1 Protective coating shall consist of a coating system employing Primer, Inner Wrap and Outer Wrap.

2.12.2 The coating system shall be mechanically applied by an approved type of wrapping machine utilizing constant tension brakes except at tie-in welds, repair patches and at other locations where mechanical application is not practicable..

2.12.3 Coating and wrapping materials shall be handled, transported, stored and applied strictly in accordance with the manufacturer's instruction.



2.12.4 Wrapping Coating material is Cold tape type from **Polyken/Denso/Atla** shall be used.

- 2.13 **Flushing and Cleaning Of Piping Systems**

- i) Sections fabricated in LSTK CONTRACTOR'S workshop shall be fitted with plastic end caps to seal pipe ends, and jointing surfaces shall be suitably protected.

These caps shall not be removed until sections are in the course of erection after delivery at SITE and then shall be removed for reuse.

- ii) During fabrication and erection the sections shall be inspected or internal cleanliness.

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- iii) The water which will be used for testing and flushing of the piping system shall be recollected per instruction given by OWNER.
- v) Piping systems shall be flushed with suitable water as supplied by LSTK Contractor unless designated for nitrogen or air testing or otherwise specified by licensor. OWNER'S approval is required before start of flushing.
- v) LSTK CONTRACTOR shall supply all equipment, pumps, gauges, etc. required for flushing and testing of the piping systems.
- vi) For hydro testing and flushing the piping LSTK CONTRACTOR shall weld and caps and install drain plugs, remove end caps after successful hydro test.

3.0 HYDRO TESTING

3.1 Inspection and hydro testing of the piping systems shall be in accordance with the drawings and specifications and in strict witness by OWNER representatives.

3.2 Atmospheric pressure systems shall be:

- Visually inspected that all joints are properly made.
- Filled with water for a 24 hours leakage test under atmospheric conditions.

If any leakage occurs in the system during testing, repairs must be made without extra costs to OWNER.

3.3 LSTK CONTRACTOR shall test all piping systems as per the project test diagrams. Testing is to be witnessed and approved by OWNER and where applicable by the appointed (independent inspection authority) filed inspector. A test schedule by test system shall be prepared by LSTK CONTRACTOR and shall be submitted to OWNER for Approval.



3.4 Testing and completion shall be in accordance with project system priorities.

3.5 All equipment, pumps, gauges, pressure recorders temporary piping and fittings, test gaskets and bolting, required for testing of the piping systems and part of LSTK CONTRACTOR'S supply. Before testing LSTK CONTRACTOR shall calibrate its testing equipment.

3.6 LSTK CONTRACTOR shall supply and install blind flanges when required to enable testing of the lines.

3.7 Inexpensive temporary gaskets supplied by LSTK CONTRACTOR, shall be used instead of permanent gaskets where test blinds are located for hydrostatic testing. On successful completion of a test the permanent gasket shall be installed when the blinds are removed.

3.8 Piping systems shall be tested with suitable water. Extreme care shall be taken that suitable water is used for stainless steel systems. For stainless steel the water must be approved by



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OWNER and shall have a content of chlorides ≤ 50 mg/L

- 3.9 The water for testing purposes will be furnished by LSTK CONTRACTOR.
- 3.10 LSTK CONTRACTOR is to perform the testing in a sequence so as to allow sufficient time for insulation and/or painting to complete within the time frame of the project schedule.
- 3.11 A formal system of documentation will be developed by LSTK CONTRACTOR and approved by OWNER for use by LSTK CONTRACTOR to certify this testing phase of the piping erection. This system will also include a section for supplying OWNER'S "But list" comments.
- 3.12 Erected piping shall be hydrostatically tested in test systems, but not through equipment, control valves etc. except where piping is welded to equipment.
- 3.13 LSTK CONTRACTOR remains responsible for ensuring that no item of equipment, or instrument, is damaged by the test pressure or the test fluid. Suitability of test fluid to be Approved prior to testing by the OWNER.
- 3.14 It is emphasized that the installation of temporary strainers prior to testing shall be part of WORK. OWNER shall be contacted concerning installation of temporary strainers.
- 3.15 When lines are pressure tested, valves at the end of the lines must be covered with a test blank for safety reasons. A record, preferably on the test diagrams, shall be kept by LSTK CONTRACTOR indicating which sections have been completed.

Note : Testing against closed valves in not allowed (spades to be used)

- 3.16 All material damaged during tests shall be replaced on LSTK CONTRACTOR'S account. All joints broken after testing for installation of strainers, orifice flanges, safety valves, etc. must be remade tightly; labour is for LSTK CONTRACTOR'S account.
- 3.17 After testing the piping systems, they shall be completely flushed and drained. OWNER will approve when a line is considered flushed and drained by LSTK CONTRACTOR.
- 3.18 When each section or circuit has been pressure tested and passed, a certificate prepared by LSTK CONTRACTOR on LSTK CONTRACTOR'S furnished forms showing details must be signed by LSTK CONTRACTOR and OWNER, when the test has been completed and the system drained, test blanks must be removed by LSTK CONTRACTOR.
- 3.19 The following activities by LSTK CONTRACTOR are included for the reinstatement of piping after hydro testing:
- LSTK CONTRACTOR installed temporary testing blinds to be pulled.
 - Temporary spool pieces taken out.

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- Gaskets renewed, temporary replaced with permanent.
- Flange connection bolts tightened.
- Post hydro punch list items corrected.
- Temporary strainers installed.
- Chemical cleaning performed.
- Supports and hangers checked if in final position.
- Rotating equipment cold alignment checked.
- Reinstallation of control and safety valves and in - line instruments which LSTK CONTRACTOR has removed for hydro-testing.

3.20 Nondestructive testing of welds and systems is to be performed in accordance with standards, codes and specifications prior to perform any hydro-test.

4.0 **PIPING MATERIAL IDENTIFICATION AND PAINTING**



4.1 All piping materials are supplied by LSTK CONTRACTOR and shall be properly stamped and color-coded to ensure that the correct materials are used as required by the drawings, specifications, codes and regulations.

4.2 All materials will be adequately marked as to its specifications. Should LSTK CONTRACTOR be required to cut same or otherwise render piece(s) to have no marking, LSTK CONTRACTOR'S transfer or replacement of proper identification marking to the pieces involved, must be done according to approved stamping method and to be counter stamped by LSTK CONTRACTOR. Paint alone is unacceptable.

4.3 The governing principle shall be that in the installed piping systems, all components can be identified and their origin and complete specifications can be determined. The method for identification and stamping or tagging of the various components of the system shall be worked out in coordination with OWNER and only be implemented after approval.

LSTK CONTRACTOR shall be held responsible for this requirement as a minimum, and any other requirements of local codes and regulations as to identification and documentation of materials.

4.4 Surface preparation and paint application of piping system by LSTK CONTRACTOR, shall be per paint specification.

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4.5 LSTK CONTRACTOR shall assure that no welds are covered by prime coats prior to acceptance of hydro test.

4.6 LSTK CONTRACTOR must ensure that all stamping such as code stamps, registration spool identification, charge numbers etc. shall be visible after paintwork.

5.0 **WELDING**

5.1 All welding shall be carried out according to codes and specifications.

5.2 Welder's qualification

5.2.1 All welders including those with valid qualifications will be required to submit a test conducted by OWNER prior to start of welding.

Welders that have a certificate which is still valid for the type of material and in accordance with ASME IX will not be tested by OWNER.

5.2.2 A current list of qualified welders must be maintained by LSTK CONTRACTOR and a copy furnished to OWNER each time a revision is made.

5.3 Welders' identification stamps shall be provided by LSTK CONTRACTOR. Each weld shall be clearly stamped with welders identification. All welding including tack welding shall be carried out by qualified welders. Unstamped welds shall be removed and replaced at LSTK CONTRACTOR'S expense.

5.4 Job SITE fabrication shall be carried out under cover where possible.

5.5 Weld spatter shall be knocked off around all welds leaving a smooth clean surface.



5.6 Where openings for branches are cut in run of pipe, all material, which may drop inside the pipe, shall be completely removed before the branch line is welded in place.

6.7 The interior welds of orifice flanges shall be ground smooth.

5.8 **Electrodes, Rods, Wires and Fluxes**

Electrodes shall be stored in the makers' airtight containers until required for use. Electrode heaters shall be used on Job SITE, for low hydrogen types of electrodes.

Electrodes and filler wires to be used at site in this job shall be procured from the approved vendors only. Electrodes and filter wires shall be **D&H, Advani Orlikon or ESAB, Mailam and Bohler group make only**

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5.9 Open Air Welding

Where welding in the open air is unavoidable, WORK must be discontinued where the quality of the weld may be impaired by weather conditions. Including but not limited to airborne moisture, sand or high winds. After rain the metal surfaces shall be dried. For metal temperature below 5 °C joints to be preheated.

5.10 Welding Procedure Qualification

LSTK CONTRACTOR shall supply welding procedure specifications and qualification in accordance with the rules as set by OWNER.

5.11 Fees for inspection required for welding procedure and welders qualifications, supply of equipment required for the qualification test of welders and welding procedures are for account of LSTK CONTRACTOR.

5.12 Inspection and Testing

5.12.1 Inspection of welds shall be in accordance with the instructions of OWNER and/or the requirements of codes and standards.

5.12.2 LSTK CONTRACTOR shall be responsible for the repair of faulty welds and for all the required extra radiography and inspection of the faulty welding work. In case of a faulty weld, 100% radiography, on LSTK CONTRACTOR'S account, shall be done on the weld performed as per code.

OWNER shall have absolute discretion in the selection of the welds, which are to be radiographed.

5.12.3 LSTK CONTRACTOR shall provide NDE service, acceptable to OWNER.



NDT inspection shall be carried out in accordance with codes for all lines as indicated in the piping specification.

6.0 STRESS RELIEVING

6.1 LSTK CONTRACTOR shall provide stress-relieving service acceptable to OWNER. Spool pieces shall be stress relieved in an approved furnace equipped with thermostatic control and temperature recorder. Field welds to be stress relieved with electric resistance heaters. Temperature cycles to be monitored with portable temperature recorder.

6.2 Stress relieved welds shall be hardness tested by approved procedure and must meet criteria spelled out in specifications.

7.0 TRANSPORTATION

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The following various categories of transportation of pipe, pipe fittings and prefabricated pipe spools will be performed by LSTK CONTRACTOR. All categories include loading and unloading materials. Categories will consist of but not limited to:

- From LSTK CONTRACTOR'S warehouse to LSTK CONTRACTOR'S pipe prefab shop.
- From LSTK CONTRACTOR'S pipe prefab shop to LSTK CONTRACTOR'S painting shop.
- From LSTK CONTRACTOR'S pipe prefab or painting shop to LSTK CONTRACTOR'S storage area or working area located on site or any other location on SITE.
- All transportation required performing nondestructive testing of prefabricated pipe spools.

8.0 LIFTING, LIFTING EQUIPMENT AND GEAR

8.1 Rigging and hoisting shall be executed as per construction specification and local requirements and safety rules, as manufacturer's instructions. If there are stringent one shall prevail.

8.2 Testing And Certification

All LSTK CONTRACTOR furnished cranes, lifting appliances and lifting gear must be properly tested, examined and/or inspected before being used on SITE, and at the intervals specified in the applicable regulations. Copies of the relevant certificates must always be available on SITE for inspection on request by OWNER or other authorities.

8.3 Operation

8.3.1 LSTK CONTRACTOR shall not permit a lifting appliance to be operated otherwise than by a person trained and competent to do so.

8.3.2 LSTK CONTRACTOR shall take express steps to ensure that all personnel employed by LSTK CONTRACTOR are competent and experienced for their assigned tasks.



9.0 DRAWINGS AND DOCUMENTS

LSTK CONTRACTOR shall fill in checklists as required by OWNER.

10.0 MISCELLANEOUS



10.1 LSTK CONTRACTOR shall furnish all field engineering surveying layout, and checking to properly install all above ground piping to meet all requirements of the drawings and specification. OWNER is authorized to reject any WORK already installed, which is not in accordance with drawing and specifications and of adequate quality.

10.2 All costs involved in demolition, removal and replacement of rejected works shall be the



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responsibility of LSTK CONTRACTOR. All materials equipment or auxiliaries not accepted by OWNER shall be removed immediately from SITE.

- 10.3 Underground service lines are marked at their installation limits to above ground piping, indicating line size, service and line number.
- 10.4 During storage, fabrication and erection, care must be taken to ensure that sand, scrap materials, welding rods, items of clothing and other foreign bodies are not allowed to enter piping.
- 10.5 All connections which are left open by LSTK CONTRACTOR shall be well protected, so that no sand, dirt or any foreign object come into the system.
- 10.6 In certain instances special bolting torques might be required on critical connections. LSTK CONTRACTOR will arrange WORK in accordance with these requirements.
- 10.7 Flanged piping connections to vessels or equipment shall be aligned and shall be properly fitted before bolting up. Piping may be heated to bring it into alignment only when approved by OWNER. Extreme care should be exercised to avoid damage. Heating, welding and flame cutting on equipment will not be permitted.
- 10.8 No cold springing or pre- stressing of piping will be allowed other than indicated on piping drawings, isometrics and manufacturer's instructions (e.g. for expansion joints).
- 10.9 Flange faces shall be clean and free from foreign matter before assembly. Damaged flange faces may be dressed with a medium cut file only if the damage does not require new facing. This shall be decided by OWNER.
- 10.10 During erection care shall be taken to remove all dirt, seals, sand and foreign matters from inside the pipe.
- 10.11 Since LSTK CONTRACTOR is responsible for both the prefabrication and the erection of all the piping, it is LSTK CONTRACTOR'S sole responsibility to ensure that all piping to be installed fits properly prior to lifting. LSTK CONTRACTOR is to check all equipment and underground piping to be piped to, for proper location and orientation. OWNER will not entertain any claims for extra work for :
- i. Taking piping down for rework after it is lifted
 - ii. Re-lifting piping after it is reworked.
- 10.12 Final hookup of piping to equipment such as pumps and compressors shall be done together with the final alignment of this equipment and shall include checking of dimensions. Piping must fill these flanges without inducing any strain on equipment.

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- 10.13 In all cases, all designated support and hangers should be in unlocked / cold position before final alignment. LSTK CONTRACTOR will be expected to expedite this critical phase of construction.
- 10.14 Certain small vessels will be considered to be piping items and shall be fabricated as such by LSTK CONTRACTOR.

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EQUIPMENT ERECTION

1.0 SURVEYING

- 1.1 Baseline and base elevation will be furnished to the LSTK CONTRACTOR. LSTK CONTRACTOR will furnish all surveying from this baseline and elevation.
- 1.2 OWNER shall have the authority at any time to determine in accordance with the drawings or written directives, the correctness or completeness of the lines in use by LSTK CONTRACTOR.
- 1.3 Any erroneous WORK shall be corrected to OWNER'S satisfaction at LSTK CONTRACTOR'S expense.

2.0 RIGGING STUDIES AND PLANS

- 2.1 LSTK CONTRACTOR shall supply rigging studies and plans as specified.

3.0 EQUIPMENT HANDLING

- 3.1 The handling of all equipment shall include, but not limited to the following activities by LSTK CONTRACTOR:
- 3.1.1 Submittal to OWNER of detailed rigging studies and plans for lifting, transporting and setting of equipment 4 weeks in advance of work for OWNER to review and approval. Complicated lifts shall be started in the morning and completed the same day.

The transportation plans are to include as a minimum:

Type of equipment to be used to transport each piece.



The planned route of the movement.

The estimated duration of the movement.

The obstructions to the route to be temporarily removed.

- 3.1.2 Receive, inspect, store, protect and perform preventative maintenance on all equipment in accordance with the specifications and drawings and/or equipment manufacturer's instructions.

- 3.1.3 Prepare foundations, pipe sleeves, paving, concrete structures and steel structures for



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setting equipment.

- 3.1.4 Transport form warehouse or point of unloading and install equipment on foundations, paving or structures.
- 3.1.5 Plumb level and align equipment with coordinates in accordance with the specifications and drawings.
- 3.1.5.1 **GENERAL**

All of the equipment must be plumbed, leveled and aligned with the coordinates specified on the drawings both in plan and elevation and to the tolerances called out in the specifications, specific manufacturer's instructions or recommended manufacture's practices.

- LSTK CONTRACTOR will be required to verify field conditions and will be responsible for final alignment of mechanical items for this project. LSTK CONTRACTOR will check the anchor bolt locations against the equipment. Any deviation must be reported to OWNER in writing.
 - LSTK CONTRACTOR will be required to supply and install shims required for all equipment erection. All cinch anchors required for equipment and supports will be supplied and erected by LSTK CONTRACTOR.
- Prior to the placement of the equipment on a foundation, the surfaces of the foundation shall be cleaned of oil, grease, excess concrete and foreign matters by LSTK CONTRACTOR.
- Prior to setting the equipment on the foundations, the underside of the equipment base plate or supports will be cleaned free of oil, grease and other loose materials by LSTK CONTRACTOR.
 - Anchor bolts shall be checked for damage to the thread and the threaded part shall be properly greased.
 - Damaged anchor bolts must be replaced by LSTK CONTRACTOR and brought to the attention of OWNER.
 - The openings between the anchor bolts and sleeves have to be cleaned of foreign materials to full depth of the opening by LSTK CONTRACTOR.
 - All steel wear plates and guide keys shall be coated by CONTRACT with proper lubrication, prior to setting the equipment.
 - Equipment shall be set true to line. at correct elevation and in proper orientation as shown



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and noted on the drawings.

- Maximum allowable setting tolerances shall be in accordance with manufacturer's requirements or with the specifications, whichever is more stringent.
- All equipment, unless otherwise specified, shall be leveled with shims at each anchor bolt (shim on both sides of each anchor bolt) and at intermediate points as required to prevent distortion of the equipment. Shims shall have square cut edges (not trimmed or sheared) and shall be of various thicknesses to minimize the number of shims required. Shims shall be supplied by LSTK CONTRACTOR.
- The equipment shall be set, leveled, aligned and inspected with precision tools (steel straight edge, graduated machinist levels, dial indicators, theodolites, water level instruments, turbine levels, etc.). Setting, leveling and alignment shall be according to manufacturer's recommended tolerances and specifications.
- There may be a number of items not installed by the manufacturer, i.e. seals, packing, lubricators, gauges, miscellaneous piping and tubing, thermometers, etc. that will come separately packed from the equipment itself that must be identified, stored, preferably inside in accordance with project criteria, and finally installed. LSTK CONTRACTOR is responsible for these activities.
- LSTK CONTRACTOR shall remove all temporary shipping supports or erection materials.
- LSTK CONTRACTOR shall do surface preparation for, and apply coating and wrapping on buried vessels before installation.

Equipment supported on legs or on saddles shall be set to the tolerances specified in specifications of the required elevation measured on the flange of the largest diameter pipe-connecting nozzle.

- For equipment with sliding type supports, LSTK CONTRACTOR will remove dirt, grease or other foreign matter and will coat with graphite grease supplied by LSTK CONTRACTOR on the support.
- The anchor bolt nuts will be placed so as not to restrict the longitudinal movement of the sliding end.
- Vessels, drums, etc. shall be aligned, where applicable and leveled per shown or drawing.
- Shims shall be placed approximately evenly spaced under the support ring of vessels, drums, tanks.
- Towers with two or more pieces shall be assembled and welded at site by LSTK CONTRACTOR.

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- LSTK CONTRACTOR is responsible to check and inspect at these equipments in the vendor's shop.
- All costs are included in the lump sum price.

3.1.5.2 Rotating Equipment

- Rotating equipment will be installed in accordance with manufacturer's instructions.

Align drivers with all rotating equipment.

- LSTK CONTRACTOR shall install all ancillary equipment such as, but not limited to, drivers, guards, harness piping and all other interconnecting piping, casing drains, base plate drains and all necessary supports.
- The measurements for the positioning and leveling of mechanical equipment will be made on the suction flange.
- LSTK CONTRACTOR to install permanent packing, seals lubricating oils, greases and circulated oil systems.
- Services of manufacturer's technical representative by LSTK CONTRACTOR shall be used to the fullest extent.
- Rotating equipment base plates will be supported for positioning and leveling on shims located as follows.
- For bases with four (4) anchor bolts. one set of shims will be placed adjacent to each anchor bolt.
- For bases with six (6) or more anchor bolts, two (2) sets of shims will be placed adjacent to each anchor bolt, one on each side of the anchor bolt.
- In addition shims shall also be placed directly under those parts of the base plate carrying the greatest weight and shall be placed closely enough to give uniform support.
- When the base plate is level in all directions as indicated by an accurate instrument on the machined pads, the anchor bolt nuts shall be brought down evenly, but not too firmly. The unit is now ready for grouting. After the grout has adequately set, pull the anchor bolt nuts down tight and recheck the base for levelness.
- Release for grouting of base plates must be approved by OWNER.
- After completion of the electric installation to the motor, the direction of rotation of the

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motor will be determined. Prior to checking the direction of rotation, the coupling between the motor and the equipment will be disconnected for the test run of motor by LSTK CONTRACTOR.

- Rough aligning of the centrifugal units and their respective drivers shall take place after the equipment has been put on the foundation.
- Coupling alignment
- Dial indicators shall be used and where possible optical alignment equipment.

Peripheral alignment shall be checked by using one dial reading peripheral differences between coupling halves as they are rotated together.

Face alignment shall be checked using two dials reading face-to-face differences between coupling halves.

- Tolerances shall be in accordance with manufacturer's instructions with and without pipe work connected.
- Manufacturer's representative shall check that the final alignment of equipment is satisfactory before any running takes place. For small equipment. Where it is agreed by OWNER that the services of a manufacturer's representative are not required, manufacturer's written instructions shall be followed.
- The final checks will be supervised by LSTK CONTRACTOR and the results recorded by LSTK CONTRACTOR and signed by OWNER and LSTK CONTRACTOR.



Final alignment shall be carried out in two stages.

- After piping is complete with all bolts removed from the flange connections.
- Final alignment with piping assemblies 100% complete and all flanges bolted up to ensure that no unforeseen vertical or horizontal pipe loading is imposed on the unit.
- The final aligning supervised by OWNER to make sure that the detailed instructions furnished by the equipment suppliers are carried out to the full satisfaction.



LSTK CONTRACTOR to supply qualified personnel in the final alignment activities.

- Prior to putting pumps, etc. into operation, loose equipment such as guards and gauges shall be installed by LSTK CONTRACTOR.



3.1.6 Mount the drivers to the rotating equipment in case of turbines and any large motors that are shipped separately.

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- 3.1.6.1 In case electric motors have to be installed in the field, this shall be done after leveling of base plate, but prior to grouting.
Chrome / nickel shim martial, supplied by LSTK CONTRACTOR shall be used for alignment of drivers and pumps and shall be installed under the entire footing of the driver.
- 3.1.6.2 Equipment and drivers shall be doweled to bed plate if required by manufacturer's instructions.
- 3.1.7 Assembly whenever required for the items / package unit like Auxiliary Boilers, Waste Heat Boilers, Air - cooled exchangers, furnaces , compressors ,Turbo generators etc. units as part of the scope of WORK of installation by LSTK CONTRACTOR.
- 3.1.7.1 Compressor seal oil and lube oil systems and control panels are included in LSTK CONTRACTOR'S installation of compressors.
- 3.1.7.2 When equipment is delivered in two or more sections for site welding the weld preparation must match accurately on mating sections before assembling.
- 3.1.7.3 LSTK CONTRACTOR shall assemble and erect items, whether skid mounted or supplied in individual components as specified in the requisition or indicated on drawings in order to make a completed unit.
- 3.1.7.4 Installation, assembly and alignment of the various components shall be done by LSTK CONTRACTOR.
- 3.1.7.5 Installation of air - cooled exchangers includes the erection of structural steel on the pipe rack, which will support the tube bundles must be done by LSTK CONTRACTOR.
- 3.1.7.6 Walkways, platforms, stairs, ladders shall be installed for the items / package unit like Auxiliary Boilers, Waste Heat Boilers, Air - cooled exchangers, furnaces, compressors, Turbo generators etc. by LSTK CONTRACTOR.
- 3.1.7.7 Drying out systems, refractory and linings is included in LSTK CONTRACTOR scope of work.
- 3.1.8 Install ladders, platforms, davits, pipe supports and pipe guides in accordance with drawings and specifications.
- 3.1.9 Open man ways. Inspect. clean and close man ways of all tanks, towers. vessels and other equipment as directed by specification or manufacturer.
- 3.1.10 Install all trays and vessel internals and support for same shipped loose. in accordance with drawings, specifications and manufacturer's recommended installation instruction.

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- 3.1.11 Under the supervision of OWNER and respective manufacturer's representative LSTK CONTRACTOR shall load the first loading of chemicals.
- a) There will be certain items of equipment such as filters and package equipment that come with cartridges filled with -desiccants, resins, etc. Their items will be installed by LSTK CONTRACTOR if they are shipped separately from the equipment.
 - b) Installations include the pick-up of these chemicals from the place of storage and transportation to point of installation.
- 3.1.12 Under the supervision of OWNER, LSTK CONTRACTOR install the first loading of catalysts. Installations include the pick-up of these catalysts from the place of storage and transportation to point of installation.
- 3.1.13 Touch - up of painting on new equipment after erection.
- 3.2 LSTK CONTRACTOR shall install grout under all equipment as required.
- 3.3 Grouting will be as per the specification per the equipment manufacturer's recommendation, whichever is more stringent.
- 3.4 The following work is included but not limited to LSTK CONTRACTOR'S scope for installation of grouting:
- 3.4.1 Prepare top surface of base and/or plinth, pockets, sleeves etc., prior to placing grout.
 - 3.4.2 Install grout mortar consisting of one part Portland cement and one part of clean sand and sufficient clean water for workability.
- This grout mortar shall be used between steel base plate and concrete foundations.
- 3.4.3 Wherever non-shrinkage grout is specified on the drawings, the same shall be supplied by LSTK CONTRACTOR and installed in accordance with manufacturer's instructing.
- 3.5 Install non-shrink grout between reciprocating / rotary equipment base frame including the filling of the equipment steel frame if required, and concrete foundation in accordance with manufacturer specifications and project specifications. Type of non-shrink grout to be approved by OWNER. After grouting, shims used in leveling equipment will not be removed except where removal is specifically required by manufacturer's instructions.
- 3.6 Unless indicated otherwise on drawings vessels supported on skirts and support rings will be grouted using a stiff mix under the support ring so as to obtain full bearing, Grout will be placed within the area of the skirt the high point of ground at the vertical axis of the tower (or

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vessel), sloping downward to the support ring with four (4) weep holes under the support ring sufficiently large to ensure drainage.



4.0 MATERIAL HANDLING SYSTEM

4.1 ERECTION & COMMISSIONING

- 4.1.1 The complete material handling system including its all equipment shall erected at site and commissioned in accordance with the best engineering practice.
- 4.1.2 Packing, forwarding, transportation, unloading and storage at site, safety and protection of various components at site, insurance etc. shall be the responsibility of the LSTK Contractor / supplier.
- 4.1.3 All men, material and tools required shall be arranged by the LSTK Contractor at his own cost. The LSTK Contractor shall also arrange for the safe handling, storage, protection and security of his good at site.
- 4.1.4 The purchaser shall be responsible for supplying his part of material only as covered by the clause pertaining to the work to be excluded from LSTK Contractor's scope of supply.
- 4.1.5 After erection at site, the belt conveyors and related equipment shall be tested for satisfactory operation for mechanical completion and full-load performance run. The LSTK Contractor shall carry out performance test as per mutually agreed procedure. The details of the procedure shall be submitted by the LSTK Contractor for purchaser's approval.

4.2 MECHANICAL COMPLETION

- 4.2.1 Mechanical completion shall be considered as achieved when the system is mechanically complete along with the pre-commissioning activities and is ready for feeding. This shall include but not limited to the following :
1. The installation as per FINAL PROPOSAL is complete in all respects in accordance with the drawings, specifications including any approved changes thereto and in accordance with all applicable codes and laws.
 2. The machinery, conveyors and all drives are aligned and run or cycled under no-load conditions.
 3. The electrical system is installed and tested in accordance with applicable codes and specifications. All wiring is checked for correct hook-up. Motor rotation is checked and power system protective devices are set.
 4. Painting is completed to the extent that the incomplete work does not prevent plant start-up and commissioning.

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5. Successful completion of no-load test of all the equipment and the complete system.
6. Temporary construction facilities are removed to the extent necessary to permit the plant start-up and commissioning.

4.2.2 The OWNER shall inspect and certify that the LSTK Contractor executed the job in accordance with drawings and specifications.

4.2.3 When the complete belt conveyors and related equipment have been fully erected at site, LSTK CONTRACTOR shall request OWNER for his agreement to start the No-load Test Run. Owner shall, within 72 hours of receipt of such request, issue his agreement or advise LSTK Contractor in writing of any deficiencies noticed in the equipment.

4.2.4 Omissions / rectifications of minor items, if any, not affecting commissioning shall not withhold MECHANICAL COMPLETION as long as the LSTK Contractor agrees to supply / rectify the same within the specified period. The decision of the OWNER is final in this regard.

4.3 COMMISSIONING AND GUARANTEE TEST

4.3.1 After issue of Mechanical completion certificates by Owner, LSTK CONTRACTOR & OWNER shall mutually decide the date of commissioning of the equipment. From the date of commissioning, the equipment shall be gradually brought up to full load or any other load at the discretion of OWNER, and thereafter the equipment shall be run for a minimum period of 5 days. OWNER shall have the right to reduce this period where deemed necessary because of OWNER's difficulties. During this period of 5 days of operation or the reduced period, the system shall run at an average of 90% of rated capacity. If the LSTK CONTRACTOR is not able to bring the load to 90% of the rated capacity as mentioned above within 2 (two) months, OWNER shall, without prejudice to any of his rights under the contract, has the right to take over the equipment and to proceed with modifications / rectifications / additions as he considers necessary at LSTK CONTRACTOR's cost and risk to achieve this sustained load run.



5.0 PREPARE EQUIPMENT FOR OPERATION

5.1 Immediately prior to turnover, LSTK CONTRACTOR will make all the equipment ready for operation. This includes, but is not limited to such activities as:

5.1.1 Removal of preservatives and rust preventatives.

5.1.2 Installation of seals or removal of steel covers.

5.1.3 Removal of moisture absorbing materials.

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- 5.1.4 Draining of oil reservoirs and the flushing and filling of the initial charge.
- 5.1.5 If required by OWNER for the final inspection the opening and closing of man ways of vessels and tanks.
- 5.1.6 Assisting equipment manufacturer's representatives by final checkout of equipment.
- 5.1.7 Remove all temporary supports, bracing, or other foreign objects that were installed in vessels rotating equipment or other equipment to prevent damage during shipping, storage, transport and erection.
- 5.1.8 Conduct all flushing, blowing and chemical cleaning required by the specifications.
- 5.1.9 Check and run in all rotating equipment, i.e. compressors, pumps.
- 6.0 Scaffolding Sufficient amount of scaffolding required for good performance of the WORK shall be supplied by LSTK CONTRACTOR.

7.0 DRAWINGS AND DOCUMENTS

- 7.1 LSTK CONTRACTOR will carry out all construction and any required procurement activities directly from the AFC construction drawings and specifications and forming part of the CONTRACT. No additional design work or development e.g. completion of drawings will be required from LSTK CONTRACTOR.**

However, the plan type drawings called out to be supplied by LSTK CONTRACTOR in previous subsections of this section are included in LSTK CONTRACTOR'S scope of WORK.

- 7.2 All of LSTK CONTRACTOR'S drawings, calculations, documents, test reports, and test certificates are to be submitted to OWNER for approval in 6-fold. After receiving approval LSTK CONTRACTOR to submit for final approval all of the above and one (1) soft copy in CF format. LSTK CONTRACTOR drawings receiving "Approved as Noted" stamp may be worked on provided all notes are incorporated. It is understood that OWNER'S approval shall not receive in no way LSTK CONTRACTOR from any of his obligations and further more shall not relieve LSTK CONTRACTOR from his obligations to timely complete the WORK according to approved project schedule by OWNER.
- 7.3 LSTK CONTRACTOR'S drawings shall be clearly marked with titles, equipment numbers or other item identification.
- 7.4 Approval of drawings and calculations by OWNER in no way absolves LSTK CONTRACTOR from its responsibility for the accuracy or for the design, construction and timely performance of the WORK.
- 7.5 LSTK CONTRACTOR shall promptly submit reports of each and every. test or inspection.
- 7.6 LSTK CONTRACTOR shall submit quality records of the materials, as specified in previous sections and the applicable engineering specifications.

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7.7 LSTK CONTRACTOR shall furnish an equipment installation record indicating date of installation and tag number of each piece of equipment.

7.8 LSTK CONTRACTOR shall furnish an equipment maintenance record indicating date and type or maintenance of each piece of equipment during the LSTK CONTRACTOR period.

7.9 LSTK CONTRACTOR shall fill out checklists as required by OWNER.

8.0 **LIFTING, LIFTING EQUIPMENT AND GEAR**

8.1 Rigging and hoisting shall be executed in accordance with construction specification local and governmental requirements and safety manuals, as well as specific equipment manufacturer's instructions. If there are conflicts, the more stringent shall prevail.

8.2 LSTK CONTRACTOR shall only perform the lifts and movements in accordance with approved LSTK CONTRACTOR submitted rigging studies and plans.

8.3 Preferably, equipment will be lifted in accordance with manufacturer's instructions, if include, using lifting trunnions, lifting lugs if provided, or by slings attached to or around the equipment, with adequate protective measures to prevent damage to equipment. No temporary lifting lugs shall be used without the written approval of OWNER.

8.4 No nozzles or other appurtenances not intended for lifting shall be used for attachment of slings.

8.5 Equipment shall be handled with sufficient care to prevent damage. Slings shall have adequate protection to prevent marring the surface of equipment. Where necessary, sling spreaders shall be used to prevent crushing or other damage to the equipment.

8.6 **Testing And Certification**

All LSTK CONTRACTOR furnished cranes, lifting appliances and lifting gear must be properly tested, examined and /or inspected before being used on site and at the intervals specified in the applicable regulations. Copies of the relevant certificates must always be available on site for inspection on request by OWNER or proper authorities.

8.7 **Operation**

8.7.1 LSTK CONTRACTOR shall not permit a lifting appliance to be operated otherwise than by a person trained and competent to do so.



8.7.2 LSTK CONTRACTOR shall take express steps to ensure that all personnel employed by LSTK CONTRACTOR are competent and experienced for their assigned tasks.

9.0 **WELDING**



Welding of or on equipment shall only be permitted with the approval or OWNER.

10.0 **EQUIPMENT PAINTING & INSULATION TOUCH**

Rotating and special equipment to be erected by LSTK CONTRACTOR will be delivered to

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SITE finished painted. LSTK CONTRACTOR is responsible to apply remedial / touch up painting for any damages to paint, or protective coatings on equipment handled by it in connection. With any aspect of this operations such as unloading. transport, handling and erection as per Annexure mention in ITB Section.

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ANNEXURE- 7 - 2E

ELECTRICAL WORK

1.0 **SCOPE : ELECTRICAL WORK COVERS**

- 1.1 Installation and erection of the following equipment (items) consists of the preparation for installation, connection, testing and pre-commissioning etc. as per specifications and as per drawings.
- 1.2 Provision of all tools, equipment and consumables used in the course of the work.
- 1.3 The installation of the following systems (items) shall consist of the connection, testing and pre-commissioning etc., so that the systems are ready for use as per specifications and as per drawings.
- 1.4 Transport, store and protect supplied materials to the construction location.

2.0 **ELECTRICAL ITEMS**

- 2.1 Generators / Motors
- 2.2 Control panels
- 2.3 Transformer

Note : Installation of all accessories, tanks, levelling and fixing in place are also considered.

2.4 **Switch Gears**

Note : Bolting together sections where supplied separately and installation of panels, levelling and fixing in place are also considered.



2.5 **Bus Ducting**

Note : Jointing and securing the associated switch boards / transformers are also considered.

- 2.6 Battery charger, battery sets and UPS unit.

- 2.7 Cables in trench / conduit / tray / Rack.

Note : Following items are also necessary .



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- a) Measuring and cutting of cable and protection of cut ends.
- b) Identification of cables
- c) Fixing of cable to tray / rack

- 2.8 Cable Glands
- 2.9 Cable terminations
- 2.10 Earthing cable in trench / conduit / tape on tray / Rack
- 2.11 Earth cable tape terminations
- 2.12 Lightening protection
- 2.13 Lighting/ fittings / supports
- 2.14 Earth Rod PRT and cover
- 2.15 Cable tiles
- 2.16 Trench marker posts
- 2.17 Air craft warning
- 2.18 Underground electrical grounding system

Note : All bellow items are also considered :

- a) Pulling of grounding cable in trenches, through culverts, protection sleeves and cable ducts as per grounding cable supplier installation instruction, project specifications and layout and detail drawings.
- b) Coil up and clearly designate the final destination of the cable ends, especially if cables have to be continued their routing underground or overhead via cable tray or otherwise to their final destination at a later date.
- c) Install, including the provision of the required tools, the required through branch and end connections.
- d) Installation of all grounding electrodes including inspection pits as per specification and the layout and detail drawings.
- e) Return of the cable drums to the storage area including a clear make up of cable lengthleft on the reels of drums that are not empty.

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- f) Measure cable resistance for grounding continuity and grounding resistance of ground rods, record data and submit the rest result reports to OWNER prior to commissioning of the installation.
- g) Check cables are in proper trenches and ground rods at their location.
- h) Perform all test; witnessed by OWNER'S REPRESENTATIVES of the founding installation including the provision of all OWNER approved testing equipment and measuring devices.

2.19 Miscellaneous Electrical equipment

2.20 Earth resistance testing including earth resistance rods for grounding, continuity of grounding, installation resistance testing for electrical cables and HL-POT testing for electrical cables.

3.0 TESTING AND COMMISSIONING

Testing and commissioning consist of the complete testing prior to commissioning, including provision of required testing apparatus and testing documents as requested and as specified in the testing specifications.

- All test results shall be recorded on the test form and submitted to OWNER. Each test record shall include. date of test, ambient temperature, climatic conditions, instruments used with serial numbers, names of test personnel and witnesses, identifications of equipment, ground electrode or circuit tested.
- Testing shall be scheduled at least 24 hours in advance and OWNER is to be notified by LSTK CONTRACTOR. LSTK CONTRACTOR will notify all necessary interested parties including manufacturer's representatives.



High potential tests shall not be repeated without authorization by OWNER.

4.0 DRAWINGS AND DOCUMENTS

4.1 LSTK CONTRACTOR will carry out all construction and any required erection activities directly from the AFC construction drawings and specifications.

4.2 LSTK CONTRACTOR shall promptly submit reports of each and every test or inspection.

4.3 For more details LSTK CONTRACTOR shall follow **Electrical design philosophy elsewhere mentioned in ITB.**

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ANNEXURE- 7 – 2F



INSTRUMENTATION WORK

1.0 GENERAL

- 1.1 Instrumentation symbols and identification of functions shall be based on the current edition of ISA S5.1.
- 1.2 Specifications for instruments and items of control equipment are shown on data sheets to be issued as they become available.
- 1.3 All materials and connections for control valves, relief valves, level controllers and similar equipment shall comply with applicable requirements for valves and fittings as noted in the piping specification.
- 1.4 LSTK CONTRACTOR shall install all shim plates, fixing material such as but not limited to anchors, red heads, etc.
- 1.5 LSTK CONTRACTOR shall install all instrument equipment tag plates.

2.0 FIELD INSTRUMENT INSPECTION AND CALIBRATION AND INSTALLATION

- 2.1.1 This item covers all activities and supply of all materials to import calibration of instruments. It includes, but is not limited to, the following:
- 2.1.1 Provision of all tools, equipment and consumables used in the course of the work.
- Calibration of instruments and provision of all necessary test equipment gauges, materials and ancillary items. All necessary testing instruments to be used must be certified by Govt. recognized testing laboratories.
 - Check orifice plates and control valves.
 - Protection of instruments to maintain cleanliness at all times.
 - Mark instrument to indicate status of calibration.
 - Return instruments, after calibration and checking to lay-down areas and / or stores including all packaging.
 - Pressure and leak test including the provision of all necessary test equipment gauges materials and ancillary items.

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Note : The calibration of all instruments within the packages is also the responsibility of LSTK Contractor.

2.1.2 LSTK CONTRACTOR shall install all instruments as listed in the instrument index and further per the relevant installation specifications, documents and drawings.

2.1.3 Field instrument installation includes, but is not limited to:



Mounting of instruments and related equipment, supports protection boxes, manifolds, junction boxes, nameplates, etc.

Installation of measuring elements (probes, sensors, detectors, etc) including their auxiliaries as required (thermo wells, supports, valves, etc.) unless done by others

Installation of on-line instruments (by piping)

The following is a typical list of on-line instruments:

- Safety blow down valves.
- Control valves (all types)
- Motor - operated valves.
- Safety shut - down valves (including solenoid valves).
- Safety / relief valves.
- Pressure / vacuum relief valves.
- Self - regulating valves.
- Level gauges.
- Level displacer chambers.
- Orifice assemblies.
- Orifice plates.
- Venturies.
- Turbine meters, annubars, magnetic flow meter.
- Positive displacement meters.



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- Variable area meters (rotameters)
- Stilling Wells.
- Thermo wells and etc.
- Installation of process connections, impulse lines and capillaries.
- Installation of purge and flushing supply tubing, filter blocks and rotameters.
- Installation of air supply lines.
- Supply and installation of instrument nameplates for field instruments.

2.2 Cable, Supports and Fixing Wire pins, Conduit



LSTK CONTRACTOR shall use for cable installation for indoor and outdoor use the materials such as tubing, cable trays, etc. as called in the specifications.

- 2.2.1 Cable tray, ladder rack and tubing systems shall be installed to ensure electrical continuity throughout the run and such that water cannot collect or remain in any part of the system.
- 2.2.2 Pulling of the cables into the trenches, through culverts, protection sleeves and cable ducts as per cable supplier installation instructions and layout drawings, cable lists, trench sections and reel schedules.
- 2.2.3 Installation of the cable separation tiles, if specified.
- 2.2.4 Coil up and clearly designate the final destination of the cable ends, especially if cables have to be continued their routing underground or overhead via cable tray or otherwise to their final destination at a later date.
- 2.2.5 Installation of the sealing shrouds to avoid water ingress after cable cutting.
- 2.2.6 Installation of the cable markers stamped with cable number by LSTK CONTRACTOR as per cable list.
- 2.2.7 Installation of cable splicing if required.
- 2.2.8 Return of the cable drums to the storage area including clear markup of the cable length left on the reels of cable drums that are not empty.
- 2.2.9 Check if cables are spaced as specified.
- 2.2.10 Measure cable resistance and cable insulation, record data and submit the test result reports

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prior to commissioning of installation.

- 2.2.11 Check whether all cables are installed in the proper trenches.
- 2.2.12 Perform all tests, witnessed by OWNER of the underground cable installation including the provision of the OWNER'S approved testing equipment and measuring devices.
- 2.2.13 Record of actual installed cable lengths and location of cable splices.
- 2.2.14 Where cables required to be installed through or across the edges of tray or other metal work the edge of the lips shall be smoothed. painted and lined with a protective sleeving to avoid cable damage.
- 2.2.15 Supporting steelwork shall be fabricated and installed by LSTK CONTRACTOR. The material shall be primed in accordance with the painting specification by LSTK CONTRACTOR.
- 2.2.16 Storage and handling of cable before and during installation shall be carried out with due regard to manufacturer's recommendations. Cable drums shall be rotated only in the direction indicated by drum markings, and open ends of cables are to be effectively sealed immediately after cutting to prevent the ingress of moisture.
- 2.2.17 At all times, the utmost care shall be exercised to avoid damaging the protective sheathing to cable or of causing excessive bending or twisting which may result in damage to core insulation, sheaths armor and so on.
- 2.2.18 The bending radius of a cable either during or after installation shall not be less than manufacturer's recommended minimum.
- 2.2.19 Cables shall be run in continuous unbroken lengths and joints shall not be permitted unless specifically called for in the cable drum-cutting schedule.
- 2.2.20 Cables installed above ground shall be routed to avoid high-risk areas, e.g. high fire risk areas, and those areas where accidental leakage or spillage may occur and cause damage to cables and supports.
- 2.2.21 During installation, the ends of cables shall temporarily be protected using compound, tape, heat shrink seals or similar approved methods to avoid damage or entry or moisture until they are permanently terminated.
- 2.2.22 Pre-cast concrete members should not be drilled for any reason. Fixing shall always be by means of clamping brackets in the most efficient way and in consultation with OWNER.
- 2.2.23 Under no circumstances shall welding be carried out to any process plant equipment, vessels, pipelines, or structures or to any protected surface unless specifically indicated on the drawings and documentation and then in strict accordance with a procedure subject to

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Approval of OWNER.

2.2.24 Fixings to the above shall normally be made where brackets and so on, have already been provided or when agreed by the use of purpose built clamps.

2.2.25 On trays horizontal cable runs shall be fastened every 1200 mm, vertical cable runs every 600 mm.

2.2.26 **Grouping**

The cables employed to convey electricity shall be grouped according to the signal kinds. The main group kinds are but not limited to the followings

- a) Intrinsically safe signals.
- b) Signal cables not intrinsically safe.
- c) Instruments power supply cables.
- d) Coaxial cables or telephone cables used as serial data buses.

2.2.27 All cable trays, ladders, tubing and supports and fixing material for indoor and outdoor use shall be installed by LSTK CONTRACTOR.

2.2.28 All cables shall always be installed and connected in such a way that no forces can act on terminals. Further, all instrument and power supply cables inside and outside buildings shall be installed in accordance with both cable lists and drawings by LSTK CONTRACTOR.

Carbon steel coated cable stub ups shall be installed by LSTK CONTRACTOR for all cables from sand trenches to 500 mm above ground, in accordance with electrical connection detail drawings.



2.2.29 **Conduit system**

Single pair cables shall be used to connect field mounted instruments to local junction boxes. Single cables shall be armoured type laid in galvanized carbon steel / aluminium pipes with open ends or on closed cable trays. In order not to damage the cable, a plastic annular cap shall cover the pipe end.

Multipair cables shall be used to connect above said local junction boxes to the control room. Multipair cables shall be armoured type and shall run over head in closed cable trays / ladders supported on the pipe racks.

2.2.30 **Wire Pins**

All stranded cable conductors shall be fitted with crimped taper pins, amp (or equivalent) and all screens with lugs. Installation of all amp wire pins and screen lugs by LSTK CONTRACTOR.

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Further, in general, all standby conductors shall be wired to terminals.

2.2.31 **Cable Marking**

All instrument cables, conductors and the instrument screen/earth wires shall be tagged on both sides in accordance with the instrument connection list for local and central control room signals by LSTK CONTRACTOR.

2.2.32 **Cable Entry Sealing**

- **General**

After installation of all cables and on direction of OWNER, LSTK CONTRACTOR shall seal off all cable entries and passages.

- **Outside walls**

All cable entries in outside walls and below grade level shall be watertight sealed. Method of sealing shall be supplied by LSTK CONTRACTOR.

- **Separation walls**

All cable entries in separation walls of buildings shall be sealed with a fire resistant sealing as described hereafter.

- **Control Room Floors**

All cable and cabinet entries in floors shall be sealed with polyurethane foam.

- **Fire - resistant sealing**

All fire resistant sealing shall be class H-30.



Small openings in walls shall be sealed with CSD –F (or equal) in luminescent foam.

Large openings in walls and between computer floor and cable basement shall be sealed by inserting CSD-F (or equal) in luminescent plates under between and above the cables. The remaining openings shall be sealed with CSD-F (or equal) in luminescent foam.

2.3 **Alarm Systems**

2.3.1 LSTK CONTRACTOR shall install the fire alarm including sensors, cabling, local panels, mimic panels and host system. In accordance with:

- Project engineering specification and codes and standards.

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- Cabling between panel and detectors, alarms, switches etc. as described above.
- Installation of all junction / terminal boxes, cable terminations and connections, supporting brackets for cabling as described above.

2.3.2 All work related to the fire and gas system, including overall test / loop check as per specifications and drawings, among which the installation, placing and connection of all cables of the fire and gas panel located in the control building and panel in the firehouse shall be done by LSTK CONTRACTOR.

2.4 **Analyzers Installation**

LSTK CONTRACTOR shall install all analyzers and sampling conditioning systems in the analyzer house as well as in the field consisting of, but not limited to:

- Installation of all vents and drains from analyzers.
- Installation of calibration gas bottles as well as regulators and connecting tubing, as required.

3.0 **LOCAL PANELS**

LSTK CONTRACTOR shall install local panels, consisting of, but not limited to:

- a) Mounting, aligning and fixing to the foundation or steelwork. Uncoil, install and terminate underground cable ends. Install and terminate all aboveground cable to / from panels.
- b) Install and connect air supply and air signal piping and tubing to 'from panels.
- c) Install cabling and connect alarm horns.
- d) Identification / tagging of all equipment, terminals, cables and tubing which is not installed by panel vendor. Tag plates to be installed by LSTK CONTRACTOR.
- e) Installation of brackets / supports for cable, etc. and installation material as required to complete the installation.



4.0 **TERMINATION OF CONTROL CABLES FROM THE LV SWITCH ROOM**

The control cables running from the switch room shall be installed and connected in the marshaling cabinet by LSTK CONTRACTOR.

5.0 **CONTROL BUILDING INSTRUMENT INSTALLATION**

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5.1 LSTK CONTRACTOR shall install all control building instrumentation in accordance with the relevant installation specifications and drawings.

6.0 **CABINETS AND CONSOLES**

6.1.1 LSTK CONTRACTOR shall install align and anchor all equipment cabinets and consoles in accordance with design drawings and seller's installation instructions.

6.1.2 The false floor shall be completely installed by LSTK CONTRACTOR.

All panels, cabinets, tables, boxes, computers etc. located on the instrument equipment layout shall be place and installed by LSTK CONTRACTOR.

6.1.3 Where cable passage is required according to installation drawings, LSTK CONTRACTOR to indicate locations of holes and passages.

6.1.4 FCS/ESD/PLC cabinets and data base unit:

These groups / cabinets shall be installed in place and bolted together by LSTK CONTRACTOR.

Internal wiring / cabling and / or connections between these groups of cabinets shall be done by LSTK CONTRACTOR in accordance with the instructions of the system vendor's representative.

6.1.5 **FCS Consoles**

The consoles shall be installed in place and bolted together by LSTK CONTRACTOR, including installation of special table with peripherals.

Internal wiring and cabling and/or connections between consoles shall be done by LSTK CONTRACTOR in accordance with the instructions of the system vendor's representative who will be present during these operations.



6.1.6 Communication racks with the same work description as specified elsewhere in Tender documents.

6.1.7 Main processor cabinets (data base units) with the same work description as as specified elsewhere in Tender documents.

6.1.8 **Marshaling Cabinets**

Cabinets shall be installed in place and bolted together by LSTK CONTRACTOR.

Cross wiring between these assembled sections shall be done by LSTK CONTRACTOR.

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6.1.9 **Fire Panel Cabinets.**

6.2 **Handling and installation. Termination and Connection of Cabling**

Cables entering instrument room are installed under false floor. These cable shall be handled, cut to length, stripped and after installation of the cabinets be terminated and connected by LSTK CONTRACTOR.

LSTK CONTRACTOR shall leave slack in the cables and provide markings.

6.3 **Installation of System Cables**

LSTK CONTRACTOR shall install, plug in and support all system cables. Cable supporting rail in cabinets is installed by cabinet / console vendors, but in any case LSTK CONTRACTOR is responsible.

- System cable shall be installed by LSTK CONTRACTOR under false floor in auxiliary room. System cables are covered by instrument cable list.

6.4 **Conduits Cable Tray / Trucking. Support Frames and Brackets**

All cable trays, cable trucking, supports / brackets, etc. if required , shall be installed by LSTK CONTRACTOR. For cable tray installation see respective part.

6.5 **Auxiliary Cable Installation and Termination.**

LSTK CONTRACTOR shall install, terminate, support and connect all auxiliary cables.



Auxiliary cables are all cables covered by instrument cable list and instrument cable layout for control room.

LSTK CONTRACTOR shall open / remove and close parts of the false floor as required for cable installation.

6.6 **Communication Cables**

LSTK CONTRACTOR shall install and support communication cables. The connection of the cables in the consoles and cabinets shall be done by LSTK CONTRACTOR, under direct supervision of system vendor. LSTK CONTRACTOR shall open / remove and close parts of the false floor as required for cable installation. Communication cables are listed on instrument cable layout for control room and the system cable list.

6.7 **Power Supply Cabling**

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LSTK CONTRACTOR shall install, terminate and connect all power supply cables between power distribution boards and cabinets, consoles, printers and other instrument equipment when listed on the power supply list

6.8 Earthing System

LSTK CONTRACTOR shall install and connect the insulated earthing cabling / wiring from the earth buses to the cabinets, consoles and all other instrument equipment.

All cabinets and consoles shall be fitted with earthing bus bars and earthing connection bolts by the vendors and under supervision of LSTK CONTRACTOR.

LSTK CONTRACTOR shall install utility, shield and dedicated earth (clean earth) cabling and connections including tags at both ends.

LSTK CONTRACTOR shall check and test earthing system in accordance with relevant documents.

7.0 LIFTING

7.1 Major instrument equipment shall be rigged from points designated or suitable to accept rigging. When available, LSTK CONTRACTOR shall utilize lugs on equipment.

7.2 When establishing hoisting loads, riggings plans and crane capacities, LSTK CONTRACTOR shall adhere to the requirements and instructions as defined in the specifications and as instructed by OWNER.

8.0 TESTING AND PRECOMMISSIONING (FUNCTION TEST)

8.1 Testing and pre-commissioning consist of the complete testing and pre-commissioning prior to commissioning, including provision of required testing apparatus and testing documents, comprising, but not limited to:



8.1.1 Check for completion and conformance to specifications.

8.1.2 Check the accessibility of all instruments and components for field adjustments, routine maintenance and removal for overhaul, and relocate as necessary.



8.1.3 Perform pressure test on all air sub headers as required by the line specifications.

8.1.4 Clean all instrument air sub headers, transmission tubing and control tubing by blowing with dry, filtered air prior to connection of instrument components

8.1.5 Leak test pneumatic transmission and control tubing, using an approved method acceptable to OWNER

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- 8.1.6 Perform hydrostatic or, where appropriate, pneumatic pressure tests on all instrument process piping, as required by the respective line specifications. Drain and below free of water, as necessary after test.
- 8.1.7 Check continuity and identification of transmission and control systems for each instrument to ensure proper hookup. Perform megger and continuity tests for instrument electrical wiring. Check correct source of power, polarity and earthing (take into account intrinsically safe technology of this procedure).
- 8.1.8 Check the bore of the orifice plates and flow direction during and after installation.
- 8.1.9 Check (on/off valve and) control valves for direction of flow and proper operation, e.g. travel, action with air failure, etc.
- 8.1.10 Calibrate all instruments (including the instruments in the fire and gas system) and synchronize transmitter and receiver readings for each instrument loop. Check the orifice plates and flow nozzles. Set air pressure regulators.
- 8.1.11 Install pressure and temperature gauges after line flushing.
- 8.2 Check fuses, perform voltage checks and energize all electrically powered instruments, alarm and shutdown system, etc. Maintain power supply.
- 8.3 Set pneumatic and electronic type switches and local control by simulation of input signals.
- 8.4 Check thermocouples and resistance thermometer circuits from element to measuring instrument by simulation.
- 8.5 Check and adjust calibration of all other field and panel mounted instruments.
- 8.6 Complete loop functional test of all instruments, including the instruments in all package units and in the fire and gas system. Functionally test complete control loops alarm and shutdown systems and partial process sequence, etc., to verify capability to measure, operate and stroke final control elements in the direction and manner required by the process application. All test results shall be recorded and submitted to OWNER. Each test record shall include date of test, ambient temperature, climatic conditions, instruments used with serial numbers, names of test personnel and witnesses, identification of equipment, ground electrode or circuit tested.
- Testing shall be scheduled at least 24 hours in advance and OWNER is to be notified by LSTK CONTRACTOR. LSTK CONTRACTOR shall advise OWNER prior to testing, of make, type and accuracy of test equipment used for above-mentioned items. All required test certificates should be of a recent date not exceeding 6 months.
- 9.0 PAINTING**
Surface preparation and application of all required paint layers shall be executed in accordance with paint specifications and related standards.

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10.0 **WELDING**

LSTK CONTRACTOR shall perform welding in accordance with the normal accepted industrial standards.

11.0 **MECHANICAL COMPLETION**

LSTK CONTRACTOR shall advise OWNER in writing when erection is completed.

Mechanical completion date shall be the date when the activities have been accomplished by LSTK CONTRACTOR as dictated by the construction schedule, which shall be submitted by LSTK CONTRACTOR and approved by OWNER on due time.

12.0 **QUALITY ASSURANCE, QUALITY CONTROL, INSPECTION, CALIBRATION TEST AND MATERIAL CERTIFICATES**

12.1 LSTK CONTRACTOR shall perform quality control, inspect, calibrate required testing, pre-commissioning and supply certificates.

12.2 LSTK CONTRACTOR shall submit reports of each and every test or inspection within three (3) days after actual test or inspection is made.

12.3 Calibration and Testing.

12.3.1 Calibration and testing to be executed by LSTK CONTRACTOR in accordance with respective specifications.



Local instruments such as transmitters, converters, receivers and so on, will be preset by bench testing by LSTK CONTRACTOR in accordance with the specifications before installation on the process, so that no new settings will be necessary for loop acceptance tests.

12.3.2 LSTK CONTRACTOR shall inspect all materials up on receipt for damage and completeness. In case of damage incomplete material, LSTK CONTRACTOR shall modify and immediately inform OWNER.

12.3.3 LSTK CONTRACTOR shall carry out all tests included in this paragraph shall fill out the installation checklists and shall submit all required test certificates and documentation as required.

12.3.4 All tools and test gear necessary to carry out described tests shall be provided by LSTK CONTRACTOR.

12.3.5 Inspection and testing shall be phased with construction and installation in such a manner as

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to involve the minimum necessary concentration of effort and manpower and the minimum loss of time in reaching the pre-commissioning stage.

- 12.3.6 All inspection and testing shall be witnessed and approved by OWNER / authorized representative.
- 12.3.7 LSTK CONTRACTOR shall be responsible for the complete loop continuity check of the field and control room installation, including the parts of the package units, which have been connected by others.
- 12.3.8 OWNER reserves the rights whenever distinguished package Plant(s)/Unit(s) vendor's representative to be present at site LSTK CONTRACTOR shall be responsible to arrange this WORK.
- 12.3.9 LSTK CONTRACTOR shall be responsible for the loop continuity checks from the marshaling cabinets or direct connected cabinet cables in the control room (termination point of underground multi core cable). The loop continuity checks shall be performed on a complete loop, including all parts of the loop as indicated on the instrument loop diagrams (ILD'S).
- 12.3.10 The communication equipment between field and control room building and/ or other buildings shall be the responsibility of LSTK CONTRACTOR.
- 12.3.11 Only complete loops shall be accepted, signed by OWNER after all calibration / function checks have been demonstrated successfully completed and recorded.
- 12.3.12 For all package units and systems supplied by LSTK CONTRACTOR, installed or partly installed and connected by LSTK CONTRACTOR.

LSTK CONTRACTOR shall perform a normal wiring and loop check of signals and supplies to and from these systems.



The following systems apply:



- Analyzer system
- Bentley Nevada system
- Flow metering system
- Fire, smoke and gas detection system
- Tank gauging
- FCS / ESD / PIC system, etc.

For more details LSTK CONTRACTOR shall follow **Instrument design philosophy elsewhere mentioned in ITB.**

13.0 **Miscellaneous**

LSTK CONTRACTOR shall remove all waste and debris from the SITE.

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ANNEXURE- 7 - 2G

INSULATION WORK

1.0 GENERAL



1.1 SCOPE

This standard covers the requirement for supply and application of materials for thermal insulation of equipment, piping and other items.

1.2 REFERENCE STANDARDS

The design shall be in accordance with established codes, sound engineering practices and shall conform to the statutory regulations applicable to the country. The main codes, standards and statutory regulations considered as minimum requirements are as follows:- (Latest revision of these shall be followed)

IS 14164	Code of Practice for Industrial Application and finishing of thermal insulation material at temperature -80°C and up to 750°C.
IS 737	Wrought aluminium and aluminium alloys, sheet, strip
IS 1254	Specification for corrugated aluminum sheet
IS 1322	Bitumen felts for waterproofing and damp proofing
IS 3069	Glossary of terms, symbols and units relating to thermal insulation materials.
IS 8183	Specifications for bonded mineral wool.
IS 9743	Thermal insulation finishing cements
IS 12436	Specification for Preformed Rigid Poly-urethane (PUF) and Poly-isocyanurate (PIR) Foams for Thermal Insulation
IS 13205	Code of practice for the application of polyurethane insulation by the in-situ pouring method.
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
ASTM C1029	Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation
ASTM C1696-16	Standard Guide for Industrial Thermal Insulation Systems
ASTM C411	Standard Test Method for Hot-Surface Performance of High - Temperature Thermal Insulation

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ASTM C450	Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C871	Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
ASTM C1338	Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
ASTM C1055	Guide for Heated System Surface Conditions that Produce Contact Burn Injuries
ASTM C1139	Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board
ASTM D1622	Test Method for Apparent Density of Rigid Cellular Plastics
ASTM C680	Standard Practice for Heat Loss or Gain and Surface Temp.

1.3 Deviations:

Should unforeseen difficulties arise to comply with requirements of this standard.

Alternative material and application techniques superior to the requirements of this standard be submitted with complete details for approval of owner.

In case of any conflict / deviations amongst various documents, the order of precedence shall be as follows:

1. Statutory regulations.
2. Job specifications.
3. Engineering design basis.
4. Standard specification.

1.4 LIMITATIONS



Temperature Limits.

This standard deals with insulation applied externally on piping equipments etc. as per the table below:-

Maximum Operating Temperature	Type of Insulation
60 ⁰ C to 750 ⁰ C for C.S., A.S. & S.S.	HOT
- 180 ⁰ C to 20 ⁰ C	COLD

1.5 THICKNESS DESIGN BASIS

Thickness calculation method as per procedure given in ASTM C-680

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1. Hot Insulation

Design Ambient Temperature	: 35°C
Design Surface Temperature	: 45°C
Permissible Heat Loss	: 100 kcal./m2 hr.
Permissible Wind Velocity Outside	: 1 m/sec
Permissible Wind Velocity Inside	: 0.25 m/sec

2. Cold Insulation

Design Ambient Temperature	: 35°C
Design Surface Temperature	: 2 °C below ambient/ 0.5 Deg C above the Dew Point
Permissible Heat Gain	: 10-12 kcal/m2 hr
Relative Humidity	: 85%
Permissible Wind Velocity Outside	: 1 m/sec.
Permissible Wind Velocity Inside	: 0.25 m/sec.

1.6 GENERAL REQUIREMENTS

1.6.1 Information to be supplied

- Material of construction / dimension of equipments / pipes required to be insulated.
- Temperature
- Location of equipment (Indoor/Outdoor/Elevn.)
- Requirement of removable box type insulation if any
- Special requirements if any regarding type of insulation material and other properties.
- These information shall be supplied in form of insulation schedule.
- Design calculations, drawings and insulation material schedule.
- Material Test certificate's.
- Insulation works execution schedule.
- Detailed procedure for all types of execution works.
- Bill of Quantities, Initial material take-off, final material take off and material requisition.
- QA/QC plan.

1.6.2 STORAGE OF MATERIAL



Insulation material shall at no time be stacked directly on the ground; instead it will be stored at a level higher than ground level. It should not only be covered by tarpaulin but other effective protections against weather are also to be provided. The contractor shall provide a properly covered storage to the satisfaction of engineer-in-charge (Refer IS: 10556).

1.6.3 HYDROSTATIC TEST FOR PIPES

Before taking up insulation job on piping or vessels it shall be ensured that hydrostatic test of the concerned equipment / piping is completed. Where it is felt necessary to take up the insulation job before such testing are performed all welded and mechanical joints shall be left un-insulated for a length of at least 150mm on either side of the joint.

1.6.4 PROTECTION OF INCOMPLETE JOBS

Any part of insulation job which is not provided with final weather proofing will be adequately protected by means of tarpaulins and other aids. After the day's work similar protection

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should be provided for the partially completed jobs to be continued the next day to avoid any absorption of rain / moisture during the night.

2.0 INSULATION SUPPORTS (CLEATS) TO BE PROVIDED BY EQUIPMENT SUPPLIER

Suitable supports (cleats) in the form of rings, lugs, studs or pins shall be provided on equipment by equipment supplier, however should any additional supports or anchorage be felt necessary for insulation works, the same shall be also considered in LTKS's scope, including all allied work necessary for the same. These will be installed by the contractor free of any extra cost. Owner shall be informed about the same in advance, so also design/drawings shall be updated accordingly.

3.0 MATERIAL REQUIREMENTS

3.1 INSULATION MATERIALS

3.1.1 General

Whenever reference to any Standard is made it is presumed that the latest revision as on date should be considered unless otherwise specified.

3.1.2 Specification and other requirements



Specification and other requirements will be as per below mentioned table:-

Hot Insulation:

For operating temperature Upto 400 deg.C,	Rockwool Mattress of density 120 kg/m ³ conforming to IS:8183.
For operating temperature 401-450 deg.C,	Rockwool Mattress of density 150 kg/m ³ conforming to IS:8183.
For operating temperature 451-500 deg.C,	1 st layer insulation shall be 25mm Ceramic Fibre Blanket of density 128 kg/m ³ conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m ³ conforming to IS:8183.
For operating temperature 501-550 deg.C	1 st layer insulation shall be 50mm Ceramic Fibre Blanket of density 128 kg/m ³ conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m ³ conforming to IS:8183.
For operating temperature 551-600 deg.C,	1 st layer insulation shall be 75mm Ceramic Fibre Blanket of density 128 kg/m ³ conforming to IS :15402 and balance layers with Rockwool Mattress of density 150 kg/m ³ conforming to IS:8183.

Bands/Wires for securing insulation shall be of ASTM 8209 Alloy 3003 H16 or 18-737 designation 31000 (old NS3) condition H3 or 18/8 Stainless steel.

For securing cladding on insulation on piping, aluminium band 12mm (min) X 24 SWG thick shall be used. For securing cladding on insulation on equipment, aluminium band 20mm wide X 24 SWG shall be used.

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Other insulating materials may be used provided they have the same or better properties and durability aspects.

Insulation thickness of insulating materials shall be based on design calculation of thermal conductivity, insulation class, etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters.

For Valves, Turbines & Compressors Insulation



Prefabricated factory made Ceramic Fibre pad to be used made out of Ceramic Fibre Blanket of density 128 kg/m³ encased in high temperature resistant cloth. The minimum thickness of the pad shall be –

- | | | | | |
|----|-----------|----|-----------|--------|
| 1. | 0 Deg.C | to | 300 Deg.C | = 25mm |
| 2. | 301 Deg.C | to | 400 Deg.C | = 50mm |
| 3. | 401 Deg.C | to | 500 Deg.C | = 75mm |

Removable insulation for flanges and valves, like tailor made jackets or pre formed insulation boxes, shall be suitable for quick removal and reinstallation. All tailor made jackets shall fit the actual valve/flange/equipment and secure adequate overlap to incoming insulated pipes.

Technical data sheet of the Ceramic Fibre Pad is as below:

A.	Purpose/Application This Engineering specification is for Fabric jacketed supercera ceramic Fibre insulated flexible reusable covers/pad for application on pipes: pipe fittings, valves, flanges etc vessels & equipments, tubes etc in hot services.			
01	Dimension (mm)	As per drawing/sketch provided by OEM.		
02	Thickness (mm)	25-100		
1. Specification of Protective jacketed material				
i	Vest Cover	Liner Fibre Glass Fabric		
ii	External Top Cover Fabric (for cold face)	Polymer Coated Fibre Glass fabric Temp. resistance 300 Deg. C, oil & water resistant		
iii	External Bottom Cover fabric (for hot face)	High silica cloth for Temp Resistance up to 900 Deg C		
2. Specification of insulation Material				
		Ceramic Fibre Blanket (As per IS 15402)		
i	Classification Temperature	1260 degree Celsius		
ii	Thickness	25 – 100mm		
iii	Bulk Density	128kg/m ³		
iv	Shot content on 70 mesh (%)	<30		
v	Tensile strength (KPa)	>40		
vi	Mean Fibre Dia (Micron)	2-4		
vii	Linear Shrinkage (%) At 1200 Deg. C for 24 Hrs	3.5		
viii	Thermal Conductivity (W/mK) Max.	1000C	2000C	3000C
		0.046	0.072	0.078
ix	Chemical composition	SiO ₂ %		49-58
		Al ₂ O ₃ %		41-48

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		ZrO ₂ %	0-7
		FeO ₃ %	<0.1
3	Hardware & Non Metal fastening		
i)	Buckle/Draw Stings	Stainless steel (min SS 316), High Temp Braided Chord of fibre glass	
ii)	Stic Pins	Stainless Steel (min SS 316), Pins to prevent the insulation from movement inside the cover	
iii)	Stitching	Double sewn with Teflon coated Fibre glass wrapped stainless thread. The sewing thread shall not resolve or decompose in typical chemical plant environment.	
iv)	Belting	High Temp Fabric same as used in hot face cover	
4	Other Properties		
i	Fire Resistance (As per BS 476 Part-4)	Non-Combustible	
ii	Chemical Stability/Resistance of Corrosion/water	Good	
iv	Shock Resistance	Excellent	

Rockwool Insulation shall be of water Repellent Grade and tested as per BS: 2972 for Water Absorption. Maximum water absorption is 0.5 kg/m² in 48 hours duration.

Precautions must be implemented in the design and fabrication of the insulation jackets to avoid the insulation material from sagging causing reduction of the insulation properties of the jackets.

Cold Insulation:

Insulation material and specifications for cold insulation for operating temperatures up to (-) 180°C and dual temperature (cold/hot) service where, upper temperature limit is 125°C shall be as given below for all sizes of piping/equipment:



- Polyurethane Foam

Preformed pipe section's and radial lags (for higher diameter pipe) of polyurethane foam of self-extinguishing type shall be in accordance with ASTM C591 TYPE-II Grade 2. The physical requirement of bulk density, chloride content, thermal conductivity and PH value of the material shall be as follows:

Temp. Limit Bulk density:	Upto (-)180°C & 120°C (max) 35.0 to 39.9kg/m ³
Chloride content :	20 ppm (max)
Thermal conductivity :	0.221 mw/cm°C at mean temp. 10 deg C
PH Value :	Neutral.
Closed cell content :	95% (min)

High density polyurethane foam block of bulk density more than 300 Kg/m³ shall be used for supports.

- Polyurethane Foam Cast-in-Situ

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Cast-in-Situ Polyurethane Foam of density 42±2 kg/m³ conforming to IS: 13205 shall be used. High density polyurethane foam block of bulk density more than 300 Kg/m³ shall be used for supports.

Temp. Limit : Up to (-) 45°C and 120°C (max.)

- **Polyisocynaurate**

Temp. Limit : Up to (-) 180°C and 125°C (max.)

Other insulating materials may be used provided they have the same or better properties and durability aspects.

Insulation material specification/ thickness/application mentioned in this document are the minimum requirements. Insulation specification/ thickness/ application shall be based on design calculation of thermal conductivity, insulation class, relevant IS/ ASTM codes etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters. LSTK shall submit detailed material specifications, durability parameters assured, test certificates and application procedure to OWNER/ PMC approval.

3.2 AUXILIARY MATERIALS FOR CLADDING

a) **Aluminium Cladding**

- **Horizontal Vessels**



Aluminium sheet as per IS-737 (designation 31000, condition H3 for flat sheet & 31500/51300, H4 for corrugated sheets)) shall be used for cladding. Insulation on overall piping, vessel and equipment, cladding will be coated on the side in contact with insulation with 3 mil thick polysurlyn film.

Specifications for aluminium Cladding material shall be as follows:

Material	Reference Code / Standard	Thickness	Application
Aluminium sheet with applied moisture barrier of 3 mil thick Polysurlyn coating	IS : 737 / ASTM C-653	22 SWG (0.71mm)	For all piping, tanks, vessels, heat exchanger, flanges, valves, equipments etc. upto 24" outside dia
		20 SWG (0.91mm)	For piping, tanks, vessels, heat exchanger, flanges, valves etc. above 24" outside dia
Removable cover for flanges, valves etc. shall be made out of minimum 18 SWG thickness Aluminium Sheets.			

- **Vertical Vessels**

Cladding material for vessels with insulation O.D. 900 mm and less shall be same as for pipes. For vessels above 900 mm insulation O.D. 22 SWG corrugated

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aluminium sheet as per IS-1254 or ribbed aluminium sheet 32 mm x 5 mm deep corrugations may be used.



Aluminium Foil to protect stainless surfaces in Temperature below 0 deg c shall be 0.1 mm (42 SWG) thick per ASTM 8209 alloy 3003 H16 or IS-737 designation 31000 (OldNS3) condition H3. For securing aluminium foil on stainless steel surface 24 SWG thick x 20mm wide aluminium bands shall be used.

- b) **Screws**
Screws used with aluminium sheeting shall be of self tapping type, A No.8x12mm long cadmium plated / SS of high quality at intervals of 150mm.
- c) **S-Clips.**
Aluminium, 20x1.5mm or 25mm wide stainless steel banding bent to form a shape of "S" provide a minimum lap of 50mm.
- d) **Bands for securing cladding.**
Aluminium of dimensions 12mm width x 0.56 mm thick (24 SWG) for pipes. Stainless Steel bands Type 304, 0.4mm thick x 13mm wide for large dia pipes (above 24") and cylindrical equipment up to outside dia 900mm, 0.5mm thick x 19mm wide for cylindrical equipment above 900mm outside dia meter.
- e) **Quick release clips for removable covers.**
Suitable quick release clips will be made as shown in fig. 7 from 20Cm width x 20 SWG aluminium sheet and some fig.7 from 20mm width x 20 SWG aluminium sheet and some suitable rectangular ring.
- f) Sealant for cladding joints with Foster 95-44 /TIKI F9544.
- g) The vapour barrier mastic shall be Foster 60-38/39 /TIKI M6038/39
- h) Adhesive for cold insulation shall be Foster 81-33 /TIKI P8133
- i) Vapour Stops at pipe support location shall be Foster 90-66 /TIKI F9066
- j) **Rivets:** Aluminium 'POP' blind eye type / Stainless Steel 9.5mm long x 5mm dia meter.
- k) Filler material shall be PUF dust or mineral wool mixed with specified adhesive shall be placed lightly so as to fill irregular voids and sealant shall be Foster Foam Seal Sealer 30-45. Glass cloth to be used for vapour barrier reinforcement shall be open weave 10 mesh having glass fibre thickness of 5 mils.

Galvanised steel sheets/ Annealed galvanised steel sheets/ Galvanised colour coated sheet are strictly **PROHIBITED** for use in cladding works. Other cladding materials (except G.I.) may be used provided they have the same or better properties and durability aspects, after prior approval from Owner/PMC.

Cladding material / auxiliary material specification/ thickness/ application mentioned in this document are the minimum requirements. Cladding material/ auxiliary material specification/ thickness/ application shall be based on design calculation of thermal conductivity, insulation class, corrosion aspects, durability, relevant IS/ ASTM codes, etc. Same shall be submitted to the Owner with necessary design calculations, drawings, test certificates and durability parameters.

LSTK shall submit material specifications, durability parameters assured, test certificates and application procedure to OWNER/PMC approval.

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4.0 **INSPECTION.**

4.1 **General**

All insulation material shall be subject to inspection by owner before application. In case of doubt, Owner's representative will have the liberty to get the material tested by the contractor at any approved test laboratory. Any material not meeting specified requirement will be rejected and the rejected material shall have to be replaced by the contractor with material of specified type and quality. Insulation found to be improperly installed shall be removed and reinstalled properly by the contractor.

Contractor shall maintain detailed log of various insulation works and same shall be updated on daily basis. QA/QC checks of work done and materials shall be also registered in the daily logs. Owner will have the liberty to check the logs.

4.2 **Inspection**

Inspection of materials and / or installation by owner shall not relieve the contractor of his responsibility to ensure that finished insulation conform to specified requirements and is free from defects, contractor shall correct any defects due to poor workmanship. Contractor shall maintain test certificates and other relevant data from manufacturer.

4.3 **Test for thickness**

Test for thickness shall be carried out after application. Thickness at any point shall not be less than 2mm than the indicated designed thickness and excess thickness up to 115% of the designed thickness is permissible. .

4.4 **Testing for bulk density**

Testing of bulk density of the insulating materials shall be carried out before the application of insulation. This should be within $\pm 15\%$ of the specified value. Test location shall be selected by owner and its repair shall be done by contractor.

5.0 **APPLICATION**



5.1 **General**

Insulation thickness shall be as per design calculations as specified in the drawings/ insulation schedule/ specification/isometric drawings prepared for equipments/piping.

Contractor shall submit detailed calculations and procedure for different insulation works based on relevant IS / ASTM codes.

5.2 **No. of Layers**

When insulation thickness exceeds 75 mm, the insulation shall be applied in multi-layers with all joints staggered. Each layer will be separately secured with metallic bands/wires.

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No. of layers shall be as follows:

Insulation Thickness

Up to 75mm
76 to 150 mm
151 and above

No. of Layers (Min.)

1 Layer
2 Layers
3 Layers or more.

5.3 GENERAL REQUIREMENTS

5.3.1 Surface preparation

- Surface to be insulated shall be cleaned of all dirt. Oil loose scale etc. by wire brushing. Insulation works shall commence only after necessary clearance from QA/QC for painting works as per painting specification. All insulation shall be applied at ambient temperature and both the metal surface and insulation material shall be dry prior to application of insulation.
- The surface for cold insulation shall be then coated with a bitumen emulsion or a mastic coating.
- If the vessel is made of stainless steel, it shall be wire-brushed. with stainless steel wire brush.

5.3.2 Expansion / contraction joint

Depending on the type of insulation used the operating temperatures and nature of the material it may be necessary to provide expansion/contraction joints on vessels or pipes to prevent the insulation from rupturing/buckling when the surface expands/contracts. Joints are to be designed as per relevant IS / ASTM codes.

5.3.3 Filling of Voids

All voids, irregularities and joints shall be packed with loose insulation material/insulation cement trowelled smooth whichever is applicable.

6.0 MEASUREMENT OF INSULATION WORK.



6.1 Measurement of insulation works shall be as per IS: 14164.

7.0 GUARANTEE



- There shall be a surface temperature recording as mentioned in the Design Parameter to be performed with the help of Thermography Camera, post the line/ equipment is charged in operating conditions. The same shall be in LSTK's scope and LSTK shall give a detailed report of the same.

-The guarantee test shall be carried out when plant is fully operative.

-The surface temperature, reading shall be taken at six points per pipe line and at each point it shall be taken on all four sides in top, bottom, left side and right side.

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- The above reading shall be taken at 2 hours intervals and shall be taken for 18 hours starting from 11 a.m. in the morning.
- Simultaneously ambient temperature shall be taken as per IS: 14164
- A graph shall be plotted between ambient and surface temperature reading
- From this graph the surface temperature against ambient temperature shall be found out
- The ambient and surface temperature shall be measured by the instrument provided by the contractor. The instrument shall be calibrated to the satisfaction of owner/consultant.
- The contractor is required to guarantee the surface temperature of 60°C (max.) for equipments and piping in case of Hot Insulation. For cold insulation of equipments and piping, the difference between skin temperature and ambient temperature shall not exceed 2 °C.
- Ambient temperature and surface temperature shall be measured by duly calibrated instruments provided by CONTRACTOR.
- The CONTRACTOR shall undertake immediate replacement of insulation material damaged in transit, storage or application, at no additional cost to Owner.
- LSTK shall produce required number of copies of test certificates as per relevant IS/ASTM Standard. LSTK shall certify/ensure that Test to be done are from NABL approved laboratory, approved by Owner.
- All materials are new and unused and are as per specifications called for in this standard.
- The operating thermal conductivity shall be as specified
- The workmanship shall be in accordance with good practice.
- **Other terms & conditions of the guarantee clause shall be as per NIT / purchase order / Commercial documents of ITB.**

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ANNEXURE- 7 - 2H

PAINTING SPECIFICATION (TS-2001)

1.0 GENERAL

1.1 Scope

This specification covers the technical requirements for shop and site application of paint and protective coatings and includes; the surface preparation, priming, application, testing and quality assurance for protective coatings of mechanical equipment, structural steelwork, plate work, tankage, guards, pipe work, handrails and associated metal surfaces, which will be exposed to atmospheric for the Project.

1.2 Definitions

C.S	-	Carbon steel and low chrome (1- ¹ / ₄ Cr through 9 Cr) alloys
S.S	-	Stainless steel, such as 304, 316, 321, 347,
Non-ferrous	-	copper, aluminium and their alloys.
High Alloy	-	Monel, Inconel, Incoloy, Alloy 20, Hastelloy, etc.
DFT	-	Dry Film thickness, the thickness of the dried or cured paint or coating film.

1.3 Safety Regulations

Protective coatings and their application shall comply with all national, state, and local codes and regulations on surface preparation, coating application, storage, handling, safety, and environmental recommendations.

Sand or other materials producing silica dust shall NOT be used for any open-air blasting operations.



1.4 Material Safety Data Sheets

The latest issue of the coating manufacturer's product datasheet, application instructions, and Material safety data Sheets shall be available prior to starting the work and shall be complied with during all preparation and painting / coating operations.

1.5 Materials

All paints and paint materials shall be obtained from the company's approved manufacturer's list. All materials shall be supplied in the manufacturer's containers, durably and legibly marked as follows.

- Specification number
- Colour reference number
- Method of application
- Batch number
- Date of Manufacture
- Shelf life expiry date
- Manufacturer's name or recognised trade mark.

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2.0 CODE AND STANDARDS:

Without prejudice to the provision of Clause 1.1 above and the detailed specifications of the contract, the following codes & standards shall be followed. Wherever reference to any code is made, it shall correspond to the latest edition of the code.

2.1 Indian Standards:

IS-5: 1994	Colors for ready mixed paints and enamels.
IS-2379: 1990	Color codes for identification of pipe lines.
IS-2629: 1985	Recommended practice for hot-dip galvanizing on iron and steel.
IS-2633: 1986	Methods for testing uniformity of coating of zinc-coated articles.
IS-8629: 1977	Code of practice for protection of iron and steel structures from atmospheric corrosion.
IS:110	Specification for Ready Mixed Paint, Brushing, Grey Filler, for Enamels, for Over Primers
IS:101	Methods of test for ready mixed paints & enamels.

2.2 Other Standards:

2.2.1 Swedish Standard: SIS-05 5900-1967 / ISO-8501-1-1988



(Surface preparations standards for Painting Steel Surface).

This standard contains photographs of the various standards on four different degrees of rusted steel and as such is preferable for inspection purpose by the Engineer-in-charge.

2.2.1 DIN: 53151 Standards for Adhesion test.

2.3 The paint manufacturer's, instructions shall be followed as far as practicable at all times. Particular attention shall be paid to the following:

- Instructions for storage to avoid exposure as well as extremes of temperature.
- Surface preparation prior to painting.
- Mixing and thinning.
- Application of paints and the recommended limit on time intervals between coats.

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3.0 SURFACE PREPARATION

3.1 Metal Surface Preparation

3.1.1 Safety

All work in adjacent areas, which may negatively affect the quality of blast cleaning, and/or impose safety hazards, must be completed or stopped before the blasting operation starts.

3.1.2 Pre-cleaning

Prior to surface preparation all weld spatter shall be removed from the surface, all sharp edges ground down and all surfaces cleaned free of contaminants including chalked paint, dust, grease, oil, chemicals and salt. All shop primed surfaces shall be water washed by means of suitable solvent, by steam cleaning, with an alkaline cleaning agent if necessary or by high-pressure water, to remove contaminants prior to top-coating

3.1.3 Surface Decontamination

Surface decontamination shall be performed prior to paint application when uncoated surface is exposed to a corrosive environment or existing paint work is to be repaired.

Existing coatings shall be removed by abrasive blast cleaning, and then high pressure potable water shall be used to clean steel surfaces.

Prior to application of coatings, the surface shall be chemically checked for the presence of contaminants. A surface contamination analysis test kit shall be used to measure the levels of chlorides, iron salts and pH in accordance with the kit manufacturer's recommendations.

Swabs taken from the steel surface, using cotton wool test swabs soaked in distilled water shall not be less than one swab for every 25m² of surface area to be painted.

Maximum allowable contaminant levels and pH range is as follows:



Sodium chloride, less than 50 microgram / cm²;

Soluble iron salts, less than 7 microgram / cm²; and

If the results of the contamination test fall outside the acceptable limits, then the wash water process shall be repeated over the entire surface to be painted, until the contaminant test is within the specified levels.

3.1.4 Abrasive Blasting

All C.S. materials shall be abrasive blast cleaned in accordance with Codes (Ref. Clause 2.0). To reduce the possibility of contaminating S.S., blasting is not usually specified. However, for coatings which require a blast-cleaned surface for proper adhesion, S.S. may be blast cleaned using clean aluminium oxide or garnet abrasives (Free from any chloride or Iron / Steel contamination). When hand or power tool cleaning is required on S.S., only S.S. wire-brushes (including 410 S.S.) which have not been previously used on C.S. surfaces may be used.

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The surface profile of steel surfaces after blasting shall be of preparation grade Sa 2-1/2 of Swedish Standards SIS-05-5900 (Latest Revision) or better according to ISO 8501-1 and shall be measured using the replica tape method or the comparator method.

The roughness (profile) of blast-cleaned surfaces shall be Medium (G) according to ISO 8503-2: 1988 (appendix 1) unless otherwise specified. Medium defines a surface profile with a maximum peak-to-valley height of 60-100 microns, and G indicates that the surface profile is obtained by grit blasting. For the evaluation of surface roughness Comparator G shall be used.

Abrasive blast cleaning shall NOT be performed when the ambient or the substrate temperatures are less than 3° C above the dew point temperature. The relative humidity should preferably be below 50% during cold weather and shall never be higher than 60% in any case.

Abrasive blast cleaning shall be performed with a clean, sharp grade of abrasive. Grain size shall be suitable for producing the specified roughness. Abrasives shall be free from oil, grease, moisture and salts, and shall contain no more than 50ppm chloride. The use of silica sand, copper slag and other potentially silica containing materials shall not be allowed

The blasting compressor shall be capable of maintaining a minimum air pressure of 7 kPa at the nozzle to obtain the acceptable surface cleanliness and profile.

The blast cleaning air compressor shall be equipped with adequately sized and properly maintained oil and water separators. The air supply shall be checked to ensure no oil and water contamination at the beginning of each work shift.

Blast cleaning abrasive shall be stored in a clean, dry environment at all times. Recycling of used abrasive is prohibited.

After blast cleaning, the surfaces shall be cleaned by washing with clean water (Pressure 7kg/Cm² using suitable nozzles. During washing broom corn brushes shall be used to remove foreign matter.

Assessment of the blast cleaned surfaces shall be carried out in accordance with reference code.



Blast cleaned surfaces which show evidence of rust bloom or that have been left uncoated overnight shall be re-cleaned to the specified degree of cleanliness prior to coating.

All grit and dust shall be removed after blasting and before coating application. Removal shall be by a combination of blowing clean with compressed air, followed by a thorough vacuum cleaning with an industrial grade, heavy duty vacuum cleaner.

All cleaned surfaces shall have protection from atmospheric corrosion as per IS8629:1977

3.1.5 Alternate Methods of Surface Preparation

When open air blasting is not permitted on site, or when space limitations or surface configurations preclude blasting, the alternate cleaning methods listed below may be used with prior approval. Alternate cleaning methods shall consider the degree of surface cleanliness and roughness profile required by the specified coating system.

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- Vacuum or suction head abrasive blast-cleaning,
- Wet jet abrasive blast-cleaning,
- Compressed-air wet abrasive blast cleaning,
- Pressurized liquid blast-cleaning,
- Power tool cleaning,
- Hand or power tool cleaning,

Hand and/or power tool cleaning shall only be used for spot repair where abrasive blasting is not permitted or is impractical, and on items which could be damaged by abrasive blasting. Power tool cleaning shall not be carried out with tools which polish the surface, e.g. power wire brushes.

The surfaces of equipments and prefabricated piping etc. which are received at site Primerised or with finish paints, depending upon their conditions, shall be touched up and painted at site. For these surfaces sand blasting is not envisaged and these surfaces shall be prepared using power brushes, buffing or scraping, so as to achieve a surface finish to St-3 as per SIS-05-5900 . After wash-up the area to be touched up shall be jointly marked, measured and recorded for payment purposes. The type of system & nos. of coat (primer and/or finish paint) to be applied after touch up, which shall be decided by OWNER/CONSULTANT in writing before taking up the job.

When paint is to be applied on damaged painted surfaces of equipments all loose and flaking paint work should be removed to a firm feathered edge. Rusted spots should be cleaned by one of the methods specified in the clauses 4.4.1 & 4.4.2 above. In case the previous paint work is not compatible to the specified one the entire coating must be removed.

It shall be ensured that sand blasted surface/machine cleaned surface is not contaminated with oil and grease. Water shall also not be allowed to come in contact with sand blasted surface.

4.0 APPLICATION

4.1 General

The final specification of paint systems to be used to suit the exposure conditions of equipment and steelwork, shall be as specified on the scope of work, equipment data sheets or the drawings.



All coatings shall be in accordance with Indian / International Standards, the coating manufacturer's product data sheets and application instructions and the requirements contained in this specification.

4.1.1 General Requirements for Shop Application

All work areas which facilitates shop paint application shall be surface prepared for painting and have the paint system applied before installation.

Equipments assembled at site shall only receive primer coat in the shop and finish coatings will be applied at site.

In all cases, where surfaces will be inaccessible after shop assembly, they shall be prepared and have the paint system applied before assembly is carried out. Drying times between successive coats shall be at least those recommended by the manufacturer.

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All known field weld areas shall be given the specified abrasive blast surface preparation but left uncoated for a distance of 50mm from the weld line. Such areas shall be given the appropriate touch-up treatment after installation.

The manufacturer's directions for preparation and application of coatings shall be followed to ensure that the durability of the coating system is not impaired.

The Contractor shall submit the full details of the proposed surface preparation and paint systems prior to the commencement of any surface preparation.

4.1.2 General Requirements for Site Application

Paint shall be stored only in accordance with the manufacturer's instructions.

All materials used for the specific system being applied shall be products supplied by one manufacturer and details of such product shall be submitted for approval before commencement of work.

The contents of cans shall be thoroughly stirred before being poured into paint pots and shall be thinned only in the specified proportions in accordance with the manufacturer's instructions.

Finish coats may be applied by spraying except where any over spray is likely to affect finished surfaces or where spraying constitutes a health hazard to workmen in the other areas. Brush and roller application will require multiple coats to achieve the specified dry film thickness.

Brush application may be used only with the approval of the company.

Roller application shall only be used on relatively large surface areas (i.e. > 50m²) and only if spraying is not an option.

The Contractor shall complete the application of any one type of paint or each coat thereof, before beginning the next coat on that section.



In cases nominated as critical, the application of each coat shall be approved before application of the next coat can proceed, in accordance with 'hold' points nominated in the Inspection and Test Plans (ITPs)

All fittings within any given area are to be painted with the same system as the area unless otherwise specified.

Where 2 coat of finish paint are indicated they shall be applied in two different shades to ensure that two coat are applied.

Paint shall not be applied in rain, snow, fog or mist or when the relative humidity is such as to cause condensation on metal surface.

The CONTRACTOR must ensure the availability of a specialist from the paint manufacturer, at SITE during pendency of CONTRACT within his quoted rates to ensure the quality of painting & procedure. Addition of drying agents, pigments or other substances is not allowed unless specifically prescribed or approved by paint manufacturer's specialist.

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Name plates/tags attached to the equipments/machineries shall not be painted or removed during painting job. Failing to comply with above, the CONTRACTOR may be required to replace name plates/tags at his cost.

4.1.3 Qualifications and Materials

All surface preparation, coatings application and inspection, shall be carried out by personnel experienced in that particular field. Contractors shall submit the names of subcontractors to be employed for the specific work together with the brand names of coating materials for approval prior to commencement of application.

4.1.4 Handling and Transport

All pipe work, steelwork and equipment that have been finish coated shall be handled with care to preserve the coating in the best practical condition.

Painted materials shall not be handled until the coating has completely cured and dried hard Supports in contact with coated steel during transport and storage shall be covered with a soft material to prevent damage to the coating. Appropriate materials shall be used during transportation between coated steelwork and holding down chains to prevent damage to the coating.

4.2 Application of Coatings

4.2.1 General

The application method and type of equipment to be used shall be suitable for the paint specified and the surface being painted.

Paints and thinners shall be brought to the point of usage in unopened original containers bearing the manufacturer's brand name and colour designation and ready-mixed unless otherwise specified. Two-pack systems shall be mixed at the site of application to the paint manufacturer's recommendations. The mixed amount prepared shall be no more than the amount that can be applied during the stated pot life.

Paint shall be applied so that an even film of uniform thickness, tint and consistency covers the entire surface and is free of pin holes, runs, sags or excessive brush marks. Film finish shall be equal to that of first class brushwork.



Unless it is practical to do so colour shades for primer, intermediate coat and finish coat must be different to identify each coat without any ambiguity

Paint ingredients shall be kept properly mixed during paint application.

Equipment shall be kept clean to ensure dirt, dried paint and other foreign materials are not deposited in the paint film. Any cleaning solvents left in the equipment shall be completely removed before painting.

To ensure the required film thickness is achieved on angles, welds, sharp external edges, nuts and bolts, a coat shall be applied to such items/locations immediately prior to the application of each coating to the whole area.

Care shall be taken to ensure paint application into all joints and crevices.

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The contact surfaces between steelwork to be fastened by means of friction grip bolting shall be abrasive blast cleaned and prime coated only, prior to erection.

4.2.2 Atmospheric conditions

Surface preparation and coating shall not be carried out in inclement weather and shall be carried out such that the surface being coated is free of moisture, wind-borne or blast cleaning dust.

Coatings shall not be applied if:

- The relative humidity exceeds 85%.
- The ambient temperature is less than 5⁰C (depending on local condition)
- The metal temperature is less than 3⁰C above the dew point.
- There is likely hood of an unfavourable change in weather conditions within two hours after painting.

As a general rule, sufficient ventilation, dehumidification and heating capacity to cope with local climatic conditions must be secured before any coating – related work is started.

In any case, humidity, ambient and surface temperature conditions at the time of paint application, and curing and drying time before application of the next coat, shall be in accordance with the paint manufacturer's recommendations. These conditions shall be recorded in the Inspection Test Record (ITR) by the Contractor and be available for review.

4.2.3 Conventional or Airless Spray

Spray equipment shall be equipped with accurate pressure regulators and gauges. Spray gun nozzles and needles shall be those recommended by the paint manufacturer.

Air from the spray gun shall be clean and dry with no traces of oil or moisture.

Coatings shall be wet on contacting the painted surface. Areas of dry spray shall be removed and the correct system re-applied.

4.2.4 Brush Application

The method of "laying-off" shall be suited to the paint specified and shall ensure minimum brush marking.



4.2.5 Roller Application

A uniform method of application shall be adopted when painting large areas. The rolling direction shall minimise paint joint build up. Edges and areas subject to possible roller damage shall be brush-painted prior to rolling.

4.2.6 Thickness of Coatings

The maximum thickness DFT in any one application shall not exceed that specified in Technical specifications/ recommended by the paint manufacturer.

Wet film thickness gauges shall be used to make frequent checks on the applied wet film.

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The Contractor shall maintain at the site of painting operations, a dry film thickness tester of an approved type with a valid current calibration.

Coating thickness checks in accordance with reference code shall be performed, and the Contractor shall undertake remedial action if the measured thickness is less than specified.

Build up of each material to required thickness shall be made prior to the application of the subsequent coat; final film build shall be the minimum specified.

4.2.7 Multiple Coat Applications (Except Wet-On-Wet)

Before successive paint coats are applied, intermediate coats shall be inspected for surface contamination. The presence of any grease or oil, shall be removed by a suitable solvent, and any salt and dirt adhering to the surface shall be removed by scrubbing with a solution of non-toxic detergent (except those prescribed by the manufacturer as "wet-on-wet"). Removal of contaminants shall only be performed after an intermediate coat has had sufficient time to cure.

The surface shall then be pressure hosed or dusted down by brush to disturb and remove deposits not apparent on visual inspection.

Coatings shall be applied only under the following conditions:

- The surface has been cleaned and is dry;
- The manufacturer's stated minimum time for re-coat has elapsed;
- The manufacturer's stated maximum time for re-coat has not elapsed. If the maximum time has elapsed then pre-treatment shall be in accordance with the paint manufacturer's recommendations; and

Damaged areas in preceding coat have been made good in accordance with this Specification.

When multiple coat of finish paint are indicated, they shall be applied in different shades to ensure that multiple coats have been applied.

4.2.8 Protective Coatings for Fasteners



Black and galvanised erection bolts/nuts and galvanised holding down bolts/nuts shall be prepared and painted in accordance with Section 4.4 of this Specification.

Black high tensile bolts/nuts shall be painted after erection to the same paint system specification as the surrounding structural steel.

4.3 Hot Dip Galvanising

All galvanising shall be carried out by the hot dipping process and conform to the requirements of IS-2629:1985 and uniformity of coating shall conform to IS 2633:1986.

All welding slag shall be removed by chipping, wire brushing, flame cleaning or abrasive blast cleaning where necessary prior to galvanising

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For temporary identification, either water-soluble marking paints or detachable metal labels shall be used. For permanent identification, figures/labels shall be heavily punched or embossed by the fabricator.

For galvanised items after pickling, the work shall be inspected and any defects that render the work unsuitable for galvanising shall be repaired. After such repairs, the work shall again be cleaned by pickling.

The coating mass of zinc shall be as specified on equipment data sheets and the Drawings. Galvanised coatings shall be tested by the methods described in referred code.

After galvanising all material shall be cooled to air temperature in such a manner that no embrittlement occurs.

Galvanised coatings shall be smooth, uniform, adherent and free from stains, surface imperfections and inclusions.

All gratings and fixtures including nuts, bolts and washers that are required to be galvanised, shall be hot dipped galvanised and all nut threads shall be re-tapped after galvanising and a lubricant applied on Cold working of galvanised steelwork shall be avoided.

4.4 Damaged or Inaccessible Surfaces

4.4.1 Damaged Paint Surface

Repair of damaged painted surfaces, as well as painting of galvanised and black bolts, and galvanised holding down bolts after erection shall comply with this Clause. The treatment shall be:



- Pre-clean the damaged or unpainted areas in accordance with Section 4.2.1 of this Specification;
 - Disc or hand sand to clean bright metal;
- Inorganic zinc primers subject to mechanical damage or weld etc shall be power tool cleaned
- Feather backs by sandpapering or whip blasting the original coatings surrounding the damaged area over a 50mm distance. A rough surface shall be obtained on epoxy coatings;
- Clean surface to remove all dust;
- Conduct surface contaminant test in accordance with Section 4.2.2 of this document; and
 - Build up a new paint system over the affected area with paints equal to those originally used and having the same dry film thickness for each coat. As an exception, damaged inorganic zinc primers shall be repaired with epoxy organic zinc rich paint and shall be applied within four hours of blast cleaning.

The new coatings shall overlap the original coating over the 50mm prepared distance and shall be colour matched to the specified colour of the original coating.

4.4.2 Damaged Galvanised Surfaces

Damaged areas caused by oxy-cutting, welding or physical impact shall be treated as follows:

- Prepare the surface by removing any weld slag followed by vigorous power wire brushing of the coating surrounding the damaged area over a 50mm distance;
- Clean surface to remove all dust; and

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- Apply two coats of organic zinc-rich primer to a minimum DFT of 100 microns.

The area to be reinstated shall be colour matched to the surrounding finish colour with 40 microns of aluminium paint to the manufacturer's **written instructions**.

4.4.3 Inaccessible Surfaces

Surfaces that will be inaccessible after erection of other elements of the structure, shall be fully painted prior to the installation of the obstructing item.

4.5 Surfaces Not To Be Coated

The following surfaces shall not be blasted or coated unless specifically directed:

Machined surfaces, bearings, seals, grease fittings, adjusting screws and name plates, and identification tags.

- Valve stems;
 - Raised faces on pipe and equipment flanges;
 - Electrical cabling;
 - Instrumentation, gauges and sight glasses;
 - Titanium, stainless steel and non-metallic surfaces; and
- Field weld margins, 50mm either side of weld, on tankage and piping, prior welding.

The rear face of piping flanges shall be shop prime coated only. Flange holes for fasteners shall be fully coated.

4.6 Wash-Up



All surface of equipments/prefabricated piping etc. Primerised / painted at Vendor shop and received at site if required shall be washed up as follow:

- a) Washing with clean water (Pressure 7 Kg/cm²) using suitable nozzles. During washing, broomcorn brushes shall be used to remove foreign matter.
- b) Solvent washing, if required, to remove traces of wash up as per above procedure of all surfaces of equipment, piping, structure etc. completely painted at contractor's shop shall be included in the quoted rates of oil, grease etc. Wash up as per above procedure of all surfaces of equipment, piping, structure etc. completely painted at contractor's shop shall be included in the quoted rates.

4.7 Touch-Up Painting

Prior to the application of any coat, all damage to the previous coat(s) shall be touched-up. Damage to finished work shall be thoroughly cleaned and re-coated.

Surface preparation shall be done as per clause no. 3.0.....

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Items supplied with the manufacturer's standard coating system shall be touched-up with the same generic coating system or recoated.

4.8 Paint Storage

The following must be ensured:

- a) All paints and painting material shall be stored only in such rooms assigned for the purpose. All necessary precaution shall be taken to prevent fire. The Storage building shall preferably be separate from adjacent buildings. A sign-board bearing the Words "PAINT STORAGE- NO NAKED LIGHT" shall be clearly displayed outside. The building shall be properly ventilated and shall be adequately protected with fire fighting equipment.
- b) Storage shall be far away from heated surface open flames, sparks & well protected from sun rays.
- c) Ambient temperature at which paints are stored shall be intimated to paint manufacturer & their advice sought regarding precautions to be taken if any, regarding flammability, explosiveness & toxicity.
- d) Maximum allowed storage time for various paint materials shall be clearly indicated on individual containers. Materials which have passed expiry date shall not be used.
- e) Paints in non-original containers and/or in containers without seals, shall not be used.



5.0 COATING SYSTEM SELECTION

Coating Systems for Structures Piping and Equipment



The following Table 1 shall be used as a general guide for the selection of a paint system suitable for a particular plant area application. Paint systems specified on equipment data sheets and the Drawings shall take precedence over the general paint system area applications listed in Table 1.

TABLE - 1



Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
01	Structural Steel work with operating temp. Up to 90 ^o C (Steel structures, Piping support, uninsulated CS piping, flanges, valves, stairways, walkways etc. except grating).	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High durability	Total dry film thickness of paint system: 320 microns as per C5 – High durability
02	Uninsulated CS piping, flanges,	Blast cleaning to near white	P1 : One coat of Ethyl Silicate zinc rich with	P1 : 75 microns	Total dry film thickness of paint	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	valves with operating temp. From Above 90° C to 200° C.	metal grade Sa-2½, of Swedish Standards SIS-05-5900 (Latest)	solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleo resinous based heat resistant ready mixed Aluminium Paint.	F3 : 2 x 25 microns for each coat Total - 125 microns.	system: 125 microns.	
03	Uninsulated CS piping, flanges, valves with operating temp. Over 200° C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
04	Insulated CS piping flanges, valves with operating temp up to 90° C	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F8 : One coat of high temperature epoxy phenolic	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.	
05	Insulated CS piping, flanges, valves with operating temp. From 90° C to 200° C.	Blast cleaning to near white metal grade Sa-2½, of Swedish Standards SIS-05-5900	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns	
06	Insulated CS piping, flanges, valves with operating temp. Over 200° C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F9 : Two coats of Inorganic Co-polymer based coating With an Inert Multipolymer Matrix.	F9 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.	
07	Uninsulated CS equipment with operating temp. Up to 90° C, to be treated at Manufacturer's	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two	P2 : 60 microns F1 : 120 – 200 microns	Total dry film thickness of paint system: 240	Total dry film thickness of paint system: 320

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	shop.	(Latest).	packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	F5 : 60 microns	microns as per C4 – High Durability	microns as per C5 – High Durability
08	Uninsulated CS equipment with operating temp. From 91°C to 200°C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
09	Uninsulated CS equipment with operating temp. Over 200°C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
10	Insulated CS equipment with operating temp. Up to 90°C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns	
11	Insulated CS equipment with operating temp. From 91°C to 200°C, to be treated at Manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns	
12	Insulated CS equipment with operating temp.	Blast cleaning to near white metal grade 2	F9 : Two coats of Inorganic Co-polymer based coating With an	F9 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
	Over 200°C, to be treated at Manufacturer's shop.	½, of Swedish Standards SIS-05-5900 (Latest).	Inert Multipolymer Matrix.			
13	Surface of structural steel for furnaces, external surface of furnaces, external surface of flue duct, metal stacks and similar with operating temp. Up to 200°C. (With exclusion of stair ways, walk ways etc.).	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleo resinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
14	For external surfaces of flue ducts, metal stacks, and similar with operating temp. Above 200°C.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
15	For surfaces of air cooler heads not galvanized with operating temperature up to 90° C, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability
		NOTE: All surfaces shall be galvanized at manufacturer's shop with exception of the end header of air cooled heat exchangers that shall be treated as described above at Manufacturer's shop. In case the same surfaces shall not be treated at shop, they shall be treated at site according to environmental and operating conditions.				

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
16	For surfaces of air cooler heads not galvanized with operating temperature up to 91 ^o C TO 200 ^o C, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special Oleouresinous based heat resistant ready mixed Aluminium Paint.	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	
		NOTE: All surfaces shall be galvanized at manufacturer's shop with exception of the end header of air cooled heat exchangers that shall be treated as described above at Manufacturer's shop. In case the same surfaces shall not be treated at shop, they shall be treated at site according to environmental and operating conditions.				
18	STORAGE TANKS					
a)	Acid / Alkali CS Storage Tank (External Surface including all stair ways)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability
b)	CS Storage Tanks, Excluding indicated in Sl. No. (a)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F1 : One coat of two pack Polyamide Cured Epoxy. F5 : Two-pack aliphatic Isocyanate cured acrylic finish	P1 : 60 microns F1 : 120 - 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks	
			paint			
19	Cold Insulated Carbon Steel and low alloy Steel (1- ¹ / ₄ Cr through 9 Cr) Piping and Equipment. (Upto 60 Deg. C)	Blast cleaning to near white metal grade 2 ¹ / ₂ , of Swedish Standards SIS-05-5900 (Latest).	F7 : Two coats of Tar Free Epoxy paint suitably pigmented	F7 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.	
20	Cold Insulated high alloy Steel piping and Equipment (Upto 200 Deg. C)	Lightly Blast cleaned as per Sa 1.0 Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns	
21	DELETED					
22	Surface (CS) with Equipment with temp. Indicating paint from 220°C to 240°C treated at Manufacturer's shop	Blast cleaning to near white metal grade 2 ¹ / ₂ , of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F6 : Temperature indicating paint	P1 : 75 microns F6 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.	
23	PACKAGE:					
a)	Surface (CS) with operating temperature upto 90°C treated at Manufacturer's shop	Blast cleaning to near white metal grade 2 ¹ / ₂ , of Swedish Standards SIS-05-5900 (Latest).	P2 : ONE coat of two pack zinc rich epoxy Primer meeting SSPC Paint 20 level 1 F1 : One coat of two packs. Polyamide Cured Epoxy. F5 : One coat of two pack aliphatic acrylic polyurethane	P2 : 60 microns F1 : 120 – 200 microns F5 : 60 microns	Total dry film thickness of paint system: 240 microns as per C4 – High Durability	Total dry film thickness of paint system: 320 microns as per C5 – High Durability
b)	Surfaces (CS) with operating temperature upto 91 ⁰ C TO 200 ⁰ C, treated at manufacturer's	Blast cleaning to near white metal grade 2 ¹ / ₂ , of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F3 : Two coats of single pack special	P1 : 75 microns F3 : 2 x 25 microns for each coat	Total dry film thickness of paint system: 125 microns.	

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Ref No.	Application	Surface Preparation	Generic Coating System	Minimum DFT	Remarks
	shop.		Oleouresinous based heat resistant ready mixed Aluminium Paint.		
c)	Surface (CS) with operating temp. Over 200°C, treated at manufacturer's shop.	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	P1 : One coat of Ethyl Silicate zinc rich with solvent Primer meeting SSPC Paint 20 level 1 F4 : Two coats of Heat Resisting Silicon Aluminium Paint.	P1 : 75 microns F4 : 2 x 25 microns for each coat Total - 50 microns.	Total dry film thickness of paint system: 125 microns.
d)	Package in Carbon Steel and low Alloy Steel (1-¼ Cr through 9 Cr) with cold insulated surface treated at manufacturer's shop (Upto 60 Deg. C)	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F7 : Two coats of Tar Free Epoxy paint suitably pigmented	F7 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns.
e)	Package in Cold Insulated high alloy Steel. (Upto 200 Deg. C)	Lightly Blast cleaned as per Sa 1.0 Swedish Standards SIS-05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 125 microns	Total dry film thickness of paint system: 250 microns
f)	DELETED				
24	For internal surface of shell, roof of CS tanks, with operating temp. Upto 110°C	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-05-5900 (Latest).	F2 : Two coats of two pack amine adduct cured Phenolic (Novolac) epoxy (immersion grade)	F2 : 2 x 150 microns for each coat	Total dry film thickness of paint system: 300 microns.
25	For underside (soil side) of the tank bottom (CS) below only of the fixed tanks,	Blast cleaning to near white metal grade 2 ½, of Swedish Standards SIS-	F7 : Two coats of Tar Free Epoxy paint suitably pigmented OR	F7 : 2 x 200 microns OR	Total dry film thickness of paint system: 400 microns. OR

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	bottom & shell shall be treated as follows:	05-5900 (Latest).	F8 : Two coats of high temperature epoxy phenolic (novolac)	F8 : 2 x 150 microns	Total dry film thickness of paint system: 300 microns.
26	CS Equipment and associated piping subject to cyclic, intermittent or regeneration operating condition (e.g. Molecular Sieve Driers) subjected to very severe corrosion with wide operating temperature range.	Blast cleaning to near white metal grade 3, of Swedish Standards SIS-05-5900 (Latest).	Primer: One coat of Thermal spray Aluminium paint and sealed with a Silicon Aluminium seal Finish Coat: One coat of Thermal spray Aluminium paint and sealed with a Silicon Aluminium seal.	Primer: 125 microns Finish: 125 microns	Total dry film thickness of paint system 250 microns.

NOTES:



Primers

ZINC ETHYL SILICATE PRIMER – P1

The zinc ethyl silicate consists of two packs. One pack contains the ethyl silicate binder with suitable solvents. The other pack contains zinc dust (NOT Paste). Zinc dust shall be ASTM D 520 Type II. They have to be mixed in suitable proportions before application as recommended by manufacturer.

Volume solids	:	Min.64% ±2
DFT Range	:	50 – 75 microns
Theoretical Spreading Rate	:	12.8 – 8.53 sqm/litre
Colour	:	Grey
Application	:	Spray (airless/air)
Drying time (dry to handle)	:	< 45 mins. @ 30 Deg. C and 65% RH
Curing	:	<16 hrs @ 30 Deg. C and 65% RH
% of total metallic zinc in dry film (As per the ASTM D520 – Spherical size)	:	(SSPC SP 20 Level 1) >85% by wt.
Specific Gravity	:	2.5 Kg/Litre min.
Storage life	:	6 months under sealed conditions

Zinc silicate Material curing shall be checked using ASTM D 4752, minimum Acceptable value is 4.

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ZINC RICH EPOXY PRIMER – P2

The zinc rich epoxy consists of two packs. One pack contains the epoxy binder with suitable solvents. The other pack contains zinc dust as per ASTM D520 Type II. They have to be mixed in suitable proportions before application as recommended by manufacturer.

Volume solids	:	65% min. ±2
DFT	:	50 – 100 microns
Theoretical Spreading Rate	:	13 – 6.5 sqm/litre
Colour	:	Grey
Application	:	Airless spray/air spray/brush
Drying time (dry to handle)	:	<10 min. @ 30 Deg C
Hared Dry	:	< 1.5 hrs @ 30 Deg C
% of total metallic zinc in dry film (As per the ASTM D520 – Spherical size)	:	(SSPC SP 20 Level 2) 81% by wt. min.
Specific Gravity	:	2.3 Kg/Litre min.
Storage life	:	12 months under sealed conditions

Finish Paints

HIGH BUILD EPOXY FINISH – F1

This finish paint is fast drying, high build, Two-pack polyamide cured epoxy resin



Volume solids	:	85% min. ±2
DFT Range	:	100 – 200 microns
Theoretical Spreading Rate	:	7.6 – 3.8 sqm/litre
Colour	:	As per Manufacturer List
Binder	:	Polyamide cured epoxy resin, Lead & Chrome Free
Application	:	Brush or spray
Drying time	:	< 2 hrs @ 30 Deg C
Over coating time	:	< 2 hrs @ 30 Deg C
Storage life	:	24 months under sealed conditions

HIGH BUILD EPOXY FINISH (Immersion Grade) – F2

This finish paint is high build, Two-pack phenolic (novolac) epoxy

Volume solids	:	68% min. ±2
DFT Range	:	100 – 150 microns
Theoretical Spreading Rate	:	6.8 – 4.5 sqm/litre
Colour	:	As per Manufacturer List
Binder	:	Amine adduct cured epoxy resin
Application	:	Brush or spray
Drying time	:	< 1.5 hrs @ 30 Deg C
Over coating time	:	< 6.5 hrs @ 30 Deg C
Storage life	:	24 months under sealed conditions

HEAT RESISTANT ALUMINIUM FINISH PAINT : F3

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It is a single pack system based on oleo resinous general purpose aluminium paint with good heat resistance upto 250 Deg. C. and light reflection.

Volume solids	:	25% min. ± 2
DFT Range	:	25 microns
Theoretical Spreading Rate	:	10 sqm/litre
Main pigment	:	Aluminium (ASTM 962), Lead & Chrome Free
Colour	:	Metallic Aluminium
Pigment Volume Concentration	:	15 – 20%
Application	:	Brush or spray
Drying time	:	Surface dry <1hr. @ 30 Deg. C Hard dry < 3 hrs. @ 30 Deg. C
Storage life	:	24 months under sealed conditions

HEAT RESISTANT SILICON ALUMINIUM FINISH PAINT : F4

It is a single pack system based on ambient curing silicone aluminium pigmented polysiloxane paint with maximum heat resistance of upto 600 Deg. C.

Volume solids	:	25% min. ± 2
DFT Range	:	25 microns
Theoretical Spreading Rate	:	10 sqm/litre
Main pigment	:	Aluminium (ASTM 962), Lead & Chrome Free
Colour	:	Metallic Aluminium
Pigment Volume Concentration	:	15 – 20%
Application	:	Brush or spray
Drying time	:	Surface dry < 1hr. at 30 Deg. C Hard dry < 3 hrs. at 30 Deg. C
Storage life	:	12 months under sealed conditions

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TWO PACK ALIPHATIC ACRYLIC POLYURETHANE FINISH PAINT – F5

It Consists of Acrylic Resin in Part A. Part B consists of an aliphatic poly-isocyanate with appropriate solvents and additives.

Volume solids	:	51% min. ±2
DFT range	:	50 – 100 microns
Theoretical Spreading Rate	:	10.2 – 5.1 sqm/litre
Main pigment	:	Suitable pigments to get the desired colour, Lead & Chrome Free
Colour	:	Metallic Aluminium
Binder	:	Shall not contain any binder other than acrylic resin; should not contain any alkyd / acrylate alkyds / esters.
Application	:	Brush or spray
Drying time	:	Surface dry < 1hr. @ 30 Deg. C Hard dry < 8 hrs. @ 30 Deg. C
ISO 11507/ASTM G 154, QUV A - Accelerated weathering	:	Gloss retention: approx. 80 % and colour change approx. DE 1.2 after 3000 hours exposure
Storage life	:	24 months under sealed conditions

TEMPERATURE INDICATING PAINT: F6

It is a single pack temperature indicating system based on silicone binder. Pigments change colour by heating. The colour change of the coating is permanent. At approximately 200°C, the colour changes from green to blue, above 310°C, the colour changes from blue to greyish white. Maximum service temperature is 400°C.

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Volume solids	:	40% min.
DFT	:	25 microns
Theoretical Spreading Rate	:	16 sqm/litre
Main pigment	:	As per shade requirement, Lead & Chrome free
Colour	:	As per manufacturer
Binder	:	Based in silicone Resins
Application	:	Brush or spray
Drying time	:	Surface dry < 1hr. @ 30 Deg. C Hard dry < 4 hrs. @ 30 Deg. C
Storage life	:	12 months under sealed conditions

TAR FREE EPOXY – F7 (Coal Tar is Banned Globally being Carcenogenic)



A high build two component abrasion resistant, pure epoxy with anti-corrosive properties meant for excellent performance.

Volume solids	:	Minimum 72%
DFT Range	:	150 – 200
Theoretical Spreading Rate	:	4.8 – 3.6 sqm/litre
Application	:	By brush or airless spray
Drying time	:	Touch Dry within 4 hrs. @ 30 Deg C Hard dry < 9 hours @ 30 Deg. C
Storage life	:	12 months under sealed conditions

EPOXY PHENOLIC (NOVOLAC) – F8

Two Pack epoxy-phenolic (novolac) cured with amine adduct used as an External coating for the protection of insulated (CUI) equipment.

Volume solids	:	68% min.
DFT Range	:	100 – 150 microns
Theoretical Spreading Rate	:	6.8 – 4.5 sqm/litre
Binder	:	Epoxy phenolic (novolac)
Dry Temp. Service	:	Min. -196 to max. 205 Deg. C.
Application	:	Airless Spray / Brush Touch up
Drying Time	:	Surface dry < 1.5hr. @ 30 Deg. C Hard dry < 6 hours @ 30 Deg. C

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Storage life	:	12 months under sealed conditions
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INORGANIC CO-POLYMER COATING – F9

MIO pigmented single component inorganic copolymer coating which cures to form an inorganic polymer matrix able to resist temperatures up to 650°C/1202°F and thermal shock/cycling dry or dry/wet service.

Volume solids	:	74% min.
DFT Range	:	150 microns
Theoretical Spreading Rate	:	5 sqm/litre
Binder	:	Inorganic copolymer coating
Dry Temp. Service	:	Min. -196 to max. 650 Deg. C.
Application	:	Airless Spray / Brush Touch up
Drying Time	:	Surface dry < 0.5hr. @ 30 Deg. C Hard dry < 1.5 hours @ 30 Deg. C
Storage life	:	12 months under sealed conditions

6.0 MACHINERY, ELECTRICAL AND INSTRUMENT EQUIPMENT:

6.1 Machinery

Steel surfaces shall be treated with complete paint system at Manufacturer's shop. The paint system shall be according to Manufacturer's Std. However, suitable for operating condition and the environmental condition where the machinery will operate. Where necessary machinery shall be restored at site by Contractor with suitable finish.



6.2 Electrical and Instrument Equipment

Steel surfaces shall be treated with complete paint system at Manufacturer's shop. The paint system shall be according to Manufacturer's Std., however suitable for operating condition and the environmental condition where the electrical and instrument equipment will operate. Where necessary Electrical and Instrument Equipment shall be restored at site by Contractor with suitable finish.



7.0 COLOURS:

These shall be as required by specification and in particular for:

Description	Colour	Ra1	Correspond. Asian Paint colors to be defined – See Note-2
- Piping with temperature less than 90°C	GREY	7035	
- Piping, hot surface, flue gas ducts and stacks with temperature above 90°C	SMOOTH	ALUMINIUM	"
- Cooling Water Piping	SEA		"

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Description	Colour	Ra1	Correspond. Asian Paint colors to be defined – See Note-2
	GREEN		
- Fire fighting Piping	Red	3002	“
- Structures upto 2 MT	BLACK	9005	“
- Structures above 2 MT	GREY	7010	“
- Stair cases – ladders	BLACK	9005	“
- Walkways	GREY	7010	“
- Handrails assemblies	YELLOW	1004	“
- Equipment	GREY	7035	“
- Hot equipment	SMOOTH	ALUMINIUM	“
- Fire fighting equipment	RED	3002	“
- Valves in general	GREY	7035	“
- Hot valves	SMOOTH	ALUMINIUM	“
- Safety and Fire fighting valves	RED	3002	“
- Valves handwheels	BLACK	9005	
- Electric Rotary Machines	SKY BLUE	5012	
- Electric Static Machines	GREY	7035	
- Machinery (compressors & pumps) with operating temperature less than 90°C	GREY	7035	“
- Machinery (compressors & pumps) with operating temperature above 90°C	SMOOTH	ALUMINIUM	“
FURNACES			
- Casing and connected steel works	SMOOTH	ALUMINIUM	“
- Steel work not connected to casing	SMOOTH	ALUMINIUM	“
AIR COOLER			
- High Temperature Surfaces (Temp. > 90°C)	SMOOTH	ALUMINIUM	
- Low Temperature surface (Temp. ≤ 90°C)	GREY	7035	“
- Flare ≤ 90°C	GREY	7035	“
- Flare ≥ 90°C)	SMOOTH	ALUMINIUM	“
TANKS			
- Shell of fixed roof	WHITE	9010	“
- Roof of fixed roof tank	WHITE	9010	

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NOTE-1: The colours shall be according to IS2379:1990/International STD. RAL or BS, proposed by Contractor or Manufacturer

8.0 PARTICULAR DESCRIPTION

The abrasive Grit Blasting shall be used for surface preparation. **Sand blasting is prohibited due to environmental regulations.**

Primerized surface shall be faultless and shall not have mud-cracking, dripping over thickness and dry sprays.

Blast cleaning and painting shall not be carried out on wet surfaces.

Blast cleaning shall not be done when surfaces temperatures are less than 3°C above dew point, or temperature is below 5°C.

No acid washes or other cleaning solutions or solvents shall be used on metal surfaces after they have been blasted.

The surface preparation of all steel surfaces to be coated shall be free of all mill scale, rust corrosion product, oxides, paint, oil or other foreign matter

Only dry abrasive blasting procedures will be allowed. The compressed air supply used for blasting shall be free of detrimental amounts of water and oil. Adequate separator and traps shall be provided and these shall be kept emptied of water and oil. Any blast cleaning set up without functioning moisture separators shall be removed from blast cleaning areas.

All welded areas and appurtenances shall be given special attention for removal of welding flux in crevices. Welding splatter, slivers, laminations and underlying mill scale exposed during sand blasting shall be removed or repaired.

The blast-cleaned or power brushing surfaces shall be coated with primer within four hours of surface preparation.

No primer or intermediate or finishing coating shall be applied without prior notification to the Company.

The application of the products shall be carried out in strict compliance with the paint manufacturer's recommendation.



The Contractor shall provide suitable protection for all adjacent plants or equipment from airborne during spraying and sand blasting.

9.0 INSPECTION AND TESTING

The inspection and testing requirements outlined in this section shall be performed for shop and site applied coating systems.

Preference shall be given to manufacturers and applicators that are quality certified to ISO 9001: 2000.

Documentation of coating material manufacturers and applicators shall include daily inspection reports, equipment reports, and shall clearly identify and trace materials supply and testing performed on coated items and areas.

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Inspection and Test Plans (ITPs), and quality control procedures used for application of coating systems shall form part of the Method Statement and shall be submitted for approval by the Principal prior to commencement of work.

The applicator shall appoint a certified inspector of coatings for inspection and testing of coating systems.

Tests of coated areas and items shall form part of the ITPs.

- Surface Preparation in accordance to Swedish Standard SIS-05-5900 (Latest).
- Blast cleaning profile shall be checked using a suitable profile meter – Acceptable profile shall be 40 - 60 microns.
- Check of time of top coating and drying in accordance with the direction of the paint manufacturer.
- Check of dry film thickness by suitable non-destructive Instrument such as “MIKROTEST”, “DIAMETER” or equivalent.
- Before any coating work is performed on the site, the contractor shall ensure that any works applied by others is acceptable.

Any defect that are discovered, are to be notified in writing to the owner before proceeding with the contract work. To ensure the good execution of painting work following test shall be performed:

- Surface Preparation
- Surface contaminant tests
- Surface profile tests
- Coating thickness tests
- Tests for cure of coatings
- Adhesion tests
- Continuity testing
- Iron contamination
- Chloride contamination
- Dust Contamination



All Inspection and Test Records (ITRs) shall be submitted with the Manufacturer’s Data Report (MDR) at the conclusion of the job.

Defective coated areas shall be suitably marked for rectification work to be performed in compliance with this specification.

Access shall be granted for inspection of all paint work, and witnessing of test work. This shall not however relieve the Contractor of their own QA/QC responsibilities.

10.0 ADHESION TEST RESULTS

For all type of primer the Contractor shall guarantee the Classification of Adhesion Test Results as per ASTM D3359. The acceptable Rate Adhesion Test Results shall be for sandblasted and primerized surfaces shall be minimum 3A (or Higher)

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For primer plus finishing coat(s) the Contractor shall guarantee the Classification of Adhesion Test Results as per ASTM D 3359. The acceptable Rate Adhesion Test Results shall be for blast cleaned and painted surfaces shall be minimum 3A (or higher).

After test, the surface must be repaired according to the system applied.

11.0 SUBMISSION OF DATA

Contractor shall submit in phase of bid the original technical data sheet and system for all material supplied by him to apply for the permanent works and test report for the paint in compliance to IS101. This material shall be subject to Owner's approval.

The test certificates of zinc silicate shall provide the specific gravity of mixed paint.

12.0 LETTER AND NUMBER INSCRIPTION

Inscriptions letters, as herebelow indicated, shall be made on equipments, piping, storage tanks, machinery etc.

12.1 Geometric forms and dimensions

Letters and numbers dimensions shall be orientatively fixed according to following:

(A – Dimension of side of unitary elements of grid)

- Storage Tanks A – 60 mm
- Equipments and piping with O.D. above 600 mm A– 40 mm and
- Equipments and pipings with O.D. from 300 to 600 mm and for machinery of great dimensions A – 20 mm
- Equipments and pipings with O.D. less than 300 mm and for machinery with small dimensions A – 10 mm

12.2 Inscription's Colours

Inscriptions shall be Black ENI 901 (RAL 9005) on light base

Inscriptions shall be White ENI 101 (RAL 9010) on dark base

12.3 Spaces and Interspaces



Spaces between words and assemblage of numbers shall have dimensions equal to 2A

Interspaces between letters or numbers shall have dimensions equal to A.

13.0 Colour Band for piping ;-

As a rule minimum width of colour band shall confirm to the following Table:-

Nominal pipe Size	Width L (mm)
3" & below	25
4" NB-6" NB	50
8" NB-12"NB	75

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14" OD & above	100
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14.0 LIST OF MANUFACTURERS :

1. M/s Berger Paints
2. M/s Jensions & Nickolson
3. M/s Jotun Paints
4. M/s Asian Paints
5. M/s Grauer & Weil (India) Limited
6. M/s Shalimar paints
7. M/s Garware Paints
8. M/s Goodlass Nerolac Paints Ltd
9. M/s. HEMPEL Paints
10. M/s International Paints (Akzo Nobel Brand)
11. M/s Carboline (India) Pvt. Ltd.
12. M/s Mohan Paints

15.0 The contractor shall obtain prior approval from Engineer-In-Charge for the brands of paint material proposed to be used. The contractor shall submit the following details of paint material either at the time of bidding or soon after award of work for approval of paints.

- a. Technical data sheet
- b. Material safety data sheet
- c. Finger printing of paint products as per ISO 20340

16.0 Owner reserves the right to take random samples and get it tested through reputed labs. In case the supplied paint material do not meet the specified performance requirements then suitable action shall be taken against the paint supplier. The decision of Engineer-In Charge shall be final and binding on the Contractor in such cases

17.0 WARRANTY:

Contractor along with Paint Manufacturer jointly shall develop the paint schemes following the system specification.

They shall jointly provide a performance guarantee for a period 5 years as stipulated below,



After 1 years – Corrosion in 3% of total painted area accepted

After 2 years – Corrosion in 6% of total painted area accepted



After 3 years – Corrosion in 9% of total painted area accepted

After 4 years – Corrosion in 12% of total painted area accepted

After 5 years – Corrosion in 15% of total painted area accepted

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where spontaneous visible corrosion has broken down the paint film to a degree exceeding “Ri 3” (as defined in ISO 4628/3-2003).

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ANNEXURE- 7 - 3

QUALITY CONTROL PROCEDURE AND INSPECTION REQUIREMENTS

1.0 LSTK CONTRACTOR'S QUALITY CONTROL



1.1 LSTK CONTRACTOR shall provide a quality control program manual include specific WORK methods and inspections, which assure quality.

This quality control program manual must be submitted to OWNER for Approval before starting the construction activities.



All installation WORK must be in strict accordance with this approved manual.

1.2 The quality control program shall include as a minimum the following:

- Methods use to control drawings; specifications and CONTRACT correspondence to assure that only the latest revisions are being used in the field.
- Inspection personal name, organization.
- Inspection methods and documentation of inspection (or tests) for shop fabrication, if required, and installation.
- Material control procedures from SITE receiving point, through "over, short and damage inspection" through storage and through installation.
- Positive material identification Procedures for:
 - Electrical cable pulling and testing.
 - Asphalt placement inspection.
 - Handling and storage methods to prevent damage.
 - Inspection and testing procedures and reports for civil, structural, piping, electrical, instrument, equipment and all installation WORK.
 - Repair.
 - Scrap and reject.
 - Grouting.
 - Welding.
 - Welder qualification.
 - Receiving all permanent plant material & equipment.
 - Rigging.
 - Welder's tests.
 - Nondestructive examinations to be used.
 - Positive material identification. etc.
- Identification of LSTK CONTRACTORS and ensuring their compliance with the manual and WORK required.
- Material certification verification methods.
- Calibration procedures for measurements and test equipment.
- Marking and identification of components in process and complete assemblies.

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- 2.0 Shop fabrication and field installation inspection OWNER'S REPRESENTATIVE to ensure specifications. in the following areas will be performed by full adherence to Receiving and inspection.
- Calibration of test inspection equipment.
 - Preventive maintenance and storage protection.
 - Internal cleanliness.
 - Proper material use and control.
 - Nondestructive testing and its results.
 - Workmanship.
- 3.0 OWNER'S REPRESENTATIVE or others as authorized by OWNER are to be permitted access to LSTK CONTRACTOR'S work areas for the purpose of inspection of material, equipment, documentation and other areas as required in LSTK CONTRACTOR'S quality assurance / quality control program.
- 4.0 No concrete will be placed by LSTK CONTRACTOR without an OWNER "Pour Release Form".
- 5.0 OWNER'S construction inspections will not relieve. LSTK CONTRACTOR of inspection or other responsibilities.
- 6.0 For piping all welders test pieces shall be supplied by LSTK CONTRACTOR and fully prepared for welding by LSTK CONTRACTOR.
- 7.0 LSTK CONTRACTOR shall evidence its familiarity and experience with the execution of the installation of WORK to the requirements of the applicable codes and shall perform its WORK in accordance to these requirements and to instructions issued by OWNER'S REPRESENTATIVE in this regard.
- 8.0 **CHECK ON QUALITY OF WORK**
- 8.1 OWNER'S REPRESENTATIVE'S inspector shall have free access to the place where the WORK is performed at all times, in order to check the quality of WORK
- 8.2 If during inspection / check reveals unsatisfactory WORK, LSTK CONTRACTOR shall immediately at LSTK CONTRACTOR'S expense. take such corrective measures as deemed required.
- 9.0 **CONTROL SYSTEMS**
- LSTK CONTRACTOR shall initiate and maintain the following control systems
- 9.1 **Backfilling**
- Compaction tests.
- 9.2 **Concrete**
- Design mix and approval record(s).
 - Batch plant inspection record.
 - Slump test record.
 - Compressive test record.
 - Pour release record.
 - Grouting release record.
 - Placement inspection records.
 - Concrete curing records.
- 9.3 **Asphalt**
- Design mix and approval records.

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- Batch plan inspection records. Placement inspection records.

9.4 **Piping**

- Weld x-ray file.
- Pipe and fitting certificate file.
- Isometric weld control sheet. Hydrostatic test records.

9.5 **Grounding**

Earth resistance test records.

9.6 **Electrical Cable and Instrument cable**

- Insulation resistance test records.
- Continuity test records.

9.7 **Material certification files**

9.8 **Equipment**

- Weld x-ray file.
- Material certificate files.
- Equipment installation records.
- Equipment maintenance record.
- Hydrostatic test records.
- Grouting release records.
- Alignment records.
- Vibration records.

10. **Requirements for Certification of Materials**

10.1 Mill certification of materials will be required based on the material type, the use and the codes and requirements.



10.2 LSTK CONTRACTOR shall provide:

Type A certification of compliance, for all but not limited to the following materials which LSTK CONTRACTOR is responsible to supply:

- Imported backfill materials.
- Ready mix concrete.
- Asphalt paving materials
- Prefab concrete items, including pre-cast manholes, catch basins, pits, sumps and sleepers.
- Paving stones and tiles.
- Inserted and embedded items, other than rebar, wire mesh and anchor bolts.
- Masonry blocks.
- Steel sliding plates.
- Special grouting materials, i.e. non-shrink type.
- Grouting materials, including grounding loop and branch wire which they are LSTK CONTRACTOR'S supply.

Type "B" "certificate, for all but not limited to the following materials, which LSTK CONTRACTOR is responsible to supply:

- Materials to be considered structural or structural grade.
- Reinforcing grade.
- Wires mesh reinforcement fabric.
- Anchor bolts.

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**10.3 Definition of Type of Certificates
Type A (certificate of Compliance):**

This is a certificate of compliance, issued by the manufacturing or processing works and signed by the quality department or persons to carry the responsibility for quality and conformity, stating that the materials supplied correspond (5) with what was agreed in the purchase order.



Type B (mill Certificate) :

This is a certificate on which the manufacturer's head of quality department confirms that the product supplied corresponds with what has been agreed in the purchase order. Certification shall be on the basis of tests carried out on the material of the product itself, as per purchase order specification. The testing and certification are to be carried out by a testing center which is independent of the production section of the manufacturing works and which has the code-approved facilities. Independence of such testing center should be warranted by LSTK CONTRACTOR.

10.4 LSTK CONTRACTOR will maintain a systematic filing system of all certificates and reports for all tests and inspections carried out by it under the applicable specifications, standards and codes of practice quoted therein.

LSTK CONTRACTOR may use its own format for records but this must be submitted to OWNER'S REPRESENTATIVE for his approval prior to use.

LSTK CONTRACTOR can expect to be audited on a continuous basis. Originals of all documents to be sent to OWNER'S REPRESENTATIVE.

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ANNEXURE- 7 – 4

SCHEDULE, PROGRESS EVALUATION AND PROGRESS REPORTING

1.0 GENERAL

1.1 WORK shall start and be completed in the field as indicated on the approved project construction schedule.

LSTK CONTRACTOR shall follow the sequence of construction in executing the WORK as shown in the schedule or as modified by OWNER.

The detailed scheduling of WORK will be supplied by the LSTK CONTRACTOR. WORK shall be conducted in such a manner that other construction activities are not affected.

Once detailed schedule, established and approved by OWNER, LSTK CONTRACTOR commits itself to follow the schedule in detail.

2.0 DETAILED & SCHEDULE

2.1 Detailed construction schedule must cover all construction work, from lowest level up to highest level.

2.2 Activities shown by means of a bar chart must include as a minimum the activities listed in 4.

3.0 PROGRESS REPORTING

LSTK CONTRACTOR shall issue a reporting procedure and a representative sample of all progress reports.



Following schedules and reports must be issued by LSTK CONTRACTOR to OWNER:

Construction schedule. (preliminary and detailed)
 Monthly status report.
 Weekly progress report.
 Monthly construction guide schedule.
 Daily manpower reports.

All except detailed construction schedule based on approved project construction schedule.

4.0 CONSTRUCTION SCHEDULE

Within **Two** months after Effective Date, LSTK CONTRACTOR will issue separate graphical "S" curves for the following work activities of total CONTRACT.

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Installation of :

- Concrete foundations, pits. manholes. catch basins, trenches and concrete structures.
- Prefabricated concrete items
- Concrete paving and elevated slabs
- Other paving and final surfacing
- Grouting.
- Final road paving.
- Underground piping.
- Underground cable trenches and cables.
- Building erection.
- Structural steel erection.
- Engineering and design of small bore carbon steel piping systems.
- Prefabrication of piping.
- Electrical installation.
- Instrument installation.
- Equipment assembly and elect
- Erection of piping.
- Flushing and cleaning
- Hydro-testing
- Painting
- Insulation.

5.0 INTRODUCTION

The introduction to the monthly status report shall include LSTK CONTRACTOR'S comments on the overall construction schedule with a status update line as attachment, and shall consist of the following items:

- Goals achieved last month.
- Goals for next month.
- Reason for delay, if any. Reason for deviation of original schedule.
- Average manpower by craft, including management and indirect staff.
- LSTK CONTRACTOR'S comments to general situation.



6.0 CONSTRUCTION ACTIVITIES STATUS

This section consists of scheduled versus actual progress curves.

The progress curves are to be commented upon by LSTK CONTRACTOR.

The basis for reporting shall be the construction schedule:

The monthly status shall be reported as a percentage of the total WORK per type of WORK.

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7.0 MANPOWER AVAILABILITY / REQUIREMENTS FOR THE MONTH COMING

LSTK CONTRACTOR shall submit its manpower availability requirements for the next month. This section consists also of the scheduled versus the actual manpower curves.

These manpower curves are accompanied by LSTK CONTRACTOR'S comments hereon.

8.0 MAIN CONSTRUCTION EQUIPMENT AVAILABILITY / REQUIREMENTS FOR THE MONTH COMING

LSTK CONTRACTOR shall submit its main construction equipment availability / requirements for the next month. This section consists also of the scheduled versus actual construction equipment requirement curves. These by LSTK CONTRACTOR'S comments hereon.

9.0 WEEKLY PROGRESS REPORT

Progress reporting will be done on a weekly basis by the actually completed work based on details of work such as quantities or piece of equipment as a percentage of the total anticipated work per work activities as defined in item 4.

9.1 Progress will only be reported on the basis of completed activities as per the percentage breakdown of the major steps as follows:

Progress Measurement Parameters

Actual physical progress in the field shall be measured based upon standard percentage of completion of progress stages, that, they are to be prepared by LSTK CONTRACTOR and Approved by OWNER to calculate actual physical progress of the WORK, the exact weight value of each activity from lowest level up to highest level in each category of the WORK shall be specified by LSTK CONTRACTOR and supplied to OWNER.

After OWNER'S Approval this weight value can be used for calculation of actual progress of the WORK

10.0 WEEKLY PROGRESS MEETING



10.1 Weekly Work List

In the weekly progress review meeting LSTK CONTRACTOR shall forecast the WORK it plans to perform during the week by means of a weekly WORK list including its manpower resource allocation as per the activities listed in 4 and 6.

This weekly program shall be in accordance with the construction guide schedules.

10.2 Work Front

LSTK CONTRACTOR shall submit monthly and weekly a total recapitulation Of the total work

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front available with estimated manpower requirements, materials and equipment which shall be supplied by LSTK CONTRACTOR.

11.0 MONTHLY CONSTRUCTION GUIDE SCHEDULE

Based on approved overall construction schedule, LSTK CONTRACTOR must issue a monthly construction guide schedule covering a two (2) months period, for each individual activity.



Progress updating of construction guide schedules must be weekly and presented in the weekly progress review meeting at site.

The updated issue will show for each individual activity:

- Percent complete.
- Weight factor complete.

12.0 DAILY MANPOWER REPORTS

LSTK CONTRACTOR shall be furnished daily manpower report as per agreed format.

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ANNEXURE- 7 – 5

EXECUTION PLAN

1.0 BIDDER ORGANISATION

1.1 Company Organisation

Bid shall include a description of the organization, its management structure and organization chart of Bidder's company with particular reference to the means whereby the execution of this project will be related to the overall company organization.

The Bidder shall also furnish the name(s) of their partners, associated/ subsidiary companies & their activities, and whether any such associated/ subsidiary company will be involved in the execution of WORK, and if so, their scope thereof.

1.2 Project Organization

Bidder shall give charts of organization, which he intends to use in the execution of the work. Such charts must show lines of authority and communication of senior personals who will be assigned to this work in Bidder's home - office and other offices where WORK shall be performed (if any) and the lines connecting such Project Organization to the Bidder's internal overall organization including partners (if any). The chart shall be supported by a narrative, which shall explain how the proposed organisation will operate and in particular will provide

The name of the location of the office(s) in which the Basic and Detail Engineering Design Packages of the plant shall be carried out.

If any parts of the Basic and Detail Engineering Design Packages are to be carried out in more than one office, then details of the distribution of the jobs between offices and coordination procedure shall also be presented.

A description of the facilities offered to the OWNER'S resident engineers.

2.0 Estimated project and Engineering man-hours

Bidder shall give an estimate of the engineering man-hours and its break down for all activities

3.0 Methods and procedures

Bidder shall summarise the methods and procedures that BIDDER intends to implement during the performance of the WORK. It shall include the proposed procedures such as Engineering, Procurement, construction strategy, WORK Progress Measurement, Pre-commissioning, Commissioning and Performance Test Run of the PLANT, and Training.



BIDDER shall also furnish proposed procedures for the Project management, communication and method and frequency of reporting the progress of the WORK.

The final form for reports, which will be subject to OWNER's Approval, shall include as a minimum the following :

- a) Planning and Scheduling
- b) Work Progress
- c) Safety and Security

NOTES:

- a) Sample reporting forms and other key standard forms shall be included.
- b) Bidder shall state the extent to which he will be using computerized drafting, etc.

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4.0 Job descriptions and personnel resumes

Bidder shall include job descriptions and personnel resumes of his staff nominated to the key positions, including (where applicable) at least the followings, or Bidder's equivalent:



Project director
 Process engineering co-ordinator
 Construction manager
 Process engineer
 Project engineering co-ordinator
 Senior pre-commissioning engineer
 Senior commissioning engineer
 Training co-ordinator and instructor.
 Construction Engineering Coordinator
 Construction Quality Control Engineer
 Construction Project Control Engineer
 Welding Specialists
 Heavy Lift Rigging Specialist
 Senior Specialist Engineers
 Senior Planning Engineers
 Materials Coordinators
 Senior Construction Engineers
 Senior Pre-commissioning Engineers
 Warehousing Officer
 Material Planning Engineers

Resumes shall give at least the name, age, nationality, education, professional exception/deviation and previous experience of each assigned personnel. Additionally, one alternative shall be offered for each position. **Bidder shall ensure that personnel to be deployed meet the minimum criteria specified in Annexure-7-6**

Bidder shall confirm that these key personnel will be made available to WORK on the Project as required by the schedule on full time basis.

Bidder shall furnish Summary of its Deployment Schedule Personnel as per **Annexure-7-7**.

Bidder understands that the said proposal represents the minimum deployment and the Bidder acknowledges that the said deployment may have to be augmented with additional number and/or categories, if required, if directed by Engineer-in-Charge in order to complete the work within the completion schedule and quoted lump sum price.

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5.0 Construction equipment and machinery

The BIDDER shall furnish details of construction equipment & machinery, testing equipment, tools/tackles, etc., which will be made available by the Bidder at the Site. Bidder shall furnish Summary of such details as per **Annexure-7-8, Annexure-7-9**.

Such list shall, in no way limit the CONTRACTOR's responsibility to arrange & provide any additional construction equipment, tools, tackle, etc., which might be required to execute and complete the WORK as per contractual schedule.

BIDDER shall furnish the procedures and his tools for erection of the Heavy Lift Equipments including tall columns):

6.0 Heavy lifts

BIDDER shall furnish his proposed, site transportation, lifting, along with preliminary rigging schemes and erection procedure for the heavy lifts. Such plans / schemes shall be furnished along with detailed write -up on heavy cranes proposed to be deployed by CONTRACTOR, duly supported by relevant technical literature.

7.0 BIDDER experience & exception/deviation to perform the work

The BIDDER should have experience in the construction of similar Plants. The BIDDER should have successfully executed and completed construction of at least one similar Plant with his own project management and with complete responsibility of construction / erection and pre-commissioning.

The BIDDER shall furnish, as a part of his Tender Documents establishing the BIDDER'S experience and exception/deviation to perform the CONTRACT. Such documentary evidence shall also establish to OWNER's satisfaction that the BIDDER has the necessary financial, technical, project management capabilities and the requisite resources to execute the Work.

Such documentary evidence shall also be furnished for BIDDER'S proposed Subcontractors, if any. The Bidder shall furnish, in a tabular form, a list of jobs of similar type and magnitude executed by them in the past. BIDDER shall also furnish details of their experience in erection of heavy lifts. The Bidder shall furnish documentary evidence, establishing to OWNER satisfaction, that such jobs have been timely and successfully executed by them. The BIDDER shall also furnish the details of their present major commitments.

8.0 QA/QC Program

Bidder shall furnish a summary description of their proposed QA/QC program.

Bidder shall furnish any other technical information / details as per the requirements of ITB.



9.0 Technical assistance

The extent of the Technical Services and Assistance to be rendered by CONTRACTOR for, commissioning and performance test run, etc., is to be proposed

10.0 Training

Bidder shall furnish the following details regarding the Training of OWNER'S personnel:

- a) Bidder's organisation set up for Training program.

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b) Training facilities available with the Bidder to train the OWNER'S personnel in

- Theory of process, operation, maintenance and manufacturing of products
- Field (on the job) training in process, operation, maintenance and manufacturing of products, to train the personnel on the job.

- Test procedure and other matters.

c) The courses and their duration, number of attendees in each course and location where such courses will be held that the Bidder would recommend OWNER to consider.

d) Bidder's experience of training the personnel for units similar to the subject PLANT.

11.0 Estimate of the number of personnel required for the safe and satisfactory operation of the Plant.



For and on behalf of

Stamp & Signature :

Name :

Designation :



Date :

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ANNEXURE-7-6

Minimum Qualification & Exp. Of Key Supervisory Construction Personnel

SL. NO.	CATEGORY	QUALIFICATION & EXPERIENCE
1	RESIDENT CONSTRUCTION MANAGER / RESIDENT ENGINEER / SITE-IN-CHARGE	Degree in Engg. With minimum 20 years relevant experience in construction should successfully constructed & commissioned at least one process unit in hydrocarbon / fertilizer sector.
2	LEAD DISCIPLINE ENGINEER	Degree in relevant Engg. discipline with minimum 15 years experience in Construction or Diploma in relevant Engg. Discipline with minimum 20 years experience in Construction.
3	LEAD WELDING / NDT ENGINEER	Degree in Mechanical Engg./Metallurgy with minimum 15 years experience in Welding / NDT (Non-Destructive Testing) plus Level-II in RT (Radiographic Testing) or diploma in Mechanical Engg. / Metallurgy with minimum 20 years experience in Welding / NDT plus Level-II in RT.
4	LEAD QA/QC ENGINEER	Degree in Engg. With 15 years Construction Experience of which 5 years should be as QA Manager.
5	LEAD PLANNING ENGINEER	Degree in Engg. With 15 years experience in Planning & Scheduling.
6	LEAD SAFETY OFFICER	Degree / Diploma in Engg. And Diploma in Industrial Safety with min. 10 years relevant experience in Construction Safety.
7	WAREHOUSE-IN-CHARGE / MATERIALS MANAGER	Graduate in Science or Diploma in Engg. / Materials Management with 15 years experience in Warehousing / Stores Management of similar nature.
8	DISCIPLINE SURVEYORS	Degree in relevant Engineering Discipline with minimum 3 years experience in Construction or diploma in relevant Engineering Discipline with minimum 6 years experience in Construction.

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9	QUANTITY SURVEYORS	Degree in relevant Engineering Discipline with minimum 3 years experience or diploma in relevant Engineering Discipline with minimum 6 years experience in quantity estimation, field measurement, rate analysis etc. in construction field.
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For and on behalf of

Stamp & Signature :

Name :



Designation :

Date :

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ANNEXURE-7-7
Deployment Schedule of Supervisory Personnel

SL. NO.	DESCRIPTION	DEPLOYMENT SCHEDULE																										TOTAL	
		1	2	3	4	5	6	7	8	9	10	.	.	.	..	..	.	.	..	.	.	..	.	.	..	35	36		37
1	PROJECT MANAGEMENT																												
1.1	PROJECT MANAGER																												
1.2	PLANNING MANAGER																												
1.3	PLANNING ENGINEERS																												
2	RESIDUAL DESIGN AND DETAILED ENGINEERING																												
2.1	PROJECT ENGINEERING MANAGER																												
2.2	ENGINEERING COORDINATOR																												
2.3	ENGG. PERSONNEL FOR VARIOUS DISCIPLINE																												
2.3.1	CIVIL STRUCTURAL																												
(i)	ENGINEERS																												
2.3.2	PRESSURE VESSELS																												
2.3.3	MECHANICAL EQPT/ ROTARY EQPT.																												
2.3.4	PIPING																												
(i)	ENGINEERS																												
2.3.5	ELECTRICAL																												



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ANNEXURE-7-8
Deployment Schedule of Construction Equipment



SL. NO.	DESCRIPTION	CAPA- CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
1	CRANES																							
1.1	1200 MT																							
1.2	700 MT																							
1.1	500 MT																							
1.2	300 MT																							
1.3	150 MT																							
1.4	75 MT																							
1.5	50 MT																							
1.6	20 MT																							
1.7	15 MT																							
1.8	10 MT																							
1.9	5 MT																							
2	DIESEL GENERATORS																							
2.1	500 KVA																							
2.2	300 KVA/250KV																							
2.3	150 KVA/125KV																							
3	COMPRESSORS																							
3.1	600 CFT																							
3.2	350 CFT																							
4	WELDING M/CS																							
4.1	DIESEL WELDING M/C																							
4.2	DIESEL GENERATOR																							

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SL. NO.	DESCRIPTION	CAPA-CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL
			4.3	WELDING TRANS FORMERS/RE C-TIFIERS																				
4.4	TIG WELDING M/CS																							
5	GRIT BLASTING M/CS																							
6	SPRAY PAINTING M/CS																							
7	STRESS RELIEVING M/CS																							
8	RADIO-GRAPHY M/CS																							
9	TEST PUMP																							
10	WATER PUMP																							
11	TRANSPORTA-TION EQPT																							
11.1	TRACTOR -TRAILOR																							
11.2	TRUCKS																							
11.3	BUS																							
12	JACKS																							
12.1	MECHANICAL																							
12.2	HYDRAULIC																							
13	CIVIL																							
13.1	EXCAVATORS																							
13.2	DUMPERS																							

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SL. NO.	DESCRIPTION	CAPA- CITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	..	33	34	35	36	37	TOTAL	
			13.3	BATCHING PLANT																					
13.4	CONCRETE PUMP CAR																								
13.5	TRANSIT MIXER																								
13.6	MIXER																								
13.7	VIBRATORS																								
13.8	COMPACTORS																								
13.9	THEODOLITES																								
14.0	OTHERS																								
14.1	INSULATION TESTING EQUIPMENT																								
14.2	SECONDARY INJECTION TESTING KIT																								
14.3	METERS, TOOLS & TACKLES ETC.																								
14.4	CALIBRATION EQUIPMENT																								
14.5	OTHER TOOLS & TACKLES																								
14.6	MULTI METERS CALIBERATORS ETC.																								
14.7	INDUCTION PIPE BENDING PLANTS																								
14.8	METALOGRAPHY																								
14.9	SPECTROMETERS																								

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ANNEXURE-7-9

Details Of Equipment Proposed to be used for Tendered Work

I / We, shall use the following MAJOR equipments owned by the tenderer for the work, if awarded to me /us :

Sl. No	Description	Quantity. (Numbers)	Make	Capacity	Owner	Approximate date when it will be deployed at site	Period of retention at site

For and on behalf of

Stamp & Signature :

Name :

Designation :

Date :

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SECTION VI- 5.0

DRAWINGS AND SOCUMENTS

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 DRAWINGS AND DOCUMENTS	PC0183/4018/SecVI/5.0	0	
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Section Number	Description
1.0	Drawings & Documents
2.0	Category of Documents
3.0	Procedure
4.0	List of Drawings & Documents

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1.0 DRAWINGS & DOCUMENTS:

This chapter details out various drawings and documents to be generated at various stages during the course of execution of the Project by the Contractor/Bidder for different project activities. Categorization of the documents/ drawings for review/ information/ records of PMC and the review/ approval requirements of the Owner/ PMC along with routing of the documents/ drawings will be conveyed separately as a philosophy.

The efficient handling of drawings and documents to be prepared by the Contractor under the contract is the key to the timely completion of the plants. The Contractor undertakes to ensure that all drawings and documents to be submitted by him to the Owner/ PMC shall be of professional quality and conforming to the contractual requirements. The Contractor also undertakes to institute a formal drawing control system which will be documented and submitted to the Owner/PMC for review or approval.

Compliance of this chapter on drawings and documents is mandatory and is non-negotiable.

The drawings / documents are to be generated by the Contractor at various stages of the project covering different activities. The drawings / documents generated will be in the category of Approval/ Review/ Information. The list of drawings and documents required is enclosed; however, the categorisation for the drawings/ documents will be informed separately. However, this will in no way relieve the Contractor of responsibility to conform to drawings, standards, specification, codes and contractual requirements / obligations.

The Contractor shall prepare the drawing numbering procedure and submit to Owner/ PMC for approval. Each Drawing submitted by the Contractor shall be clearly marked with the name of the Owner, PMC with revision number & date. It should contain the minimum following details:

- a. Size of Drawing.
- b. Discipline of Engineering for which the drawing is issued.
- c. Discipline wise segregation of numbering sequence for example:
100 Series for Process. 200 Series for Mechanical etc.

For drafting of Drawings, Computer aided design and drafting, AutoCAD shall be used. Further, standard, approved and well established P.C. based computer programmes/software packages, available in market shall only be used by the Contractor/his subcontractors/vendors etc. The Contractor shall bring out the list of all such packages in the offer for each discipline

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for evaluation of bid. Every time a computer aided design is submitted for review/ approval to Owner/PMC, it shall accompany with input/output data on Compact disc (CD) along with the name of the software package and operable on any system along with the requisite No. of Hard Copies (specified elsewhere in the Bidding document).

For drawing, data sheet and all graphic works Auto CAD 2015 and for all texts, MS Word Package 2012 shall be used. Hard Copies (4 nos.) and Soft Copies of all calculations & Drawings shall be made available by the Contractor for PMC review. Line List, Data Sheet & spread sheets shall be provided in MS Excel & all text items shall be in MS Word. All other documents like presentations etc. and other data shall be in MS Office; the required operating system for Data Exchange shall be at least Windows.

All documents before forwarding to Owner/PMC will have to be vetted in detail by the Contractor/duly approved engineering sub-contractor appointed by the Contractor. Document received without vetting will be returned.

The review by the PMC/Owner shall not be construed by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and drawings.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Owner, Unit Designation, Specifications, Title, Specification number and the name of the Project with Revision number and date. If standards, catalogue pages are to be submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English.

All the dimensions should be in metric units. Upon receiving comments on Drawings & Documents by the Contractor, the subsequent submission should give compliance report, separately on each of the comments, document-wise. Comments given by PMC/Owner to be discussed and finalised within agreed schedule.

The schedule of submission of the Drawings & Documents shall be in accordance with project plans only. The detailed list under different category, document-wise, shall be prepared by the Contractor for approval of Owner/PMC. This activity is to be completed within one month of Fax of Intent.

Sequence of submission of drawing is essential for proper review of documents and timely completion of the project is to be adhered. In case sequence is not maintained, the documents submitted will not be reviewed by Owner/ PMC and responsibility of timely execution of plant shall be to the Contractor's account.

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2.0 CATEGORY OF DOCUMENTS:

Category	Description	Action by Owner/ PMC
1	Records/ Information	Contractor can continue to progress with the work. This drawings or documents will be retained with Owner/PMC for information only. Owner/ PMC reserves the right to advise the Contractor of any comments (deviations from the contract) at any time and the contractor is liable to respond to satisfy that the work being done is in accordance with the contract; deviations, if any will be bidder's risk and cost.
2	Review/Approval	<p>Owner/PMC will review and advise the Contractor of any Comments on Contractor's Drawings / documents within specified schedule (ie 2 weeks), from date of receipt in PMC office of Contractor's drawings/documents. The review period is defined as date of receipt of documents by PMC, to date of issue of comments by PMC. This review period shall be valid only if submission of drawings is done by Contractor in accordance with approved drawings / documents schedule as indicated in ITB. In case of any non-conformity to the above by Contractor due to which the period of review extends beyond 2 weeks by the PMC, schedule delay, if any will have to be absorbed by the Contractor.</p> <p>Review of documents / drawings shall be categorized as follows:</p> <ul style="list-style-type: none"> i) Code-3: Not accepted. New Document / Drawing to be submitted ii) Code-2: Accepted with comments as marked iii) Code-1: Final approval

The documents falling under Review category will be returned with comments within specified time schedules subject to fulfilling other conditions enumerated. The information category

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document will be retained for information only but however Owner/PMC reserves the right to comment at any stage of the Project, but not later than two weeks of receipt.

Where clearance of Owner/ PMC is required for ordering of equipment materials, enquiry documents and one technically selected offer is to be submitted for review. The unpriced copies of purchase orders detailing both technical and commercial aspects for all items shall be submitted to PMC/ Owner within 15 days of issue of the same.

Each purchase order forwarded should contain complete technical documents. It is obligatory for the Contractor to obtain acceptance on all the technical documents and accepted copy only to be forwarded to Owner / PMC. Any inaccuracies /omissions/inconsistencies noticed and brought to the notice of the Contractor at any stage of the project will be rectified/ replaced by Contractor without any cost & time implication to the Owner/ PMC.

Detailed manufacturing schedules of fabricated/ manufactured items shall be submitted within one month of ordering, Status report for all the items in detail, will be submitted once in a month.

Documents to Boiler Regulation authorities shall be submitted and getting the documents reviewed by PMC/Owner. To any other agencies, documents shall be submitted under intimation to PMC/Owner.

As built drawings and documents will be generated within one month of completion of activities on respective items of work.

As Built Drawings:

Contractor will furnish reproducible and electronic files of all the drawings under their scope to Owner / PMC, certified as "As-Built Issue" by Third Party Inspection Agency (TPIA) for Vendor Items coming under Third Party Inspection / Contractor for all other drawings.

Upon completion of identifiable units or components of the fabrication, construction and installation phase of the project the Contractor will complete all the related plans to the "as built" stage including all Vendor drawings and furnish Owner/PMC with the following:

- a. One complete set of all original tracings copies.
- b. One complete set of reduced size (A3-297x420 mm) copies of all drawings.
- c. One set of CD for all documents/drawings/data
- d. All the as built drawings duly certified should be scanned and converted into electronic files made on magnetic/discs/optical long storage.

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- e. All other project documents such as operating and maintenance manuals, manufacturers' Catalogues etc. shall also be scanned on magnetic/optical discs for safe storage and retrievals by the Owner when needed.
- f. 10 complete sets of full size prints of the drawings and 4 sets of reduced size prints.
- g. 10 complete bound sets of Manufacturer's specifications including design calculations.
- h. 10 complete sets in hard binders of the Manufacturers data book including certified prints and data for all items including test reports. Data Books shall be complete with index as tag numbers associated with Manufacturer's data shown. Equipment data shall include as a minimum requirement the principal and description of operation, drawings and dimensions, spare parts lists and un-priced purchase orders and bill of material.
- i. 10 bound copies each of the Spare Parts data books and the Lubricants inventory Schedule.
- j. 10 complete sets of field records shall be signed by both the Contractor's and Owner's Representative at the site.
- k. Original approvals and related drawings and documents from the statutory authority.
- l. Copies of correspondence with the statutory authorities.

3.0 PROCEDURE:

The procedure for compilation of final as-built documents / drawings shall be informed later. However the Procedure for routing the final / as built documents/ drawings to PMC / Owner shall be informed during the execution stage.

4.0 LIST OF DRAWINGS & DOCUMENTS:

Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
A.	MATERIAL HANDLING				
1.0	Flow Diagram of Material Handling system	Y	Y	-	Y
2.0	Conveyors Layout drg.	Y	Y	-	Y
3.0	Wagon tippler and track hopper building Layout including scheme of wagon unloading	Y	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
4.0	Layout of all the Transfer Tower showing outline dimensions of all the equipments	N	Y	-	Y
5.0	General Arrangement drawing (showing part list, quantity, weight, main dimensions, all specifications etc.) of all equipments e.g – Bulk material handling Conveyors, Wagon tippler, Paddle feeder, Hopper, Wagon, Dust extraction system etc.	N	Y	-	Y
6.0	Data Sheet/Specification Sheet of all equipments completely filled in as per format	Y	Y	-	Y
7.0	Power, capacity and Pulley shaft dia calculations of all the conveyors as per CEMA / IS 11592.	N	Y	-	Y
9.0	Hopper capacity calculation	N	Y	-	-
10.0	Dust Extraction system design basis/calculation	N	Y	-	-
11.0	Civil Scope Drg. with Load data for design of buildings, gantry, foundations etc	N	Y	-	-
12.0	Detail GA drg. of all conveyors gantry, transfer towers, wagon unloading plant including railway platform showing all the equipments & machinery inline with Civil drg.(by others)	N	Y	-	Y
13.0	Catalogue for spare parts	N	-	Y	-
14.0	Design calculations of equipments structural including base plates	N	-	Y	-
14.0	Instruction manual showing installation, operation & maintenance procedure for all mechanical as well as electrical & Instrument items, parts list and bearing lubrication schedule substantiated by sketches and drawings.	N	-	-	-
15.0	Any other drawing required by owner / Consultant.	Y	Y	-	Y



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B.	ROTATING EQUIPMENT				
	PUMPS				
1	General Description and Equipment List	N	Y	-	Y
2	List of drawings / documents including drawing number, revision number, description and approval status	N	Y	-	Y
3	Detailed manufacturing programme (Time bar chart)	N	Y	-	Y
4	Certified dimensional outline drawing	N	Y	-	Y
5	Cross sectional drawing and bill of material	N	Y	-	Y
6	Shaft seal drawing and bill of material	N	Y	-	Y
7	Shaft coupling assembly drawing and bill of materials including allowable misalignment clearances, shaft bores & key ways dimensions with tolerances and the style of coupling guard	N	Y	-	Y
8	Primary & auxiliary sealing schematic and bill of materials including seal fluid, fluid flows, pressure pipe and valve sizes, instrumentation, orifice sizes, and piping arrangement drawings	N	Y	-	Y
9	Cooling or heating schematic and bill of materials including cooling & heating media, fluid flows, pressure, pipe and valve sizes, instrumentation, orifice sizes and piping arrangement drawings	N	Y	-	Y
10	Lube oil schematic and bill of materials	N	Y	-	Y
11	Lube oil system arrangement drawing including sizes, rating and location of all customer connections	N	Y	-	Y
12	Lube oil component drawings data	N	Y	-	Y
13	Electrical and instrumentation schematics, wiring diagrams and bill of materials	N	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
14	Electrical and instrumentation arrangement drawing and list of components	N	Y	-	Y
15	Performance curves	N	Y	-	Y
16	Pump specification sheet with complete details in Performance enclosed with enquiry / order	N	Y	-	Y
17	Certified foundation assembly drawing of pump with driver & all accessories mounted on base plate with load diagram for foundation design	N	Y	-	Y
18	Engineering flow diagram showing:	N	Y	-	Y
	- Lubrication & sealing lines				
	- Flushing / washing lines				
	- Cooling / steam lines				
19	Reference list for pumps supplied in past for similar duty conditions. Reference list shall contain complete address of user, user's purchase order number, brief specifications and date of commissioning	N	-	-	Y
20	Lube oil schedule	N	Y	-	Y
21	Automatic recirculation valve assembly drawing, sectional drawing with bill of material	N	Y	-	Y
22	Quality Assurance Plan.	N	Y	-	-
23	Material test certificates and Inspection & performance test report along with dispatch clearance certificates from inspector	N	-	-	Y
24	Instruction manuals describing installation, operation and maintenance procedures	N	-	-	Y
25	Spare parts list	N	-	-	Y
26	Parts catalogue complete with reference drawing nos. and sketches etc.	N	-	-	Y
	FANS & BLOWERS				
1	General Description and Equipment List	N	Y	-	Y
2	Specification sheets completely filled	N	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	in proforma.				
3	Characteristic Curves - Performance curves, showing discharge pressure, capacity, and brake horse power at the inlet specified conditions (Pressure, capacity, temperature, molecular weight).	N	Y	-	Y
4	Spare parts list	N	-	-	Y
5	Details of Lubrication and sealing system	N	Y	-	Y
6	Data for selection of motor :	N	Y	-	Y
	a) Type				
	b) HP absorbed at duty point				
	c) RPM				
	d) Recommended HP				
	e) Max. starting torque as % NRT				
	f) GD2 figure for rotating mass of the Fan / Blower				
	g) Speed vs. Torque for the Fan / Blower				
7	General Arrangement Drawing with all main dimensions, size and location of connections for ducting with all horizontal & vertical clearance necessary for installation and disassembly.	N	Y	-	Y
8	Cross sectional drawing of fan with parts list	N	Y	-	Y
9	Instruction manual for erection, installation operation and maintenance of fan and its accessories (Important clearances to be maintained should be clearly specified).	N	-	-	Y
10	Q.A.P and Test procedure	N	Y	-	Y
11	Lubrication schedule	N	Y	-	Y
12	Reference list indicating duty condition, location, year of installation, name of client etc.	N	-	-	-
13	GA drawing with all details & dims. Including fan, drive, motor	N	Y	-	Y
	HVAC PACKAGE				



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
1	General Description and Equipment List	N	Y	-	Y
2	List of drawings / documents including drawing number, revision number and description & approval status	N	Y	-	Y
3	Specification sheets - Completely filled in proforma.	N	Y	-	Y
4	General Assembly drawings - with main overall dimensions including those required for accessories and auxiliaries and all horizontal & vertical clearances for dismantling, direction of rotation etc.	N	Y	-	Y
5	Spare Part List	N	Y	-	Y
6	Description of Lubrication and sealing system	N	Y	-	Y
7	Manufacturing schedule, QAP	N	Y	-	Y
8	Cross-Sectional drawing of AC Plant and auxiliaries alongwith Bill of Materials	N	Y	-	Y
9	Instruction manuals for erection, commissioning , operation and maintenance of AC Plant and accessories.	N	-	-	Y
10	Material test certificates and Inspection & performance test report alongwith despatch clearance certificates from inspector	N	-	-	Y
11	Reference list for similar types of AC Plant supplied in past for similar duty conditions. Reference list shall contain complete address of user, user's purchase order number, brief specifications and date of commissioning along with operating conditions..	N	-	-	Y
12	Lube oil schedule.	N	Y	-	Y
	COMPRESSORS				
1	List of drawings / documents	N	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	including drawing number, revision number, description and approval status				
2	Detailed manufacturing programme (Time bar chart)	N	Y	-	Y
3	Specification sheet complete filled in PDIL proforma enclosed with enquiry/order.	N	Y	-	Y
4	Equipment layout with main overall dimensions including those required for foundations and piping design for compressor and auxiliaries. (This layout shall include the driven equipment and its auxiliaries).	N	Y	-	Y
5	Performance curves for compressor.				
	i) For constant speed motor driven compressors Discharge pressure , Brake horse power , Polytropic head and Efficiency Vs Inlet capacity (from surge point to 115 % of rated capacity) of the compressor at specified inlet pressure, temp. and mol. wt of the gas for each stage and for overall compressor	N	Y	-	Y
	ii) Torque Vs Speed curve for the compressors.	N	-	Y	Y
6	Performance Curve of driver	N	Y	-	Y
7	i) Calculation of the lateral critical speeds of the compressors.	N	-	Y	Y
	ii) Calculation of the torsional critical speeds. Analytical report for torsional vibration of whole set.				
	iii) Thrust loading curves for each casing / barrel for various operating conditions.				
	iv) Response curve of deflection Vs RPM for varying amount of imbalance.				
	v) Torsional critical response curve				
8	Overall dimensional drawing with all main dimensions, size and location of	N	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	piping connections for compressors and its auxiliaries.				
9	Cross sectional drgs. Of the compressor showing details of construction including sealing details, bearing etc. With part no., description and material of construction.	N	Y	-	Y
10	Coupling drawings	N	-	Y	Y
11	Seal assembly drawings & Bill of material	N	-	Y	Y
12	Lube oil Pumps				
	a) Specification sheet	N	Y		Y
	b) Performance curve	N	Y		Y
	c) Cross Sectional drawing	N			Y
13	Certified foundation scope drawing of the compressor with driver and all accessories resting on the foundation and control panel. In the event of motor not in the scope of supply of vendor the motor frame dimensions shall be supplied by the purchaser later). Direction and magnitude of all unbalanced forces, couples and centre of gravity along with direction of rotation shall also be mentioned	N	Y	-	Y
14	a) Engineering flow diagram indicating all instruments, valves, etc. marked with battery limit of supply of :	N	Y	-	Y
	- Process Gas lines - Cooling Water lines - Lubricating Oil lines - Condensate drain and vent lines				
	The above drawings shall identify all components by size, pressure rating and material				
	b) Material balance for gas, lube & seal oil.				
15	Piping layout plan and elevation drawings for gas, cooling water and utility lines, lube and seal oil lines etc.	N	Y	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
16	Driver : Selection details	N	-	Y	Y
	a) Speed - torque diagram				
	b) GD2 of the rotating masses of the compressor referred to the motor speed				
17	a) Piping isometrics for gas pipes DN>20, piping manifold and all oil lines.	N	-	-	Y
	b) Flexibility analysis for gas lines.				
18	Piping support location drgs. With forces, moments and movements for gas pipes and with weights for all lines.	N	Y	-	Y
19	Certified allowable forces, moments, movements, stresses for compressor nozzles.	N	Y	-	Y
20	Bill of Material for Piping and supports.	N	Y	-	Y
21	Bill of Material for insulation for Piping.	N	Y	-	Y
22	Bill of quantity for Painting for piping, equipments and auxiliaries.	N	Y	-	Y
23	Thermal calculation for heat exchangers, Mechanical calculation and fabrication drawings for heat exchangers and Pressure vessels.	N	Y	-	Y
24	Inspection and Test Procedure.	N	-	-	Y
25	Quality Assurance Plan.	N	Y	-	-
26	Inspection and test reports, material test certificates, radiographic reports duly approved by specified inspecting authority, certificates for compressors, heat exchangers, pressure vessels, pipings, valves, instruments and other auxiliaries.	N	-	-	Y
27	Lubrication schedule	N	-	-	Y
28	Instruction manual for erection, installation, operation and maintenance of compressor and its accessories (important clearances to be maintained should be clearly specified.).	N	-	-	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
29	Recommended list of spares for two years trouble free operation	N	-	-	-
30	List of special tools	N	-	Y	Y
31	Installation list of similar machines shall also include the following : a) Client, location and year of installation b) Drive c) Model No. and type of compressor d) Duty condition of the compressor e) Speed and KW rating	N	-	-	-
C.	STATIC EQUIPMENT				
STORAGE TANK					
1.1	Contractor document index with schedule of submission	-	-	Y	-
1.2	Mechanical Engineering Datasheet	-	-	Y	Y
1.3	General arrangement drawings of tank indicating design data , fabricated equipment weight, general notes, nozzle schedule, details of shell, supporting arrangement , main weld seams ,nozzle orientation plan etc.	N	Y	-	Y
1.4	Bottom And Annular Ring Layout & Weld Detail	N	Y		Y
1.5	Detail of sump for drain nozzles	N		Y	Y
1.6	Shell plate layout (showing location of nozzles and manhole)	N		Y	Y
1.7	Mechanical design calculations complying with the specifications and codes.	N	Y	-	Y
1.8	Detail of wind girder	N	Y	-	Y
1.9	Stairways, intermediate & top plate form	N	-	Y	Y
1.10	Roof plate layout & weld detail	N	Y	-	Y
1.11	Detail of nozzles on shell & roof	N	-	Y	Y
1.12	Details of internals like guide rollers, roof stoppers, still wells, dip pipe, heating coil e.t.c	N	-	Y	Y
1.13	Materials test certificates duly stamped by inspecting authority (**)	N	-	-	Y
5.14	QAP & inspection and test plan (**)	N	Y	-	Y
1.15	Welding procedure and qualification test reports (**)	N	-	Y	Y
1.16	Destructive and non destructive procedure & test reports (**)	N	-	Y	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
1.17	Heat treatment. Hydrotest procedure and time temperature charts (**)	N	-	Y	Y
1.18	Records of vacuum box test, spark test for rubber lining, plumpness, roundness, peaking, banding etc. (**)	N	-	Y	Y
1.19	Radiographic examination reports & films (**)	N	-	-	Y
1.20	All final as- built shop drgs. & design calculations	N	-	Y	Y
1.21	Completion certificates (including inspection certificates, hydrostatic test certificate , local code requirements) (**)	N	-	Y	Y
1.22	Vendor's quality assurance Practice (**)		-	-	Y
1.22	1. Final civil load data including details of foundation/anchor bolts 2. Foundation settlement check record (**)	N	-	Y	Y
1.23	List of spare parts and details (**)	N	Y	-	Y
1.24	Information on all bought out Components i.e vendors, size, model No., catalogues, installation & Operating manual, drawings and Calculations as applicable	-	-	Y	Y
Document marked as (**) are to be approved by authorized Third Party Inspection Agency and Statutory Authorities as applicable.					
PRESSURE VESSEL					
1.1	Mechanical Engineering Datasheet	-	-	Y	Y
1.2	General arrangement drawings indicating design data , fabricated equipment weight, general notes, nozzle schedule, details of shell, heads supporting arrangement , main weld seams ,nozzle orientation plan etc	N	Y	-	Y
1.3	Detail of nozzles, manholes, accessories etc.	N	-	Y	Y
1.4	Detail of internals such as tray, tray support ring, bolting bars etc.	N	-	Y	Y
1.5	Detail of demister	N	Y	-	Y
1.6	Mechanical & Structural Design calculations, Hydrodynamic calculation for Internals including fabrication drgs. of main equipment & Internals complying with the specifications and codes.	N	Y	-	Y
1.7	Detail of packing support, demister support, grating & grating support	N	Y	-	Y
1.8	Detail of internal distributor	N	Y	-	Y
1.9	Detail of external clips such as ladder,	N	-	Y	Y



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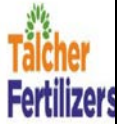
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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	platform, pipe support				
1.10	Detail of insulation ,fireproofing	N	-	Y	Y
1.11	Detail of pipe davit	N	-	Y	Y
1.12	Detail of lifting lug, tailing lug & trunion etc. including design calculation	N	-	Y	Y
1.13	Shell development drawings incorporating all attachments and weld seams	N	-	Y	Y
1.14	Name plate drawing detail along with name plate bracket	N	Y	-	Y
1.15	Template Drawing For Anchor Chair Of Equipment	N	-	Y	Y
1.16	Mechanical design calculation (strength calculation)	N	Y	-	Y
1.17	Approved certificate & approved Documents from statutory Authority (if applicable)	N	-	Y	Y
1.18	Certified 'as built' drawings Incorporating actual dimensions And material used, duly certified by the inspector	N	-	Y	Y
1.19	Data folder as per specification	N	-	Y	Y
1.20	Materials test certificates duly stamped by inspecting authority (**)	N	-	-	Y
1.21	QAP & inspection and test plan (**)	N	Y	-	Y
1.22	Welding procedure and qualification test reports (**)	N	-	Y	Y
1.23	Destructive and non destructive procedure & test reports (**)	N	-	-	Y
1.24	Heat treatment, Hydro test procedure and time temperature charts (**)	N	-	Y	Y
1.25	Radiographic examination reports & films (**)	N	-	-	Y
1.26	Records/ drawings, charts duly approved, signed and stamped by Statutory Authorities (**)	N	-	-	Y
1.27	Completion certificates (including Inspection certificate, hydrostatic Test certificate, local code Requirements, rubbing of code Stamp and name plate etc.) (**)	N	-	-	Y
1.28	Packing and forwarding instruction (**)	N	-	-	Y
1.29	Transportation drawing showing overall dimension, C.G. weight and handling instructions duly approved by appropriate authority	N	-	Y	Y
1.30	Erection scheme drawings Including weights, C.G., slinging Facilities, guideline & instructions	N	-	Y	Y
1.31	Assembly & Installation Detail (**)	N	-	Y	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
1.32	Final civil load data including details of foundation/anchor bolts	N	-	Y	Y
1.33	List of spare parts and details (**)	N	Y	-	Y

LEGEND: Y – Yes, N – No

Notes :

- Final documentations shall be supplied in hard copies as well as soft copies in CD Formats. Applicable. Software are MS Office 2000, Word, Access, and Excel.
- Document marked as (**) are to be approved by authorized Third Party Inspection Agency and Statutory Authorities as applicable.
- Final documentation shall be supplied in hard copies (6 prints) and soft (two CDs/DVDs) in addition to Submission through email.
- All drawing & documents shall be submitted in A2/A3 or A4 paper size. Documents in higher paper size shall be submitted in exceptional circumstances or as indicated in MR/Tender.
- Bill of material (showing part no. MOC, Size, quantity, weight of each part) shall form part of the respective drawing.
- Each vendor Drawing/Data (**listed under Review & information**) shall have been reviewed by the Contractor for ensuring strict compliance to the NIT Specification requirements and shall carry the Reviewers signature /seal of the Contractor, prior to submission for PMCs Review/Record and as Final Documentation. Drawings submitted without Contractors review shall be returned. Any Deviation to Purchase Specifications shall be clearly brought out through Deviation Waivers Permits for PMCs Approval.

D.	PIPING				
1.0	Equipment layout drawing	N	Y	-	Y
2.0	Piping Layout drawing	N	Y	Y	Y
3.0	Design data:				
3.1	Design basis	N	Y	-	Y
3.2	Piping material specification	N	Y	-	Y
3.3	Valve material specification(Valve Data Sheet)	N	Y	-	Y
4.0	<i>Material Take-offs (Linewise & consolidated BOQ)</i>	N	-	Y	Y
5.0	<i>Material Requisitions schedule</i>	N	-	Y	Y
6.0	Quality control plan/Inspection test plan	N	-	Y	Y
7.0	Vendor Drawings(Valves, Strainers, Traps etc)	N	Y	Y	Y



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
8.0	Issued for construction (IFC) Drawing				
8.1	Piping GA drawings	N	-	Y	Y
8.2	Isometrics	N	-	Y	Y
8.3	Piping supports, operating platforms drg.	N	-	Y	Y
9.0	Design calculation / Documents.	N	-	Y	Y
10.0	Flexibility Analysis of Piping	N	Y	-	Y
11.0	Support and load data	N	-	Y	Y
12.0	All inspection, testing & NDT Records.	N	-	Y	Y
13.0	As Built Drgs/Docs/MTCs	N	-	-	Y
14.0	3D model	N	Y	Y	Y
E.	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



**ROM COAL/PETCOKE/LIMESTONE HANDLING
FROM RAILWAY SIDING TO STORAGE YARD
TALCHER FERTILIZER PLANT, ODISHA
DRAWINGS AND DOCUMENTS**

PC0183/4018/SecVI/5.0

0

DOCUMENT NO

REV

SHEET 20 of 20



Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
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
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	
	This section is further elaborated in respective Section of Instrumentation and				



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Sl. No.	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
	the same shall have precedence in case of conflict.				

S. No	Description	With Bid (Y/N)	For Review/ Approval	For Information	Final/ Approved/ As-built
F.	ELECTRICAL				
1.0	Load List indicating rated and absorbed power of loads and duty type (Continuous / Standby / Intermittent) at different voltages including emergency loads.	N	-	Y	Y
2.0	Load Data indicating normal, peak, starting and construction power requirement at various voltage levels.	N	-	Y	Y
3.0	Single line distribution diagram (power, lighting, DC supply and UPS supply) including protection and metering details giving rating of each equipment.	N	Y	-	Y
4.0	Specification Sheets and Technical Particulars of Electrical Equipment	N	Y	-	Y
5.0	General arrangement and foundation drawings of all equipment.	N	-	Y	Y
6.0	Equipment layout in Sub Station, MCC room, and plant area showing location of all electrical equipment.	N	Y	-	Y
7.0	Cable schedule.	N	Y	-	Y
8.0	Cable rack / trench / pipe layout.	N	Y	-	Y
9.0	Power Layout.	N	Y	-	Y
10.0	Schematic diagram for all control panel & switch boards.	N	Y	-	Y
11.0	Feeder Details of all switch boards	N	Y	-	Y
12.0	Interconnection & Terminal connection diagram	N	-	Y	Y
13.0	List of controls, interlocks, indication & metering at various locations for all drives.	N	-	Y	Y
14.0	Characteristic curves for motor/ relays etc.	N	-	Y	Y
15.0	Sizing Calculations for Electrical System and Equipment.	N	Y	-	Y
16.0	Design calculations (for system design and equipment sizing, earthing, lighting,	N	Y	-	Y

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	cables, bus ducts etc.)				
17.0	Earthing and lightning protection layout	N	Y	-	Y
18.0	Lighting layout and Distribution diagram	N	Y	-	Y
19.0	Drawings and documents asked for each equipment as per respective Technical Specifications	N	Y	-	Y
20.0	Control & operation write up/Block logic diagrams.	N	Y	-	Y
21.0	Catalogues for all bought out items	N	-	Y	Y
22.0	Bill of Materials covering all electrical equipment and installation materials	N	-	Y	Y
23.0	Installation operation and maintenance(Manual)	N	-	-	Y
24.0	Relay Co-ordination and settings	N	-	Y	Y
25.0	Spare Parts list	N	-	Y	Y
26.0	Test Certificates	N	-	Y	Y
27.0	Guarantee Certificates	N	-	Y	Y
28.0	Quality Assurance Plan & Formats	N	Y	-	Y
29.0	Hazardous area Classification Drawing	N	Y	-	Y
30.0	Erection Drawings & Details	N	Y	-	Y
31.0	Construction & Commissioning specification and procedure for all equipment.	N	-	Y	Y
32.0	Any other drawings & data as required for satisfactory installation, operation & maintenance.	N	Y	Y	Y

Note:-

- a. Various Layout drawing for Substation indicated herein shall refers to substation & MCC room, while plant indicated herein shall refers to complete raw material handling & wagon unloading package including wagon tippler complex and track hopper building, Transfer tower, Conveyor gantry etc.
- b. 4 hard copies & 1 soft copy shall be supplied with bid.
- c. 4 hard copies & 1 soft copy shall be supplied for approval/information after order within 4 weeks.
- d. 8 hard copies & soft copies in **CD/Pen drive** 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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SECTION VI- 6.0

SPARE PARTS

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

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

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SECTION NUMBER	DESCRIPTION
1.0	Spare parts for Commissioning
2.0	Mandatory spare parts
3.0	Vendor recommended spare parts

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1.0 SPARES PARTS FOR COMMISSIONING:

Contractor shall supply free of cost spare parts and consumables (except raw materials and Utilities supplied by others) required during Pre-commissioning & Commissioning of the plants until the plant is handed over to the Owner after Performance Test.

2.0 SPARE PARTS FOR TWO YEARS OPERATION (MANDATORY SPARES):

Contractor shall supply Mandatory spare parts (along with the equipment) as detailed below:

I. Material Handling

S.No.		ITEM	QUANTITY	Unit
1		Mechanical		
A)		Paddle Feeder		
1		Rotor arm with Liners & Bolts	1	sets of each type
2		Liners of rotor arms	2	sets of each type
3		Gear box (including Paddle wheel, Travel drive, cable reel drive)		
	i)	Complete assembly	1	set of each type
	ii)	Bearings	1	set of each type
	iii)	Oil Seals	2	nos. of each size
	iv)	Input shaft with pinion	2	sets of each type
4		Hydraulic Power Pack		
	i)	Rotor Pump with electric motor, coupling, valves & EP control(mounted on pump)etc.	2	set of each type and rating
	ii)	Solenoid Valves complete with coils	2	set of each type and size
	iii)	Filter element (1 No. Pressure Filter + 1 No. Return Filter)	10	sets of each type
	iv)	Hydraulic Hoses	4	sets
	v)	Hydraulic Motor (for Paddle wheel)	2	no's of each type
	vi)	Hydraulic Motor (for Traverse Drive), if applicable	2	no's of each type
	vii)	Traverse pump with electric motor, coupling, valves (mounted on	2	sets of each type
	viii)	Oil cooling fan with motor	2	sets of each type
	ix)	Oil filling motor	1	no's of each type
	x)	Servo motor	1	no's of each type
5		Dust Suppression System for Paddle Feeder		
	i)	Dust suppression pump and motor assembly	1	no's of each type
	ii)	Spray nozzles of dust suppression system	10	no's of each type

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6		Carriage wheel assembly		
	i)	Bearings	2	nos. of each type & size
	ii)	Plummer Block	2	nos. of each type & size
	iii)	Oil seals	2	nos. of each type & size
	iv)	Carriage wheel with shaft (without Plummer blocks)	1	sets
	v)	Traverse drive assy including electric motor, gear box, coupling etc. Or Geared Motor, as Applicable	1	set
	vi)	Tension roller of paddle feeder trolley	1	set
7	i)	All type of coupling (including those between electric motor and pump, between hydraulic motor and gearbox and between gear box and paddle wheel & between carriage wheel and motor), as applicable	2	nos. of each type
	ii)	Coupling bolt with bushes / spider/inserts	2	sets of each size
	iii)	Rubber bush / spider / inserts	8	sets of each size
8	i)	Brakes	2	sets of each type & size
	ii)	Brake shoe	4	sets of each type & size
9		Cable reel drive		
	I.	Complete drive unit assembly including motor, gear box, coupling etc.	1	sets of each type & rating
	II.	Plummer Block and bearings for cable reel drum	1	sets
	III.	Cable guide assembly	1	set
	IV.	Torque regulator unit	1	set
	V.	Friction pads	2	set
	VI.	Spring stacks	2	set
	VII.	Oil seals	4	sets
	VIII.	Eddy current/magnetic coupling	1	set of each type & rating
	IX.	Spare Festoon hanger cum roller assembly(below CRD)	10	nos.
	X.	Spare energy chain links (if applicable)	5%	of population
B)		IDLERS		
1	I)	35° Troughing idlers complete with base frame and mounting brackets etc.	200	Nos.

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	ii)	Rolls for (i) above	300	nos.
2	i)	Troughing idlers complete with base frame & mounting brackets etc.(for belt feeder).	20	nos.
	ii)	Rolls for (i) above	30	nos. of each type
3	i)	350 impact idlers complete with mounting brackets and base frame etc.	100	nos.
	ii)	Rolls for (i) above	300	nos.
4		350 troughing training idler complete with base frame and brackets etc. (if used)	20	% of total installed quantity
5		Transition idler complete as in (1) above	5	nos.
6		Flat return idlers complete with mounting brackets etc.	100	nos.
7		Flat return idlers complete with mounting brackets etc.(for belt feeders)	10	nos.
8		Flat return trainer complete with mounting brackets etc.	10	nos.
9		Belt cleaning spiral rubber disc return idler complete with mounting brackets etc.	10	nos.
10	i)	Two roll 10° troughing return idler assy	40	nos.
	ii)	Rolls for (I) above	40	nos.
11		SS idlers	2	sets of each type
C)		CONVEYOR GEAR BOXES		
		(including boom conveyor, belt feeders)		
	i)	Input shafts with pinion	1	set of each type and rating
	ii)	Oil seals	2	sets of each type and rating
	iii)	Bearings	1	set of each type and rating
	iv)	Hold back device	2	nos. of each type and rating
	v)	Cooling fan with cover	2	nos.of each type and rating
	vi)	Complete gear box assy with hold back device	1	set of each type and rating
D)		CONVEYOR DRIVE AND CONVEYOR BELT		
a)		Gear Coupling		
	i)	Gear Coupling	2	No's. of each type
	ii)	Bolts for gear coupling	2	sets of each size
	iii)	Seal kit for gear coupling (o-ring)	2	sets of each type
b)		Fluid Coupling		

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	i)	Fluid Coupling complete	1	no. of each type and size
	ii)	Multi Disc assembly (for fluid coupling), if applicable.	4	no's each type and size
	iii)	Resilient Drive plate assy., if applicable	1	no. of each type and size
	iv)	Bearings	1	no. of each type and size
	v)	Seal kit for fluid coupling	2	sets of each size
	vi)	Fusible plug	10	nos. of each size
	vii)	Complete actuator and engaging assembly (including motor, gear box etc.)	1	set of each type
	Viii)	Oil Cooler assembly (if applicable)	1	set of each type
	ix)	Oil pump-motor set (if applicable)	1	set of each type
	x)	Water pump motor	1	set of each type
	xi)	Oil filters	5	sets of each type
	xii)	Oil Cooler valves (if applicable)	2	No's. of each type
	c)	Belting		
		Conveyor Belt		
	i)	Main Conveyors one		drum length of 250 m of each type, size and rating
	d)	Brakes		
	i)	Brakes	1	no of each size & type
	ii)	Brake shoes	2	sets of each size
	E)	PULLEYS		
	i)	Pulleys complete with shaft excluding bearing & plummer	1 no. of each type and size in	pulley drum and shaft
			2	no. of each type and size in pulley drum and shaft dia.(for population more than 10 No's)
			2	each type and size
	ii)	Plummer Block complete with bearings & sleeves	2	no. each type and size
	iii)	SS Pulleys complete with shaft excluding bearing & plummer blocks (complete with lagging)	1	no. of each type and size in pulley drum and shaft dia.
	F)	BELT CLEANERS AND SKIRT BOARD		
	i)	Modular segments for belt cleaner	5	%of total population of each type & size

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	ii)	Modular segments for skirt board	5	%of total population of each type & size
	iii)	Complete belt cleaner (internal / external)	2	%of total population of each type & size
G)		IN-LINE MAGNETIC SEPARATORS		
	i)	Cleated conveyor belt	1	Set
	ii)	Motor, gear box drive assy.complete	1	Set
	iii)	Pulleys with plummer block & bearings	1	set of each size & type
H)		ELECTRIC HOISTS		
	i)	Brake linings	2	sets of each type
	ii)	Rope guide & rope tightner	1	no. of each type
	iii)	Limit switch	2	nos. of each type & size
	iv)	Gear box/gear set	2	sets of each type
	v)	Motor/geared motor	1	no of each type & rating
	vi)	Drum bearing	1	set of each type & rating
I)		FLAP GATES		
	i)	Limit switch	8	nos. of each type & rating
	ii)	Actuator (complete with motor, gearbox, limit switches etc.)	1	nos. of each type & rating
	iii)	Oil seals of Actuator	2	nos. of each type & rating
	iv)	Flap gate shaft	1	nos. of each type & rating
	v)	Pressure nut	12	nos. of each type & size
J)		RACK & PINION GATE		
	i)	Limit switch	2	no. of each type & size
	ii)	Rollers with bearings	2	no. of each size
	iii)	Motor gear box assembly	1	set of each type
	iv)	Actuator (complete with motor, gearbox, limit switches etc.)	1	no's of each type & rating
K)		SUMP PUMP		
	i)	Complete pump assembly with pump, motor, coupling base etc	1	Set
	ii)	Impeller with key & nut	2	set of each size & type
	iii)	Oil seal	2	nos. of each size
	iv)	Coupling bolt with bushes	2	set of each type
	v)	Pump shaft	2	no. of each size
	vi)	Shaft sleeve	2	sets of each size

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	vii)	Bearing bush	2	sets of each size
	viii)	Set of bearings	2	Sets
L)		DUST SUPPRESSION & SERVICE WATER SYSTEM		
	a)	Pump impeller with key & nut	1	set of each type & size
	b)	Pump Shaft	1	no of each type & size
	c)	Bearings	1	sets each type & size
	d)	Wearing rings	2	sets of each type & size
	e)	Shaft sleeve	2	sets of each type & size
	f)	Bushings	2	sets of each type & size
	g)	Coupling bolts & nuts (with bushes) 2 sets	1	sets each type & size
	h)	Spray nozzles (for fog type dust suppression)	50	nos. of each type & size
	i)	Spray nozzles (for plain water dust suppression)	25	nos. of each type & size
	j)	Solenoid valves	5	% of each type and size
	k)	Globe valve / plug valves	10	% of each type and size
	l)	Gate valve	2	nos. of each size
	m)	Strainers	1	no. of each type
	n)	Compressor		
	(i)	Air filter element	8	Nos.
	(ii)	Oil filter	6	Nos.
	(iii)	Discharge check valve	3	Nos.
	(iv)	Oil Pump Parts (including distance ring, eccentric rings, Pump element, Pin, Key O, Ring) as applicable)	2	Sets
	(v)	Inlet valve assembly	2	Nos.
	(vi)	Electronic regulator	3	Nos.
M)		VENTILATION SYSTEM		
	i)	V-Belt	1	set of each type
	ii)	Pre-filter element of pressurizing fans	2	sets of each type
	iii)	Foundation Rubber pads	1	sets of each type & size
	iv)	Bearings	1	sets of each type & size
	v)	Plummer Blocks	1	set of each type &

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				size
N)		SIDE ARM CHARGER		
	1	Gear box spares		
	i)	Gear Internal	1	set each type
	ii)	Oil Seal	1	set each type
	iii)	Bearing	1	set each type
	2	Carriage Wheels		
	(a)	Bearings	1	set of each size and type
	(b)	Oil Seals	2	set of each size and type
	(c)	Plummer Block	1	set of each type and size
	(d)	Carriage wheel fitted with shaft(without Plummer Block)	1	Set
	3	Coupling 1 set each type		
	4	Travel Wheel Assembly 1 no		
	5	Bearing 1 no. of each type		
	6	Speed Reducers		
	(a)	Internals complete including input and output shafts and gears etc.	1	set of each type and rating.
	(b)	Oil seals	4	sets of each type and rating
	(c)	Bearings	2	sets of each type and rating
	7	Motor		
	(a)	Motor including slip ring motor	1	set of each type and size
	(b)	Bearings	1	set of each type and size
	(c)	Oil Seal	1	set of each type and size
	8	Brakes		
	(a)	Complete assembly	1	no. of each type and size
	(b)	Linings & springs	1	set of each type and size

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	9	Couplings		
	(a)	Complete assembly	1	no. of each type and size
	(b)	Pins, bushes and nuts	1	set of each type and size
	10	Hydraulic Power Pack		
	i)	Hydraulic Pump with electric motor, coupling, valves & servo motor (mounted on pump)etc.	1	set of each type and rating
	ii)	Solenoid Valves complete with coils	1	set of each type and size
	iii)	Filter element (1 No. Pressure Filter + 1 No. Return Filter)	4	sets of each type
	iv)	Hydraulic Hoses	2	Sets
	v)	Hydraulic Motor	1	no's of each type
	vi)	Traverse pump with electric motor, coupling, valves (mounted on pump) & servo motor (mounted on pump)etc.	2	sets of each type
	vii)	Hydraulic cylinder	1	no. of each type
	viii)	Oil cooling fan with motor	2	sets of each type
	ix)	Oil filling motor	1	no's of each type
	x)	Servo motor	1	no's of each type
O)		Wagon Tippler and Accessories		
	1	Speed Reducers		
	(a)	Internals complete including input and output shafts and gears etc.	1	set of each type and rating
	(b)	Oil Seals	4	sets of each type and rating
	(c)	Bearings	2	sets of each type and rating
	2	Motor		
	(a)	Motor including slip ring motor	1	no. of each type
	(b)	Bearings	1	set of each type and size
	(c)	Oil Seal	1	set of each type and size
	3	Brakes		
	(a)	Complete assembly	1	no. of each type and size
	(b)	Linings & springs	1	set of each type and size
	4	Couplings		
	(a)	Complete assembly	1	no. of each type and size
	(b)	Pins, bushes and nuts	1	set of each type and size
	5	Hydraulic Power Pack		
	(a)	Hydraulic Pump with electric motor,	1	set of each type and size

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		coupling, valves (mounted on pump) etc		
	(b)	Hydraulic Motor	1	no. of each type and size
	(c)	Valves	1	no. of each type and size
	(d)	O.P. Coolers	1	no.
	(e)	Filter Elements	10	nos. of each type
	(f)	Pressure Switch	1	no. of each type
	(g)	Temperature Switch	1	no. of each type
	6	Bearings(not covered separately)	1	set of each type and size
	7	Limit Switches	2	nos. of each type.
	8	Cylinder Manifold block with all valves mounted on it	1	set
	9	Hydraulic cylinder with piston	1	set of each type and size
	10	Seals of hydraulic cylinder and pumps etc.	2	sets of each type.
	11	Hydraulic hoses	2	Sets
	12	Gear box total	1	Set
	13	Gear flexible coupling	1	Set
	14	Rod end bearings with housing	1	set for all four clamps
	15	Pressure Switches	1	no
	16	Common manifold block complete with all valves mounted on it.	1	no.
	17	Main Pivot bearing	1	no.
	18	Pinion support & bearing	1	no. each type.
	19	Pinion	2	no.
	20	Latch (Pinion & rack segment locking device)	1	no.
	21	Chain & Sprocket	1	Set
	22	One set of bush bearing liners for all drive group bearings	1	set
	23	Paul lever assy.	1	set of each type
	24	Rack segment two pieces (in case of non machined) and one complete set in case of machined rack segment		
	25	Spur wheel along with key.	1	set of each type
	26	Drive shaft fitted with pinion	1	set of each type
	27	Bolts for rack segment (fitted bolts) one complete set	2	Sets
	28	Coupling bolts of drive shaft (fitted/machined bolts) one complete set	2	Sets
P)		APRON FEEDER		
	1	Head Pulley complete with shaft	1	no.
	2	Tail pulley complete with shaft	1	no.

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	3	Drive Motor	1	no. of each type and size
	4	Gear Box	1	no. of each type and size & direction.
	5	Complete internals of gear box including input and output shafts	1	set of each type & size
	6	Reduction gears	1	sets of each type and size
	7	Fluid coupling, flexible coupling etc.	1	No. of each type and size
	8	Traction rollers	20	%of population
	9	Carrying idlers	20	%of population
	10	Return Rollers	20	%of population
	11	Sprocket segments	2	sets of each type and size
	12	Link Chain	20	% of each type and size
	13	Pans (flights)	10	%
	14	Plummer Blocks	1	no. of each type and size
	15	Bearings	1	set of each type and size
	II.	“ELECTRICAL”		
Q.		CONVEYORS		
	1.	Conveyor Drive Motor	1	no. of each type and rating
	2.	Belt Sway Switches	10	No's of each type
	3.	Pull cord switches	20	No's of each type
	4.	Zero speed switches	5	No's of each type
	5.	Sensor/ probe of Zero speed switches	5	No's of each type
	6.	Chute Block switches	5	No's of each type
	7.	Under belt switches	5	No's of each type
	8.	Micro/limit switch of pull cord switch, Belt Sway Switches, Chute Block switches	5	No's of each type
	9.	Motor terminal block with studs for all motors	1	set for each rating and type of motor
R.		BELT WEIGHER		
	1.	Set of cards	2	nos. of each type
	2.	Load Cells	2	nos. of each type
	3.	Speed sensor	2	nos. of each type
	4.	Cables for load cells & speed sensor	2	Sets
	5.	Winding temp. indicator with alarm	1	no. of each type

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		& trip contacts		
	6.	Oil Temperature indicator with alarm & trip contacts, if applicable	1	no. of each type
	7.	Pressure relief device, if applicable	1	no. of each type
	8.	Diaphragm for explosion vent	1	no. of each type
	9.	Bucholtz relay	1	no. of each type
	10.	Silica gel breather (complete)	2	no. of each type
	11.	Set of gaskets (complete)	1	set of each type
	12.	Oil seals	5	Nos of each type
S.		DUST SUPPRESSION & SERVICE WATER SYSTEM		
	1	Electric motor	1	no. of each type & rating
	2	Flow switches	2	nos. of each type
	3	Pressure switches	2	nos. of each type
	4	Level switch with its panel	2	nos. of each type
	1	Electric motor	1	no. of each type & rating

II. Electrical

Sr. No.	Item	Quantity
1.0	UPS of Each Rating	
A.	Semiconductor Fuses or HRC Fuse Links of each rating	30%
B.	MCB, MCCB and control switches of each rating	1 Set
C.	SCR, diodes and transistors of each type	50%
D.	Capacitors, resistors and chokes of each type	50%
E.	Signal Lamps of each colour & voltage	30%
F.	Control Cards	1 Set
G.	Semiconductor fuses & HRC fuse links of each type	1 Set
H.	IGBT of each type	1 Set
I.	Software and programming terminal	1 Set
J.	Batteries	5 cells
K.	Isolator switch of each type	1 No.
L.	Ventilation Fan each type	2 Nos.
M.	PCBs of each type	1 No.
N.	Electrolyte	10%
2.0	Power and Distribution Transformer (of each type & rating)	
A.	HV Bushing complete with metal parts for all 3 phases	1 Set

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Sr. No.	Item	Quantity
B.	LV Bushing complete with metal parts for all 3 phases	1 Set
C.	Neutral Bushing complete with metal parts	1 Set
D.	NCTs of each type	1 No.
E.	Complete set of Gaskets	1 Set
F.	Complete set of valves (1 no of each type)	1 Set.
G.	Radiator	1 No.
H.	PRV with alarm and trip contacts	1 Set
I.	Explosion vent diaphragm	1 No.
J.	Oil level gauge	1 No.
K.	Complete charge of silica gel with breather	2 Sets
L.	Gland packing / O-ring for every valve	1 Set
M.	Buchhloz relay	1 No.
N.	Analog type OTI	1 No.
O.	Analog type WTI	1 No.
P.	CT for WTI	1 No.
Q.	Magnetic oil level gauge	1 No.
R.	Dial type thermometer	1 No.
S.	Sealing/gauge glass of conservator	1 No.
T.	Oil (% extra of total transformer oil)	10%
U.	Miscellaneous spares (control switches, fuses lamps) for Marshalling Box	2 Sets

V.	Cooler Fan with Motor	1 No.
W.	Remote tap position indicator	1 No.
X.	Oil surge relay for OLTC	1 No.
Y.	Starter contactors, switches and relays for electrical control panels	1 Set
3.0	DRY TYPE Transformer (of each type & rating)	
A.	HV Bushing complete with metal parts for all 3 phases	1 Set
B.	LV Bushing complete with metal parts for all 3 phases	1 Set
C.	Neutral Bushing complete with metal parts	1 Set
D.	Complete set of Gaskets	1 Set
4.0	Neutral Earthing Resistor (of each rating)	
A.	Bushing with accessories	1 Set

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B.	Support Insulators	2 Nos.
C.	Bushing Insulator	1 No.
D.	Resistor Element	20% minimum one cartridge per type
5.0	Each 11 kV Switchboard and 3.3 kV Switchboard	
A.	Complete VCB (ready to use) of each rating	1 No.
B.	Trip bar spring and any other spring used in the circuit breaker mechanism for breaker of each rating	1 No.
C.	Shunt trip coil for breaker of each rating	10%
D.	Closing coil for breaker of each rating	10%
E.	Spring charging motor of each rating	1 No.
F.	Spring charging handle for breaker of each rating	1 No.
G.	Racking out handles for breaker of each rating	1 No.
H.	Secondary Isolating contact blocks for breaker of each rating	1 No.
I.	Micro Switch for Test/ Service Position for breaker of each rating	1 No.
J.	Micro Switch for Spring Charging for breaker of each rating	1 No.
K.	Main contact sets/ Jaw contact, Moving coil, Fixed coil complete for breaker of each rating	1 Set
L.	Trip-Neutral-Close Control Switch	2 Nos.
M.	Local-OFF-Remote Selector Switch	2 Nos.
N.	Ammeter Selector Switch	2 Nos.
O.	Voltmeter Selector Switch	2 Nos.
P.	Push Button Element of each type & rating	20 %
Q.	Push Button Actuator of each type	20 %
R.	Trip Selector Switch	2 Nos.
S.	Panel limit switches & interlocking switches	10% each type

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T.	Panel operating switches (all types)	1 Set each
U.	Breaker limit switches & interlocking switches	10% each type
V.	Protection Relays for different type of feeders i.e Incoming Feeder, Bus-coupler Feeder, Outgoing feeder, Motor Feeder, Transformer Feeder etc.	1 No. for each type of feeder
W.	Trip relays of each type	2 Nos
X.	Auxiliary Relays of each Type	2 Nos.
Y.	Miniature Circuit Breaker of each type & rating	20 %
Z.	Meters (of each type & rating) i) Ammeter ii) Voltmeter iii) Multifunction Meter iv) Energy Meter	1 No. 1 No. 1 No. 1 No.
AA.	Instrument Transformers of each type & rating i) CT ii) PT	3 Nos. 1 Nos.
BB.	Fuses of each type & rating i) HRC HV for VT ii) HRC LV	20 % 20 %
CC.	Lamp Complete assembly of each colour & voltage	10%
DD.	Current transducers of each rating	20%
EE.	Voltage transducers of each rating	20%
FF.	Power Transducers of each rating	20%
GG.	Bus-Bar Support Insulators	1 Set
HH.	Surge Arrestors	1 No.
II.	Inspection Glass	3 Nos.
JJ.	Sprouts	1 Set
KK.	Panel Space Heaters with Thermostat	2 Nos.
LL.	Alarm Annunciator of each type	1 No.
MM.	Interpanel insulation barriers	20% Minimum 1 No.
NN.	Earthing Trolley	1 No.
OO.	Maintenance Trolley for breaker of all rating	1 No.
PP.	Set of gaskets for all ratings & type	1 Set
QQ.	Panel shutter assembly	2 No.
RR.	Removable bus bar shrouds	1 Set
SS.	Bus bar mounted power fix contacts	1 Set
6.0	Each LT (415V) Switchboard (PMCC/EPMCC/APFC/PCC/MCC/ASDB/ DCDB/UPSDB/LSDB)	
A.	Complete ACB (ready to use) of each rating	1 No.

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B.	Trip coils for breaker of each rating	10%
C.	Closing coils for breaker of each rating	10%
D.	Spring charging motors of each rating	1 No.
E.	Secondary Isolating contact blocks for breaker of each rating	1 Set.
F.	Arcing contacts & arcing chutes block for breaker of each rating	1 Set.

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G.	Main contact sets/ Jaw contact compete for breaker of each rating	1 Sets
H.	Trip-Neutral-Close Control Switch	2 Nos.
I.	Local-OFF-Remote Selector Switch	2 Nos.
J.	Ammeter Selector Switch	2 Nos.
K.	Voltmeter Selector Switch	2 Nos.
L.	Push Button Element of each type & rating	20 %
M.	Push Button Actuator of each type	20 %
N.	Trip Selector Switch	2 Nos.
O.	Panel limit switches & interlocking switches	10% each type
P.	Panel operating switches (all types)	1 Set each
Q.	Breaker limit switches & interlocking switches	10% each type
R.	Protection Relays for different type of feeders i.e Incoming Feeder, Buscoupler Feeder, Outgoing feeder, Motor Feeder etc.	1 No. for each type of feeder
S.	Trip relays of each type	2 Nos
T.	Auxiliary Relays of each Type	2 Nos.
U.	Thermal over Load Relay of each rating	2 Nos.
V.	Contactors of each type & rating	2 Nos.
W.	Coils for Contactors – each type/voltage	2 Nos.
X.	ELCB & RCBO of each type	2 Nos.
Y.	Miniature Circuit Breaker of each type & rating	20 %
Z.	SFU of each rating	20 %
AA.	Meters (of each type & rating) i) Ammeter ii) Voltmeter iii) Multifunction Meter iv) Energy Meter	1 No. 1 No. 1 No. 1 No.
BB.	Instrument Transformers of each type & rating i) CT ii) PT	3 Nos. 1 Nos.
CC.	Fuses of of each type & rating HRC LV	20 %
DD.	Lamp Complete assembly of each colour& voltage	10%
EE.	Current transducers of each rating	20%
FF.	Voltage transducers of each rating	20%
GG.	Power Transducers of each rating	20%
HH.	Bus-Bar Support Insulators	1 Set
II.	Panel Space Heaters with Thermostat	2 Nos.
JJ.	Alarm Annunciator of each type	1 No.
KK.	Interpanel insulation barriers	20% Minimum 1 No
LL.	Maintenance Trolley for breaker of all rating	1 No.
MM.	Set of gaskets for all ratings & type	1 Set
NN.	Panel shutter assembly	2 Nos.

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OO.	Removable bus bar shrouds	1 Set
PP.	Bus bar mounted power fix contacts	1 Set
7.0	Each Bus Duct	
A.	Bus support insulators each type	2 Nos.
B.	Flexible connector (for switchgear end connection)	1 Set
C.	Flexible connector (for Transformer end connection)	1 Set
D.	Gasket	1 Set
E.	Bus duct CT's / VT's	1 Set
F.	Set of special tools, for dismantling and maintenance	1 Set
8.0	HV Motor (For each rating)	
A.	Bearings housing (complete with End Shield) both Driving End and Non driving end	1 set
B.	Cooling fan	1 No.
C.	Space heater	2 Nos.
D.	Terminal box	1 No.
E.	Terminal stud with bushing & star links	2 sets
F.	RTDs for HV motors for Bearing/ hot air	2 Nos. each
G.	Dial Type thermometer	2 sets
H.	Grease nipple & Plug (if installed)	2 Nos.
I.	Charge of Lubricating oil (if not centrally lubricated)	1 Charge
9.0	LV Motor (For each rating)	
A.	Bearings housing (complete with End Shield) both Driving End and Non driving end	1 set
B.	Cooling fan	2 No.
C.	Terminal box	1 No.
D.	Terminal stud with bushing & star links	1 No.
E.	Space heater, if installed	2 Nos.
F.	Grease nipple & Plug, if installed	2 Nos.
G.	Cooling fan cover	1 No.
10.0	Interlocking switch socket & plug	
A.	Switch of each rating	3 Nos.
B.	Fuse base of each rating	3 Nos.
C.	Fuse of each rating	3 Nos.
D.	Plug Top	3 Nos.
11.0	Lighting Fixtures	
A.	LED Lighting fixtures (along with Driver) alongwith LED Lamp	10% of the total no. of fixtures (Minimum of 5 No's of each type)

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B.	Terminal block of each type	5 Nos.
C.	Heat resistance toughened glass cover of each type	5 Nos.
D.	Fuse holder of each type	5 Nos.
E.	Fuse of each Type	5 Nos.
F.	Allen keys of different sizes as applicable	2 Sets
12.0	Battery Charger	
A.	Set of diodes of each type and rating	2 Sets
B.	Set of silicon controlled Rectifiers	2 Sets
C.	Set of chokes of each type and rating	1 Set
D.	Set of resistors of each type and rating	1 Set
E.	Set of capacitors of each type and rating	1 Set
F.	Set of transistors of each type and rating	1 Set
G.	Set of load breaking switches of each type and rating	1 Set
H.	Off-Load Tap Changing Device	1 Set
I.	Current Regulator	1 Set
J.	Semiconductor fuses of each type and rating	3 Nos.
K.	Set of contactors of each type and rating	2 Sets
L.	Set of thermal overload relays of each type and rating	2 Sets
M.	Set of auxiliary contactors of each type and rating	2 Sets
N.	Set of power contactors of each type and rating	2 Sets
O.	Set of control and selector switches of each type and rating	2 Sets
P.	Set of controller cards of each installed charger	2 Sets
Q.	Indicating lights of each colour & voltage	2 Sets
R.	D.C. Ammeter	1 No.
S.	Miniature circuit Breaker of each type & rating	1 No.
T.	PCB's of each type	1 No.
U.	Float indicator	1 No.
V.	Thermometer	1 No.
W.	Under, over voltage and earth leakage protection devices	1 No.
X.	Panel / cabinet space heater	2 Nos.
Y.	Thermostat	2 Nos.
13.0	Each Battery Bank	
A.	Complete cells of each type	4 Sets

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B.	Float guide	2 Nos.
C.	Cell lid	2 Nos.
D.	Level indicators	2 Nos.
E.	Vent plugs	2 Nos.
F.	Inter cell connectors with nuts, bolts and washers	2 Sets
G.	P.V.C. Spill Trays	2 Sets
H.	Terminal Post	2 Sets
14.0	Local Control Station	
A.	Trip – neutral – close switch	20%
B.	Auto Manual / Local -Remote switch	20%
C.	Ammeters of different ranges	20%
D.	Terminal block	20%
E.	Indicating Lamps of different type	20%
F.	Push Buttons of different type	20%
G.	Complete LCS of each type	20%
15.0	Junction Box	
A.	Junction Box of each type	10 Sets
16.0	Electricals for Overhead Cranes & Hoists (per crane/hoist)	
A.	Bearings of each type & no.	1 Set

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B.	Contactora Coil of various ratings	1 Set
C.	Complete set of contactora of each rating	1 Set
D.	Limit switches of each type	2 Nos.
E.	Push Button Elements	20%
F.	Push Button Actuators	20%
G.	Fuses of various ratings	20%
H.	Fuse fittings of various ratings	20%
I.	Indication lamp fittings of each type	20%
J.	Overload relays of various ranges	1 Set
K.	Brake coils for various brakes	1 Set
L.	Set of carbon brushes in case of S.R. motors	1 Set
M.	Set of resistors for S.R. motors	1 Set
N.	Any special tools and tackles required for maintenance	1 Set
17.0 Variable Frequency Drives		
A.	Set of fuses of all types & sizes used in system	5 Sets
B.	Controller Card of each type	1 Set
C.	Power Devices of each type	2 Sets
D.	Software for parameter setting each type	1 Set
18.0 Fire Alarm & Detection System		
A.	Detectors of each type	20%
B.	Loop card of each type	10%
C.	Charger card	10%
D.	Interface Units of each type	10%
E.	Power supply unit of each type	10%
F.	PCB of all types	20%
G.	Manual Call Points	10%
H.	Fuses of each type & rating	10%
I.	Control relays of each type	10%
J.	Audible hooter/buzzer	10%
19.0 Capacitor Bank		
A.	Capacitor Unit of each rating	3 Sets.
B.	Fuses (if used) of each rating	3 Sets
C.	Power Contactora of each rating	3 Sets.
D.	PF controller card/unit of each type	1 Set
E.	Limit Switch for Capacitor Bank of each type	3 Sets
20.0 Each ANNUNCIATOR PANEL		
A.	Hooters	1 No.

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B.	Push Buttons of each type	3 Sets
C.	Terminals	3 Nos.
D.	Acrylics	1 No.
E.	PCB card of each type	1 No.
F.	LED of each colour & voltage	3 Sets
G.	DIP Switches	3 Nos.
H.	CPU	1 No.
I.	SMPS	1 No.
J.	Relays of each type	20% (Min. 1 No.)

- 1) Set means complete replacement of particular part in one machine.
- 2) The above spares do not includes commissioning spares and shall be purely warehouse spare.
- 3) Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
- 4) Wherever "% qty." is specified, Bidder to quote in next higher rounded figure
- 5) Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.
- 6) Electrical EQUIPMENT which has not been mentioned in this table and needs spare parts, CONTRACTOR shall consider spare parts for them, the quantities for such spare parts shall then be APPROVED by OWNER/CONSULTANT.

III Instrumentation Items:

- Set means complete replacement of particular part in one machine.
- Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
- Wherever "% qty." is specified, Bidder to quote in next higher rounded figure
- Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.

Sl. No.	DESCRIPTION	QUANTITY
1.0	Field instruments	
	Pressure Gauges, Differential Pressure Gauge, Draft Gauges, Field Indicators, RTD/T/C with Thermowells, welded thermowell, Skin Thermocouple Sets, Speed Probes with Cables and Fixing Screws and Bolts, Vibration Probes, with Cables (including extension cable) and Fixing Screws and Bolts, Speed Transmitter with Cables and Fixing Screws and Bolts, Proximeters of diff. model and Fixing Screws and Bolts, Gas Sensors with Cables and Fixing Screws and Bolts, Load Cell assembly , each type	10% of each type of instruments, subject to minimum 2 nos. of each type

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	safety switches	
	Pressure Switches, DP Switches, Purge Rotameters	10% of each type of instruments, subject to minimum 2 nos of each type
	Special thermocouples (like reactors) /multipoint thermocouples,	10% of each length subject to minimum 1 number of each type.
	Skin Type Thermocouple-	10% of total subject to minimum 1 number Complete Set of each type.
	Float and micro switch assembly for level switch	10% of each length subject to minimum 1 number of each type.
	Transmitters for Flow, Pressure, Temperature, Level, Diff. Pressure application, Remote Seal Transmitter, Transmitter for LEL/GAS Detector System including Sensors .	10% of each type of instruments, subject to minimum 2 nos of each type
	Hydra Step	1 no. Electronic unit or 10% subject to minimum. 20% or Min 3 Nos of Sensor Probes
	Mass flow meter & Mag Flow meter	A) Power fuses 6 nos per set B) Sensor assembly-10% min 1 no C) 10% or minimum one number complete electronic head unit
	Vortex Flow Meter	A) One sensing probe ,one set of gasket and Packing for each type and Size B) 10% or minimum one number complete electronic head unit
	Ultrasonic Flow meter	A) 1 pair probe for each instrument B) 1 number electronic card of each type C) 2 numbers fuses of all Types.
	Glass tube Rota meters	20% or min 2 Nos of glass tubes of each size/rating /make.
	Variable Area Flow meter (Rota meters)	10% or minimum one no. float & set of Packing for each type, size, rating and material
	Averaging Pitot Tube	Set of Gasket, O-ring, Packing for Retract Mechanism and one no. Needle Valve with each Pitot Tube.
	Flame scanners and optical pyrometer	a)10% subject to minimum 1 No. of

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	a) Electronics b) Detectors / sensors or spares with limited life	each type. b)As required for 1 year operation or Min 2 Nos Complete flame scanner
2.0	Displacer type Level Transmitters	A) 10% of each type of instruments head with Torque Tube Assembly and Transmitter, subject to minimum 2 nos of each type. 1 No of float of each type. B) 10% Electronic cards and Display module – Minimum 1 no. of each type
2.1a	Ultrasonic / Guided Wave Radar Type – Level Instrument High Frequency LT	A) 10% complete Instrument – Minimum 1 No. of each Type / Range / Material B) 10% Electronic – module / Cards /Display module – Minimum 1 no. of each type
2.2	Level gauge- Transparent / Reflex Type	20% subject to minimum 10 numbers of glass along with pair of Gaskets and glands sets for I/V valves of each type, size (Cushion & Wet Gaskets), whichever is higher.
2.2.1	Level Gauge	10% subject to minimum 1 set of Float, Magnet/ball follower-ring gaskets of each type.
3.0	Control Valve, Shut Down, On-Off, Butterfly, Ball Valves, Gate Valves, Angle Valves, PCV, MOV, Flap gate , Safety Valve Spares	
3.1	Soft part / actuator spares, including actuator diaphragm, actuator seal kit and spring sets, for each type of actuator	20% of each type of instruments, subject to minimum 1 no. of each type
3.2	Trim Set	Trim set consisting of seat ring / seal ring, plug with stem, cage (wherever applicable), packing material for each make, type , size, pressure rating valve to be provided as spare
3.3	Complete Actuator with Hand Wheel assembly	one complete Actuator for each type and size
3.4	Complete Spare Control Valve for Antisurge Control Valve	One No
3.5	Gland packing, O rings, Packing and Bonnet gasket, seat gasket	100 % for each valve. i.e. one set for each tag.
3.6	Greases and grease guns	5 sets of each type of grease and 1 grease gun of each type

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3.7	Solenoid valves	10% of each type of instruments, subject to minimum 2 nos of each type
3.8	Proximity switches including enclosure	10% of each type of instruments, including enclosure- subject to minimum 2 nos of each type
3.9	SMART Positioners	10% of each type of instruments, subject to minimum 2 nos of each type
3.11	Other accessories: Quick Exhaust relay, Volume Boosters, Air Filter regulators, position Transmitters, change over relay, NRV, Pilot valves.	10% of each type of instruments, subject to minimum 3 nos of each type. Air filter regulator shall be minimum 20%.
3.12	PRDS & De-super heater unit	a)Same as those of Control Valves b) Gaskets for valve and connections per unit (if such gaskets, are special and supplied by PRDS/De-Super heater vendor
3.13	For PCV Repair kit consisting of (orifice, plug, spring, gasket, diaphragm, spring, O-ring for each valve.	20% or minimum 1 no. in each type
3.14	HHT loaded with latest HART configurator software (Emerson make)	1 no. minimum
3.15	Safety Valve:	Set of each type/ size. 1 Set comprising of 1 upper adjusting ring, 1 lower adjusting ring, 1 disk, 1 Nozzle, 1 stem & 1 Gasket set
		20% of each size and rating of Discs, Nozzles, bellows, springs etc. Additionally Minimum 2 Nos of Complete PSV for critical application (Very high pressure PSV's e.g Boiler drum application etc.)
4.0	DCS, ESD, F&G PLC, Storage PLC, Analyser PLC, Any other Control and PLC system.	
4.1	CPU	10% or minimum 1 no. each type.
4.1a	Communication cards, Processor cards (Controller) ,FTA cards	2 nos of each type of cards.
4.2	System Pre-fab cables, I/O Card cables, communication bus cables.	10% or min. 5 sets of each type with all connectors, plugs,
4.3	Racks, Backplane units	2 Nos each type
4.4	Local Panel, Hardwire console & annunciator All items like Push buttons, indicators, hand switches lamps, relays selector switches, IS type indicators / Annunciators, holders etc. mounted in the local panel	10% or minimum 2 no. each type.
4.5	HDD unit	2 set of each type (normal as well as Raid-5) with all connectors, plugs.

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4.6	Various Keyboards (including operator keyboard) /mouse	2 nos. of keyboard each type and 5 Nos. of mouse.
4.7	Relays	5% of each type of relays, including relevant terminal modules/sockets minimum 5 nos of each type
4.8	Pushbuttons, Lamps, Selector switches	10% of each type , including relevant terminal modules/accessories as a complete set
4.10	All type of system/PDB/Marshalling cabinet /console filters	100%
4.11	All type of system/PDB/Marshalling cabinet/console fan	2 Nos of each type including relevant terminal modules/pre-fab system cables.
4.12	All type of system/PDB/Marshalling cabinet/console Tube light	2 Nos of each type.
4.13	All type of various PDBs Voltmeters	2 Nos of each type.
4.14	I/O Cards	20% of each type of card, including relevant terminal modules/pre-fab system cables, etc., subject to minimum of 5 nos. each
4.15	Various System Battery, Terminators	1 no. of each type
4.16	All system Fuses and various glass fuses	100% for imported fuses
4.17	All PDB fuses, like HRC, GSA Fuses	100% of total qty. of each type
4.18	MCBs	5 Nos. of each type
4.19	Terminal Blocks	Spare Terminal Blocks along with DIN rail – 100 nos each type
4.20a	Cables for wiring inside Marshalling Racks of DCS of relevant size	100 mtr of each color and size
4.20b	Cables for wiring inside Marshalling Racks of ESD of relevant size	100 mtr of each color and size
4.21	24 V DC Bulk Power Supply modules	Min. 2 nos of each type
4.22	System DC Power supply for DCS	Min. 2 nos of each type
4.23	System DC Power supply for ESD	Min. 2 nos of each type
4.23 a	Diode-o ring modules	10% or minimum 1 no. each type.
4.24	Safety barriers, active isolators, signal convertors, trip amplifiers, signal multipliers	10% of each type of instruments, subject to minimum 5 nos of each type
4.25	Hubs, Bus units, Switches, Routers	20% or Min 1 nos of each type
4.26	OPC / Modbus interface Cards	1 No each along with connectors / cables
4.27	DCS operator and engineering subsystem	
	Communication card Operator Station communication bus	1 No.
	Communication card for Engineering Station	1 No.

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	communication bus	
	Motherboard for Operator Workstation	1 No.
	Motherboard for Engineering Workstation	1 No.
	SMPS	1 No.
4.28	PLC operator and engineering subsystem	
	Communication card for PLC programming Station communication bus	1 No.
	Communication card for PLC SOE Station communication bus	1 No.
	Communication card for PLC Operating Station communication bus	1 No.
5.0	Special control system modules a) Woodward Digital Governor, b) Woodward PROTECH 2003/Braun Speed Trip unit, Speed Probes c) Any other Control system module associated with Speed trip and Monitoring system. d) Voith Make E/H Converters.	1 no. of each (Controller, IOs ,cables, barriers Complete unit). Speed Probe - 2 nos of Speed Governing, 2 nos for Over speed Trip. <ul style="list-style-type: none"> • 1 no of each electronics & sensor • 1 no I/H converter complete set.
6.0	Bentley Nevada 3500 Series Vibration Monitoring System Spares	
6.1	Central Rack cards : Power supply card, Vibration/Thrust Monitoring card, Axial displacement card, Speed monitor card, Key phasor module, Relay module, Display Unit., transducers and transmitters	20% of each type of cards, subject to minimum 2 nos of each type
6.2	Vibration probes with leads, axial displacement probes with leads, Bearing thermo elements, speed probes with leads, I/H converter, E/H Converter, trip solenoid valves, transducers, barriers for vibration probes/ Proximeter.	10% or minimum 1 no. of each type. Proximeter 20%
7.0	Consumables for DCS	
7.1	Printer papers A3, A4 size	A3- 10 Rims, A4- 50 Rims
7.2	Laser Cartridges (Black and Color)	For 6 month usage, min. 2 sets for each printer
7.3	DATs of HP/ 3-M	25 nos. each
7.4	CDs of HP/Samsung	200 with individual casing
7.5	DVDs of HP/Samsung	200 with individual casing
8.0	GC Spares	
a	Set of Filters	1 set
b	Detector Assembly	1 set
c	PCB assembly Power Supply	2 nos.
d	PCB assembly Digital temp control	2 nos each type
e	Pressure Regulator	1 no
f	Thermocouple Assembly	1 no

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g	Sol Valve	1 no
h	Backplane Assembly	1 no
i	PCB Assembly	1 no
j	Ignitor Assembly	1 no
k	Pressure Sensor	1 no
l	Filament Kit	2 nos
m	Set of Fuses	1 no
n	Set of Fittings	1 no
o	Pressure Gauge	1 no
p	Temperature gauge	1 no
q	Sample flow meter	1 no
r	Bypass flow meter	1 no
9.0	Gas Analyzer Spares applicable for all Gas Analyzers / MassSpectrometer	
a	Sample Flow Meter	1 no
b	By pass Flow meter	1 no
c	Solenoid Valve	1 no
d	Communication board	1 no of each type
e	Display Unit	1 no each type
f	CPU Board	1 no each type
g	Sensor Electronic	1 no each type
h	Modulation Unit	1 no each type
i	Sample Cell	1 no
j	Sensor	1 no each type
k	O Ring	3 sets
l	Thermal fuses	2 sets
m	Heating cartridge	1 set
n	Thermal trip	2 set
o	Analogue module	1 set each type
p	Filter membrane (pack of 25)	1 set
q	Fuse	1 set each type
10.0	pH / Conductivity Analyzer	2 (Two) Complete Analyzer complete with sensor, cables, transmitters etc of each type
11.0	Silica Analyzer/Sodium/chlorine/ moisture /Turbidity /density/O2/CO/NOx/SPM Spares	
a	Sensor board	1 no.
b	Sensor and Detector	1 no each type
c	Rotameter (if applicable)	1 no.
d	Pressure Control Valve (if applicable)	1 no.
e	Fuses	5. sets.
f	Electronic card	1 no. each type

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g	Other Aux. Cards	1 each
h	Probe	1 no. each type
i	Filters, O-rings, Gaskets	2 sets
j	Consumable Kit	2 sets
12.0	Sample Conditioning system applicable for all analyzers / Mass spectrometer	
a	Complete sample kit for sample pumps inclusive of 'O' rings, Seal ring, Diaphragm	1 set
b	Solenoid valve for, more than one stream application	1 no
c	Flow switch	1 no
d	Vaporization system if required, which includes vaporizer, thermostat, electrical tracing cable and heater	1 set
e	Cooling system if required, which includes one cooler, flow conditioning system	1 set
f	Sample handling system fitting, valves, pressure gauges, regulators, solenoid valves, flow meters / flow switches and other components, etc	10% or minimum 1 no. of each type
g	Consumables like filters, membranes, reagents, cal. Gas, carriers	For 1 year of continuous operation
13.0	Flame Scanner	Two complete instrument of each type
14.0	Ferruling machine	1 no along with printer ribbon and sleeves size of 5.0 mm ² and 3.5 mm ² 100 meter each
	Other Items	
15.0	Snubber, Syphon, Gauge Saver	10% (subject to minimum of 2) of each item used, whichever is higher
16.0	Loop powered indicators	10% (subject to minimum of 2) of Loop powered indicators used, whichever is higher
17.0	Panel mounted instruments	10% or minimum one no. whichever is higher
25.0	Tools	
25.1	Technician's Tool Kit Set including screw drivers, slide wrench, O & D Spanners Kits	10 nos
25.2	Crimping Tool for RJ-45 Connector, Tapria	5 nos
25.3	Crimping Tool 0.5 to 4.0 mm ² wire, Tapria	5 nos
25.4	Crimping Tool BNC connector for Bentely Nevada	2 nos
25.5	Torque Wrench (Adjustable)	2 nos
25.6	Insulation Remover	5 nos
25.7	IC Puller	2 nos of each type
25.8	Logic probe	2 nos.
25.9	Screw driver kit (Taparia make)	5 set
25.10	Allen Key Set (1mm to 8 mm)	5 set

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25.11	Lamp puller	3 nos.
25.12	Torches (LED) handheld	10 nos
25.13	Torches (Head Lamp)	10 nos
25.14	Battery charger alongwith 1 set of batteries	2 nos of each type
26.0	CCTV camera, camera station, lens with zoom, Pan & Tilt Unit, Receiver Unit, electronic unit, , power supply, etc.	10% or minimum one of each type of module.
27.0	EPABX Unit, Electronic Card each type	10% or minimum one of each type of module.
28.0	Gas Detector system a) Transmitter assembly (including field display) b) Sensors	10% subject to minimum 1 No. of each type. 20% subject to minimum 2 No. of each type
29.0	Smoke Detectors , MCP, Sounders, Hooters	10% or minimum one of each type of module.
30.0	Pressure Relief Valves/Thermal Relief Valves/ Vacuum Relief Valves / Low Pressure Relief Valves / Pilot Operated Valves	10% of minimum one of each type & size for nozzle, disc insert, guide whichever is higher
30.0a	Rupture Disc	2 spare disc for each Tag.
31.0	MOVs Main PCB of each type Local / Remote / off Selector Switch each type Open / close / stop Selector Switch each type	1 Nos 1 Nos 1 Nos
31.0	Installation Material	
31.1	Instrument valves and	10% subject to minimum 1 no. of each type.
31.1.1	Valve manifolds	10% subject to minimum 3 no. of each type.
31.2	Tube fittings	10% subject to minimum 10 no. of each type.
31.3	Tubes	10% of the total length of each type
31.4	Cables	10% of the total length of each type
31.5	Junction boxes and cable glands	10% subject to minimum 1 no. of each type

IV- STATIC EQUIPMENT:

SI.No	Spare Items	Quantities
1.0	Pressure Vessels & Storage tanks - Each type	
1.1	Gaskets for each nozzle with blind/companion flange	200 %

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1.2	Bolting for each nozzle with blind/companion flange	10 % (Minimum 2 numbers) for each nozzles
1.3	Bolting for internal flange	10 % (Minimum 2 numbers) for each nozzles
1.4	Gasket for internal flange	200 %
1.5	Spare for internals Clamps Washer Bubble Caps / valve	2 % excess, min. 5 piece 20 % excess, min. 3 piece 10%
1.6	Sight/light glass assembly complete with bolting and gasket	300% of each installed glass
1.7	Filter Cartridge/Elements	200%

Notes:

- 1) Quantities shown are for each size and type of part.
- 2) The parts listed are the principal parts only. Other parts shall be considered for recommendation in quantities consistent with the above table.
- 3) All special tools and tackles required for maintenance for critical items shall be supplied along with equipment.

Notes:

1. The above spares do not include installed spares / commissioning spares. The above shall be 2 years spares.
2. Set means complete replacement of particular part in one machine/equipment/Reformer/Fired heater etc.
3. Item wise price against each item shall be furnished.
4. Wherever "Each Type" is specified, it means "of the Type/make/model/size/rating and exactly replaceable"
5. Wherever "% qty." is specified, Contractor to quote in next higher rounded figure
6. Out of % age spares and minimum qty specified against each item - higher of the two shall be supplied.
7. Spares mentioned above to be offered as 2 years spares. However, if these spares are not used in the equipments being offered / supplied, the same need not be supplied. Bidder shall clearly indicate against each such spare that these spares / items are not used in their equipments.
8. The above is owner's recommended list of spares. The supplier may add other items as per their recommendations.
9. The quotation should contain sectional drawing showing location & part no. (For exact identification) & material specification.
10. If any item is not mentioned above but supplied by the bidder. Bidder to consider 10% or minimum ONE for such items.

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V Piping :

Piping Items:

Following mandatory spares are to be supplied for the Piping items:

Sl. No.	Part Description	Size Range (NB)	Quantity Required (% of as built)	Remark
1	Pipes & Fittings	≤1.5"	5%	min. qty. 6 mtr. / 1 No.
2	Pipes & Fittings	≥ 2"	2%	min. qty. 6 mtr. /1 No.
3	Flanges	≤6"	5%	min. qty. 1 No.
4	Flanges	8" to 36"	2%	min. qty. 1 No.
5	Valves	≤14"	5%	min. qty. 1 No.
6	Valves	≥16" with rating ≥900#		Note-5
7	Bolts, Nuts & Gaskets		10%	min. qty. 1 No.
8	Traps		2%	min. qty. 1 No.
9	Expansion Bellow		10%	min. qty. 1 No.
10	Strainer element		10%	min. qty. 1 No.(Note-6)
11	Complete Gear Box for gear operated Valves		5%	min. qty. 1 No.
12	Seal ring for the Pressure seal type valves		5%	min. qty. 10 Nos.
13	Hose assembly		50%	min. qty. 10 Nos.

FIRE FIGHTING SYSTEM :

Sl. No.	Part Description	Size Range (NB)	Quantity Required (% or part or fraction of as built quantity)	Remark
1	Hose box, RRL hose (63mm) with couplings, jet nozzle with branch pipe, hydrant valve, landing valve		5%	min. qty. 1 No.
2	Hose reel with valve, nozzle, drum & mountings		5%	min. qty. 1 No.
3	Monitor (Per type & capacity)		1 no. each	
4	Portable fire extinguisher per type & capacity (upto 10 kg)		1%	min. qty. 1 No.
5	Wheel mounted fire extinguisher per type & capacity (greater than 10 kg)		1 no. each	
6	Spray / sprinkler head per size, rating & material		10%	min. qty. 1 No.

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Note :

1. Percent of quantity required as mandatory spares is for each and every item/size/rating/thickness/material consumed in as built.
2. No substitution in size, rating and material is allowed.
3. Pipe length in meter and other items in No. or Set shall be supplied.
4. Fractional part of quantity shall be converted into nearest upward whole part.
5. For rating $\geq 900\#$ and sizes $\geq 16"$, minimum one qty. valve spare shall be supplied for each size, rating & material.
6. Percent of quantity required as mandatory spares for strainer element is for each and every Strainer/size/rating/material consumed in as built.

VI ROTATING

1.0 SPARES PARTS FOR COMMISSIONING:

LSTK Contractor shall supply free of cost spare parts and consumables (except raw materials and Utilities supplied by others) required during Pre-commissioning & Commissioning of the plants until the plant is handed over to the Owner after Performance Test.

2.0 MANDATORY SPARE PARTS

LSTK Contractor shall supply mandatory spare parts as per list of spares as detailed below:

- i. Centrifugal / Axial / Rotary Compressor
- ii. Reciprocating Compressor
- iii. Screw Compressor
- iv. Centrifugal Fan
- v. Centrifugal Pump
- vi. Reciprocating Pump
- vii. Metering Pump
- viii. HVAC
- ix. EOT

2.1 Centrifugal/ Axial/ Rotary Compressor:

SI. No.	DESCRIPTION	QUANTITY
1.0	Compressor	
1.1	Completely assembled dynamically balanced spare rotor including clearance check and mechanical run test	1 set
1.2	Complete spare coupling including distance piece and set of coupling bolts & nuts	1 set
1.3	Stator blade carrier with stator blades completely assembled (for axial compressor)	1 set
1.4	Complete set of radial bearing (Both suction & discharge side)	1 set

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1.5	Complete set of Pads for radial bearing with built-in temperature elements (Both suction & discharge side)	1 set
1.6	Complete set of thrust bearings (Both active & inactive sides)	1 set
1.7	Complete set of Pads for thrust bearings with built-in temperature elements (Both active & inactive sides)	1 set
1.8	Complete set of labyrinth seals for each casing including labyrinths for balance piston , oil scraper rings etc.	1 set
1.9	Complete set of Dry Gas Seals & assembly (if applicable)	1Set
1.10	Complete set of all oil seals	2 sets
1.11	Complete set of 'O' rings, gaskets, sealing rings for compressor	4 sets
1.12	Sealing compound	1 charge
1.13	Timing gears for Rotary Compressor	1 set
2.0	Gear Box	
2.1	Complete set of bearings for gear box including driver end, intermediate stages and driven end	2 sets
2.2	Complete set of all gear wheels with shaft	1 set
2.3	Complete set of all Oil seals	2 sets
3.0	Gas Coolers	
3.1	Spare tubes for each cooler (when tubes can be easily replaced)	5% of total tubes
	In case of finned tube, complete tube bundle	1 set
3.2	Rupture disc for each cooler	2 nos
3.3	Set of all gaskets for each cooler	2 sets
4.0	Lube Oil System	
4.1	Spares for lube oil pump :	
	a) gears with Shaft	1 set
	b) complete set of bearings	1 set
	c) complete set of seal	2 sets
4.2	Lube oil filter cartridges	4 sets
5.0	Accessories	1 set
5.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
5.2	Spare elements for permanent filters in gas line	1 set
5.3	Complete Set of inlet air Filters for Air compressor, as applicable	2 sets
6.0	Instrumentation	
	As per Instrumentation specification enclosed with enquiry / order specification.	

2.2 Reciprocating Compressor:

Sl. No.	DESCRIPTION	QUANTITY
1.0	Compressor	

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1.1	Main bearings	1 set
1.2	Crankshaft journal bearings	1 set
1.3	Big end bearing	1 set
1.4	Cross head pin bearings	1 set
1.5	Complete Set of Connecting rod with fasteners	1 Set of each size
1.6	Complete Set Cross head body & guide assembly with fasteners	1 set of each size
1.7	Piston assembly complete with piston rod, piston, piston rings & lock nut etc. for each stage	1 set
1.8	Piston rings for each piston	2 sets
1.9	Complete stuffing box internal packing	1 set
1.10	Oil slinger ring	1 set
1.11	Liner for each stage	1 set
1.12	Complete inlet valves assembly with internals for each cylinder	1 set
1.13	Complete discharge valves assembly with internals for each cylinder	1 Set
1.14	Complete Set of all Gasket and O-Ring .	2 sets
2.0	Gas Coolers	
2.1	Tubes for gas cooler	1 set
2.2	Tubes for oil cooler (when tube are easily replaceable)	5 % for each cooler
2.3	Complete set of Gaskets for coolers & pressure Vessels	2 sets
3.0	Lube Oil System	
3.1	Spares for lube oil pump :	
	a) gears with Shaft	1 set
	b) complete set of bearings	1 set
	c) complete set of seal	2 sets
3.2	Lube oil filter cartridges	4 sets
3.3	Cylinder lubrication system :	
	a) Complete set of Lubricator bearings	1 set
	b) Pumping unit assembly	1set
	c) Check valves of each size	1 set of each size
	d) Sight glass	1 set
4.0	Accessories	1 set
4.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
5.0	Instrumentation	
	As per Instrumentation specification enclosed with enquiry / order specification.	

2.3 Screw Compressor:

Sl. No.	DESCRIPTION	QUANTITY
1.0	Compressor	
1.1	Completely assembled dynamically balanced spare rotor including clearance check and mechanical run test	1 set
1.2	Complete spare coupling including distance piece and set of coupling bolts & nuts	1 set

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1.3	Complete Set of radial bearings (Both suction & discharge side)	1 set
1.4	Complete Set of Pads for radial bearings (Both suction & discharge side)	1 set
1.5	Complete Set of thrust bearings (both active & inactive sides), if applicable.	1 set
1.6	Complete Set of Pads for thrust bearings (both active & inactive sides), if applicable.	1 set
1.7	Complete Set of Mechanical seal	1 set
1.8	Complete Set of oil seals	2 sets
1.9	Complete Set of 'O' rings, gaskets, sealing rings. for compressor	4 sets
2.0	Oil System	
2.1	Spare for oil pump	
	- Complete rotating assembly	1 set
	- Bearings	1 set
	- Oil seal	1 set
	- Gaskets & 'O' rings	2 sets
2.2	Cartridge for oil filter	4 sets
2.3	Gaskets for Oil cooler	2 sets
3.0	Gear Box	
3.1	Set of bearings for gear box including drive end, intermediate stages & driven end	2 sets
3.2	Set of spare wheels & shaft	1 set
3.3	Complete Set Oil seals	2 sets
4.0	Accessories	
4.1	Set of spares for all valves (Isolation, control, safety, non return etc.) in gas lines consisting of spindle, seat , disc, flap, packing , fasteners etc.	1 set
4.2	Spare elements for permanent filters in gas line	1 set
5.0	Instrumentation	
	As per Instrumentation specification	

2.4 Centrifugal Fan:

SI. No.	DESCRIPTION	QUANTITY
1.0	Completely dynamically balanced rotor assembly including impeller, wheel, key etc.	1 Set
2.0	Shaft sleeve	1 Set
3.0	Complete set of all Bearings	1 Set
4.0	Stuffing box packing rings	1 Set
5.0	Complete set of all Gasket & 'O' rings	1 Set
6.0	Complete mechanical seal , if applicable	1 Set
7.0	Coupling bushes	1 Set
8.0	Complete set of coupling with elements	1 Set.

2.5 Centrifugal Pump:

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Sl. No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
1.	Impeller	1 set	1 set	1 set	1 set
2.	Impeller locking nut	2 sets	2 sets	2 sets	2 sets
3.	Wear Rings complete set	1 set	2 sets	3 sets	4 sets
4.	Shaft with keys	1 No.	1 No.	1 No.	1 No.
5.	Shaft Sleeve	1 set	2 sets	3 sets	4 sets
6.	Interstage sleeves	1 set	2 sets	3 sets	4 sets
7.	Interstage Bushes	1 set	2 sets	3 sets	4 sets
8.	Complete Set of Mech. Seal where applicable	1 set	1 set	2 sets	2 sets
9.	Constant level Oiler	2 sets	2 sets	2 sets	2 sets
10.	Deflectors	2 sets	2 sets	3 sets	3 sets
11.	Complete set of coupling with element and fasteners	1 set	1 set	2 sets	2 sets
12.	Complete set of all Bearings	1 set	2 sets	2 sets	2 sets
13.	Complete set of Gaskets & 'O' Rings	2 sets	3 sets	4 sets	6 sets
14.	Labyrinths	2 sets	3 sets	4 sets	5 sets
15.	Throat Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.
16.	Throttle Bushing	1 No.	2 Nos.	3 Nos.	4 Nos.
17.	Complete set of Oil Seals	2 sets	3 sets	4 sets	6 sets
18.	Balancing drum & sleeves, as applicable.	1 set	1 set	2 sets	2 sets
19.	Leak-off valve-gaskets, 'O' Rings and springs	2 sets	3 sets	4 sets	5 sets
20.	Spares for gear box (complete set of bearings, all gears wheels with shaft and seals)	1 set	1 set	1 set	1 set

2.6 Reciprocating Pump:

SI No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
A	Main Frame				
1.	Main Bearings	1 set	1 set	1 set	1 set
2.	Big End Bearings	1 set	1 set	1 set	1 set
3.	Thrust Bearings	1 set	1 set	2 sets	2 sets
4.	Crosshead shoes	1 set	1 set	1 set	1 set
5.	Crosshead bushes	1 set	1 set	1 set	1 set
6.	Connecting rod with complete Fasteners for all size	2 sets.	2 sets	4 sets	4 sets
7.	Crank shaft	1 No.	1 No.	1 No.	1 No.

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8.	Lube oil pump	1 No.	1 No.	1 No.	1 No.
9.	Spare parts for lube oil pump (set of gears, bushes, gaskets etc.)	1 set	1 set	2 sets	2 sets
10.	Cartridge for oil filter.	2 Nos.	2 Nos.	4 Nos.	4 Nos.
11.	Special gaskets, oil seals, 'O' rings, special bolts etc.	2 sets	2 sets	4 sets	4 sets
B	Fluid End				
1.	Cylinders	1 No.	1 No.	2 Nos.	2 Nos.
2.	Plungers / piston & piston rod assembly, piston rings (if applicable)	1 set	1 set	1 set	1 set
3.	Stuffing box Packings	2 sets	2 sets	4 sets	4 sets
4.	Plunger Packings	2 sets	2 sets	4 sets	4 sets
5.	Complete set of Suction valve & seat	1 set	2 sets	3 sets	4 sets
6.	Complete set of Discharge valve & seat	1 set	2 sets	3 sets	4 sets
7.	Flushing pump (if applicable)	1 No.	1 No.	1 No.	1 No.
8.	Spares for flushing pump.	1 set	1 set	2 sets	2 sets
	- Plunger - Plunger Packings - Valves - Gaskets				
9.	Special gaskets, springs, 'O' rings, and ring nuts for stuffing box packing, cylinder bolts.	2 sets	2 sets	4 sets	4 sets
C	Gear Reducer (If Applicable)				
	Spares for gear box (complete set of bearings, all gears wheels with shaft and seals)	1 set	1 set	2 sets	2 sets
D	Lube Oil Coolers (If Applicable)				
1.	Special gaskets, if any	2 sets	2 sets	4 sets	4 sets
2.	Spare tubes.	10 %	10 %	10 %	10 %

2.7 Metering Pump:

SI. No.	Description	Quantity			
		No. of Pumps working			
		1	2	3	4
A	POWER END				
1.	Main Bearings	1 set	1 set	1 set	1 set
2.	Big End Bearings	1 set	1 set	1 set	1 set
3.	Crosshead shoes	1 set	1 set	1 set	1 set
4.	Crosshead bushes	1 set	1 set	1 set	1 set
5.	Connecting rod with complete Fasteners for all size	2 sets.	2 sets	4 sets	4 sets
6.	Special gaskets, oil seals, 'O'	2 sets	2 sets	4 sets	4 sets

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	rings , special bolts etc.				
B	FLUID END				
1.	Cylinders	1 No.	1 No.	2 Nos.	2 Nos.
2.	Plungers	1 set	1 set	1 set	1 set
3.	Diaphragm	1 set	2 sets	3 sets	4 sets
4.	Stuffing box Packings	2 sets	2 sets	4 sets	4 sets
5.	Complete set of Suction valve & seat	1 set	2 sets	3 sets	4 sets
6.	Complete set of Discharge valve & seat	1 set	2 sets	3 sets	4 sets
7.	Special gaskets , springs , 'O' rings , ring nuts for stuffing box packing , cylinder bolts	2 sets	2 sets	4 sets	4 sets

2.8 HVAC

SL. NO.	DESCRIPTION	QUANTITY
1.	Consumable for smooth 2 year operation	1set/type
2.	V-belt (As applicable)	2set/each unit
3.	Filter	1set/each unit
4.	Chemical Filter	1set/each unit
5.	Refrigerant	1 set or cylinder/each type
6.	Complete Set of bushes	1set/type
7.	Pump set	1set/type
8.	Coupling	1set/type
9.	Differential Pressure Switch	1set/type
10.	Gear Reducer (As applicable)	1set/type
11.	Motor - Electricals Spares	As per applicability, Quantity as specified in Electricals Specification
12.	Instrumentation Spares	As per applicability, Quantity as specified in Instrumentation Specification

In case any additional spares are recommended other than the above mentioned spares e.g. based upon the recommendation of OEMs, then LSTK contractor shall consider all such spares in their scope.

2.9 EOT Cranes

SL. NO.	DESCRIPTION	QUANTITY
1.	Wire rope for main hoist	1 set
2.	Wire rope for Auxiliary hoist	1 set
3.	Rope guide for main Hoist	1 set
4.	Rope guide for Auxiliary Hoist	1 set
5.	Brake linings of each type	2 sets

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6.	Gear sets	2 sets
7.	All type of Bearings	2 sets
8.	All type of Seal, Gaskets , O-rings	2 sets

Note :- Set means complete replacement of particular part in one machine.

3.0 VENDOR'S RECOMMENDED SPARE PARTS

Contractor/Bidder shall provide the list of spare parts for first two years of operation of the equipment as recommended by OEM (Original Equipment Manufacturer) with recommended quantities and itemized prices covering mandatory spares. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment is facilitated. Recommended spares and their quantities shall take into account related factors of equipment reliability, effect of equipment downtime upon production or safety, cost of parts and availability of vendor's service facilities around the proposed location of equipment.

Contractor shall submit list of recommended spare parts of specialised items not covered in mandatory spares, along with itemised price. Owner will review and decide the recommended spares required for the project.

NOTES:-

1. The above nos. of spares are minimum.
2. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
3. Wherever % age is identified, Contractor shall supply next rounded figure.
4. The terminology used under 'Part Description' is the commonly used name of the part and may vary from manufacturer to manufacturer.
5. Mandatory spares shall be applicable for Electrical / Instrumentation items of sub packages also as per above mandatory spares philosophy.
6. Mandatory spares shall be procured along with the main equipment. These spares include only those spares, which are critical for equipment and require longer delivery periods.
7. The word 'Set' means the quantity required for full replacement of that part in one machine.
8. The Bidder shall quote for all the mandatory spares as defined above & as applicable to the proposed design of the equipment. In case, any spare which is listed above but not applicable due to specific construction/design of the equipment, the same shall be highlighted as 'Not Applicable' against that spare supported with proper technical explanation.

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9. Spare parts shall be identical in all respects to the parts fitted on the main equipment, including dimensions, material of construction, testing & heat treatment.

Mandatory spares as specified elsewhere in the engineering specifications for other items are also to be provided by the contractor before Commissioning of the plant.

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SECTION – VI – 7.0

SITE WORKING AND SAFETY CONDITIONS

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	ISSUED FOR ENQUIRY	JKY	JKY	RRK
REV	REV ATE	PURPOSE	PREPD	REVWD	APPD





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1.0 SITE LOCATION

The proposed project will be located within the premises of existing closed coal based Ammonia- urea complex of TALCHER FERTILIZERS LIMITED, Talcher, ANGUL DISTRICT, ODISHA (INDIA).

2.0 SITE ESTABLISHMENT

2.1 The LSTK contractor shall provide all huts, stores, tarpaulins and other covers for the accommodation of his staff, workmen and materials. All materials likely to deteriorate in the open shall be stored under suitable cover.

2.2 The LSTK contractor shall advise the owner within 15 days of the placement of LOI his space requirement which shall include for office, covered storage, open storage, fabrication space, etc. Depending on availability & requirement, space shall be allotted to the contractor for the duration of this contract. He will not be permitted to make use of any other space without the sanction of the Owner. The use of this space shall strictly be made for the execution of this contract only. The sanitary conditions of the ground in or around such structures shall, at all times, be maintained by the contractor in a manner satisfactory to the owner.

2.3 The security of the LSTK contractor's equipment and materials is his own responsibility.



2.4 The LSTK contractor's shall clear away periodically any rubbish, scrap materials, etc. and dump the same in the area indicated by the owner/consultant. All construction material shall be neatly stacked in an orderly manner as directed by the owner and care shall be taken to allow proper access to workmen and easy movement of men, vehicles, cranes and materials.

2.5 The LSTK contractor shall maintain all the drawings carefully mounted on the board of appropriate size and well protected from the ravages of weather termites and other insects.

2.6 The LSTK contractor shall not permit the entry to the site of any person not directly connected/concerned with the work without first having obtained the written permission of owner.

2.7 The LSTK contractor shall submit a list of plant, equipments, tools, tackles, etc. which he will use, to perform the work. The contractor shall submit a list in duplicate of all materials, tools and tackles etc. brought inside the plant site duly signed by owner's security staff as per the rules laid by owner. These tools, etc. shall not be removed from the site till the completion of job. A gate pass must be obtained from the owner in order to remove from site any plant, machinery, tools, materials and equipment.

2.8 All items such as instructions and other pertinent data regarding erection/commissioning and maintenance should be typed and classified for transmittal in a manner approved by the owner.

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2.9 All employees of the LSTK contractor shall conform to any rules of conduct, etc. established by owner. Failure to comply with the rules of conduct will be sufficient cause for removal of such person from the site.

2.10 The LSTK contractor will be responsible for providing all plant, tools and tackles, consumables and scaffolding required for the execution of his work as per the best engineering practices.

2.11 The receipt, unloading, movement and storage at site of all the LSTK contractor plant, tools and materials is his responsibility. The receipt, movement & storage of material issued by owner also shall be the responsibility of the Construction Contractor.

2.12 ELECTRICITY

As per commercial part.

2.13 CONSTRUCTION WATER

As per commercial part.

2.14 FIRST AID

The LSTK contractor may have access to the Owner's qualified first aid personnel and ambulance, in case of accidents, if available. The contractor will, however provide a first aid post for minor injuries to their staff.

3.0 SUPERVISION OF WORK

3.1 The LSTK contractor shall submit to the Owner resume of his site supervisors for approval prior to commencement of the work. Once approved, the LSTK contractor shall not remove his site supervisors without prior concurrence of the Owner.



3.2 The entire work is to be completed as per the agreed time schedule. The programme of work in details shall be submitted by the LSTK contractor before commencement of work. The detailed programmes prepared by the LSTK contractor shall conform to the targets set forth in the time schedule and will be subject to the approval of the owner. All the work shall be carried out in such a manner that the work of other agencies at site is not hampered due to any action of the LSTK contractor.

4.0 INSPECTION

The work of the LSTK contractor shall be subject to inspection by the Owner at all times.

5.0 EMPLOYMENT OF LABOUR

5.1 The LSTK contractor will be expected to employ on the work only his regular skilled employees with experience of this particular work. The permission of the Owner must be obtained before tradesman is recruited locally for the work. This rule does not apply to unskilled labour. No female labour shall be employed in dark hours/ i.e.

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hours prohibited under the applicable law. No person below the age of eighteen years shall be employed at any point of time.



- 5.2 All traveling expenses including provision of all necessary transport to and from site, lodging allowances and other payments to the LSTK contractor employees are his own responsibility.
- 5.3 The hours of work on LSTK Contractors / Owner and contractor shall adhere to the same.
- 5.4 All Construction contractors employees shall wear safety helmet and such identification marks as may be provided by LSTK contractor on work site and duly approved by Owner.
- 5.5 All notices displayed on the site and any instructions issued by the Owner shall be strictly adhered to by the LSTK Contractors and/or his LSTK contractor employees.
- 5.6 It shall be the responsibility of LSTK contractor to provide suitable accommodation including necessary facilities for their labour and staff.
- 5.7 LSTK contractor will arrange for Ration Cards and Permits for labour as per statutory provisions for its labour, as necessary.
- 5.8 The LSTK contractor shall be required to maintain employment records as covered in relevant Acts and produce documentary evidence to the effect that he has discharged his obligations under the Employees Provident Fund Act 1952 for the workmen working at site.
- 5.9 In case the Owner becomes liable to pay any wages or dues to the labour of the LSTK Contractors or his contractor or any Govt. agency under any of the provision of the Minimum Wages Act, Workmen Compensation Act or any other law due to act of omission of the contractor, the Owner may make such payment and shall recover the sum from Contractor's bills or any other dues.

6.0 COMPLETION OF WORK

Before finally leaving site, all the LSTK contractor store, huts, plant, tools and rubbish shall be removed and the site left clean and tidy. The space allocated by Owner shall be vacated and handed over to the Owner.

7.0 WORKING AND SAFETY REGULATIONS

- 7.1 The LSTK Contractor shall observe all statutory safety and legal requirements regulations issued by Central and State Governments applicable to the work as well as any local regulations applicable to the site issue by the consultant or any other authority.
- 7.2 Particular attention is drawn to the following:
 - a) In case of accident, the Owner shall be informed in writing forthwith.
The LSTK Contractor shall strictly follow regulations laid down by Factory Inspector, Govt. and State authorities in this regard.
 - b) LSTK contractor shall fence his plant, platforms, excavations etc.

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- c) Compliance with all electricity regulations.
- d) Compliance with statutory requirements for inspection and test of all lifting appliances and auxiliary lifting gear.
- e) Safety belts proposed to be used, shall be got checked by Fire & Safety Department of LSTK Contractor / OWNER in written before use.
- f) Before using the lifting or pulling equipment, LSTK contractor shall carryout load test which shall be witnessed by LSTK Contractor / OWNER.

7.3 Staircase, doors or gangways shall not be obstructed in any way that will interfere with means of access of escape.

7.4 No excavations will be started without the permission of the LSTK Contractor / OWNER, who will inform the LSTK contractor of the position of any pipes or cables known to be buried in the area. All excavations must be effectively railed off at all times, or completely boarded over properly marked during the hours of darkness by red warning lamps, using Flame proof warning lamps in non smoking areas. Debris or material which cannot be immediately removed must be heaped in such a way as to be immediately remove and also to leave adequate passage way. Any finds such as relics or antiques coins or fossils etc. shall be promptly handed over to the Owner.

7.5 The LSTK contractor will notify the Owner of his intention to bring on the site any equipment, such as, space heating or welding apparatus or any container holding liquid or gaseous fuel or other substance which might create a hazard. The Owner will have a right to prohibit the use of such equipment or to prescribe the conditions under which such equipment may be used. The LSTK Contractor will have the right to inspect any construction plant, and to forbid its use if in his opinion it is un-suitable or unsafe. No claim arising there from shall be made by the LSTK Contractor.



The LSTK contractor or any one acting on his instructions will not bring on to the site any radio active substance or any apparatus using such substances or any X ray apparatus until written permission and direction regarding the use of such equipment has been received from the Owner.

The LSTK contractor shall be responsible for the safe storage of the radio graphic sources or those of his Construction contractors.

7.6 The LSTK contractor will meet all requirements, and act on the instructions of the Owner where it is necessary to operate a permit to work system.

7.7 Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosive, the LSTK contractor shall be responsible for carrying out such provision and/or storage in accordance with the rules and regulation laid down in Petroleum Act 1934, Explosive Act 1948 and Petroleum and Carbide of Calcium Manual Published by the Chief Inspector of Explosive of India. All such storage shall have prior approvals of the Consultant. In case any approval or clearance from Explosive or any statutory authorities is required, the contractor shall be responsible for obtaining the same.



7.8 The LSTK contractor shall have his own Fire Fighting Extinguishers and Equipment.

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- 7.9 The LSTK contractor shall be responsible for the provision of all safety notices safety equipments including the safety gadgets for his workmen required by both the relevant legislation and such as the Owner may deem necessary.
- 7.10 While working at heights, safety belts shall necessarily be used.
- 7.11 “LSTK contractor shall employ a safety officer for safe executing the construction activities of the project who will be responsible for implementing safety requirement contained in the documents.
The safety officer shall possess a recognised degree in engineering discipline preferably, F&S or (Any branch of engineering) and had a post qualification construction experience of minimum two years.
In addition, he/she shall also possess a recognised degree or diploma in industrial safety and preferably have adequate knowledge of the language spoken by majority of the workers at the construction sites.
Contractor shall ensure physical presence of safety personnel at each work location wherever Hot Work permit is required. No work shall be started at site until above safety personnel are physically present at site. The contractor shall submit a safety organogram clearly indicating the lines of responsibility and reporting system and elaborate the responsibilities of safety personnel in the HSE MAUAL/Program. The contractor should furnish Bio-Data/Resume of the safety personnel as above, at least 01 month before the mobilization for PDIL/owner’s approval.
- 7.12 LSTK contractor shall use only steel planks and clamps executing scaffolding. Wooden planks and rope shall not be allowed for this purpose.
- 7.13 LSTK contractor shall use asbestos cloth to ensure falling of weld spatters down below during above ground welding to ensure safety of electrical cables and personnel and avoiding any fire hazards.

8.0 ELECTRICAL SAFETY REGULATIONS

- 8.1 In no circumstances will the LSTK contractor interfere with fuse and electrical equipment belonging to the owner or other contractors.
- 8.2 Before the LSTK contractor connects any electrical appliances to any plug or socket belonging to the other contractor or owner, he will -
- i. Satisfy the Owner that the appliance is in good working condition.
 - ii. Uses of matching sixes plug & does not uses bare wire to insert in socket.
 - iii. Inform the Owner of the maximum current rating, voltage and phase of appliance.
 - iv. Obtain permission of the Owner dealing the sockets to which the appliance may be connected.
 - v. Use distribution board with ELCB for feeding power to hand held tools.
- 8.3 The Owner will not grant permission to plug in until he is satisfied that-
- i. The appliance is in good condition and is fitted with a suitable plug.

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- ii. The appliance is fitted with a suitable cable having two earth conductors, one of which shall be earthed metal sheath surrounding the cores.

8.4 No electric cable in use by the other LSTK contractor/owner will be distributed without prior permission. No weight of any description be imposed on any such cable and no ladder or similar equipment will rest against or be attached to it. Cables / Wires used shall be in good condition without cuts & in insulation & joints.

8.5 The voltage for all portable equipment e.g. drilling machines, temporary lighting etc. will not exceed 240 volts.

8.6 No work must be carried out on any live equipment. The equipment must be made safe and a "permit to work" issued before any work is carried out.

8.7 LSTK contractor shall employ electrician to maintain his temporary electrical installation.

8.8 Take necessary clearance for working in hazardous area.

9.0 REPORTING

a) The LSTK contractor must report the following information to the Owner in writing daily. Number of men employed, trades-wise,

- Progress achieved;
- Concrete pour card, if any.

b) If during excavation any materials such as but not limited to precious materials or treasure troves etc are found, the same shall be reported to owner immediately and shall be the property of owner.



10.0 GENERAL SAFETY REQUIREMENTS TO BE OBSERVED DURING SITE FABRICATION AND ERECTION BY THE CONSTRUCTION CONTRACTOR

1. Before starting the work, **LSTK contractor** should get safety work permit and should strictly follow instructions written by the concerned authority in work permit. Permit is required for all types of job i.e. Hot, Cold Excavation, Chipping, Grinding etc.

2. Smoking is strictly prohibited inside factory areas.



3. Safety appraisal and equipments shall be provided to workmen as per the nature of work. Welders shall use gloves, goggles, shields etc. during welding, gas cutting etc. All technicians shall use gloves, goggles during grinding, chipping etc. If any unsafe practice is observed Fire & Safety Sections or the authority issuing the work permit is authorized to stop the work without any prior notice.

4. Temporary fire extinguishers, water hose shall be available near work place and in case of fire, Owner's Fire & Safety Section should be immediately

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informed by LSTK contractor from nearest available telephone. Project Manager should also be immediately informed.



5. LSTK contractor shall secure necessary insurance of his workmen for the entire duration of works under the contract. Owner is not responsible for any accident/injury caused whatsoever, to any person employed by the Construction Contractor. However, LSTK contractor has to inform Owner's Fire & Safety Section about accident, if any, immediately.
6. Temporary switch boards, cables, wires and electrical equipments should be installed in accordance with standard electrical practice with proper earthing etc. and should have prior approval of LSTK Contractor / Owner electrical engineer. Switch board shall be suitably protected against rainwater. The cable used for welding machine should have flexible tough rubber sheathing.
7. Temporary cables and wires including welding cables should be routed as not to cluster the work areas. Also any possibility of damage to live wires by falling objects should be avoided. Temporary electrical lines for power & lighting shall run overhead or underground so that they should not hinder the movement of men, materials and vehicles.
8. Portable hand lamps being used by construction crew shall be preferably of 24 Volts supply bulb to be protected with safety shields.
9. Earthing for welding shall not be taken through existing structure or equipments due to the very explosive nature of the plant, raw materials, reaction during process and final product. There is every possibility of fire and explosion in the equipment due to electric spark caused by loose earthing connection etc.
10. LSTK contractor should be careful while excavating so that no underground cable or pipe line is damaged. As soon as any brick cover or under ground cables are exposed he should stop the work and inform Construction Manager immediately for necessary action.
11. LSTK contractor should not leave any welding machine etc. running after the work is stopped. Before leaving the work place, Contractor should ensure that welding sets are disconnected from welding socket outlet.
12. All work areas shall be kept reasonably clear and clean for easy movement of men & material. Also all approach roads shall be free from obstacles for easy movement of cranes, vehicles, fork-lifts, trollies etc. and all debris shall be periodically removed.
13. All temporary structure and supports for erection purpose such as scaffolding, ladders, walkways, platform, shuttering etc. shall be sufficiently strong for safe use and to prevent collapse & accidental fall of workman. Same shall be removed immediately after the work is completed.
14. All workmen working at unsafe elevation during the construction activity such as concreting, plastering, welding, erection work, painting, insulation etc. shall be safe and sufficient passage and should be properly instructed to take necessary safety precautions and observe safe practice to prevent accidental fall. Safety belts and helmets shall be used wherever necessary.

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15. All supervisors, welders, electricians, technicians, riggers, engaged in the work shall be adequately skilled, experienced and acquainted with standard rules, regulation & practices of the work.
16. All open trenches, pits and other excavation carried shall be barricaded out by Construction Contractor, to avoid accident.
17. All lifting tools, tackles & accessories shall be in good working condition and of suitable capacity for the purpose for which they are used. All certificates/permits/licenses etc. required under any law or regulation for the same shall be available and valid during the entire period of the execution of the work under this WO/Contract.
18. LSTK contractor shall not use any structure or equipments erected or under erection for fastening, lifting or flying tackle guy-ropes etc. which may impose such loads for which structure or equipments are not designed to carry. However, LSTK contractor has to get prior approval from Construction Manager of Owner before using beams, permanent structure for the above purpose.
19. When work is carried out at high elevations, it is the responsibility of the LSTK contractor to ensure that tools and materials are not left in a position where they can fall on peoples moving /working below. Where necessary, places below should be cordoned off and caution boards be provided by contractor. Also, LSTK contractor should not cut existing hand railing/structure.
20. Contractor's men must not tamper with any machines, switches, valve or equipment not connected with their work. Welding holders should not be tested on running pipe lines.
21. Nylon rope should not be used for scaffolding where hot line is running near by, because there is every possibility of wire rope catching the fire. Also, no scaffolding is to be made on hot as well as insulated lines.
22. Necessary sign boards clearly indicating "RADIOGRAPHY HAZARDS" on all the four sides of the cordoned area surrounding radiography source will have to be displayed by Construction Contractor. Surrounding area will be cordoned with the help of manila rope and his personnel will be kept for watching/guard on all the four sides to prevent entry of personnel till the radiography work is completed. Construction Contractor's personnel should be able to communicate clearly/properly to stop entry of unauthorized personnel within the area cordoned for the radiography work.

Refuse Disposal

23. Refuse must be removed daily to prevent accumulation. Materials liable to cause persons to slip or trip and fall should be cleared immediately.
24. Refuse removal teams working after work hour should be organized where normal cleaning can not cope with the build up of waste materials.

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25. Projecting nails should be removed or bent over.

Personal Protective Equipments

26. Helmets should be provided for all who are exposed to the dangers of falling material or structures they might strike against.
27. Suitable eye protection should be provided for all who are exposed to flying particles, harmful glare and dangerous substances.
28. In the handling of rough objects, gloves should be provided and used.
29. Safety footwear should be provided to all who are exposed to foot injury, should be good fitting and comfortable to wear.
30. Safety belts should be provided where other means are not practicable. Both the anchorage points and lifelines provided for attaching safety belts should be of adequate strength. The umbilical line should be fixed in such a way that user's freefall will not exceed 1 metre.
31. Catch net should be used where persons are liable to fall and these should be securely supported at a level as near as possible to the working level.
32. Noise defenders should be provided for work area where the noise level exceeds 85 dBA.
33. Respiratory protection should be provided by employers and used by workers where the dust level remains high and where control at source is not practicable.

Inspection & Record Keeping



34. Where defects render the scaffolds unsafe, they should be rectified immediately. Where this is not practicable, a sign should be put warning against using it.

Winches

35. Adequate foundations should be provided for winches.

Lifting Gear

36. All lifting gear and slinging should be tested before use and thereafter inspected regularly by competent engineers. Workers should also check the lifting gear visually before using them.
37. Each piece of lifting gear should bear its safe working load, its identification number and its last inspection date. It could in addition be colour coded according to due date of inspection.

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38. Wire ropes should be preserved against rusting, kinking, fraying, birdcaging and heat damage. Defective wires should be destroyed to prevent recycling.

Concrete Mixers

39. Moving parts which are liable to become nip points, such as gears, chains and rollers should be guarded.
40. Where concrete mixers are driven by internal combustion engines, exhaust points should be located away from the workers' work station so as to eliminate their exposure to obnoxious fumes.

Electrical Components

41. All components and conductors used must be in good condition.
42. Proper junction boxes and distribution boards from which electric power could be tapped should be provided at every floor level.

Demolition: General Provisions

43. Uncontrolled collapse of walls or other structures under demolition should be prevented.
44. The throwing of materials over the sides of the buildings should not be permitted.

Waste Handling

45. Where demolition is carried out near public areas:
- Hoardings slopping inwards should be erected around the building.
 - Protective nettings should be hung around the building to prevent materials falling outside the periphery shelter
 - asbestos



Where asbestos materials are present, appropriate dust control and respiratory protection approved by the local authority must be used.

Excavation: General Provisions

46. Test for toxic gases should be carried out where their presence is suspected.
47. Exposure of shorings to vibration such as that produced by engines or vehicular traffic should be kept to a minimum.

General – Ventilation, Fire Protection/Fighting

48. Where flammable gas concentration could reach explosive levels, it may be necessary to provide intrinsically safe electrical equipments.

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49. Adequate lighting and emergency lighting should be provided.
50. Adequate evacuation stairways should be provided for rapid evacuation in case of an emergency.

First Aid

51. Sufficient First Aid Boxes containing simple dressings and supplies should be provided on the site under the control of the foreman.

Awareness

52. The contractor shall brief the visitor about HSE precautions which are required to be taken before proceeding to site and make necessary arrangement to issue appropriate PPE's like HELMET, Safety shoes etc. to the visitors.

The contractor shall promote and develop consciousness about Health, safety and environment among all personnel working for the contractor. Regular awareness programmes and fabrication shop/work site meeting at least on fortnightly basis shall be arranged on HSE activities to cover hazards involved in various operations during construction phase. During the awareness program, step shall be taken by the contractor to motivate & encourage the workmen and supervisory staff by issuing/awarding them the tokens/gifts/mementos/ Monetary incentives.

A verbal warning shall be given to the workers during the first HSE violations. A written warning shall be issued on second violations and thereafter for the third violations; the services of worker shall be terminated. For all these violations, a penalties' shall be imposed, separately on the contractor. Records of warning for each worker shall be kept in the records.

53. Penalty

The Contractor shall adhere consistently to all provisions of HSE requirements. In case of noncompliance's and also for repeated failure in implementation of any of the HSE provisions,

Consultant/Owner may impose stoppage of work without any cost & time implication to the Owner and/or impose a suitable penalty.

The amount of penalty shall be limited to 0.5 % (Zero decimal five percent) of the contract value for LSTK contract.



The amount of penalty applicable for the Contractor on different types of HSE violations is as below.

1. For not using personal protective equipment (Helmet, Shoes, Goggles, Gloves, Full body harness, Face shield, Boiler suit, etc.)

Rs 500/- per day/ Item / Person.

2. Working without Work Permit/Clearance Rs 20000/- per occasion.

- 3 Execution of work without deployment of requisite field engineer / supervisor at work spot Rs. 5000/- per violation per day.

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4. Unsafe electrical practices (not installing ELCB, using poor joints of cables, using naked wire without top plug into socket, laying wire/cables on the roads, electrical jobs by incompetent person, etc.)

Rs 10000/- per item per day.

5. Working at height without full body harness, using non-standard/ rejected scaffolding and not arranging fall protection arrangement as required, like handrails, life-lines, Safety Nets etc.

Rs. 10000/- per case per day.

6. Unsafe handling of compressed gas cylinders (No trolley, jubilee clips double gauge regulator, and not keeping cylinders vertical during storage/handling, not using safety cap of cylinder).

Rs 500/- per item per day.

7. Use of domestic LPG for cutting purpose / not using flash back arresters on both the hoses/tubes on both ends.

Rs. 3000/- per occasion.

8. No fencing/barricading of excavated areas /trenches.

Rs. 3000/- per occasion.

9. Not providing shoring/strutting/proper slope and not keeping the excavated earth at least 1.5M away from excavated area.

Rs.5, 000/- per occasion.

10. Non display of scaffold tags, caution boards, list of hospitals, emergency services available at work locations.

Rs.1000/- per occasion per day



11. Traffic rules violations like over speeding of vehicles, rash driving, talking on mobile phones during vehicle driving, wrong parking, not using seat belts, vehicles not fitted with reverse horn / warning alarms / flicker lamps during foggy weather.

Rs. 2000/- per occasion per day

12. Absence of Contractor's RCM/SIC or his nominated representative (prior approval must be taken for each meeting for nomination) from site HSE meetings whenever called by Consultant/Owner & failure to nominate his immediate deputy (in the site organ gram) for such HSE meetings.

Rs10000/- per meeting.

13. Failure to maintain HSE records by Contractor

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Safety personnel, in line with approved HSE Plan/Procedures/Contract specifications.

Rs 10000/- per month.

14. Failure to conduct daily site safety inspection (by Contractor's safety engineers/safety officers), internal HSE meeting, internal HSE Awareness/Motivation Program, Site HSE Training and HSE audit at predefined frequencies (as approved in HSE Plan).

Rs.10000/- per occasion.

15. Failure to submit the monthly HSE report by 5th of subsequent month to Project's Engineer-in-Charge /Owner

Rs. 10000/- per occasion and Rs.1000/- per day of further delay.

16. Poor House Keeping Rs. 5000/- per occasion per subject

17. Failure to report & follow up accident (including Near Miss) reporting system within specific timeframe.

Rs. 20000/- per occasion

18. Degradation of environment (not confining toxic spills, spilling oil/lubricants onto ground).

Rs10000/- per occasion

19. Not medically examining the workers before allowing them to work at height / to work in confined space / to work in shot-blasting / to work for painting / to work in bitumen or asphalt works, not providing ear muffs while allowing them to work in noise polluted areas, made them to work in air polluted areas without respiratory protective devices,etc.

Rs 5000/- per occasion per worker

20. Violation of any other safety condition as per job HSE plan / work permit and HSE conditions of contract (e.g. using crowbar on cable trenches, improper welding booth, not keeping fire extinguisher ready at hot work site, unsafe rigging practices, non-availability of First-Aid box at site, not using hood with respiratory devices by blaster for shot//grit blasting, etc.)

Rs. 5000/- per occasion



21. Failure to carry-out Safety audit in time (internal & external), close-out of identified shortfalls of Observations of Safety Aspects(OSA),etc

Rs. 20,000/- per occasion

22. Carrying out sand blasting instead of grit/shot blasting

Rs. 50,000/- per day

23. Failure to deploy adequately qualified and competent Safety Officer

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Rs. 10000/- per day per Officer

24. Utilization of hydra/ back-hoe loader for material shifting or any other unauthorized /unsafe lifting works

Rs 25,000/- per occasion

25. Any violation not covered above to be decided by Consultant/Owner.

26. Any physical injury - maximum of Rs.2,00,000 per injury

27. Fatal accident - Rs. 25,00,000 per fatality

Note:- This penalty shall be in addition to all other penalties specified elsewhere in the contract. The decision of imposing stop-work instruction and imposition of work penalty shall rest with PDIL/Owner. The same shall be binding by the contractor. Imposition of penalty does not make the contractor eligible to continue the work in unsafe manner.

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SECTION VI- 8.0

PERFORMANCE AND GUARANTEE

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 LTD, ODISHA PERFORMANCE AND GUARANTEE	PC0183/4018/SecVI/8.0	0	
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1.0 PERFORMANCE GUARANTEE:

- i. Contractor/bidder shall be fully responsible for design and manufacturing work as well as the smooth functioning of the equipment covered under the mentioned specification as a minimum.
- ii. The system shall be performance tested at site after commissioning. The guaranteed parameters shall be checked during the performance test. The performance testing procedures shall be mutually decided after finalization of order.
- iii. Necessary Instruments for performance testing shall be arranged by the contractor/bidder and calibrated before undertaking the performance test.
- iv. All the equipments shall be designed for minimum life of 25 years.
The complete Raw material Handling & wagon unloading system shall be guaranteed for satisfactory operation while handling the specified capacity continuously for 24 hours per day, 7 days per week and 330 days per year to ensure trouble free performance.
- v. All equipment and component parts shall be guaranteed by the contractor/bidder against faulty design, effective material or poor workmanship for a period stipulated in the bid package.
- vi. If any equipment or component(s) fail to perform the stipulated duty or malfunction, contractor shall rectify, modify, replace or make good the defective equipment/component(s) free of cost on notification by the purchaser within a reasonable time period mutually agreed upon.
In case, the contractor/bidder fails to achieve the specified performance even after the modifications within one month time of the trial runs, the Owner reserves the right to make alternative arrangements for modification/rectifications at contractor/bidder's cost & risk without any prejudice to any terms of the contract.
- vii. All the equipments of the complete Raw material Handling & wagon unloading system should be able to achieve 100% of the specified design capacities at a particular period and normally. However, a margin of 5% should be kept over the specified design capacity while designing the equipment, for occasional over-loading.

Contractor shall guarantee the capacity of the following equipment as enlisted:

- a) All Belt conveyors (Rated capacity-1250tph , Design capacity-1500tph)
- b) Wagon tippler (25 tips per hours) with side arm charger
- c) Apron Feeder

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- d) Paddle feeder
- e) All Dry Fog Dust Suppression System and ventilation system
- viii. For other equipment, performance as per data sheet/ specifications shall be demonstrated.
- ix. Contractor shall demonstrate re-starting of conveyors under loaded belt conditions for load not exceeding the rated load.
- x. Capacity shall be determined based on the electronic weigh scale readings duly calibrated prior to the PG test .Measuring tolerance shall be as per the accuracy limit of the instrument.
- xi. Duration of the test shall be a continuous period of 4 hours/day for 3 consecutive days. During the PG test, system shall be operated at design capacity. Acceptance of the system shall be based on its capability to handle coal, petcoke and limestone at its design capacity for duration of 4 hours (continuous) without any spillage or undue vibration & noise.
- xii. If the system fails to achieve PG parameters, Contractor/bidder shall carry out necessary modification at his own cost till the Design capacity is achieved within a reasonable period not exceeding six (6) months from the date of failure of PG test and a second PG test shall be organized or as per Special Conditions of Contract (SCC).
- xiii. Utility (Power) Consumption:
- Power consumption shall be considered for calculation of guaranteed work cost, refer relevant clause of commercial section (SCC) in this regard. For equipments to be considered for guaranteed power consumptions refer to Material Handling Design Specification.
- xiv. Noise Pollution
- The equipment shall be guaranteed against excessive noise pollution. Noise should not exceed 85 dBA measured at a distance of 1.0 meters from the noise emitting source.
- xv. Accuracy
- Accuracy of all equipments & items shall be guaranteed as mentioned.
- xvi. Training
- Bidder / Contractor shall provide training to seven (7) persons for seven (7) days for smooth operation of plant. Owner's manpower shall be able to develop a thorough understanding of the

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plants and the know-how and processes behind it, be in a position to take positive and corrective action to prevent any upset and breakdown conditions from occurring, and to optimize plants' operations, maintenance and organization.

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SECTION VI- 9.0

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

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2.0	Normal & Emergency Power requirement
3.0	Plant layout for Battery Limit Plant
4.0	Details of Instrumentation system
5.0	Comprehensive Engineering Specifications/ Standards & design
6.0	Details of Shop & Field Testing & Inspection Procedures
7.0	Implementation plan
8.0	Project Plan
9.0	Time Schedule Network
10.0	List of Vendor's not covered under ITB Vendor List
11.0	Quality Assurance & Quality Control Procedure
12.0	List of Spare Part

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INFORMATION REQUIRED IN THE TECHNICAL PROPOSAL:

The Technical proposal of the bid shall include, but not necessarily be limited to the following:

- 1.0 **Flow diagram** indicating the major equipment in proper Flow sequence, Critical Instrumentation, Control points and the material of construction adopted.
- 2.0 **Normal & Emergency Power Requirement**
- 3.0 **Plant Layout for Battery Limit plant** showing principal equipment and machinery including detailed floor plans and elevations. The plot plan should show clearances required, roads and all principal racks.
- 4.0 **Details of Instrumentation System** including the proposed models etc. as also details of the proposed control systems (DCS) Safety Interlock and Trip system shall be enclosed. Instrumentation Control Philosophy, Logic Diagrams & Safety valve Specifications shall also be enclosed.
- 5.0 **Comprehensive Engineering Specification/Standards and Design Codes** for all types of Equipments/items including Mechanical, Electrical, Instrumentation, Structural proposed to be adopted by the Contractor.
- 6.0 **Details of Shop & Field Testing and Inspection Procedures** proposed to be adopted. Inspection of equipment & machinery should be carried out by a Third Party Inspector. Owner also has the right to inspect any equipment, machinery at any stage.
- 7.0 **An Implementation Plan showing man-power deployment schedule** during various stages of implementation period, including peak requirements. Contractor/bidder shall indicate the schedule, category and number of personnel proposed for supervisory services during different phases of work, indicating clearly as to how many of them would be deployed by Contractor. Contractor shall also indicate the correspondence and documentation system to be followed.
- 8.0 **Project Plan** showing Project Organisation, Project team, Project services offered by the Contractor/bidder at home office and at site. Contractor/bidder would also indicate the activities proposed to be carried out.

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9.0 **Time Schedule Network.** A time schedule for the complete project in the form of a Bar Chart and Network indicating the time allocated for various activities. Master time schedule/ network (PERT Network/ Bar chart) showing all activities shall be submitted by the Contractor/bidder.

10.0 **List of Vendor's not covered under ITB Vendor List.**

Bidder shall furnish list of vendors with proven track record for approval for the items not covered under ITB which shall be discussed & finalised with selected contractor/bidder.

11.0 **Quality Assurance & Quality Control procedure** to be followed by Contractor/bidder for the implementation of this project.

12.0 **List of Spare part.** Complete list of itemised commissioning, mandatory & recommended spare (spare parts not covered under mandatory spares list) parts for 2 years operations for all Process, Mechanical, Electrical, and Instrument items considered for this project.

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SECTION VI- 10.0

VENDOR LIST

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

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

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SUB-VENDOR LIST:

Contractor/Bidder shall select sub vendors from the vendor list as specified below. However, if, bidder is the manufacturer of any item, it shall be acceptable subject to furnishing of proven track record/credential by bidder for similar or comparable plant design capacity and approval of owner/consultant during detail engineering stage. Bidder shall ensure that sub vendor for the specified item has supplied item for the specified service & the supplied item is in satisfactory service since last 3 years as on date of offer.

Any equipment/item for which vendor list is not enclosed; Contractor/Bidder shall furnish a list of proposed vendors along-with their references for supply for the specified services of similar type of equipment. However, all proposed additional sub-vendors shall have proven track record/credential and shall be subjected to owner's / consultant approval during detail engineering.

A. MATERIAL HANDLING

SL. No.	Vendor's Name	Country
Conveyor Belting		
1.	MRF Ltd.	India
2.	Phoenix conveyor belt limited	India
3.	Oriental Rubber Industries Ltd.	India
4.	Universal Conveyor belting ltd.	India
5.	Anil Rubber pvt. Ltd.	India
Gear Reducer & Gear Boxes		
1.	Radicon	India
2.	New Allenbury Works.	India
3.	FMG	India
4.	Elecon Engg. co. Ltd.	India
5.	Shanti	India
Couplings		
1.	Fenner India Ltd.	India
2.	New Allenbury Works	India
3.	Elecon Engg. co. Ltd.	India
4.	Hi-Cliff	India
5.	David Brown	India
6.	FMG	India
Bearings		
1.	SKF India Ltd.	India
2.	FAG Bearing India Ltd.	India
Skirt Boards		
1.	TEGA India Ltd.	India



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SL. No.	Vendor's Name	Country
2.	Kaveri ultra-polymers Ltd.	India
External Belt Cleaner		
1.	Hosch equipment India Ltd.	India
2.	Kaveri ultra-polymers Ltd.	India
Continuous Belt weigher		
1.	Encardio-rite Electronics pvt. Ltd.	France
2.	Transweigh (India) Ltd.	India
3.	Weitex India limited	India
4.	Preciamolen	India
5.	Schenck Process	India
Wagon tippler		
Casing		
1.	Thyssunkrupp Industruies India Ltd	India
2.	Flsmidth	India
3.	Tenova	India
4.	Elecon Engg. Co. Ltd	India
Chain & Sprocket		
1.	Thyssunkrupp Industruies India Ltd	India
2.	Flsmidth	India
3.	Tenova	India
4.	Elecon Engg. Co. Ltd	India
Side arm charger		
1.	Thyssunkrupp Industruies India Ltd	India
2.	Flsmidth	India
3.	Tenova	India
4.	Elecon Engg. Co. Ltd	India
Paddle feeder		
1.	Thyssunkrupp Industruies India Ltd	India
2.	Flsmidth	India
3.	Tenova	India
4.	Elecon Engg. Co. Ltd	India
Wagon & Truck Loader		
1.	Elecon Engg. Co. Ltd	India
2.	Beumer India Private Limited	India
3.	Mollers Gmbh	Germany
4.	Boubiela Moret	France
Electric Hoists		
1.	Elecon Engg. Co. Ltd	India
2.	Greaves Ltd.	India
3.	W.H. Brady & Co. Ltd	India

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SL. No.	Vendor's Name	Country
4.	Hercules Hoists Ltd.	India
Chain Pulley Block		
1.	Hercules Hoists Ltd.	India
2.	W.H. Brady & Co. Ltd	India
3.	Mangla Hoist & Hydraulics Ltd.	India
4.	Tractel Tirfor India Pvt. Ltd.	India

B. ROTATING EQUIPMENT

SL.NO	VENDOR'S NAME	COUNTRY
Pumps for Chemicals/ Acid/ Alkali/ BFW/ Condensate Use		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	AKAY INDUSTRIES PVT. LTD	INDIA
3.	BEACON WEIR LTD	INDIA
4.	ITT CORPORATION INDIA PVT. LTD.	INDIA
5.	KIRLOSKAR BROTHERS LTD.	INDIA
6.	KIRLOSKAR EBARA PUMPS LTD	INDIA
7.	KISHORE PUMPS PVT. LTD	INDIA
8.	KSB PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SAM TURBO INDUSTRY PRIVATE LTD. (CHEMICAL PUMPS CAPACITY- 900 M3/HR. HEAD- 60 M)	INDIA
11.	SULZER PUMPS INDIA LTD. (SINGLE STAGE ONLY)	INDIA
12.	PUMPEN FABRIK ERNST VOGEL	AUSTRIA
13.	ENSIVAL S.A	BELGIUM
14.	GE POWER (NUOVO PIGNONE SPA)	ITALY
15.	WEIR GABBIONETA SRL(FORMERLY POMPE GABBIONETA SPA)	ITALY
16.	ARAI PUMP MFG. CO. LTD	JAPAN
17.	SANWA HYDROTECH CORPORATION	JAPAN
18.	GOULD PUMPS INC.	SINGAPORE
19.	FLOWSERVE (IDP)	U.K
20.	LABOUR PUMP CO. LTD	U.K
COOLING WATER PUMPS (HORIZONTAL)		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	BEACON WEIR LTD	INDIA
3.	FLOWMORE LTD (FORMALLY FLOWMORE PVT. LTD.)	INDIA
4.	JYOTI LIMITED	INDIA
5.	KIRLOSKAR BROTHERS LTD.	INDIA
6.	MATHER & PLATT (INDIA) LTD. (A SUBSIDIARY OF WILO SE GERMAN)	INDIA



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7.	SAM TURBO INDUSTRY PRIVATE LTD. (CHEMICAL PUMPS CAPACITY- 440 M3/HR. HEAD- 44 M)	INDIA
8.	VOLTAS LTD. (PUMPS & PROJECTS BUSINESS DIVISION)	INDIA
9.	KSB AG	GERMANY
10.	MITSUBISHI HEAVY INDUSTRIES LTD	JAPAN
11.	SHIN NIPPON MACHINERY CO. LTD	JAPAN
12.	TORISHIMA PUMP MFG. CO. LTD	JAPAN
13.	FLOWSERVE (IDP)	U.K
PUMPS FOR SLURRY SERVICE		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	AKAY INDUSTRIES PVT. LTD	INDIA
3.	BEACON WEIR LTD	INDIA
4.	BEST & CROMPTON ENGG. CO.	INDIA
5.	FLOWMORE LTD. (FORMALLY FLOWMORE PVT. LTD.)	INDIA
6.	GREAVES LTD.	INDIA
7.	KISHORE PUMPS PVT LTD	INDIA
8.	KSB PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SAM TURBO INDUSTRY PRIVATE LTD.	INDIA
11.	SU MOTORS PVT. LTD	INDIA
12.	SULZER PUMPS INDIA LTD.	INDIA
PUMPS FOR UTILITY SERVICES		
1.	AKAY INDUSTRIES PVT. LIMITED	INDIA
2.	BEACON WEIR LTD	INDIA
3.	BEST & CROMPTON ENGG. CO.	INDIA
4.	FLOWMORE LTD. (FORMALLY FLOWMORE PVT. LTD.)	INDIA
5.	FLOWSERVE INDIA CONTROL LTD.	INDIA
6.	KIRLOSKAR BROTHERS LIMITED	INDIA
7.	KIRLOSKAR EBARA PUMPS LIMITED	INDIA
8.	KISHORE PUMPS LTD	INDIA
9.	MICROFINISH PUMPS PVT. LTD	INDIA
10.	SU MOTORS PVT. LTD	INDIA
11.	SULZER PUMPS INDIA LTD.	INDIA
PUMPS FOR VERY LOW NPSH REQUIREMENTS (AMMONIA/ NAPHTHA)		
1.	ITT CORPORATION INDIA PVT. LTD.	INDIA
2.	KSB PUMPS LTD.	INDIA
3.	SULZER PUMPS INDIA LTD	INDIA
4.	KSB GUINARD	FRANCE
5.	KSB AG	GERMANY
6.	GE POWER (NUOVO PIGNONE SPA)	ITALY
7.	WEIR GABBIONETA SRL(FORMALLY POMPE GABBIONETA SPA)	ITALY
8.	ARAI PUMP MFG. CO LTD	JAPAN
9.	EBARA CORPORATION	JAPAN
10.	NIKKISO SUNDSTRAND CO. LTD	JAPAN
11.	SANWA HYDRITECH CORPORATION (ONLY	JAPAN

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	HORIZONTAL PUMPS)	
12.	GOULD PUMPS INC	SINGAPORE
13.	HAYWARD TYLER LTD	U.K
14.	BYRON JACKSON PUMP	U.S.A
CENTRIFUGAL MONOBLOCK PUMP SET		
1.	CROMPTON GREAVES LTD	INDIA
2.	JYOTI LIMITED	INDIA
3.	KIRLOSKAR BROTHERS LTD.	INDIA
4.	MATHER & PLATT (INDIA) LTD.(A SUBSIDIARY OF WILO SE GERMAN)	INDIA
5.	PRECISION ENGINEERING INDUSTRIES (SMALL PUMPS UPTO 2 HP)	INDIA
6.	UJALA	INDIA
SUMP PUMPS		
1.	AKAY INDUSTRIES PVT. LTD	INDIA
2.	BEACON WEIR LTD	INDIA
3.	KISHORE PUMPS PVT. LTD	INDIA
4.	SAM TURBO INDUSTRY PRIVATE LTD. (CAPACITY – 550M3/HR. HEAD- 35M)	INDIA

PUMPS FOR CHEMICAL DOSING/ METERING		
1.	BRAN & LUEBBE INDIA	INDIA
2.	MATZ PUMPS PRIVATE LIMITED	INDIA
3.	MILTON ROY INDIA (P) LTD	INDIA
4.	POSITIVE METERING PUMPS (I) PVT. LTD.	INDIA
5.	SHAPO TOOLS	INDIA
6.	SWELORE ENGINEERING PVT. LTD	INDIA
7.	V.K PUMPS INDUSTRIES PVT. LTD	INDIA
8.	VARICON SYSTEMS (MOTOR DRIVEN/ PNEUMATIC)	INDIA
9.	DOSAPRO MILLTON ROY	FRANCE
10.	LEWA HERBERTOTT GMBH & CO	GERMANY
11.	PERONI POMPE SPA	ITALY
12.	NIGATA WORTHINGTON PUMPS	JAPAN
13.	NIKKISO CO. LTD.	JAPAN
14.	BRAN & LUEBBE LTD.	U.K
PUMPS FOR MISC. SERVICE		
1.	A.R WILFLEY INDIA PVT. LTD	INDIA
2.	KSB PUMPS LTD.	INDIA
3.	SULZER PUMPS INDIA LTD	INDIA
4.	V.K PUMPS INDUSTRIES PVT. LTD (FOR NON CRITICAL USE)	INDIA
5.	UT PUMPS & SYSTEM PVT. LTD (HP TRIPLEX PLUNGER PUMPS CAPACITY 215 LPH, PR. 250	INDIA

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	BAR)	
6.	LEWA HERBERTOTT GMBH & CO	GERMANY
7.	URACA PUMPENFABRIK GMBH & CO	GERMANY
8.	DOSAPRO MILLTON ROY	ITALY
9.	PERONI POMPE SPA (CAPACITY = 95 M3/HR, PRE = 306 KG/CM2)	ITALY
10.	NIGATA WORTHINGTON PUMPS	JAPAN
11.	NIKKISO CO. LTD.	JAPAN
12.	BRAN & LUEBBE LTD.	U.K

ROTARY PUMPS AND SCREW PUMPS

1.	AIRAUTO INDUSTRIES	INDIA
2.	DELTA CORPORATION	INDIA
3.	ROTO PUMPS LTD	INDIA
4.	UT PUMPS AND SYSTEMS LTD (SINGLE SCREW: CAP. 5M3/HR PR. 0.06 BAR, TWIN SCREW: CAP 25M3/HR PR. 25 BAR, TRIPLE SCREW: CAP 53.4 M3/HR PR. 10 BAR)	INDIA

DIAPHRAGM PUMPS

1.	HI-LIFE MANUFACTURING CO. (2.5-4.5 m3/hr)	INDIA
2.	S R METERING PUMPS & SYSTEMS (36-10080 LPH)	INDIA

COMPRESSOR FOR MP SERVICE (PROCESS AIR, REF, CO₂,N₂, NG)

1.	BHEL	INDIA
2.	CAMERON COMPRESSION SYSTEM (API 617: 60000 CFM@ 80 BAR, API 672: 950000 CFM@ 80 BAR)	INDIA
3.	MANNESMAN DEMAG AG	GERMANY
4.	GHH BORSIG TURBOMASCHINEN GMBH	GERMANY
5.	SIEMENS AG PGI	GERMANY
6.	GE POWER (NUOVO PIGNONE SPA)	ITALY
7.	HITACHI LTD	JAPAN
8.	KOBE STEEL LTD	JAPAN
9.	MITSUBISHI HEAVY INDUSTRIES LTD.	JAPAN
10.	DRESSER-RAND CO.	SINGAPORE

RECIPROCATING COMPRESSOR

1.	ATLAS COPCO (FOR AIR SERVICE ONLY)	INDIA
2.	DRESSER-RAND INDIA PVT LTD.	INDIA
3.	BURCKHARDT COMPRESSION (INDIA) PVT. LTD.	INDIA
4.	CAMERON COMPRESSION SYSTEM	INDIA
5.	INGERSOLL RAND INDIA LTD. (FOR AIR & N ₂)	INDIA
6.	KIRLOSKAR PNEUMATIC CO. LTD (FOR AIR SERVICE ONLY)	INDIA
7.	HOWDEN (FORMERLY BURTON CORBLIN)	FRANCE

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8.	LINDE AG WERKSGRUPPE	GERMANY
9.	GE POWER (NUOVO PIGNONE SPA)	ITALY
10.	ISHIKAWAJIMA HARIMA HEAVY INDS CO. LTD (IHI)	JAPAN
11.	KOBE STEEL LTD.	JAPAN
12.	mitsui ENGINEERING & SHIP BUILDING CO. LTD	JAPAN
13.	BURCKHARDT COMPRESSION AG	SWITZERLAND
14.	THOMASSEN TURBINE SYSTEMS B.V	NETHERLANDS
PASSIVATION AIR COMPRESSOR		
1.	BURCKHARDT COMPRESSION (INDIA) PVT. LTD. (CAPACITY UPTO 100 NM3/HR. PRESSURE UPTO 160 KG/CM2G)	INDIA
2.	HOWDEN (FORMERLY BURTON CORBLIN)	FRANCE
SCREW COMPRESSOR		
1.	ATLAS COPCO KOMPRESSORTEKNIK AIS	DENMARK
2.	MAN TURBOMASCHINEN AG GHH BORSIG	GERMANY
3.	KOBE STEEL LTD.	JAPAN
4.	SULZER TURBO LIMITED	SWITZERLAND
5.	HOWDEN SIROCCO LIMITED	U.K
FANS & BLOWERS		
1.	ABB FLAKT INDIA LTD.	INDIA
2.	AEROTO BOLDROCCHI INDIA PVT. LTD. (ID& FD FANS / BLOWERS.CAPACITY 0.84 M3/S TO 423.9 M3/S, PR. 0.16 KPA TO 64.6 KPA, POWER 2 KW TO 2000 KW	INDIA
3	BHEL	INDIA
4..	TLT ENGINEERING INDIA PVT. LTD	INDIA
5.	ILLONOIS BLOWERS INC	U.S.A
EOT CRANE		
1.	AVON CRANES	INDIA
2.	SAMCO ENGINEERING PVT. LTD (upto 30 tonnes capacity)	INDIA
3.	THE ACME MANUFACTURING CO.LTD.	INDIA
4.	WMI CRANES	INDIA
HOT CRANE		
1.	ANUPAM INDUSTRIES LIMITED.	INDIA
2.	CONSOLIDATED HOISTS PVT.LTD.	INDIA
3.	GRIP ENGINEERS PVT. LTD.	INDIA
4.	HERCULES HOISTS LTD.	INDIA
5.	LIFTING EQPT.& ACCESSORIES LTD.	INDIA
6.	MEEKA MACHINERY CO.	INDIA
7.	REVA ENGG. INDUSTRIES LIMITED	INDIA
8.	UNICON TECHNOLOGY INTERNATIONAL (P) LTD.	INDIA
9.	W.H.BRADY & CO LTD.	INDIA

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ELECTRIC HOISTS		
1.	ELECON ENGG. CO. LTD.	INDIA
2.	GREAVES LTD.	INDIA
3.	HERCULES HOISTS LTD.	INDIA
4.	HOIST-O-MECH.LTD.	INDIA
5.	HOPES METAL INDUSTRIES(I) LTD.	INDIA
6.	SAMCO ENGINEERING PVT. LTD (upto 20 tonnes capacity)	INDIA
7.	SAYAJI IRON & ENGG.CO(P)LIMITED	INDIA
8.	VAUGHAN BURN CRANE CO.LIMITED	INDIA
9.	W.H. BRADY & CO. LIMITED	INDIA

COUPLINGS		
1.	ELECON ENGG. CO. LTD (FOR FLEXIBLE COUPLING)	INDIA
2.	FENNER INDIA LTD. (FOR FLEXIBLE COUPLING)	INDIA
3.	HI-CLIFF (FOR GEAR COUPLING)	INDIA
4.	RATHI TRANSPower PVT. LTD	INDIA
5.	RATHI TURBOFLEX PVT. LTD	INDIA

GEAR REDUCER & GEAR BOXES		
1.	RADICON	INDIA
2.	NEW ALLENBURY WORKS.	INDIA
3.	FMG	INDIA
4.	ELECON ENGINEERING CO. LTD.	INDIA

AIR CONDITIONING SYSTEM		
1.	AIR CONDITIONING CORP. LTD	INDIA
2.	BLUE STAR LTD.	INDIA
3.	KIRLOSKAR ELECTRIC COMPANY LTD.	INDIA
4.	PATELS AIR TEMP INDIA LTD.	INDIA
5.	SUVIDHA ENGINEERS	INDIA
6.	VOLTAS LTD.	INDIA

C. STATIC EQUIPMENT

SL. NO.	VENDOR'S NAME	COUNTRY
VESSELS IN CS/AS/SS PRESSURE UPTO 10 Kg/cm²g		
1	AERO ENGINEERS	INDIA
2	AIRFRIGE INDUSTRIES	INDIA
3	ARTSON ENGINEERING LIMITED	INDIA
4	B H P V	INDIA



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5	BHARAT HEAVY ELECTRICALS LTD.	INDIA
6	FABTECH PROJECTS & ENGINNERS LTD. (For CS Only)	INDIA
7	FLOWLINK INDUSTRIES PVT. LTD. (CS/SS Except Urea Service)	INDIA
8	FURNACE FABRICA (INDIA) LTD. (CS/SS)	INDIA
9	G R ENGINEERING PRIVATE LIMITED	INDIA
10	GANSONS LTD.	INDIA
11	GEMINI ENGI-FAB PVT. LTD. (Excluding AS Mati)	INDIA
12	GHANSHYAM STEEL WORKS LTD. (CS/SS)	INDIA
13	GMM PFAUDLER LIMITED	INDIA
14	GODREJ & BOYCE MFG. CO. LTD	INDIA
15	GRAND PRIX ENGINEERING PVT. LTD. (upto 4m D x 6m L x80mm Thk)	INDIA
16	GRASIM INDUSTRIES	INDIA
17	HEATEX INDIAN CORPORATION	INDIA
18	HINDUSTAN DORR-OLIVER LTD.	INDIA
19	ICEM ENGG. CO. LTD.	INDIA
20	INDIA TUBE MILLS & METAL INDUSTRIES LTD. (For CS/SS only)	INDIA
21	INDUS PROJECTS LTD (FORMERLY INDUS ENGG)	INDIA
22	ISHAN EQUIPMENTS PVT. LTD. (CS/SS only)	INDIA
23	KINETICS TECHNOLOGY INDIA LTD.	INDIA
24	LARSEN & TOUBRO LTD.	INDIA
25	LLOYDS STEEL INDUSTRIES LIMITD	INDIA
26	LOYAL EQUIPMENTS PVT. LTD. CS/SS and Non IBR only)	INDIA
27	MARS DESIGN PVT. LTD.	INDIA
28	MISTRY PRABHUDAS MANJI ENGG. PVT. LTD.	INDIA
29	MOD FABRICATORS	INDIA
30	MULTI-MAX ENGINEERING WORKS PVT. LTD. (CS and SS Material only)	INDIA
31	NAVA BHARAT FERRO ALLOYS LTD	INDIA
32	NEW FIELD INDUSTRIAL EQUIPMENT PVT. LTD. CS/SS Only)	INDIA
33	NIVITA ENGINEERING WORKS	INDIA
34	NOVATECH PROJECTS INDIA (P) LTD. (CS and SS material only)	INDIA
35	ORIENTAL MANUFACTURERS PROVATE LIMITED (CS/SS only)	INDIA
36	PATELS AIRTEM (INDIA LIMITED)	INDIA
37	PRECISION EQUIPMENTS (CHAANAI) PVT LTD	INDIA
38	PROJECT TECHNOLOGISTS PVT. LTD.	INDIA
39	R.D. ENGINEERS (INDIA) PVT. LTD.	INDIA
40	RAJ ENGG. CO.	INDIA
41	RELIANCE FABRICATIONS PVT. LTD.	INDIA
42	REYNOLDS CHEMEQUIP PRIVATE LIMITED (CS/SS)	INDIA

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43	SHRENO LTD. (UNIT 2)	INDIA
44	TAS ENGINEERING CO. (P) LIMITED	INDIA
45	TATA CHEMICALS LTD	INDIA
46	THE ANUP ENGINEERING LIMITED	INDIA
47	ISGEC HEAVY ENGINEERING LIMITED	INDIA
48	TITANIUM EQUIPMENT AND ANODE MFG. CO. LTD.	INDIA
49	TRIVENI STRUCTURALS LTD.	INDIA
50	UNITOP ENGINEERS PVT. LTD. (Max. Shell Dia 4.65, Water vol. 140m3)	INDIA
51	HYOSUNG CORPORATION (CS/SS/LAS only)	INDIA
52	APPARATEBAU SCHWEISS TECHNIK GMBH	INDIA
53	SCHOELLER-BLECKMANN NITEC GMBH	INDIA
54	OLMI SPA	INDIA
55	JAPAN STEEL WORKS LTD	INDIA
56	DOOSAN MECATEC CO. LTD.	INDIA
57	HANJUNG DCM CO. LTD.	INDIA
58	HUNDAI HEAVY INDUSTRIES	INDIA
59	KOREA HEAVY INDUSTRIES & CONSTN. CO. LTD	INDIA
60	CHEM PROCESS SYETEM PVT. LTD. (CS/SS ONLY)	INDIA
61	COPERION IDEAL PVT. LTD.	INDIA
62	ESSAR HEAHY ENGINEERING SERVICES	INDIA
63	PHILS HEAVY ENGINEERIG PVT. LTD.	INDIA
64	PRAJ INDUSTRIES LIMITED	INDIA



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65	SPETECH PLANT EQUIPMENT PVT. LTD. (CS ONLY)	INDIA
66	TECHNO PROCESS EQUIPMENT (I) LTD. (CS/AS/SS(AS only for P3 Material))	INDIA
67	UNIVERSAL HEAT EXCHANGER LIMITED (CS/SS/LTCS only)	INDIA
68	VIJAY TANKS & VESSELS LIMITED (CS/LAS AND SS ONLY)	INDIA
69	VIJAY TANKS & VESSELS LIMITED (KANDLA) (CS/ SS ONLY)	INDIA
70	SUNGJIN GEOTECH CO. LTD. (CS and SS only)	INDIA
71	BTL EPC LIMITED (CS ONLY)	INDIA
72	CRYOSTAR TANKS AND VESSEL PVT.LTD. (CS ONLY)	INDIA
73	THE KCP LIMITED	INDIA
	VESSELS IN CS/AS/SS PRESSURE 11 TO 60 Kg/cm2g	
1	ALTECH INFRASTRUCTURE (INDIA) PVT. LTD. (Upto 20 Kg/cm2(g)CS Material)	INDIA
2	ARIEN NEW DELHI PRIVATE LIMITED (CS/SS UP TO 11 to 30 kg/cm2(g))	INDIA
3	B H P V	INDIA
4	BHARAT HEAVY ELECTRICALS LTD.	INDIA
5	EXPO GAS CONTAINERS LTD. (Upto 30 Kg/sq cm (g) CS/SS Material.)	INDIA
6	FABTECH PROJECTS & ENGINNERS LTD. (For CS Only)	INDIA
7	FURNACE FABRICA (INDIA) LTD. (CS/SS UP TO 11 to 30 kg/cm2(g))	INDIA
8	G R ENGINEERING PRIVATE LIMITED	INDIA
9	GANSONS LTD.	INDIA
10	GHANSHYAM STEEL WORKS LTD (CS/SS)	INDIA
11	GODREJ & BOYCE MFG. CO. LTD	INDIA
12	GRAND PRIX ENGINEERING PVT. LTD.	INDIA
13	GRASIM INDUSTRIES (upto 30Kg/cm2g)	INDIA
14	HEATEX INDIAN CORPORATION	INDIA
15	HINDUSTAN DORR-OLIVER LTD. (CS/SS Only)	INDIA
16	INDIA TUBE MILLS & METAL INDUSTRIES LTD. (For CS/SS only upto 30 Kg/cm2g)	INDIA
17	INDUS PROJECTS LTD (FORMERLY INDUS ENGG)	INDIA
18	ISHAN EQUIPMENTS PVT. LTD. (CS/SS Upto 30 Kg/Cm2(g) only)	INDIA
19	KAVERI ENGG. INDUSTRIES LTD.,	INDIA
20	LARSEN & TOUBRO LTD	INDIA
21	LLOYDS STEEL INDUSTRIES LIMITED	INDIA
22	LOYAL EQUIPMENTS PVT. LTD. (Upto 11-30 Kg/cm2, CS/SS and Non IBR only.)	INDIA
23	MULTI-MAX ENGINEERING WORKS PVT. LTD. (Up to 30 Kg/cm2g (CS and SS Materials only)	INDIA
24	NEW FIELD INDUSTRIAL EQUIPMENT PVT. LTD. (Upto 30 Kg/cm2g (CS/SS Only)	INDIA
25	ORIENTAL MANUFACTURERS PRIVATE LIMITED (CS/SS only)	INDIA
26	PATELS AIRTEMP (INDIA LIMITED (CS & SS only)	INDIA



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27	PRECISION EQUIPMENTS (CHENNAI) PVT. LTD (up to 44 Kg/cm ² g)	INDIA
28	RAJ ENGG. CO. (up to 30kg/cm ² (g) CS/SS/AS (P3 & P4 only)	INDIA
29	THE ANUP ENGINEERING LIMITED	INDIA
30	NEWTON ENGINEERING AND CHEMICAL LIMITED (UP TO 36 KG/CM ²)	INDIA
31	THE INDIAN SUGAR & GENERAL ENGG. CORPN. (ISGEC), DAHEJ (Except Urea Plant Critical Equipment)	INDIA
32	THE INDIAN SUGAR & GENERAL ENGG. CORPN. (ISGEC), YAMUNA NGR	INDIA
33	HYOSUNG CORPORATION (CS/SS/LAS only)	KOREA
34	SCHOELLER-BLECKMANN NITEC GMBH	AUSTRIA
35	BORSING GmbH	GERMANY
36	BELLELI S.P.A	ITALY
37	FBM HUDSON ITALIANA Spa	ITALY
38	GE POWER (NUOVO PIGNONE SPA)	ITALY
39	ROLLE S.P.A. (11 TO 60 kg/cm ² pr.)	ITALY
40	WALTER TOSTO Spa	ITALY
41	HITACHI ZOSEN	JAPAN
42	KOBE STEEL LIMITED	JAPAN
43	mitsubishi heavy industries LTD.	JAPAN
44	MITSUI ENGINEERING & SHIPBUILDING CO. LTD	JAPAN
45	DOOSAN MECATEC CO. LTD.	KOREA
46	HANJUNG DCM CO. LTD.	KOREA
47	HANTECH LIMITED	KOREA
48	KOREA HEAVY INDUSTRIES & CONSTN. CO. LTD	KOREA
49	MECANICA DE LA PENNA S.A.	SPAIN
50	BEAIRD INDUSTRIES LOUISIANA	U.S.A
51	CHEM PROCESS SYSTEM PVT. LTD. (CS/SS up to 30 kg/cm ² g only)	INDIA
52	CICB-CHEMICON PVT. LTD. (up to 30 kg/cm ² only (CS only)	INDIA
53	ESSAR HEAVY ENGINEERING SERVICES	INDIA
54	FAB-TECH WORKS & CONSTRUCTIONS PRIVATE LIMITED (CS/SS/LTCS)	INDIA
55	GMM PFAULER LIMITED (CS/SS only)	INDIA
56	INDCON PROJECTS & EQUIPMENT LIMITED (for CS/LTCS/SS only upto 30 kg/cm ² g)	INDIA
57	MEENAKSHI ASSOCIATED (P) LTD. (CS/LTCS/SS upto 30 kg/cm ² g)	INDIA
58	NUBERG ENGINEERING LIMITED (CS/SS upto 30 kg/cm ² g)	INDIA
59	PHILS HEAVY ENGINEERING PVT. LTD. (upto 30 kg/cm ² g)	INDIA
60	R.D. ENGINEERS (INDIA) PVT. LTD. (upto 30 kg/cm ² g)	INDIA
61	RELIANCE FABRICATIONS PVT. LTD. (CS/SS upto 30 kg/cm ² g)	INDIA
62	SPETECH PLANT EQUIPMENT PVT. LTD. (CS upto 30 kg/cm ² g)	INDIA
63	TECHNO PROCESS EQUIPMENTS (I) LTD. (CS/AS/SS upto 30 kg/cm ² g (AS only for P3 Material))	INDIA

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64	PRAJ INDUSTRIES LTD (CS/SS ONLY)	INDIA
65	UNIQUE CHEMOPLANT EQUIPMENTS (CS/SS only upto 30 kg/cm ² g)	INDIA
66	UNIVERSAL HEAT EXCHANGERS LIMITED (CS/SS/LTCS upto 30 kg/cm ² g)	INDIA
67	VIJYA TANKS & VESSELS LIMITED (CS/SS and LAS from 11 to 30 kg/cm ² g only)	INDIA
68	VIJYA TANKS & VESSELS LIMITED (KANDLA)(CS/SS upto 30 kg/cm ² g only)	INDIA
69	AERO ENGINEERS (CS only)	INDIA
70	AVADH INDUSTRIES (Upto 34 kg/cm ² g), CS only	INDIA
71	GEMINI ENGI-FAB PVT. LTD. (Upto 40 Kg/cm ² g)	INDIA
72	JINDAL STEEL & POWER LTD. (MACHINERY DIVISION) (CS only)	INDIA
73	BTL EPC LIMITED (UP TO 30 KG/CM ² CS ONLY)	INDIA
74	TECHNOPROCESS EQUIPMENT INDIA PVT. LTD (NON IBR)	INDIA
75	THE KCP LIMITED	INDIA
76	ALPEC CO. LTD. (CS & AS only)	KOREA
77	SUNGJIN GEOTEC CO., LTD. (CS and SS only)	KOREA
	DEMISTERS	
1	EVERGREEN INDUSTRIES	INDIA
2	GRAND PRIX ENGINEERING PVT. LTD.	INDIA
3	HAVER STANDARD INDIA PVT. LTD. (Demister pads with grids)	INDIA
4	HEIN LEHMANN (I) LTD.	INDIA
5	MISTER – MESH WIRE PRODUCTS	INDIA
6	COSTACURTA VICO S.P.A	ITALY
7	GLITSH ITALIANA, SPA	ITALY
8	KNITMESH LTD.	U.K.
9	KEVIN ENTERPRISES PVT. LIMITED	INDIA

Note: LSTK contractor shall select sub vendors from the vendor list as specified. Bidder shall ensure that sub vendor for the specified item has supplied item for the specified service & the supplied item is in satisfactory service. LSTK contractor shall evaluate and decide present financial, performance, Credential and Shop loading conditions of the vendors. LSTK bidder to furnish list of proven sub-suppliers for static equipment within the package Item with PTR (proven track record) & requisite documents subject to owner's/consultant approval during detail engg. Documents & PTR shall be in English language only. Integral static equipment in a package shall be fabricated by package vendor/ proven Sub-suppliers. Any addition to vendor list shall be reviewed and approved by Owner subject to submission of back-up credentials with proven & reliable record of performance for similar or comparable plant design capacity by LSTK contractor.

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D. PIPING

MECHANICAL – PIPING		
	CS PIPES IS-1239 (BLACK & GI)	
1	AMBICA TUBES CO.	INDIA
2	ANIL METAL CORPORATION	INDIA
3	CHETAN STEELS (Upto 6")	INDIA
4	DADU PIPES (P) LIMITED (½" to 6")	INDIA
5	GOOD LUCK STEEL TUBES LTD. (15 mm to 150 mm dia)	INDIA
6	GUJRAT STEEL TUBES LTD.	INDIA
7	HI-TECH PIPES LTD. (ERW MS / GI Pipes:½" NB to 6" NB, (Thickness 2.2 mm to 6.0 mm))	INDIA
8	INDIAN TUBE CO. (TATA DIV. OF TUBES & PIPES) (For >200M)	INDIA
9	INDUS TUBES LIMITED (½" to 6")	INDIA
10	JAY LAKSHMI STEEL & ENGINEERING CO.	INDIA
11	JINDAL PIPES LTD. (1/2" to 4")	INDIA
12	JOTINDRA STEEL & TUBES LTD. (½" to 6")	INDIA
13	KALPESH TUBE(INDIA), (TRADER) (upto a max order value Rs.25.0 lakh)	INDIA
14	MUKAT PIPES LTD	INDIA
15	NAVRATAN PIPE AND PROFILE LTD. (Upto 6")	INDIA
16	P.K.FORGE & FITTING INDUSTRIES	INDIA
17	SAGAR STEEL CORPORATION (TRADER)	INDIA
18	SANGHVI METALS (TRADER)	INDIA
19	SURINDRA ENGINEERING CO. PVT. LTD.	INDIA
20	SURYA ROSHNI LTD. (15mm to 150mm)	INDIA
21	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
22	WELSPUN GUJARAT STAHL ROHREN LIMITED (ANJAR) (Upto 6")	INDIA
23	ZENITH LIMITED	INDIA
	CS WELDED PIPES IS-3589	
1	ANIL METAL CORPORATION	INDIA
2	DADU PIPES (P) LIMITED (6" to 12" (Thickness up to 9.5 mm))	INDIA
3	EVERGREEN HARDWARE STORES	INDIA
4	GOOD LUCK STEEL TUBES LTD. (Upto 150mm dia, 8 mm thick.)	INDIA
5	GUJRAT STEEL TUBES LTD.	INDIA
6	HEAVY METAL & TUBES LIMITED	INDIA
7	HI-TECH PIPES LTD. (ERW MS / GI Pipes: 6" NB OD to 12", (Thickness 2.6	INDIA

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	mm to 8.0 mm))	
8	INDUS TUBES LIMITED (6" to 12")	INDIA
9	JAY LAKSHMI STEEL & ENGINEERING CO.	INDIA
10	JINDAL PIPES LTD. (8" to 14")	INDIA
11	JOTINDRA STEEL & TUBES LTD. (6" to 14")	INDIA
12	KALPESH TUBE(INDIA), (TRADER)	INDIA
13	LALIT PIPES & PIPES LIMITED (16" to 64", thickness upto 20mm)	INDIA
14	MUKAT PIPES LTD	INDIA
15	NAVRATAN PIPE AND PROFILE LTD. (Upto 10")	INDIA
16	P.K.FORGE & FITTING INDUSTRIES	INDIA
17	PRATIBHA INDUSTRIES LTD., (16" NB to 24" NB, Wall Thickness: 6 mm to 20 mm)	INDIA
18	RATNAMANI METALS & TUBES LIMITED	INDIA
19	SAGAR STEEL CORPORATION (TRADER)	INDIA
20	SANGHVI METALS (TRADER)	INDIA
21	SAW PIPES	INDIA
22	SHRI RAM METALS	INDIA
23	STEEL AUTHORITY OF INDIA LTD.	INDIA
24	SURINDRA ENGINEERING CO. PVT. LTD.	INDIA
25	SURYA ROSHNI LTD. (6" to 16" ,(150mm to 400mm))	INDIA
26	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
27	WELSPUN GUJARAT STAHL ROHREN LIMITED (DAHEJ) (Upto 72" (50 mm thk.))	INDIA
28	WELSPUN GUJARAT STAHL ROHREN LIMITED (ANJAR) (Upto 100" (30 mm thk.))	INDIA
	CS WELDED PIPES TO API 5L SPIRAL/ LONG. WELDED	
1	HEAVY METAL PIPE CENTRE (UPTO 24" (Upto SCHXXS) (PDIL approved Manufacturer's Make only)	INDIA
2	JINDAL PIPES LTD. (2" TO 14")	INDIA
3	JOTINDRA STEEL & TUBES LTD. (½" TO 14")	INDIA
4	KALPESH TUBE(INDIA), (TRADER)	INDIA
5	LALIT PIPES & PIPES LTD. (16" to 64" thickness upto 20mm)	INDIA
6	MUKAT PIPES LTD.	INDIA
7	P.K.FORGE & FITTING INDUSTRIES	INDIA
8	PRATIBHA INDUSTRIES LTD. (16" to 24" thickness 6mm to 14.27mm)	INDIA
9	RATNAMANI METALS & TUBES LTD.	INDIA
10	SAGAR STEEL CORPORATION (TRADER)	INDIA
11	STEEL AUTHORITY OF INDIA LTD.	INDIA
12	SURINDRA ENGINEERING CO. PVT. LTD.	INDIA

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13	SURYA ROSHINI LTD (GR. A, 3" TO 4", GR. B, 6" TO 14")	INDIA
14	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
15	WELSPUN GUJARAT STAHL ROHREN LIMITED (DAHEJ) (upto 72" (50 MM THK))	INDIA
16	WELSPUN GUJARAT STAHL ROHREN LIMITED (ANJAR) (upto 100" (30 MM THK.))	INDIA
17	ETS TROUVAY & CAUVIN	FRANCE
18	PHOCEENNE	FRANCE
19	MANNESMANN HANDEL AG	GERMANY
20	THYSSEN-KRUPP STAHLUNION GMBH	GERMANY
21	DALMINE SPA	ITALY
22	RACCORTUBI SRL	ITALY
23	KOSEI SANGYO LTD	JAPAN
24	MARUBENI ITOCHU STEEL	JAPAN
25	MITSUBISHI CORPORATION	JAPAN
26	NIPPON KOKAN	JAPAN
27	NIPPON STEEL CORPORATION	JAPAN
28	NISHITANI & CO. LTD.	JAPAN
29	NISSHO IWAI CORPORATION	JAPAN
30	OKURA & CO. LTD.	JAPAN
31	SOJITZ CORPORATION	JAPAN
32	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
33	HYUNDAI CORPORATION	KOREA
34	BRITISH STEEL CORPORATION	U.K.
35	CORUS TUBES LIMITED	U.K.
36	SAW PIPES USA, INC	U.S.A
	CS/AS/ LTCS SEAMLESS PIPES	
1	ANAND SEAMLESS TUBES PVT. LTD. (CS Seamless Pipes upto 2")	INDIA
2	BHEL (VALVES DIVISION)	INDIA
3	CHETAN STEELS (Upto 12", SCH80)	INDIA
4	HEAVY METAL & TUBES LIMITED (upto 8", thickness upto 18.26mm)	INDIA
5	HEAVY METAL PIPE CENTRE (UPTO 24" (upto SCHXXS) (PDIL approved Manufacturer's make only))	INDIA
6	INDIAN TUBE CO. (TATA DEV. OF TUBES & PIPES)	INDIA
7	ISMT LIMITED	INDIA
8	JAY LAKSHMI STEELS & ENGINEERING CO.	INDIA
9	JINDAL SAW LTD.	INDIA

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10	MAHARASHTRA SEAMLESS LTD.	INDIA
11	P.K.FORGE & FITTING INDUSTRIES	INDIA
12	RATNADEEP METAL & TUBES PVT. LTD. (<=168.3MM OD)	INDIA
13	SAINEST TUBES PVT. LTD. (½ " NB TO 3" upto SCH. 160 (ASTM A 106 GR. B, A333 GR. 1 & 6 & A335 GR. P11))	INDIA
14	ETS TROUVAY & CAUVIN	FRANCE
15	PHOCEENNE	FRANCE
16	HORST KURVERS GMBH	GERMANY
17	MANNESMANN HANDEL AG	GERMANY
18	DALMINE SPA	ITALY
19	GAM RACCORDI S.P.A	ITALY
20	IBF SEAMLESS PIPES SPA	ITALY
21	RACCORTUBI SRL	ITALY
22	MARUBENI ITOCHU STEEL	JAPAN
23	MITSUBISHI CORPORATION	JAPAN
24	NIPPON STEEL CORPORATION	JAPAN
25	NISHITANI & CO. LTD.	JAPAN
26	NISSHO IWAI CORPORATION	JAPAN
27	OKURA & CO. LTD.	JAPAN
28	SOJITZ CORPORATION	JAPAN
29	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
30	HYUNDAI CORPORATION	KOREA
31	AB SANDVIK STEEL	SWEDEN
32	BRITISH STEEL CORPORATION	U.K.
33	CORUS TUBES LIMITED	U.K.
34	VOMAL INTERNATIONAL LIMITED	U.K.
	SS SEAMLESS/ WELDED PIPES	
1	APEX TUBES PVT LIMITED (SEAMLESS upto 8" (SCH. 80S) & WELDED upto 48" (SCH160))	INDIA
2	BHANDARI FOILS & TUBES LIMITED (SEAMLESS upto 4" (SCH. 80) & WELDED UPTO 20" (THK. <= 8MM))	INDIA
3	CHETAN STEELS (upto 6" SCH. 40)	INDIA
4	CHOKSI TUBE COMPANY LTD.	INDIA
5	DIVINE TUBES PVT. LTD. (UPTO 8")	INDIA
6	HEAVY METAL & TUBES LIMITED (UPTO 8" (THICKNESS UPTO 18.26 MM))	INDIA
7	HEAVY METAL PIPE CENTRE (UPTO 8" (upto SCH80S) (PDIL APPROVED MANUFACTURER'S MAKE ONLY))	INDIA

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8	JAY LAKSHMI STEEL & ENGINEERING CO.	INDIA
9	JINDAL SAW LTD.	INDIA
10	KRYSTAL STEEL MANUFACTURING PVT. LTD. (upto 2" (MATERIAL UPTO GRADE SS 321))	INDIA
11	MARDALE PIPES PLUS LTD.	INDIA
12	MODERN TUBE INDUSTRIES LTD. (upto 2" (upto SS Grade 321))	INDIA
13	NUCLEAR FUEL COMPLEX	INDIA
14	P.K.FORGE & FITTING INDUSTRIES	INDIA
15	PRAKASH STEELAGE LTD. (Seamless: upto 12" & Welded: upto 24")	INDIA
16	QUALITY STAINLESS PVT. LTD. (Seamless: upto 6"(SCH40S), Welded: upto 20"(SCH40S)(UPTO SS GRADE 316L))	INDIA
17	RATNADEEP METAL & TUBES PVT. LTD. (SMLS<=168.3MM O.D., WELDED <=50.8MM O.D.)	INDIA
18	RATNAMANI METALS & TUBES LTD.	INDIA
19	REMI EDELSTAHL TUBULARS LTD. (RAJENDRA MECHANICAL INDUSTRIES (Welded Upto 48" seamless upto 8" (Thk: upto 12.7mm))	INDIA
20	SANDVIK ASIA PVT. LTD. (¾" TO 2" (THK: UPTO 8.74 MM))	INDIA
21	SANGHVI METALS (TRADER)	INDIA
22	SCORODITE STAINLESS (INDIA) PVT. LTD. (Seamless UPTO 16"NB, Welding upto 36")	INDIA
23	SUBHLAXMI METALS & TUBES PVT. LTD. (SS Seamless: ¾"NB to 2"NB; Thk:1.2mm to 8mm, L upto 14mtr; SS Welded ¾" NB to 8"NB; Thk:1.2 mm to 8mm Lupto 14mtr (Material: SS 304, SS304L, SS316, SS316L, SS321, SS347, SS347H))	INDIA
24	SURAJ LIMITED (SURAJ STAINLESS LIMITED)	INDIA
25	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
26	WELSPUN SPECIALITY SOLUTIONS LIMITED (UPTO 4"(ONLY FOR SEAMLESS PIPES))	INDIA
27	ZHEJIANG JIULI STAINLESS STEEL PIPE CO. LTD.	CHINA
28	ETS TROUVAY & CAUVIN	FRANCE
29	PHOCEENNE	FRANCE
30	H. BUTTING GMBH & CO. (SEAMLESS : UPTO 30" (UPTO 16MM THK) & WELDED: UPTO 72" (UPTO 64MM)	GERMANY
31	HORST KURVERS GMBH	GERMANY
32	MANNESMANN HANDEL AG	GERMANY
33	THYSSEN-KRUPP STAHLUNION GMBH	GERMANY
34	DALMINE SPA	ITALY
35	GAM RACCORDI S.P.A (THICKNESS 2" TO 24")	ITALY
36	IBF SEAMLESS PIPES SPA	ITALY
37	RACCORTUBI SRL	ITALY

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38	MARUBENI ITOCHU STEEL	JAPAN
39	MITSUBISHI CORPORATION	JAPAN
40	NIPPON STEEL CORPORATION	JAPAN
41	NISHITANI & CO. LTD.	JAPAN
42	NISSHO IWAI CORPORATION	JAPAN
43	OKURA & CO. LTD.	JAPAN
44	SOJITZ CORPORATION	JAPAN
45	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
46	HYUNDAI CORPORATION	KOREA
47	T.T.I. – TUBACEX TUBOS INOXIDABLES, S.A. (Upto 10")	SPAIN
48	AB SANDVIK STEEL	SWEDEN
49	SOSTA BV (UPTO 72" (THICKNESS UPTO 25.4 MM))	NETHERLANDS
50	VOMAL INTERNATIONAL LIMITED	U.K.
51	CORUS TUBES LIMITED	U.K.
52	BRITISH STEEL CORPORATION	U.K.
	SS SEAMLESS TUBES	
1	ANIL METAL CORPORATION	INDIA
2	APEX TUBES PVT. LIMITED (UPTO 50.8 MM OD (THICKNESS UPTO 4.00 MM))	INDIA
3	BHANDARI FOILS & TUBES LIMITED (UPTO 50MM OD)	INDIA
4	DIVINE TUBES PVT. LTD. (UPTO 3")	INDIA
5	HEAVY METAL & TUBES LIMITED (UPTO 8" (THICKNESS UPTO 18.26 MM))	INDIA
6	KRYSTAL STEEL MANUFACTURING PVT. LTD. (UPTO 50.8 MM OD (MATERIAL UPTO GRADE SS 321))	INDIA
7	MODERN TUBE INDUSTRIES LIMITED (UPTO 50.80 MM OD (UPTO SS GRADE 321))	INDIA
8	PRAKASH STEELAGE LTD. (114.3 mm OD, Thickness upto 6 mm)	INDIA
9	RATNAMANI METALS & TUBES LTD.	INDIA
10	SANDVIK ASIA PVT. LTD. (OD UPTO 60.33 (THK: UPTO 8.74 MM))	INDIA
11	SCORODITE STAINLESS (INDIA) PVT.LTD. (19.05 mm OD TO 50.80mm OD, Thickness upto 3mm)	INDIA
12	SURAJ LIMITED (SURAJ STAINLESS LIMITED)	INDIA
13	WELSPUN SPECIALITY SOLUTIONS LIMITED (UPTO 114.3mm OD)	INDIA
14	T.T.I.-TUBACEX TUBOS INOXIDABLES, S.A.(Upto 250.0mm OD)	SPAIN
	SS PIPES UREA GRADE	
1	KEY-TECH ENGINEERING COMPANY (UPTO 8")	INDIA
2	BHDT GMBH	AUSTRIA

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3	SCHOELLER-BLECKMANN NITEC GMBH	AUSTRIA
4	ETS TROUVAY & CAUVIN	FRANCE
5	PHOCEENNE	FRANCE
6	HORST KURVERS GmbH	GERMANY
7	MANNESMANN HANDEL AG	GERMANY
8	THYSSEN-KRUPP STAHLUNION GmbH	GERMANY
9	DALMINE SPA	ITALY
10	IBF SEAMLESS PIPES Spa	ITALY
11	MARUBENI ITOCHU STEEL	JAPAN
12	mitsubishi CORPORATION	JAPAN
13	NIPPON STEEL CORPORATION	JAPAN
14	NISHITANI & CO. LTD.	JAPAN
15	NISSHO IWAI CORPORATION	JAPAN
16	OKURA & CO. LTD.	JAPAN
17	SOJITZ CORPORATION	JAPAN
18.	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
19	HYUNDAI CORPORATION	KOREA
20	T.T.I- TUBACEX TUBOS INOXIDABLES, S.A. (Upto 10")	SPAIN
21	AB SANDVIK STEEL	SWEDEN
22	BRITISH STEEL CORPORATION	U.K
23	CORUS TUBES LIMITED	U.K
24	VOMAL INTERNATIONAL LIMITED	U.K
	HDPE/MDPE PIPES & PIPE FITTINGS	
1	ASTRAL	INDIA
2	AQUAGUARD PLASTICS & POLYMERS	INDIA
3	CLIMAX SYNTHETICS	INDIA
4	FIBRO PLASTICHEM (I) PVT. LTD.	INDIA
5	NATIONAL ORG CHEMICAL INDIA LTD.	INDIA
6	PARTH POLY VALVES PVT. LTD. (3/4" TO 8"(150#))	INDIA
7	PENNWALT AGRU PLASTICS LTD. (UPTO 250MM DIA)	INDIA
8	RELIANCE INDUSTRIES "RELPIPE"	INDIA
9	SONAL ENGG. PLASTIC FABRICATOR	INDIA
	SS WLEDED TUBES	
1	APEX TUBES PVT. LTD. (Upto 102mm OD (Thickness Upto 4.00mm)	INDIA
2	DIVINE TUBES PVT. LTD (Upto 4")	INDIA
3	KRYSTAL STEEL MANUFACTURING PVT. LTD (Upto 50.8 OD- (Material upto Gr. SS321))	INDIA

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4	MAXIM TUBES COMPANY PVT. LTD (6mm to 114.3mm (0.5mm to 4.5mm thk))	INDIA
5	MODERN TUBE INDUSTRIES LTD (Upto 50.80 OD(UPTO SS321 Grade))	INDIA
6	PRAKASH STEELAGE LIMITED (114.3mm OD, thickness upto 6mm)	INDIA
7	QUALITY STAINLESS PVT. LTD (Upto 4"OD(upto 4.0mm thk)upto Grade SS316L))	INDIA
8	REMI EDELSTAHL TUBULARS LTD. (RAJENDRA MECHANICAL INDUSTRIES(50.8mm OD))	INDIA
9	SCODA TUBES LTD. (9.52 mm OD to 50.8mm OD)	INDIA
10	SCORODITE STAINLESS (INDIA) PVT. LTD. (19.05 mm OD to 50.80mm OD, thk upto 3mm)	INDIA
11	STEAMLINE INDUSTRIES LTD. (6.00mm OD to 50.8mm OD)	INDIA
12	SUNRISE STAINLESS PVT. LTD (Upto 4" OD Thickness upto 6mm)	INDIA
13	SURAJ LIMITED (SURAJ STAINLESS LIMITED)	INDIA
14	WELSPUN SPECIALITY SOLUTIONS LIMITED (Upto 50.8mm OD)	INDIA
	FITTINGS: CS/AS/SS SEAMLESS & FORGED	
1	AMFORGE INDUSTRIES (Upto 24")	INDIA
2	ANIL METAL CORPORATION	INDIA
3	CHETAN STEELS (UPTO 6" SCH. 80)	INDIA
4	COMMERCIAL SUPPLYING AGENCY	INDIA
5	CSA FITTINGS (Forged ½" to 2"-(Upto 9000#) & Seamless: 2" to 8" (upto SCHXXS))	INDIA
6	EBY FASTENERS	INDIA
7	EBY INDUSTRIES	INDIA
8	FIT-TECH INDUSTRIES (Upto 24")	INDIA
9	FLASH FORGE(P) LTD.(Forged upto 4" (upto 9000#) & Seamless up to 42")	INDIA
10	GUJARAT INFRAPIPES PVT. LTD.	INDIA
11	JAY LAKSHMI STEELS & ENGINEERING CO.	INDIA
12	KALPESH TUBE(INDIA),(TRADER) (UPTO A MAX ORDER VALUE RS.25.0 LAKH)	INDIA
13	M.S FITTINGS MANUFACTURING CO. PVT LTD.	INDIA
14	MARDALE PIPES PLUS LTD.	INDIA
15	NAVKAR FORGINGS & FITTINGS PVT. LTD (Forged 3"(UPTO 6000#) & Seamless(Upto 16" SCH XXS))	INDIA
16	NL HAZRA (upto SCH80)	INDIA
17	P.K TUBES & FITTINGS PVT. LTD. (Forged upto 1 ½" & Seamless upto 24" (SCH160))	INDIA
18	P.K FORGE & FITTING INDUSTRIES	INDIA

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19	PARAS FITTINGS PVT. LTD. (Forged: CS ½" to 2" & CS Seamless: 2" to 8" (upto SCHXXS))	INDIA
20	PARMAR TECHNO FORGE (Elbow- ½" to 12"; Tee- ½" to 8"; Reducer (conc & eccn)- ½" to 12" , Cap ½" to 18" (CS&SS))	INDIA
21	PERFECT MARKETTING PVT. LTD.	INDIA
22	PETROCHEM INDUSTRIES (Seamless: Upto 16" (All Fittings) & upto 36" (Only caps) SCH : XXS /80S, Forged: upto 3"-6000#)	INDIA
23	RAJENDRA FORGE INDUSTRIES (CS: UPTO 12" SCH 40 & SS: 6" SCH 40S)	INDIA
24	S & G ENGINEERS (P) LTD.	INDIA
25	SAGAR STEEL CORPORATION (TRADER)	INDIA
26	SANGHVI METALS (TRADER)	INDIA
27	SAWAN ENGINEERS PVT LTD (Upto 36" (SCH160))	INDIA
28	SHIVANANDA PIPE FITTINGS LTD.,	INDIA
29	STEWARTS AND LLOYDS OF INDIA LIMITED	INDIA
30	TEEKAY TUBES PRIVATE LIMITED	INDIA
31	THE BENGAL MILL STORES SUPPLY CO.(TRADER)	INDIA
32	TOPAZ PIPING INDUSTRIES (2" to 36" (SCH 10 to Sch160))	INDIA
33	TUBE BEND (CALCUTTA) PVT. LTD. (CS FITTINGS ONLY)	INDIA
34	TUBE PRODUCTS INCORPORATE	INDIA
35	ZOLOTO INDUSTRIES (15mm to 150mm (only CS Galv.))	INDIA
36	PETROL RACCORD S.P.A. (Seamless: 1" to 42" (Elbows) & 1" to 56" Tee/Reducer/Caps))	ITALY
37	ETS TROUVAY & CAUVIN	FRANCE
38	PHOCEENNE	FRANCE
39	VALLOUREC	FRANCE
40	SEIKMANN ANLAGEN-TECHNIK GMBH.	GERMANY
41	TPS-TECHNITUBE ROHRENWERKE GMBH	GERMANY
42	HORST KURVERS GMBH	GERMANY
43	MANNESMANN HANDEL AG	GERMANY
44	DALMINE SPA	ITALY
45	GAM RACCORDI S.P.A	ITALY
46	IBF SEAMLESS PIPES SPA	ITALY
47	IND MECCANICA BASSI LUIGI & C. SPA	ITALY
48	MANTOVANI SPA	ITALY
49	RACCORTUBI SRL	ITALY
58	TECHNO FORGE SPA	ITALY
51	MARUBENI ITOCHU STEEL	JAPAN
52	NIPPON KOKAN	JAPAN

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53	NISHITANI & CO. LTD.	JAPAN
54	NISSHO IWAI CORPORATION	JAPAN
55	OKURA & CO. LTD.	JAPAN
56	SOJITZ CORPORATION	JAPAN
57	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
58	HAITIMA CORPORATION	TAIWAN
59	BRITISH STEEL CORPORATION	U.K.
60	CORUS TUBES LIMITED	U.K.
61	EUROTUBE LIMITED	U.K.
62	VOMAL INTERNATIONAL LIMITED	U.K.
63	BONNEY FORGE	U.S.A.
	FITTINGS: SS UREA GRADE	
1	KEY-TECH ENGINEERING COMPANY (Upto 8")	INDIA
2	PETROL RACCORD S.P.A (Size upto 14")	ITALY
3	BHDT GMBH	AUSTRIA
4	ETS TROUVAY & CAUVIN	FRANCE
5	PHOCEENNE	FRANCE
6	VALLOUREC	FRANCE
7	HORST KURVERS GmbH	GERMANY
8	MANNESMANN HANDEL AG	GERMANY
9	SEIKMANN ANLAGEN-TECHNIK GMPH	GERMANY
10	TPS-TECHNITUBE ROHRENWERKE GMBH	GERMANY
11	DALMINE SPA	ITALY
12	IBF SEAMLESS PIPES Spa	ITALY
13	IND MECCANICA BASSI LUIGI & C.SPA	ITALY
14	RACCORTUBI SRL	ITALY
15	TECHNO FORGE SPA	ITALY
16	MARUBENI ITOCHU STEEL	JAPAN
17	NIPPON KOKAN	JAPAN
18	NISHITANI & CO. LTD	JAPAN
19	NISSHO IWAI CORPORATION	JAPAN
20	OKURA & CO. LTD	JAPAN
21	SOJITZ CORPORATION	JAPAN
22	SUMITOMO METAL INDUSTRIES LTD.	JAPAN
23	AVESTA CANDVITE TUBE AD	SWEDEN
24	HELENS ENERGY	SWEDEN

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25	BRITISH STEEL CORPORATION	U.K
26	CORUS TUBES LTD	U.K
27	EUROTUBE LTD	U.K
28	VOMAL INTERNATIONAL LTD	U.K
	FRP/PVC PIPE AND PIPE FITTINGS	
1	ASTRAL POLYTECHNIK PVT. LTD. (1/2" to 12" Size)	INDIA
2	GANDHI AND ASSOCIATES	INDIA
3	SONAL ENGG. PLASTIC FABRICATOR	INDIA
	CAST IRON FITTINGS & PIPES	
1	CRAWLEY & RAY (F&E) PVT. LTD	INDIA
2	IISCO LTD	INDIA
3	KESORAM SPUN PIPES & FOUNDRIES	INDIA
4	SAYAJI IRON & ENGG. CO (P) LIMITED	INDIA
5	SHAKTI CAST (P) LTD	INDIA
6	SHALIMAR WORKS LTD	INDIA
7	SHIVA ENGINEERING WORKS	INDIA
8	VISVESARAYA IRON & STEEL LTD.	INDIA
	FORGED FLANGES	
1	AJAY FORGING PVT. LTD	INDIA
2	AMFORGE INDUSTRIES(Upto 24"(upto1500#) & Upto 12"(FOR 2500#)	INDIA
3	ANANDMAYEE FORGINGS PVT. LTD.	INDIA
4	C D ENGINEERING	INDIA
5	CHANDAN STEELS LIMITED (ONLY SS Flanges- Upto36"-150#, Upto24"-300#, Upto20"-600#, Upto16"-900#, Upto12"-1500#, Upto8"-2500#)	INDIA
6	CHETAN STEELS (UPTO 6", 150#)	INDIA
7	CHW FORGE PVT. LTD. (FORMELY CHAUDHARY HAMMER WORKS)	INDIA
8	ECHJAY INDUSTRIES LTD	INDIA
9	FERROUS ALLOYS FORGING PVT. LTD	INDIA
10	GOLDEN IRON & STEEL WORKS	INDIA
11	GOOD LUCK ENGINEERING CO. (1/2"-12" (UPTO 2500#), 14"-16" (UPTO 900#), 18"-32" (UPTO 600#), 34"-48" (UPTO 300#),	INDIA
12	J.K FORGINGS (1/2" to 60" ANSI B 16.5, Class 150 to 2500)	INDIA
13	KUNJ FORGINGS PVT. LTD. (upto 60" (upto 300#) & upto 12" (upto 2500#))	INDIA
14	MAHESH INDUSTRIES (1/2" to 8"NB,Rating-150#,SWRF,SORF & BLRF material: ASTM A105 only; 2"NB to 4"NB, Rating- 150# WNRF FLANGES, Material-A105 only)	INDIA
15	METAL FORGINGS PVT. LTD. (Upto86"-150#; 60"-300# TO 600#; 48"-900#	

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	; 24"-1500#; 12"-2500#)	
16	P.K TUBES & FITTINGS PVT. LTD. (Upto 24"(upto1500#) & Upto 12"(upto2500#) Spectacle Blind and Spacer & Blinds only)	INDIA
17	PARAMOUNT FORGE (CS,AS & SS : ½" TO 42" (UPTO 600#), ½" TO 24" (UPTO 900#), ½" TO 16" (UPTO 1500#), ½" TO 12" (UPTO 2500#)).	INDIA
18	PERFECT MARKETING (P) LTD.	INDIA
19	PUNJAB STEEL	INDIA
20	R D FORGE (A UNIT OF R D CHEMICALS PVT LTD) (1/2" to 54" (150#), ½" to 40"-300#, ½" to 42"- 600#,1/2" to 20"-900#, 1/2" to 20"-1500#, ½" to 12" -2500# (CS, AS & SS))	INDIA
21	RAJENDRA FORGE INDUSTRIES (CS & SS : UPTO 12", 300#)	INDIA
22	S & G ENGINEERS (P) LTD.	INDIA
23	SANGHVI FORGINGS & ENGINEERING LTD (Upto 42" (upto 300#), 36" (600#), 24" (upto 1500#) & 12" (2500#))	INDIA
24	SANGHVI METALS (TRADER)	INDIA
25	SAWAN ENGINEERS PVT LIMITED	INDIA
26	TECHNO FORGE LTD. (UPTO 42" (UPTO 300#), UPTO 24" (600#), UPTO 20" (900#), UPTO 16" (1500#), upto 12" (2500#))	INDIA
27	TUBE BEND (CALCUTTA) PVT LTD	INDIA
28	ETS TROUVAY & CAUVIN	FRANCE
29	PHOCEENNE	FRANCE
30	HORST KURVERS GMBH	GERMANY
31	I.S. INTERNATIONAL	ITALY
32	MANTOVANI SPA	ITALY
33	OFFICINE NICOLA GALPERTI & FIGLIO S.P.A	ITALY
34	RACCORTUBI SRL	ITALY
35	NICHINAN SANGYO CO. LTD.,	JAPAN
36	NISHITANI & CO. LTD.	JAPAN
37	SOJITZ CORPORATION	JAPAN
38	VOMAL INTERNATIONAL LIMITED	U.K.
	PLATE RING FLANGES	
1	FABWELL ENGINEERS	INDIA
2	MAHESH INDUSTRIES (1/2" TO 16"NB -150# &300# SWRF, SORF & BLRF, Material: MS Plate Flanges of IS 2062 Grade)	INDIA
3	MOD FABRICATORS	INDIA
4	P K TUBES & FITTINGS PVT. LTD (Upto 48"- (Spectacle Blinds and Spacer & Blind only))	INDIA
5	PARAMOUNT FORGE (CS & SS: ½" to 84")	INDIA
6	PERFECT MARKETING (P) LTD	INDIA

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7	R SQUARE ENGINEERS	INDIA
8	SANGHVI METALS (TRADER)	INDIA
	FITTINGS: CS/AS/SS WELDED	
1	PARAS ENGINEERING WORKS (8" to 36" NB- SCH 5 to SCH XXS- (CS&SS))	INDIA
2	CHETAN STEELS (Upto 10" SCH80)	INDIA
3	FIT- TECH INDUSTRIES (Upto 48")	INDIA
4	FLASH FORGE (P) LTD. (Upto 42")	INDIA
5	NAVKAR FORGING & FITTINGS PVT. LTD (Upto24"- (SCH XXS, Material: CS only))	INDIA
6	P K TUBES & FITTINGS PVT. LTD (Upto 48"- (SCH160))	INDIA
7	PETROCHEM INDUSTRIES (6" to 36" (all Fittings) & 6" to 56" (Only Conc/Ecc. Reducers) SCH :XXS/80S)	INDIA
8	RAJENDRA FORGE INDUSTRIES (CS & SS: Upto 12", SCH40)	INDIA
9	SAWAN ENGINEERS PVT. LIMITED (Upto 52" (SCH160))	INDIA
10	TOPAZ PIPING INDUSTRIES (8" to 48" (SCH 10 to SCH160))	INDIA
11	PETROL RACCORD S.P.A (4"-56" (Tees/Reducers/Elbows))	ITALY
12	TK CORPORATION	KOREA
	PIPE COATING	
1	PRATIBHA INDUSTRIES LTD, (External Coating 4" to 24" Pipe OD)	INDIA
2	WELSPUN GUJARAT STAHL ROHREN LIMITED (DAHEJ) (4" to 64" for external coating & 16" to 64" for internal coating)	INDIA
	GATE/ GLOBE/ CHECK VALVES CS/SS/AS < 900 LBS	
1	AV VALVES LTD. (CAST UPTO 42"(150#), 28" (300#), 24" (600#) & FORGE UPTO 2" (800#))	INDIA
2	ADVANCE VALVES (2"-80"(Upto 600#) Dual Plate Check Valves only))	INDIA
3	ASSOCIATED TOOLINGS (I) PVT. LTD. (1/2" to 2", upto 800#)	INDIA
4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	AUTOCAP INDUSTRIES (1/2" to 2", 800# (only CS & SS))	INDIA
6	BELL- O-SEAL VALVES LTD. (FOR ZERO LEAKAGE, HAZARDOUS FLUIDS.)	INDIA
7	BHEL (VALVES DIVISION)	INDIA
8	BRIGHTCH VALVES AND CONTROLS PVT. LTD. (Upto 8" x 300# for CS, AS & SS Material)	INDIA
9	CHEMTECH INDUSTRIAL VALVES PVT. LTD.	INDIA
10	CHEMTROLS SAMIL (INDIA) PVT. LTD (Upto 12"-150# -Dual Plate Check Valve only)	INDIA
11	CRAWLEY & RAY (FOUNDERS & ENGINEERS) PVT. LTD. (<=300#, (only CS))	INDIA
12	DATRE CORPORATION LTD. (Upto 300#, 2"-8" (Gate), 2"- 6" (Globe &	INDIA

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	Check))	
13	DEWRANCE MACNEILL & CO. LTD.	INDIA
14	ECONO VALVES PVT. LTD.	INDIA
15	EXPERT ENGINEERING ENTERPRISES (Forged upto 2"-800#, Gate & Globe Valve: upto 12"-150# & 300#, Check Valve upto 32"-150# & 300#)	INDIA
16	FLOCON SYSTEMS PVT. LTD. (CS upto 6" 150#)	INDIA
17	FLOVEL VALVES PVT. LTD.(SINGLE DISC, DUAL PLATE & NOZZLE CHECK VALVES ONLY: UPTO 48"(150#) & 24 (UPTO 600#))	INDIA
18	FLUIDTECH EQUIPMENT PVT. LTD. (CAST # (CS & SS): 2" to 12" 150# & 2" to 8" 300# AND FORGED (CS AND SS) ½" TO 2" (800#)	INDIA
19	FORWARD ALLOYS & CASTINGS (UPTO 14")	INDIA
20	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: upto 24"(150#), 20"(300#), 10" (600#) & Forged : upto 2" (800#)	INDIA
21	HAWA ENGINEERS LTD. (Gate Valves: upto 40"(150#), upto 26" (300#), upto 24" (600#), upto 2" (800#); Globe Valves: upto 20"(150#), upto 16" (300#), upto 12" (600#), upto 2" (800#), Check Valves: upto 36"(150#), upto 24" (300#), upto 16" (600#), upto 2" (800#) (Dual Plate: 36" (150#)	INDIA
22	HAWA VALVES INDIA PVT. LTD. (CS upto 6", 150#)	INDIA
23	HI-TECH VALVES PVT. LTD. (CS, <=800#, SIZE ½"-2", <=300# FOR SIZE 2"-6")	INDIA
24	INTERVALVE POONAWALLA LTD. (CAST UPTO 24" (UPTO 300#) & UPTO 12" 600# , FORGED UPTO 2" (800#))	INDIA
25	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 48" (150#) & 24"(UPTO 600#) & FORGED UPTO 2" (800#))	INDIA
26	KIRLOSKAR BROTHERS LTD.(CS UPTO 12" size, 300#)	INDIA
27	KSB PUMPS LIMITED (VALVES DIVN)	INDIA
28	LARSEN & TOUBRO LIMITED (1/2" TO 24")	INDIA
29	LEADER VALVES LTD. (Casting<=20" upto 600#, & 30"-150#, Forging<=2" upto 800#)	INDIA
30	M.H. VALVES PVT. LTD. (1/2" to 1 1/2"-800#, 2" to 6"-600#)	INDIA
31	MICON ENGINEERS (HUBLI) [PVT. LTD.(Cast: Upto 12" (150# & 300#), 6" (600#) & Forged: upto 2" (800#))	INDIA
32	MICROFINISH VALVES LTD.	INDIA
33	NEOSEAL ENGINEERING PRIVATE LTD (Upto 24" rating upto 600#)	INDIA
34	NITON VALVES INDUSTRIES PVT. LTD. (Forging upto 800#, <=1.5" size)	INDIA
35	NSSL LTD. (Cast: UPTO 80" (150#), 56" (UPTO 600#) & FORGED UPTO 2" (800 #))	INDIA
36	OSWAL INDUSTRIES LTD. (UPTO 48" (150#), 32" (300#) & 24" (600#)	INDIA
37	S & M INDUSTRIAL VALVES LTD. (CS Gate & Globe Valves 2" – 24" <=300#)	INDIA
38	SHALIMAR VALVES PVT. LTD. (Cast Upto 24" (Upto 600#), Forged: ½" to	INDIA

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	1 ½" (800#)	
39	SHREERAJ INDUSTRIES (CS upto 150#)	INDIA
40	STEEL STRONG VALVES (I) PVT. LTD. (Upto 42")	INDIA
41	VENUS PUMP & ENGINEERING WORKS.	INDIA
42	VIBA FLUID CONTROL	INDIA
43	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast UPTO 36" (150#); 24" (300#); 12" (600#) & Forged: Upto 2" (800#))	INDIA
44	ZED VALVES CO. PVT. LTD. (Upto 14" (600#))	INDIA
45	ZOLOTO INDUSTRIES. (40 MM TO 200 MM(ONLY CS & SS))	INDIA
46	VELAN INC. (UPTO 48" , Rating upto 600#)	CANADA
47	BOTELI VALVE GROUP CO. LTD.(Cast Upto 56" (150#), 36" (300#), 24" (600#) & Forged: Upto 2" (800#))	CHINA
48	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
49	PEMTO VALVE	GERMANY
50	CESARE BONETTI SPA (Cast Upto 42" (Upto 300#), 24" (600#) Forged: upto 1 ½" (800#))	ITALY
51	FASANI S.P.A.	ITALY
52	FRIULCO SPA (UPTO 48" (150#), 32" (Upto 600#)	ITALY
53	GTC ITALIA, S.R.L.	ITALY
54	MANTOVANI SpA	ITALY
55	OMB S.P.A.	ITALY
56	PETROL VALVES S.R.L.	ITALY
57	MATSURA H. P MACHINE WORKS CO.LTD.	JAPAN
58	NISHITANI & CO. LTD.	JAPAN
59	SOJITZ CORPORATION	JAPAN
60	REDPOINT ALLOYS BV	NETHERLAND
61	BABCOCK BORSIG ESPANA , S.A	SPAIN
62	POYAM VALVES (AMPO S.CCP.) (Size upto 60" (Rating upto 800#)	SPAIN
63	WALTHAN & WEIR	SPAIN
64	SUFA LIMITED	U.A.E.
65	BEL VALVES	U.K.
	GATE/ GLOBE/ CHECK VALVES CS/SS/AS >=900 LBS	
1	A V VALVES LIMITED (Cast Upto 24" (900# & 1500#), 8" (2500#) Forged: Upto 2" (2500#))	INDIA
2	ADVANCE VALVES (2"-36" (900#) 2"-24" (1500#), 2"-12(2500#) DUAL PLATE CHECK VALVES ONLY)	INDIA
3	ASSOCIATED TOOLINGS (I) PVT. LTD. (½" TO 2" (RATING :900# & 1500#))	INDIA

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4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	BHEL (VALVES DIVISION)	INDIA
6	FLOVEL VALVES PVT. LTD. (Dual Plate Check Valves only: Upto 24" (900#))	INDIA
7	HAWA ENGINEERS LTD. (Gate Valves: upto 20"(900#), upto 10" (1500# & 2500#); Globe Valves: upto 8"(900# & 1500#), upto 1" (2500#); Check Valves: upto 10"(900#), upto 6" (1500#), upto 1" (2500#)	INDIA
8	INTERVALVE POONAWALLA LTD.(Forged: Upto 2" (1500#))	INDIA
9	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 12" (1500#),10" (2500#) & FORGED UPTO 2" (2500#))	INDIA
10	KSB PUMPS LIMITED (VALVES DIVN)	INDIA
11	LARSEN & TOUBRO LIMITED (1/2" TO 2")	INDIA
12	LEADER VALVES LIMITED (Casting<=12" upto2500#, Forging <=2" upto 2500#)	INDIA
13	METROPOLITAN INDUSTRIES (SIZE=200mm, rating=2500 lb)	INDIA
14	MICON ENGINEERS (HUBLI) PVT. LTD. (FORGED: UPTO 2" (1500#))	INDIA
15	NEOSEAL ENGINEERING PVT. LTD. (Upto24"- rating upto 2500#)	INDIA
16	NSSL LIMITED. (CAST: Upto 36"(900#), 24" (upto 2500#) & FORGED: Upto 2" (Upto 2500#))	INDIA
17	OSWAL INDUSTRIES LTD. (Upto 12" (900# & 1500#))	INDIA
18	SHALIMAR VALVES PVT.LTD.(CAST: UPTO 20"(900#), FORGED: ½" TO 1 ½" (1500#))	INDIA
19	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast UPTO 12" (upto 2500#) & Forged: Upto 2" (1500#), 1" (2500#))	INDIA
20	VELAN INC. (UPTO 24" (Rating upto 2500#))	CANADA
21	BOTELI VALVE GROUP CO. LTD.(Cast Upto 16" (Upto 1500#), 12" (2500#) & Forged: Upto 2" (1500# & 2500#))	CHINA
22	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
23	BFE BONNEY FORGE VALVE LICENSEE	ITALY
24	CESARE BONETTI SPA (Upto 24" (Upto 2500#)	ITALY
25	FASANI S.P.A.	ITALY
26	FRIULCO SPA (UPTO 32" (900#); 24" (1500#); 14" (2500#))	ITALY
27	GTC ITALIA S.R.L.	ITALY
28	OMB S.P.A.	ITALY
29	PETROL VALVES S.R.L.	ITALY
30	VALVITALIA SPA	ITALY
31	MATSURA H. P MACHINE WORKS CO.LTD.	JAPAN
32	NISHITANI & CO. LTD.	JAPAN
33	BABCOCK BORSIG ESPANA, S.A.	SPAIN

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34	POYAM VALVES, (AMPO S. COOP.) (SIZE UPTO 30" (RATING UPTO 2500#))	SPAIN
35	SUFA LIMITED	U.A.E.
36	BEL VALVES	U.K.
	BALL VALVES (SOFT SEATED)	
1	A V VALVES LIMITED (Upto 12" (Upto 600#))	INDIA
2	AIRA EURO AUTOMATION PVT. LTD. (Upto 6", Rating 150# & 300#),	INDIA
3	AQUA VALVES PVT. LTD.	INDIA
4	BRIGHTCH VALVES & CONTROLS PVT. LTD. (4" x 150# for CS, AS & SS material)	INDIA
5	CHEMTECH INDUSTRIAL VALVES PVT. LTD.	INDIA
6	CRAWLEY & RAY (FOUNDER & ENGINEERS) PVT. LTD. (DN25)	INDIA
7	DELVAL FLOW CONTROLS PVT. LTD. (Upto 12" (Upto 900#))	INDIA
8	FLOCON SYSTEMS PVT. LTD. (CS upto 6", 150#)	INDIA
9	FLOW CONTROL	INDIA
10	FLOWCHEM INDUSTRIES (UPTO 300# and upto 10")	INDIA
11	FLUIDTECH EQUIPMENT PVT. LTD(UPTO 4" (300#))	INDIA
12	FORWARD ALLOYS AND CASTINGS (Upto 900#)	INDIA
13	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12" (Upto 300#), 4" (Upto 900#) & Forged: Upto 2" (800#))	INDIA
14	HAWA ENGINEERS LTD. (Upto 16" (150# & 300#), Upto 12" (600# & 900#))	INDIA
15	INTERVALVE POONAWALLA LTD. (Forged: Upto 2" (800#), Cast: Upto 12" (Upto 300#))	INDIA
16	JC VALVES & CONTROLS INDIA PVT. LTD. (CAST UPTO 28" (upto 600#),12" (900#, 1500#) & 10"(2500#))	INDIA
17	KSB PUMPS LTD. (VALVES DIVN.) (CS upto 100DN, 20 bar)	INDIA
18	LEADER VALVES LTD. (Casting <=6" upto 600# & forging <=2" upto 800#)	INDIA
19	MEVADA ENGINEERING WORKS PVT. LTD., MUMBAI (Upto 2"(800#), (Forged), UPTO 14"(300#), Material: CS/AS/SS	INDIA
20	MICON ENGINEERS (HUBLI) PVT. LTD. (Cast: Upto 6" (150# & 300#) & Forged: Upto 2" (800#)	INDIA
21	MICROFINISH VALVES (P) LTD.	INDIA
22	NEOSEAL ENGINEERING PVT. LTD (Upto 12" rating upto 600# and Upto 8" upto 2500#)	INDIA
23	NSSL LTD. (Upto 12" (150# & 300#))	INDIA
24	OSWAL INDUSTRIES LTD. (Upto 24" (150#, 300# & 600#))	INDIA
25	SHALIMAR VALVES PVT. LTD. (Upto 18" (600#) Material: CS/AS/SS)	INDIA
26	VIBA FLUID CONTROL (Upto 300#)	INDIA

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27	VIRGO ENGINEERS LTD. (Upto 16" (upto 600#))	INDIA
28	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast: Upto 30" (150# & 300#), 20" (600#), 16" (900#), 12" (1500#) & Forged: Upto 2" (800#))	INDIA
29	XOMOX SANMAR LTD.(FISHER XOMOX)	INDIA
30	BHDT GMBH	AUSTRIA
31	BOTELI VALVE GROUP CO. LTD. (Upto 32" (150# & 300#), 30" (600#), 24" (900#))	CHINA
32	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
33	VELAN INC.(UPTO 16", 600#)	CANADA
34	ETS TROUVAY & CAUVIN	FRANCE
35	PERRIN GMBH (SIZE UPTO 24", RATING UPTO 2500#)	GERMANY
36	CESARE BONETTI SPA (Cast: Upto 4" (150#) & Forged: Upto 1" (800#) Floating only)	ITALY
37	FRIULCO SPA (UPTO 48" (150# & 300#); 20" (upto 1500#); 12" (2500#))	ITALY
38	GTC ITALIA S.R.L	ITALY
39	MANTOVANUI SPA	ITALY
40	PETROL VALVES S.R.L	ITALY
41	PIBIVESSE SRL (UPTO 48" , 600#)	ITALY
42	METSO AUTOMATION	SINGAPORE
43	POYAM VALVES (AMPO S. COOP.) (Size upto 42" (Rating upto 2500#))	SPAIN
44	HATIMA CORPORATION	TAIWAN
BALL VALVES (METAL SEATED)		
1	AIRA EURO AUTOMATION PVT. LTD. (Upto 6", Rating 150# & 300#),	INDIA
2	BRIGHTTECH VALVES & CONTROLS PVT. LTD. (4" x 150# for CS, AS & SS material)	INDIA
3	DELVAL FLOW CONTROLS PVT. LTD. (Upto 12" (Upto 900#))	INDIA
4	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12" (Upto 300#), 4" (Upto 900#) & Forged: Upto 2" (800#))	INDIA
5	HAWA ENGINEERS LTD. (Upto 16" (150# & 300#), Upto 12" (600# & 900#))	INDIA
6	INTERVALVE POONAWALLA LTD.(UPTO 12" , 150#).	INDIA
7	JC VALVES & CONTROLS INDIA PVT. LTD. (UPTO 28" (upto 600#),12" (upto 1500#), 10" (2500#))	INDIA
8	MICON ENGINEERS (HUBLI) PVT. LTD. (Cast: Upto 6" (150# & 300#) & Forged: Upto 2" (800#)	INDIA
9	MICROFINISH VALVES PVT LTD.	INDIA
10	NEOSEAL ENGINEERING PVT. LTD (Upto 12" rating upto 600#)	
11	NSSL LIMITED (Upto 12" NB, (150# & 300#))	INDIA

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12	OSWAL INDUSTRIES LTD. (UPTO 24" (150#, 300#, & 600#))	INDIA
13	VIRGO ENGINEERS LTD. (UPTO16" (UPTO 600#))	INDIA
14	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Cast: Upto 30" (150# & 300#); 20" (600#), 16" (900#), 12" (1500#) & Forged: Upto 2" (800#)	INDIA
15	VELAN INC. (SIZE UPTO 16" (Rating Upto 600#))	CANADA
16	BOTELI VALVE GROUP CO. LTD. (Upto 32" (150# & 300#), 30" (600#), 24" (900#)	CHINA
17	PERRIN GMBH (SIZE UPTO 24" (RATING UPTO 2500#))	GERMANY
18	ALFA VALVOLE SRL	ITALY
19	CESARE BONETTI SPA (UPTO 24" (150#) & 4" (UPTO 1500#) TRUNNION MOUNTED ONLY)	ITALY
20	FRIULCO SPA (UPTO 48" (150# & 300#); 20" (UPTO 1500#); 12" (2500#))	ITALY
21	GE POWER (NUOVO PIGNONE SPA)	ITALY
22	GTC ITALIA, S.R.L.	ITALY
23	PETROL VALVES S.R.L	ITALY
24	PIBIVIESSE SRL(UPTO 48", 600#)	ITALY
25	VALVITALIA SPA	ITALY
26	RED POINT ALLOYS BV	NETHERLAND
27	METSO AUTOMATION	SINGAPORE
28	ORBIT VALVES PLC	SINGAPORE
29	POYAM VALVES, (AMPO S. COOP.) (SIZE UPTO 42" (RATING UPTO 2500#))	SPAIN
	BUTTERFLY VALVES	
1	A V VALVES LIMITED (UPTO 48" (150#))	INDIA
2	ADVANCE VALVES (2"-120"(UPTO150#), 2"-80"(UPTO 900#))	INDIA
3	AIRA EURO AUTOMATION PVT. LTD. (Upto 48", Rating: upto 300#)	INDIA
4	AUDCO INDIA LIMITED (L&T VALVES DIVN.)	INDIA
5	BDK PROCESS CONTROL PVT LTD. (UPTO 1600MM)	INDIA
6	CHEMTECH INDUSTRIAL VALVES PVT LTD	INDIA
7	CRAWLEY & RAY (FOUNDER & ENGINEERS) PVT. LTD. (40mm-1000mm)	INDIA
8	DELVAL FLOW CONTROLS PVT. LTD. (Upto 24" (Upto 300#))	INDIA
9	FLOCON SYSTEMS PVT. LTD. (CS upto 12", 150#)	INDIA
10	FLUIDTECH EQUIPMENT PVT. LTD. (CS upto 12" (300#))	INDIA
11	FOURESS ENGINEERING (I) LTD.	INDIA
12	HAWA ENGINEERS LTD. (2" to 48"(PN10/PN16/150#/300#))	INDIA
13	HAWA VALVES INDIA PVT. LTD. (CS UPTO 6", 150#)	INDIA
14	HI-TECH BUTTERFLY VALVES INDIA PVT. LTD	INDIA

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	(<300#,<30"(TEFLON/RUBBER) ,<72"(METAL))	
15	INSTRUMENTATION LTD. (PALAKKAD)	INDIA
16	INTERVALVE POONAWALLA LTD. (Upto 72" (150#) & Upto 16" (300#))	INDIA
17	JC VALVES & CONTROLS INDIA PVT. LTD. (Upto 20" (150#) & 10" (300#))	INDIA
18	L&T LTD (1/2" TO 24")	INDIA
19	LEADER VALVES LTD.(upto 16"- 150#)	INDIA
20	MATHER & PLATT (INDIA) LTD. A SUBSIDIARY OF WILO SE GERMAN (UPTO DN1600,PN10, Double flange type)	INDIA
21	METROPOLITAN INDUSTRIES (SIZE=2000mm)	INDIA
22	MICON ENGINEERS (HUBLI) PVT. LTD.(Upto 24" (PN10 & PN16))	INDIA
23	VENUS PUMP & ENGINEERING WORKS (upto 600NB, 150#)	INDIA
24	VIRGO ENGINEERS LTD. ((Triple offset only): 3" to 24", Upto 600# (CS/SS))	INDIA
25	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Upto 56" (Upto 150#), 24" (300#))	INDIA
26	XOMOX SANMAR LIMITED (FISHER XOMOX)	INDIA
27	TOMOE VALVE CO. LTD. (Upto 48"(150# & 300#), Upto 24"(600#, 900# & 1500#))	JAPAN
28	BHDT GMBH	AUSTRIA
29	VELAN INC. (Size upto 48"(Rating upto 600#)	CANADA
30	BOTELI VALVE GROUP CO. LTD. (Upto 36" (150# & 300#)	CHINA
31	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
32	GRISS SAPAG INDUSTRIAL VALVES	FRANCE
33	ADAMS ARMATUREN	GERMANY
34	GTC ITALIA, S.R.L.	ITALY
35	HAITIMA CORPORATION	TAIWAN
36	LEEDS VALVE LTD	U.K
37	WEIR VALVES & CONTROLS DIVISION.	U.K
38	CURTIS WRIGHT FLOW CONTROL CORPOARATION	U.S.A.
39	EMERSON PROCESS MGT	U.S.A.
40	LEAR SIEGLER MEAS. CTRLS. CORP	U.S.A.
41	SPX VALVES & CONTROLS (COPEP-VULCAN LTD)	U.S.A.
42	TYCO INTERNATIONAL INC.,U.S.A.	U.S.A.
43	XOMOS (CRANE CO.)	U.S.A.
	BLOWDOWN VALVES	
1	VELAN INC.(SIZE UPTO 2"(RATING UPTO 1500#)	CANADA
2	GESTRA AG	GERMANY
3	CEASRE BONETTI SPA(UPTO 3"(UPTO 2500#))	ITALY

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4	TYCO INTERNATIONAL INC, U.S.A.	U.S.A.
	SAMPLING VALVES/ NEEDLE VALVES	
1	ASSOCIATED TOOLINGS (I) PVT. LTD. (1/2" to 1 1/2", Rating: 800#)	INDIA
2	CHEMTECH INDUSTRIAL VALVES PVT LTD	INDIA
3	EXCELSIOR ENGG WORKS	INDIA
4	EXPERT ENGINEERING ENTERPRISES(UPTO 12"-150# & 300#)	INDIA
5	LEADER VALVES LIMITED(SIZE<=1 1/2"-800#)	INDIA
6	TECNOMATIC (INDIA) PVT LTD.	INDIA
7	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (UPTO 50MM SIZE (upto 2500#))	INDIA
	PLUG VALVES (NON LUBRICATED)	
1	A V VALVES LIMITED (UPTO 20"(150#)(CS&SS))	INDIA
2	AUDCO INDIA LTD (L&T VALVES DIVN.)	INDIA
3	AZ ARMATUREN GMBH (1/2" TO 20"(150#, 300# & 600#), Matl. CS, AS &SS)	INDIA
4	BDK PROCESS CONTROL PVT LTD.	INDIA
5	CHEMTECH INDUSTRIAL VALVES PVT LTD	INDIA
6	CHEMTROLS SAMIL (INDIA) PVT LTD (Upto 12"-150# & 300#))	INDIA
7	CRAWLEY & RAY (FOUNDERS & ENGINEERS) PVT. LTD (DN 200)	INDIA
8	FLUIDTECH EQUIPMENT PVT. LTD. (Upto 4" (300#))	INDIA
9	GURU INDUSTRIAL VALVES PVT. LTD. (Cast CS only: Upto 12" (Upto 300#), Upto 4" (Upto 900#)) & Forged: Upto 2" (800#)	INDIA
10	HAWA ENGINEERS LTD. (1/2" TO 8" (150#))	INDIA
11	JC VALVES & CONTROLS INDIA PVT. LTD. (Upto 12" (Upto 300#))	INDIA
12	LARSON & TOUBRO LTD (1/2" TO 24")	INDIA
13	LEADER VALVES LIMITED (Upto 6" (Upto 300#))	INDIA
14	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (UPTO 16"(150#), 12" (300#), 3" (600#))	INDIA
15	XOMOX SANMAR LIMITED (FISHER XOMOX)	INDIA
16	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
17	O.M.S. SALERI DI SALERI P & FIGLI S.M.C.	ITALY
18	POYAM VALVES, (AMPO S. COOP.) (UPTO 30" (UPTO 900#) FOR LIFT PLUG VALVES ONLY.)	SPAIN
	PLUG VALVES (LUBRICATED)	
1	A V VALVES LIMITED (Upto 20"-150# CS & SS)	INDIA
2	AUDCO INDIA LTD (L&T VALVES DIVISION)	INDIA
3	BDK PROCESS CONTROLS PVT. LTD	INDIA
4	ECONO VALVES PVT. LTD (<=8" (150 - 300#), <= 1 1/2" (<=800#))	INDIA

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5	FLUIDTECH EQUIPMENT PVT. LTD (Upto 4"-300#)	INDIA
6	GURU INDUSTRIAL VALVES PVT. LTD (Cast CS only: Upto 12"-300#, 4" Upto 900# & Forged: upto 2"-800#)	INDIA
7	HAWA ENGINEERS LTD. (1/2" TO 8" -150#)	INDIA
8	JC VALVES & CONTROLS INDIAN PVT. LTD (Upto 12"-300#)	INDIA
9	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT.LTD)Upto 8"-125#	INDIA
10	ZHEJIANG JIEHUA VALVES CO. LTD	CHINA
11	DELTA VALVES EUROPE	ITALY
12	O.M.S SALERI DI SALERI P & FIGLI S.M.C	ITALY
13	BABCOCK BORSIG ESPANA, S.A	SPAIN
DIAPHRAGM VALVES/RUBBER LINED CHECK VALVES		
1	A V VALVES LIMITED (Upto 12"-125#)	INDIA
2	AKAY INDUSTRIES PVT LTD	INDIA
3	BDK PROCESS CONTROLS PVT. LTD. (Upto 150#, 6 mm to 350mm)	INDIA
4	CHEMTECH INDUSTRIAL VALVES PVT. LTD	INDIA
5	CRAWLEY & RAY (FOUNDERS & ENGINEERS) PVT. LTD (25NB to 200NB)	INDIA
6	HAWA ENGINEERS LTD (1/2" to 8" –PN10)	INDIA
7	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT LTD)(UPTO 14"(PN16))	INDIA
CAST IRON VALVES		
1	A V VALVES LTD. (Upto 48" (125#))	INDIA
2	CRAWLEY & RAY (F&E) PVT. LTD. (BUTTERFLY)	INDIA
3	FLUIDTECH EQUIPMENT PVT. LTD. (Upto 24" (PN 1.0 & PN 1.6))	INDIA
4	GEETA ENGINEERING WORKS	INDIA
5	KIRLOSKAR BROTHERS LIMITED (Sluice, gate, butterfly valves PN1.0 & PN1.6)	INDIA
6	LEADER VALVES LTD. (size<=24" upto PN16 rating)	INDIA
7	S & M INDUSTRIAL VALVES LIMITED (ONLY GATE & GLOBE VALVES, 50mm-600mm, 125#)	INDIA
8	VENUS PUMPS & ENGINEERING WORKS (sluice<900mm, Diaphragm<300mm, stop<500mm)	INDIA
9	WEIR BDK VALVES (A UNIT OF WEIR INDIA PVT. LTD.) (Upto 12" (PN6))	INDIA
PVC/CPVC VALVES		
1	ASTRAL POLYTECHNIK PVT. LTD (Size ½"-6", BUTTERFLY VALVE Upto 24")	INDIA
2	S & M INDUSTRIAL VALVES LTD. (32mm-80mm)	INDIA
FLAT GASKETS/ RUBBER GASKET		
1	FERROLITE JOININGS (P) LTD.	INDIA

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2	GASKETS (INDIA) PVT. LTD	INDIA
3	GOODRICH GASKET PVT. LTD. (UPTO 24")	INDIA
4	HINDUSTAN ASBESTOS & ALLIED PRODUCTS	INDIA
5	HINDUSTAN COMPOSITE LTD.	INDIA
6	HINDUSTAN FERREDO LTD.	INDIA
7	IGP ENGINEERS LIMITED	INDIA
8	MADRAS INDUSTRIAL PRODUCTS(UPTO 48")	INDIA
9	MECHANICAL PACKING INDUSTRIES LTD.	INDIA
10	NEOSEAL ENGINEERING PVT. LTD (Upto 80" 150#- Only rubber gasket)	INDIA
11	PACKING & JOINTINGS (P) LTD.	INDIA
12	PERFECT MARKETING (P) LTD,	INDIA
13	PRASHANT ENGG STORES	INDIA
14	REINZ TALBROS PVT. LTD.	INDIA
15	SPIRALSEAL GASKETS PVT. LTD. (CAF & Teflon)	INDIA
16	STARFLEX SEALING INDIA PVT. LTD.	INDIA
17	THE BENGAL MILL STORES SUPPLY CO. (TRADER)	INDIA
18	UNIQUE INDUSTRIAL PACKINGS PVT. LTD.	INDIA
SPIRALLY WOUND GASKETS		
1	GASKETS (INDIA) PVT. LTD	INDIA
2	GOODRICH GASKET PVT. LTD. (upto 24")	INDIA
3	IGP ENGINEERS LIMITED(10 TO 3550MM, 150#-2500# FOR EXCH GSKT)	INDIA
4	MADRAS INDUSTRIAL PRODUCTS(UPTO 52")	INDIA
5	NEOSEAL ENGINEERING PVT. LTD (Upto 84" 150#- AND 30" UPTO600#)	INDIA
6	PACKINGS & JOINTINGS PVT. LTD	INDIA
7	PERFECT MARKETING (P) LTD,	INDIA
8	PRASHANT ENGG STORES	INDIA
9	SPIRASEAL GASKETS PVT. LTD.(SS UPTO 12" & 150#)	INDIA
10	STARFLEX SEALING INDIA PVT. LTD.	INDIA
11	THE BENGAL MILL STORES SUPPLY CO. (TRADER)	INDIA
12	UNIQUE INDUSTRIAL PACKINGS PVT.LTD. (UPTO 42"(600#) & UPTO 24" (2500#))	INDIA
13	ZHEJIANG JIEHUA VALVE CO. LTD.	CHINA
LENS GASKETS & RING JOINT (METALLIC)		
1	GASKETS (INDIA) PVT. LTD	INDIA
2	GOODRICH GASKET PVT. LTD. (0.5" to 24")	INDIA
3	IGP ENGINEERS LTD. (150# to 2500#)	INDIA

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4	MADRAS INDUSTRIAL PRODUCT	INDIA
5	METROPOLITAN INDUSTRIES (3mm thk, 300#)	INDIA
6	NEOSEAL ENGINEERING PVT. LTD. (Upto 30", Upto 900# AND Upto 20"- upto 2500#)	INDIA
7	PACKINGS & JOINTINGS PVT. LTD.	INDIA
8	PRASHANT ENGG STORES	INDIA
9	SPIRASEAL GASKET PVT. LTD	INDIA
10	STARFLEX SEALING INDIA PVT. LTD	INDIA
11	UNIQUE INDUSTRIAL PACKINGS PVT. LTD (Ring Joint Gasket only, Upto 16"- 1500#)	INDIA
12	BHDT GMBH	AUSTRIA
13	MANTOVANI SPA	ITALY
	EXPANSION JOINTS & BELLOWS	
1	CORI ENGINEERS PVT. LTD. (For Rubber)	INDIA
2	D.WREN & CO. (For Rubber & Fabric)	INDIA
3	FLEXATHERM EXPANLLOW PVT. LTD. (Circular: Upto 240", Rectangular No bar for size, (Upto 600#))	INDIA
4	FLEXICAN BELLOWS & HOSES PVT. LTD	INDIA
5	FLUIDYNE ENGINEERS (I) PVT. LTD(METALLIC BELLOWS UPTO 800mm DIA)	INDIA
6	KELD ELLETOFT INDIA PVT. LTD (For Fabric)	INDIA
7	LONESTAR INDUSTRIES	INDIA
8	MB METALLIC BELLOWS PVT. LTD	INDIA
9	PRASHANT ENGG. STORES	INDIA
10	STANDARD PRECISION BELLOWS	INDIA
11	TUBOFLEX	GERMANY
12	FLEXIDER S.P.A.	ITALY
	STRAINERS (PERMANENT INCLUDING Y-TYPE)	
1	CHEMTECH INDUSTRIAL VALVES PVT. LTD	INDIA
2	FLAIR STRAINERS & FILTERS (SIZE UPTO 42" (RATING UPTO 1500#))	INDIA
3	GRAND PRIX ENGINEERING PVT. LTD. (UPTO 60" PIPELINE, UPTO ANSI 1500#)	INDIA
4	GREAVES LIMITED	INDIA
5	GUJARAT OTOFILT	INDIA
6	HAWA ENGINEERS LTD. (1/2" to 24"(150# / 300# / PN10 / PN40))	INDIA
7	KWIKFLO FILTERS PVT. LTD.	INDIA
8	LEADER VALVES LTD. (upto 300# & upto 12" size)	INDIA
9	MOD FABRICATORS	INDIA

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10	MULTITEX FILTERATION ENGINEERS LTD	INDIA
11	ZOLOTO INDUSTRIES (15MM TO 100MM)	INDIA
12	BOTELI VALVE GROUP CO. LTD. (Y - TYPE ONLY: 14" (150#) & 3" (300# & 600#))	CHINA
STEAM TRAPS		
1	GREAVES LTD.	INDIA
2	MOD FABRICATORS (for Drip Rings)	INDIA
3	PENNANT ENGINEERING PVT. LTD.	INDIA
4	VIRGO ENGINEERS LTD. (1/2" to 4" (upto 600#) (CS/SS))	INDIA
5	YARWAY CORPORATION	INDIA
6	ZOLOTO INDUSTRIES (15 mm to 25 mm)	INDIA
7	GESTRA AG	GERMANY
8	ARMSTRONG INTERNATIONAL INC.	U.S.A
9	OGONTZ CORPORATION	U.S.A
10	TYCO INTERNATIONAL INC.,U.S.A.	U.S.A
SPRING SUPPORTS		
1	PIPE SUPPORTS CO. (Upto 14MT)	
2	MYRICS PIPING SYSTEM PVT.LTD.	INDIA
3	PIPE SUPPORTS INDIA PVT. LTD.	INDIA
4	PIPING & ENERGY PRODUCTS (P) LTD.	INDIA
5	SARATHI ENGG. ENTERPRISES PVT. LTD.	INDIA
6	SPRING SUPPORTS MFG. CO.	INDIA
7	FLEXIDER S.P.A.	ITALY
FLAME ARRESTORS		
1	AIROIL FLAREGAS (INDIA) PVT. LIMITED	INDIA
2	EMFA INDUSTRIES	INDIA
3	M.H. VALVES PVT. LTD (1/2"-1.5" :800#, 2"-6" :600#)	INDIA
4	NIRMAL INDUSTRIAL CONTROLS PVT. LTD (1/2" TO 8", RATING:150#)	INDIA
5	PETROL SERVICE INDIA PVT. LTD.	INDIA
6	L & J TECHNOLOGIES	U.S.A.
SPRAY NOZZLE ASSEMBLY		
1	CHEMTROLS SAMIL (INDIA) PVT. LTD.	INDIA
FASTENERS		
1	AEP COMPANY	INDIA
2	CAPITAL INDUSTRIES	INDIA
3	CONSOLE ENGG. & FASTNERS INDUSTRIES	INDIA

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4	EBY FASTNERS	INDIA
5	FIT TIGHT NUTS & BOLTS LTD.	INDIA
6	FIX FIT FASTENERS MFG. PVT. LTD.	INDIA
7	HEM INDUSTRIES (Upto 4")	
8	INDUSTRIAL ENGINEERING CORPORATION (SIZE UPTO 4" (M100))	INDIA
9	MEGA ENGINEERING PRIVATE LIMITED (1/2" TO 3" MATERIAL: CS/AS/SS)	INDIA
10	METRO MECHANICAL PVT.LTD.	INDIA
11	NAGBHUSHANAM INDUSTRIES	INDIA
12	NIREKA ENGG. CO. PVT. LTD.	INDIA
13	PACIFIC FORGING & FASTENERS PVT. LTD. (M 10 TO M125)	INDIA
14	PERFECT MARKETING (P) LTD,	INDIA
15	PIONEER NUTS & BOLTS PVT. LTD. (1/4" TO 4" DIA)	INDIA
16	PRECISION AUTO ENGINEERS	INDIA
17	PRECISION ENGINEERING INDUSTRIES	INDIA
18	PTD FASTNERS PVT. LTD.	INDIA
19	SANGHVI METALS (TRADER)	INDIA
20	SUNDARAM FASTENERS LIMITED	INDIA
21	UDHERA FASTENERS	INDIA

SMOKE / GAS DETECTOR

1	CEASEFIRE INDUSTRIES LTD	INDIA
2	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
3	UNITECH MACHINES LTD.	INDIA
4	ZENITH FIRE SEVICES INDIA PVT. LTD	INDIA

MARINE LOADING ARM

1	LLOYDS STEELS INDUSTRIES LIMITED (8" TO 20")	INDIA
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TRUCK/WAGON LOADING ARM

1	LLOYDS STEELS INDUSTRIES LIMITED (2" TO 4")	INDIA
2	WOODFIELD SYSTEMS INTERNATIONAL PVT LTD (upto SIZE: CORE-4"/ JACKET-6")	INDIA

NOTE(Piping vendor list):

1. Make of the items not indicated and any other make for the specified item shall be subject to owner's / consultant's approval.
2. Any item for which vendor list is not enclosed; bidder has to furnish a list of their proposed vendors along with their references for supply of similar type of items with their proven track record. Vendor for these items shall be finalized during execution/detail engineering stage.

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3. Any addition to vendor list of listed item shall be reviewed and approved by Owner/PMC, subject to submission of proper justification/reason and back-up credentials with proven & reliable record of performance for similar items on case to case basis.
4. In case of trader/stockist, make of items shall be as per approved vendor list.

FIRE FIGHTING SYSTEM		
1	AGNICE FIRE PROTECTION LTD.	INDIA
2	BHARTIYA CACCIALANZA FIRE SYSTEMS LTD	INDIA
3	BLUE STAR LTD.	INDIA
4	DE'S TECHNICO	INDIA
5	DE'S TECHNICO PVT. LTD.	INDIA
6	FUTECH CONSULTANTS PVT. LTD.	INDIA
7	GENERAL MECHANICAL WORKS	INDIA
8	HD FIRE PROTECTION COMPANY	INDIA
9	LAL ENTERPRISES	INDIA
10	MATHER & PLATT (INDIA) LTD. (A Subsidiary of WILO SE German)	INDIA
11	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA
12	NEWFIRE ENGINEERS SERVICES	INDIA
13	PRAGATI ENGG. (PVT.) LTD.	INDIA
14	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
15	RADIANT FIRE PROTECTION ENGINEERS	INDIA
16	STEELAGE INDUSTRIES LTD.	INDIA
17	TECHNOFAB ENGG.	INDIA
18	TRI-PARULEX FIRE PROTECTION SYSTEMS	INDIA
19	UNITECH MACHINES LTD	INDIA
20	VIJAY FIRE PROTECTION SYSTEM LTD.	INDIA
2.0	HOSE PIPE (METALLIC) & CAM LOCK COUPLING	
1	AEROFLEX INDUSTRIES LIMITED (Size 6mm to 250mm dia. (SS Corrg. Flex. Hose with Braid, Braid & Assembly)	INDIA
2	CHHATARIA RUBBER CHEMICALS INDUSTRIES	INDIA
3	D. WREN & CO.	INDIA
4	FLEXATHERM EXPANLLOW PVT. LTD. (1/2" to 6")	INDIA
5	GAYATRI INDUSTRIES	INDIA
6	GAYATRI INDUSTRIAL CORPORATION (UPTO 6" ID)	INDIA
7	HELIFEX HYDRAULICS & ENGG CO. LTD.	INDIA
8	NEW AGE FIRE FIGHTING CO.LTD.	INDIA

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9	SENIOR INDIA PVT. LTD.	INDIA
3.0	HOSE PIPE (NON-METALLIC) & CAM LOCK COUPLING	
1	CHHATARIA RUBBER CHEMICALS INDUSTRIES	INDIA
2	D. WREN & CO.	INDIA
3	GAYATRI INDUSTRIES	INDIA
4	GAYATRI INDUSTRIAL CORPORATION (UPTO 8" ID)	INDIA
5	HELIFEX HYDRAULICS & ENGG CO. LTD.	INDIA
6	PADMINI INDUSTRIES LIMITED	INDIA
7	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
8	SENIOR INDIA PVT. LTD.	INDIA
4.0	HYDRANT VALVE /LANDING VALVE	
1	MINIMAX	INDIA
2	NEW AGE FIRE FIGHTING CO.LTD.	INDIA
3	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA
4	SAFEX	INDIA
5.0	WATER CUM FOAM MONITOR	
1	HD FIRE	INDIA
2	FIRETECH EQUIPMENTS & SYSTEMS PVT. LTD.	INDIA
3	NEW AGE FIRE FIGHTING CO.LTD.	INDIA
4	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA
6.0	HOSE REEL	
1	MINIMAX	INDIA
2	NEW AGE FIRE FIGHTING CO.LTD.	INDIA
3	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA
7.0	UNIVERSAL TRIPPLE PURPOSE NOZZLE / AIR RELEASE VALVE / HOSE BOX	
1	MINIMAX	INDIA
2	NEW AGE FIRE FIGHTING CO.LTD.	INDIA
3	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA
8.0	SPRAY NOZZLE / WATER CURTAIN NOZZLE/QBD	
1	HD FIRE	INDIA
2	NEW AGE	INDIA
3	SHAH BHOGILAL JETHALAL & BROTHERS	INDIA
4	TYCO SAFETY PRODUCTS	INDIA
5	VIKING	INDIA
9.0	PORTABLE FIRE EXTINGUISHERS & FIRE FIGHTING CHEMICALS	
1	CEASEFIRE INDUSTRIES LTD.	INDIA
2	KANADIA FYR FYTER (MAKE- KANEX)	INDIA
3	MINIMAX	INDIA
4	PYROTEK INDUSTRIES (INDJA) PVT. LTD.	INDIA

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5	SAFEX FIRE	INDIA
6	SUPREMEX EQUIPMENTS	INDIA
7	UNITECH MACHINES LTD.	INDIA
8	ZENITH FIRE SEVICES INDIA PVT. LTD	INDIA
10.0	DELUGE VALVE	
1	DARLING MUESCO (I) PVT.LTD	INDIA
2	HD FIRE	INDIA
3	TYCO SAFETY PRODUCTS	INDIA
4	VIKING	INDIA
11.0	CLEAN AGENT SYSTEM	
1	HONEYWELL	INDIA
2	GUNNEBO INDIA PVT. LTD	INDIA
3	MX SYSTEMS INTERNATIONAL PVT. LTD.	INDIA
4	NOHMI BOSAI INDIA PVT. LTD.	INDIA
5	SEVO SYSTEMS	INDIA
6	SIEMENS	INDIA
7	ROTAREX ENGG INDIA PVT. LTD.	INDIA
8	UTC FIRE & SECURITY INDIA LTD.	INDIA
12.0	PERSONNEL PROTECTION EQUIPMENT(SAFETY EQUIPMENTS)	
1	VIJAY SABRE SAFETY PVT. LTD.	INDIA
2	SURE SAFETY INDIA LTD.	INDIA
3	DRAGER	INDIA
13.0	SAFETY SHOWER	
1	UNICARE	INDIA
2	SURE SAFETY INDIA LTD.	INDIA
14.0	FIRE FIGHTING EQUIPMENTS	
1	DE'S TECHNICO PVT. LTD.	INDIA
2	HD FIRE PROTECT PVT. LTD.	INDIA
3	PYROTEK INDUSTRIES (INDIA) PVT. LTD.	INDIA
4	VENUS PUMP & ENGG. WORKS	INDIA
5	WINCO VALVES PVT. LTD.	INDIA
6	ZENITH FIRE SEVICES INDIA PVT. LTD	INDIA
Note:	Fire fighting equipments shall include hydrant post, hydrant valve, deluge valve, monitor, foam tank/can, safety equipment, personnel protection equipment, foam chamber, deflector, fire extinguisher, spray & sprinkler	

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E. ELECTRICAL

UPS System		
1.	VERTIV Energy Private Limited* (formally known as Emerson Network Power (India) Pvt. Ltd)	India
2.	GE Power Controls India Pvt. Ltd	India
3.	AEG Telefunken AG.	Germany
4.	Asea Brown Boveri	Sweden
5.	General Electric Co.	U.S.A.
6.	Westinghouse Electric Corporation	U.S.A.
7.	PILLER [PCI LTD	GERMANY INDIA
8.	GUTOR	GERMANY
9.	Hitachi Hi-rel Power Electronics Pvt. Ltd.	India
Transformers – 11 kV & Below		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Power Products and System India Ltd	India
3.	BHEL (ELECTRICAL MACHINES DIVN.)	India
4.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
5.	Siemens Ltd.	India
6.	Toshiba Transmission & Distribution System India Pvt Ltd	India
7.	Bharat Bijlee Ltd	India
8.	Kirloskar Electric Company Ltd.	India
9.	Voltamp Transformers Ltd.	India
Auxiliary Supply Transformers		
1.	GE T&D India Limited (Formerly known as Alstom T&D Ltd)	India
2.	ABB Limited	India
3.	BHEL (ELECTRICAL MACHINES DIVN.)	India
4.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
5.	Siemens Ltd.	India
6.	Toshiba Transmission & Distribution System India Pvt Ltd	India
7.	Bharat Bijlee Ltd	India
8.	Kirloskar Electric Company Ltd.	India
9.	Voltamp Transformers Ltd.	India
10.	Esennar Transformers (P) Ltd.	India



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11.	Gujarat Plug-In Devices Pvt. Ltd. (Upto 300 KVA)	India
12.	IMP Power Ltd.	India
13.	Indcoil Transformers Pvt. Ltd.	India
14.	Kalpa Electrical Pvt. Ltd.	India
15.	Mehru Electricals (Formerly Automatic Electric Limited)	India
16.	Shephard Transformers Ltd.	India
17.	Vardhman Electro-mech Pvt. Ltd.	India
Neutral Earthing Resistor		
1.	Elecmec Corporation	India
2.	Lotus Powergear Pvt Ltd	India
3.	Resitech Electricals Private Limited	India
4.	RSI Switchgear Private Ltd.	India
5.	S R Narkhede Engineering Pvt. Ltd.	India
HV Switchboard (11 kV & 3.3 kV)		
1.	ABB India Limited	India
2.	Siemens Ltd	India
3.	BHEL (Electrical Machines Divn.)	India
4.	Schneider Electric	India
415 V SWITCH BOARD(PCC/MCC/PMCC)		
1.	Alstom Limited (Areva T & D)	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Larsen & Toubro Ltd.(EI.Products Divn)	India
4.	Siemens Ltd.	India
5.	CG Power and Industrial Solution Limited (Formerly known as Crompton Greaves Ltd)	India
6.	Schneider	India
Floor Mounting Type Distribution Boards		
1.	Associated Switchgears & Projects Ltd.	India
2.	Elecmec Corporation	India
3.	GE Power Controls India Pvt. Ltd.	India
4.	Intrelec	India
5.	Jakson Engineers Ltd	India
6.	Larsen & Toubro Ltd.(EI.Products Divn)	India
7.	Lotus Powergear Pvt Ltd	India
8.	Siemens Ltd.	India
9.	Spaceage Switchgears Limited	India
10.	Tricolite Electrical Industries Pvt. Ltd.	India



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11.	United Electric Co. (Delhi) Pvt. Ltd	India
12.	Venus Controls & Switchgear (P) Ltd.	India
13.	Schneider	India
Wall Mounting Type Distribution Boards		
1.	Anand Power Limited	India
2.	Associated Switchgears & Projects Ltd.	India
3.	Cosmic Power Systems Pvt. Ltd.	India
4.	Elecmech Corporation	India
5.	GE Power Controls India Pvt. Ltd.	India
6.	Intrelec	India
7.	Larsen & Toubro Ltd.(El.Products Divn)	India
8.	Lotus Powergear Pvt Ltd	India
9.	Siemens Ltd.	India
10.	Spaceage Switchgears Limited	India
11.	Tricolite Electrical Industries Pvt. Ltd.	India
12.	Trident Switchgears Pvt. Ltd. (Upto 3200 A)	India
13.	United Electric Co. (Delhi) Pvt. Ltd	India
14.	Venus Controls & Switchgear (P) Ltd.	India
15.	Schneider	India
Control & Relay Panel		
1.	Alstom Limited (Areva T&D)	India
2.	ABB.	India
3.	Elecmech Corporation	India
4.	Larsen & Toubro Ltd. (El. Products Divn)	India
5.	Siemens Ltd.	India
6.	Schneider	India
Protective Relays (other than BMR)		
1.	Alstom Limited (Areva T & D)	India
2.	ABB.	India
3.	Schneider – MICOM Model	India
4.	SEL – Schweitzer Engineering Laboratories	India
5.	Woodward	India
6.	Siemens Ltd.- SIPROTEC Model	India
Vacuum Circuit Breakers (VCB)		
1.	Alstom Limited (Areva T & D)	India
2.	ABB	India
3.	BHEL (Electrical Machines Divn.)	India



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4.	Siemens Ltd.	India
5.	Schneider	India
Air Circuit Breakers (ACB)		
1.	GE Power Controls India Pvt. Ltd.	India
2.	Larsen & Toubro Ltd.(EI.Products Divn)	India
3.	Siemens Ltd.	India
4.	ABB	India
5.	Schneider Electric	India
Moulded Case Circuit Breakers (MCCB)		
1.	Crompton Greaves Ltd.	India
2.	GE Power Controls India Pvt. Ltd.	India
3.	Larsen & Toubro Ltd.(EI.Products Divn)	India
4.	Siemens Ltd.	India
5.	ABB	India
6.	Schneider Electric	India
Miniature Circuit Breakers (MCB) / RCBO		
1.	Indo Asian Fusegear Ltd	India
2.	Legrand India Ltd	India
3.	S & S Power Switchgear Ltd	India
4.	Standard Electricals Limited	India
5.	Siemens Ltd.	India
6.	ABB	India
7.	Schneider Electric	India
ELCB		
1.	GE Power Controls India Pvt. Ltd.	India
2.	Havells India Ltd.	India
3.	Indo Asian Fusegear Ltd	India
4.	Legrand India Ltd	India
5.	S & S Power Switchgear Ltd	India
6.	Siemens Ltd.	India
7.	Standard Electricals Limited	India
8.	ABB	India
9.	Schneider Electric	India
Low Voltage Industrial Switches/Isolators		
1.	ABB	India
2.	GE Power Controls India Pvt. Ltd.	India



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3.	Havells India Ltd.	India
4.	Kaycee Industries Ltd	India
5.	Larsen & Toubro Ltd.(EI.Products Divn)	India
6.	Siemens Ltd.	India
7.	Schneider Electric	India
Current Transformers (11 kV & 3.3 kV)		
1.	Anant Powertech	India
2.	ABB	India
3.	Kalpa Electrical Private Limited	India
4.	Mehru Electricals (Formerly Automatic Electric Limited)	India
5.	Perfect Sales Corporation	India
6.	Silkans	India
7.	Kappa	India
8.	Pragati	India
Potential Transformer (11 kV & 3.3 kV)		
1.	Anant Powertech	India
2.	ABB	India
3.	Kalpa Electrical Private Limited	India
4.	Mehru Electricals (Formerly Automatic Electric Limited)	India
5.	Perfect Sales Corporation	India
Current Transformers (415V)		
1.	Alstom Limited (Areva T & D)	
2.	Anant Powertech	India
3.	Indcoil Transformers Pvt. Ltd.	India
4.	Kappa Electricals	India
5.	Mehru Electricals (Formerly Automatic Electric Limited)	India
6.	Perfect Sales Corporation	India
7.	Siemens Ltd.	India
8.	Silkans	India
9.	Pragati	India
10.	Automatic Electric	India
11.	Rishabh	India
Potential Transformers (415V)		
1.	Alstom Limited (Areva T & D)	India
2.	Indcoil Transformers Pvt. Ltd.	India
3.	Kalpa Electrical Private Limited	India



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4.	Kappa Electricals	India
5.	Larsen & Toubro Ltd.(El. Products Divn)	India
6.	Mehru Electricals (Formerly Automatic Electric Limited)	India
7.	Perfect Sales Corporation	India
8.	Siemens Ltd.	India
Meters		
1.	Alstom Limited (Areva T & D)	India
2.	IMP Power Ltd.	India
3.	M.B. Control & Systems Pvt. Ltd. (Only For Multifunctional Meter)	India
4.	Meco Instruments	India
5.	Mehru Electricals (Formerly Automatic Electric Limited)	India
6.	Rishabh Instruments Pvt. Ltd.	India
7.	Seahorse Industries Ltd.	India
Multi Function Meter (MFM)		
1	Secure meter Limited	India
2	SEMS	India
3	Larsen & Toubro Ltd.	India
4	SATEC	India
5	Alstom Limited (Areva T & D)	India
6	Siemens Ltd.	India
7	Asea Brown Boveri Ltd.	India
8	Schneider Electric	India
Bus Ducts (11 kV & 3.3 kV)		
1.	Best & Crompton Engg. Co.	India
2.	C & S Electric Ltd.	India
3.	Crompton Greaves Ltd.	India
4.	Intrelec	India
5.	Powergear Limited	India
6.	Spaceage Switchgears Limited	India
7.	United Electric Co. (Delhi) Pvt. Ltd.	India
Bus Duct (415 V)		
1.	Associated Switchgears & Projects Ltd.	India
2.	Best & Crompton Engg. Co.	India
3.	C & S Electric Ltd.	India
4.	Intrelec	India
5.	Lotus Powergear Pvt Ltd	India
6.	Spaceage Switchgears Limited	India
7.	United Electric Co. (Delhi) Pvt. Ltd.	India
8.	Venus Controls & Switchgear (P) Ltd.	India



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9.	Globe Electrical Industries (MV bus duct)	India
10.	Powergear Ltd.	India
Induction Motors – HV (11kV & 3.3 kV) (Safe/Hazardous Area)		
1.	BHEL (Electrical Machines Divn.)	India
2.	Jeumont Industrie	France
3.	Fuji Electric Systems Co. Ltd	Japan
4.	Mitsubishi Corporation	Japan
5.	Toshiba Corporation	Japan
6.	Toshiba Mitsubishi Electric Industrial Systems Corporation (Excluding Flame-proof motors of frame size more than 900)	Japan
7.	Peebles Electrical Machines	UK
8.	Siemens	India / Germany
9.	ABB	Finland/Switzerland/India
10.	Jeumont Electric India Private Limited	India
Induction Motors – LV (415 V) (Safe Area)		
1.	ABB	India
2.	Bharat Bijlee Ltd	India
3.	Crompton Greaves Ltd	India
4.	Kirloskar Electric Company Ltd	India
5.	Siemens Ltd	India
6.	Jeumont Industrie	France
7.	Siemens AG, Germany	Germany
8.	Fuji Electric Systems Co. Ltd.	Japan
9.	Mitsubishi Corporation	Japan
10.	Toshiba Corporation	Japan
11.	Asea Brown Boveri	Sweden
12.	General Electric Co.	USA
Industrial Type Sw. Socket & Plug		
1.	Baliga Lighting Equipments Limited	India
2.	Chloride Power Systems and Solutions Ltd. (formerly CALDYNE)	India
3.	Crompton Greaves Ltd	India
4.	Cyclo Electric Devices & Services Co.	India
5.	Ex-protecta	India
6.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame	India
7.	FCG Power Industries Ltd	India
8.	Flameproof Equipments Pvt. Ltd.	India
9.	Legrand India Ltd	India
10.	Legrand S.A.	France



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11.	BBC-Brown Boveri & Cie AG	Germany
12.	R Stahl Schaltgerate Gmbh	Germany
13.	Weidmuller Ltd.	Germany
14.	CORTEM S.p.A.	Italy
Street/Flood Lighting Fixtures		
1.	Bajaj Electricals Limited	India
2.	Crompton Greaves Ltd	India
3.	Havells India Ltd.	India
4.	Philips India Ltd.	India
5.	Surya Roshni Ltd.	India
6.	Wipro Lighting	India
Hose Proof Industrial Lighting Fixtures		
1.	Bajaj Electricals Limited	India
2.	Crompton Greaves Ltd.	India
3.	Philips India Ltd.	India
4.	Surya Roshni Ltd.	India
5.	Wipro Lighting	India
Air Obstruction Lights (Neon Type)		
1.	Bajaj Electricals Limited	India
2.	Elecab Poysa	India
3.	Wipro Lighting	India
Lighting Poles		
1.	Bharti Exports	India
2.	Metalite Industries	India
3.	Premier Power Products (Calcutta) Pvt. Ltd.	India
4.	Sadhana Engineering Corporation	India
5.	Surya Roshni Ltd.	India
Explosion Proof Lighting Fixtures		
1.	Baliga Lighting Equipments Limited	India
2.	Crompton Greaves Ltd	India
3.	Ex-Protecta	
4.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
5.	FCG Power Industries Ltd	India
6.	Flameproof Equipments Pvt. Ltd.	India
7.	Flexpro Electricals Pvt. Ltd.	India
Battery Charger		
1.	Amco Power Systems Limited	India
2.	Chloride Power Systems and Solutions Ltd.	India



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	(formerly CALDYNE)	
3.	Chhabi Electricals Pvt. Ltd.	India
4.	HBL Nife Power Systems Ltd.	India
5.	Universal Industrial Products	India
Battery (Ni-Cd)		
1.	AMCO Power Systems Ltd.	India
2.	HBL Nife Power Systems Ltd.	India
3.	Fuji Electric Systems Co. Ltd.	Japan
4.	Hitachi Limited	Japan
HT Power Cables		
1.	Cable Corpn. of India Limited	India
2.	KEC International Ltd. (Formerly RPG Cables Limited)	India
3.	KEI Industries Limited (Upto 33 kV)	India
4.	Ravin Cables Limited	India
5.	Torrent Cables Ltd.	India
6.	Universal Cables Ltd.	India
7.	Uniflex	India
8.	Polycab	India
LT Power Cables		
1.	Cable Corpn. of India Limited	India
2.	Cords Cable Industries Ltd	India
3.	Delton Cables Ltd	India
4.	Finolex Cables Ltd	India
5.	KEC International Ltd. (Formerly RPG Cables Limited)	India
6.	KEI Industries Limited	India
7.	Plaza Cable Industries Limited	India
8.	Ravin Cables Limited	India
9.	Torrent Cables Ltd	India
10.	Universal Cables Ltd.	India
11.	Polycab	India
LT Control Cables (1.1 kV)		
1.	Cable Corpn. of India Limited	India
2.	Cords Cable Industries Ltd	India
3.	Delton Cables Ltd	India
4.	Finolex Cables Ltd	India
5.	KEC International Ltd. (Formerly RPG Cables Limited)	India
6.	KEI Industries Limited	India



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7.	Plaza Cable Industries Limited	India
8.	Radiant Cables Pvt. Limited	
9.	Ravin Cables Limited	India
10.	Torrent Cables Ltd	India
11.	Universal Cables Ltd.	India
12.	Miracle cables	India
13.	Polycab	India
Cables For Earthing		
1.	Advance Cable Technologies (P) Ltd.	India
2.	Delton Cables Ltd	India
3.	Finolex Cables Ltd	India
4.	Gupta Electric & Machinery Stores (GEMSCAB)	India
5.	J K Cables Limited	India
6.	Netco Cable Industries (Pvt.) Ltd.	India
7.	Prestige Cable Industries	India
8.	Shyam Cables Industries	India
9.	Special Cables Pvt. Ltd.	India
10.	T C Communication Pvt Ltd	India
11.	Universal Cables Ltd.	India
Cable Jointing Kits		
1.	Raychem RPG Ltd.	India
Pre-Fabricated Al-Cable Trays		
1.	Globe Electrical Industries	India
2.	Hindustan Vidyut Products	India
3.	Indiana Engg Works Pvt Ltd	India
4.	Indmark Formtech Pvt. Ltd.	India
5.	Jamna Metal Company	India
6.	Kanade Anand Udyog Pvt. Ltd.	India
7.	Maheshwari Electrical Mfrs. (P) Ltd.	India
8.	Metalite Industries	India
9.	Parekh Engineering Company	India
10.	Premier Power Products (Calcutta) Pvt. Ltd.	India
11.	Rukmani Electricals & Components Pvt Ltd	India
12.	Sadhana Engineering Corporation	India
13.	Sree Atreya Enterprises	India
14.	Stealite Engg Co	India
Pre-Fabricated G.I. Cable Trays		
1.	Globe Electrical Industries	India
2.	Indiana Engg Works Pvt Ltd	India



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3.	Jamna Metal Company	India
4.	Maheshwari Electrical Mfrs. (P) Ltd.	India
5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Rukmani Electricals & Components Pvt Ltd	India
Hose Proof Local Control Station		
1.	Baliga Lighting Equipments Limited	India
2.	Bhartia Industries Ltd. (Divn. Bch)	India
3.	C & S Electric Ltd.	India
4.	Ex-Protecta	
5.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
6.	FCG Power Industries Ltd.	India
7.	Flameproof Equipments Pvt. Limited	India
8.	Hotline Switchgear & Controls	India
9.	Power Engg Co	India
Flameproof Items (Switch, Switch Socket, Plugs, Isolators, Junction Box, Local Control Station, Distribution Board)		
1.	Baliga Lighting Equipments Ltd.	India
2.	Ex-Protecta	India
3.	FCG Flameproof Control Gears Pvt. Ltd.(Formerly CEAG Flame)	India
4.	FCG Power Industries Ltd	India
5.	Flameproof Equipments Pvt. Ltd.	India
6.	Flexpro Electricals Pvt. Ltd.	India
7.	Legrand S.A.	France
8.	AEG Telefunken AG	Germany
9.	BBC-Brown Boveri & CIE AG	Germany
10.	R Stahl Schaltgerate GMBH	Germany
11.	Siemens AG, Germany	Germany
12.	Weidmuller Ltd.	Germany
13.	Cortem S.p.A.	Italy
14.	Fuji Electric Systems Co. Ltd.	Japan
15.	Togami Electric Mfg. Company	Japan
16.	Toshiba Corporation	Japan
17.	Asea Brown Boveri	Sweden
18.	Crouse-Hinds (Europe) Ltd.	U.K.
19.	GEC Industrial Control Ltd.	U.K.
20.	M&C Switchgear	U.K.
Hose proof Junction Boxes		
1.	Baliga Lighting Equipments Limited	India



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2.	Bhartia Industries Ltd. (Divn. Bch)	India
3.	Ex-protecta	India
4.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
5.	Flameproof Equipments Pvt. Ltd.	India
6.	FCG Power Industries Ltd	India
Limit Switches / Belt Monitoring Switches		
1.	A G System Controls	India
2.	AG Mechanical Enterprises (P) Ltd.	India
3.	Balaji Electricals	India
4.	Bhartia Industries Ltd. (Divn. Bch)	India
5.	Jayashree Electrodevices Pvt. Ltd.	India
6.	Protocontrol Instruments (I) Pvt. Ltd.	India
7.	R.K. Electrical Engg. Works	India
Limit Switches (Flameproof Type)		
1.	Baliga Lighting Equipments Limited	India
2.	Ex-protecta	India
3.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
4.	Flameproof Equipments Pvt. Ltd.	India
5.	FCG Power Industries Ltd	India
6.	Protocontrol Instruments (I) Pvt. Ltd.	India
Horn/Hooter/Klaxon		
1.	Baliga Lighting Equipments Limited	India
2.	Flameproof Equipments Pvt. Ltd.	India
3.	Worthmax Engineers	India
Variable Speed Motor Package (HV Motors)		
1.	Asea Brown Boveri Ltd.	Finland
2.	BHEL (Electrical Machines Divn.)	India
3.	Danfoss Industries Pvt. Ltd. (Upto 1400 KW)	India
4.	Alsthom Atlantique	France
5.	Siemens AG	Germany
6.	Ansaldo Robicon	Italy
7.	Fuji Electric Systems Co. Ltd.	Japan
8.	Toshiba Mitsubishi Electric Industrial Systems Corporation	Japan
9.	GEC Industrial Control Ltd.	UK
Variable Speed Motor Package (LV Motors)		
1.	Amtech Electronics (India) Ltd.	India
2.	Asea Brown Boveri Ltd.	Finland
3.	BHEL (Electrical Machines Divn.)	India



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4.	Crompton Greaves Ltd.	India
5.	Danfoss Industries Pvt. Ltd.	India
6.	Larsen & Toubro Ltd. (El. Products Divn)	India
7.	Kirloskar Electric Company Ltd.	India
8.	Rockwell Automatic India Ltd.	India
9.	Siemens Ltd.	India
10.	Alsthom Atlantique	France
11.	Siemens AG	Germany
12.	Ansaldo Robicon	Italy
13.	Fuji Electric Systems Co. Ltd.	Japan
14.	Toshiba Mitsubishi Electric Industrial Systems Corporation	Japan
15.	GEC Industrial Control Ltd.	UK
Capacitors		
1.	BHEL (Electrical Machines Divn.)	India
2.	Crompton Greaves Ltd.	India
3.	Kapsales Electricals Ltd.	India
4.	Shreem Capacitors Pvt. Ltd.	India
5.	Universal Cables Ltd.	India
6.	ABB	India
Earthing & Lightning Protection Material – (Al) Wire/Strip		
1.	Anand Electric Trading Co.	India
2.	C & S Electric Ltd.	India
3.	Indmark Formtech Pvt. Ltd.	India
4.	Jayant Metal Mfg. Co.	India
5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Jamna Metal Company	India
7.	Mahavir Industrial Corporation	India
8.	Metropolitan Industries	India
9.	Sai Galvanisers & Fabricators Pvt Ltd	India
Earthing & Lightning Protection Material – (GI) Wire/Strip		
1.	Anand Electric Trading Co.	India
2.	Controls & Switchgear Co. Ltd.	India
3.	Jayant Metal Mfg. Co.	India
4.	Indmark Formtech Pvt. Ltd.	India
5.	Premier Power Products (Calcutta) Pvt. Ltd.	India
6.	Jamna Metal Co.	India
7.	Mahavir Industrial Corporation	India
8.	Metropolitan Industries	India
9.	Sai Galvanisers & Fabricators Pvt Ltd	India
10.	Bharti Exports	India



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11.	Metalite Industries	India
12.	Rukmani Electricals & Components Pvt Ltd	India
13.	Sadhana Engineering Corporation	India
14.	Stealite Engg Co	India
GI Pipes & Conduits		
1.	Bharti Exports	India
2.	Indian Tube Co. (Tata Div. of Tubes & Pipes)	India
3.	Jindal Pipes Ltd.	India
4.	Meghjyot Enterprises	India
5.	Rukmani Electricals & Components Pvt Ltd	India
6.	Steelcraft	India
Industrial Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Comet Brass Products	India
3.	Comet Industries	India
4.	Dowell's Electricals	India
5.	Electromac Industries	India
6.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
7.	Gland-Mech. Industries	India
8.	Industrial products Equipment	India
9.	Power Engg Co	India
10.	Quality & Precision Indl. Equipment	India
11.	S J Metal Industries (Jainson)	India
Cable Lugs		
1.	Dowell's Electricals	India
2.	Forward Engg Industries	India
3.	KSE Electrical Pvt. Ltd.	India
4.	MG Electrica	Indai
5.	Power Engg Co	India
6.	S J Metal Industries (Jainson)	India
7.	Usha Martin Industries Ltd. (Ismal Divn)	India
Flameproof Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Comet Brass Products	India
3.	Comet Industries	India
4.	Dowell's Electricals	India
5.	Electromac Industries	India
6.	Ex-Protecta	
7.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
8.	FCG Power Industries Ltd	India
9.	Flameproof Equipments Pvt. Ltd.	India
10.	Flexpro Electricals Pvt. Ltd.	India
11.	Industrial Products Equipment	India



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12.	Kaysons Techno Equipments Pvt. Ltd.	India
13.	Power Engg Co	India
14.	Prompt Engineering Works	India
15.	Sudhir Switchgears Pvt. Ltd.	India
Explosion Proof Exhaust Fan		
1.	Alstom Limited (Areva T & D)	India
2.	Crompton Greaves Ltd	India
3.	FCG Flameproof Control Gears Pvt. Ltd. (Formerly CEAG Flame)	India
4.	Flameproof Equipments Pvt. Ltd.	India

Fuse		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India
3.	Alstom Power	India
4.	Havells India Ltd.	India

Contactors / Relay /		
1.	Larsen & Toubro Ltd. (El. Products Divn.)	India
2.	Siemens Ltd.	India

Timer		
1.	ABB	India
2.	Alstom Power	India
3.	Bhartia Cutler Hammer	India
4.	Siemens Ltd	India

Control Switches		
1.	Alstom Power	India
2.	Siemens Ltd.	India
3.	Kaycee	India
4.	Larsen & Toubro Ltd. (El. Products Divn.)	India

Push Buttons		
1.	Alstom Power	India
2.	Larsen & Toubro Ltd. (El. Products Divn.)	India
3.	Siemens Ltd.	India
4.	Tecnik	India
5.	Tulsi	India

Signal Lamps		
1.	Alstom Power	India
2.	Binoy	India
3.	Larsen & Toubro Ltd. (El. Products Divn.)	India
4.	Siemens Ltd.	India
5.	Tulsi	India



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Terminal Blocks		
1.	Connectwell	India
2.	Elmex	India
3.	Larsen & Toubro Ltd. (El. Products Divn.)	India
4.	Siemens Ltd.	India

Programmable Logic Controller		
1.	Rockwell Automation India Pvt. Ltd.	India
2.	Siemens Ltd.	India
3.	ABB	India

Optical Fiber Cable		
1.	Finolex	India
2.	DLink	India
3.	Molex	India
4.	Lucent	India
5.	Ericson	India
6.	Sterlite	India
7.	HFCL	India
8.	OPTEL	India
9.		

Transducer		
1.	Crompton	UK
2.	Elster (ABB)	India

HDPE Pipe		
1.	Astral	India
2.	Reliance Industries 'RELPIPE	India
3.	APOLLO	India
4.	Cliamx Synthesis	India

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F. INSTRUMENTATION:

Sl.No	Vendor's Name	Country
Gas Analysers (IR, Thermal Conductivity, Paramagnetic)		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Chemtrols Industries Limited (Maihak Make)	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Endress+ Hauser (India) pvt. Ltd.	India
5.	Yokagawa	India
6.	Ametek ,INC	U.S.A
7.	Emerson Process Mgt Singapore Ltd.	Singapore
8.	MaihakAktiengesellschaft	Germany
9.	M.S.A International	U.S.A
10.	Siemens AG	Germany
Sodium Analyser		
1.	ABB	
2.	HACH	
3.	THERMOFISHER	
4.	WALTRON	
5.	AWA	
Chlorine Analyser		
1.	ABB	INDIA
2.	HACH	FRANCE
3.	KROHNE	U.K
4.	E&H	
5.	WALTRON	
6.	THERMOFISHER	
Turbidity Analyser		
1.	HACH	
2.	YOKOGAWA	JAPAN
SDI Analyser		
1.	RODI	USA
pH, conductivity & ORP Analyser		
1.	ABB India Limited	India
2.	BELA INSTRUMENTS (For Knick, GmbH make), Mumbai(For ConductivityAnalyser)	India
3.	Chemtrols Industries Limited	India
4.	Emerson Process Management (I) Pvt. Ltd	India
5.	Endress+ Hauser (India) pvt. Ltd. (Liquid Analyser)	India
6.	Forbes polymetron Pvt. Ltd.	India
7.	POTENCE CONTROLS (for GLI International make), Mumbai.(For ConductivityAnalyser)	India
8.	Yokogawa India Ltd.	India
9.	Emerson Process Mgt Singapore Ltd.	Singapore
10.	Foxbro Far East PTE Ltd.	Singapore
11.	Hach Company	U.S.A
12.	Yokogawa Electric Corporation	Japan
13.	Zellweger SA	France
Trace Analyser/ Ion Selective		

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1.	ABB India Limited	India
2.	Chemtrols Industries Limited	India
3.	Forbes Polymetron Pvt. Ltd	India
4.	Bran & Luebbe Ltd	U.K
5.	Hach company	U.S.A
6.	Zellweger SA	France
PC / SERVERS		
1.	DELL	INDIA
Fire alarm System		
1.	HONEYWELL	INDIA
2.	SIEMENS	INDIA
SO_x/ NO_x Analyser		
1.	ABB India Ltd.	India
2.	Chemtrols Industries Limited	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Yokogawa India Ltd.	India
5.	Emerson Process Management Singapore Ltd	Singapore
6.	Horiba Ltd.	Japan
7.	Lear Siegler Meas. Controls Corp.	U.S.A
8.	M.S.A International	U.S.A
9.	Sick AG	Germany
10.	Siemens AG	Germany
11.	Thermo Environment Instruments Inc	U.S.A
12.	Yokogawa Electric Corporation	Japan
Mass Spectrometer		
1.	ABB India Ltd.	India
2.	Orbital Science Corporation	U.S.A
3.	VG Gas Analysis Systems	U.K.
Gas Chromatograph		
1.	ABB India Limited	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Applied Automation Inc	Singapore
4.	ABB Process Analytics	U.K
5.	Foxbaro Far East Pte Ltd	Singapore
6.	Siemens	Germany
7.	Yokogawa India Ltd.	India
Flue Gas Analyser (ZrO₂ type)		
1.	ABB Ltd (BU – Analytical & Adv)	India
2.	Chemtrol (For MAIHAK Only)	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Endress+Hauser	India
5.	Yokogawa India Ltd.	India
6.	Ametek Inc	U.S.A
7.	GE Panametrics	Ireland
H₂S/ Total Sulphur Analysers		
1.	ABB India Ltd.	India
2.	Barton Instrument Systems Limited	U.K
System House Analysers		
1.	ABB Ltd (BU – Analytical & Adv)	India
2.	Adage Automation Pvt. Ltd.	India

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3.	Analyser Instrument Co.Pvt. Ltd.	India
4.	Chemtrols Industries Limited	India
5.	Emerson Process Management (I) Pvt. Ltd	India
6.	Yokogawa India Ltd.	India
7.	Intech	Italy
Density Analysers		
1.	Chemtrols Industries Limited	India
2.	Emerson Process Management (I) Pvt. Ltd (coriolis type)	India
3.	Bopp & Reuther MesstechnikGmbh (coriolis type)	Germany
4	Solartron Mobrey	U.K
Moisture Analysers		
1.	Chemtrols Industries Limited	India
2.	AmetekInc	U.S.A
3	GE Panametrics	Italy
Gas & Fire Detection System		
1.	Andrew Yule & Company Ltd. (Fire)	India
2.	Chemtrols Industries Limited	India
3.	Honeywell Automation India Limited (Gas)	India
4.	J B Boda And Brothers Pvt. Ltd. (Gas Make-International Sensor Technology)	India
5.	Pollution Protection System Mumbai Pvt Ltd (Gas)	India
6.	General Monitors (Gas)	U.K
7	Teledyne Fluid Systems (Gas)	Thailand
Air Quality Monitoring System		
1	Chemtrol Industries Ltd.	India
Sample Handling System		
1.	Analyser Instrument Co.Pvt. Ltd.	India
Flow Element: Orifice/ Venturi/ Flow Nozzle		
1.	Baliga Lighting (only Orifice)	India
2.	Chemtrol Industries Ltd.	India
3.	Delta Engineering, Pune	India
4.	Eureka Industrial Equipments Pvt. Ltd.	India
5	FORBES MARSHALL	India
6	Flowtech Instruments (Orifice/Venturi)	India
7	General Instruments Consortium	India
8.	Instrumentation Ltd.	India
9.	Micro Precision Products Private Ltd.	India
10.	Micro India Flow Elements Pvt. Ltd.	India
11	Minco(India) Flow Instruments Pvt. Ltd.	India
12	Unicontrols Instrument Pvt. Ltd.	India
13	Bopp & Reuther Messtechnik GMBH	Geramny
14	Daniel Measurement & Control	USA
15	ISA Controls Limited	U.K
16	Technomatic SPA	Italy
Pitot Tube/ Annubar		
1.	ABB India Limited	India
2.	Control Engineers	India
3.	Emerson Process Management (I) Pvt. Ltd.	India
4	Micro Precision Products Private Ltd.	India
5.	Unicontrols Instruments Pvt. Ltd.	India
6.	Daniel Measurement & Control	U.S.A



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7.	ISA Controls Limited	U.K
8	Technomatic Spa	Italy
Rotameters		
1.	ABB india Ltd.	India
2.	Chemtrols Industries Ltd.	India
3.	Delta Control	India
4.	Eureka Industrial Equipments Pvt. Ltd.	India
5	Flowtech Instruments services	India
6.	Instrumentation Engineers Pvt. Ltd.	India
7.	Krohne Marshall Pvt. Ltd.	India
8.	Placka Instruments & Controls Pvt. Ltd. (Purge Rotameter Only)	India
9.	Rota Instrumentation	India
10	Yokogawa	India
11	Rota Yokogawa Gmbh & Co. Kg	Germany
12	Tokyo Keiso Co.Ltd.	Japan
13	Azbil Corporation	Japan
14	Emerson Process Mgt	U.S.A
15	Krohne	Germany
Mass Flow Meter (Coriolis Type)		
1.	ABB India Limited	India
2	Chemtrol Industries Ltd	India
3.	Emerson Process Management (I) Pvt. Ltd.	India
5	Endress + Hauser	India
6.	SIEMENS Ltd.	India
7.	Yokogawa	India
8.	Bopp & Reuther Messtechik GMBH	Germany
7	Krohne	Germany
8	Schlumberger resource management Ltd.	U.S.A
Turbine Flowmeter		
1.	ABB India Ltd.	India
2.	Chemtrol Industries Ltd	India
3.	Krohne	India
4.	Yokogawa	India
5.	Azbil Corporation	Japan
6.	Bopp & Reuther Messtechnik Gmbh	Germany
7.	Barton Instrument System Ltd.	U.K.
8.	Emerson Process Mgt	U.K.
9.	Emerson Process Mgt.	U.S.A
10.	Instromet International N.V.	Holland
11.	Itochu Corporation	Japan
12.	Oval Asea Pacific Pte Ltd.	Singapore
13.	Rockwell International Corporation	U.S.A
Vortex meter		
1.	ABB India Ltd.	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Krohne Marshall Pvt. Ltd.	India
4	Siemens Ltd.	India
5.	Yokogawa Limited	India
6	Bopp & Reuther Messtechnik Gmbh	Germany
7.	Endress + Hauser	Germany

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8.	Itochu Corporation	Japan
9.	Krohne	Germany
10.	Schlumberger resource management Ltd.	U.S.A
PD Meter		
1.	Chemtrols Industries Ltd.	India
2.	Rock Flow Meters (i) Pvt. Ltd.	India
3.	Bopp & Reuther MesstechnikGmbh	Germany
4.	Emerson Process Management	U.S.A
5.	Oval Asea Pacific Pte Ltd.	Singapore
6.	Schlumberger resource management Ltd.	U.S.A
Magnetic Flow meter		
1.	ABB India Ltd.	India
2.	Chemtrol Industries Ltd	India
3.	Emerson Process Management (I) Pvt. Ltd.	India
4.	Endress + Hauser (India) Pvt. Ltd.	India
5.	Krohne Marshall Pvt. Ltd.	India
6.	Siemens Ltd.	India
7.	SBEM Pvt. Ltd.	India
8.	Yokogawa	India
9.	Azbil Corporation	Japan
10.	Bopp & Reuther MesstechnikGmbh	Germany
11.	Krohne	Germany
Insertion Type Flow Meter		
1	Emerson Process Management (I) Pvt. Ltd.	India
2	Siemens Ltd.	India
Ultrasonic Flow Meter		
1	Chemtrol Industries Ltd	India
2.	Endress + Hauser (India) Pvt. Ltd.	India
3.	Emerson Process Management	India
4.	Siemens Ltd.	India
5	Yokogawa	india
Orifice Meter		
1	Chemtrol Industries Ltd	India
Metering Skid		
1.	Chemtrol Industries Ltd.	India
Pressure Gauges		
1.	Ashcroft India(P) Ltd. (standard normal type)	India
2.	A.N. Instruments Pvt. Ltd.	India
3.	Baumer Technologies India Pvt . Ltd	India
4.	Forbes Marshall	India
5.	General Instruments Consortium,	India
6.	H.Guru Industries	India
7.	Peejee Engg. Works	India
8.	Precision Industries Ltd. (standard normal type)	India
9.	Premium Instrument & Controls Ltd.	India
10.	Manometer (India) Pvt. Ltd.	India
11.	Walchand Nagar Industries Ltd.	India
12.	Wika	India
13.	Budenberg Gauge Co. Ltd	U.K
14.	Dresser Europe S.A	Germany



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15.	Nagano keiki Seisakusho	Japan
16.	Rueger Sa	Switzerland
17.	Spriano Spa	Italy
18.	WikaAlexanderWiegardGmbh & Co.	Germany
Local D/P Indicators		
1.	Precision Mass Products Pvt. Ltd	India
2.	Switzer Instrument Co.	India
3.	Wika	India
4.	Barton Instrument Systems Limited	U.K
5.	Delta Controls Ltd.	U.K
Pressure & D/P Transmitters		
1.	ABB India Ltd.	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Endress + Hauser (India) Pvt.Ltd.	India
4.	Honeywell Automation India Limited	India
5.	Siemens Ltd.	India
6.	Yokogawa Limited	India
7.	Azbil Corporation	Japan
8.	Emerson Process Mgt Singapore Ltd	Singapore
9.	Honeywell Inc.	U.S.A
10.	Moore Products Company	U.S.A
11.	Siemens Ag, Germany	Germany
12.	Smar Singapore Pte. Ltd.	Singapore
13.	VEGA Grieshaber KG	Germany
14.	Yokogawa Electric Corporation	Japan
Pressure & D/P Switches Including Vol. Seal		
1.	Endress + Hauser(India) Pvt. Ltd.	India
2.	Indfos Industries Ltd. (Except Vol.Seal)	India
3.	Kaustubha Udyog (Except Vol.Seal)	India
4.	Precision Mass Products Pvt. Ltd	India
5.	Switzer Instrument Co. (Except Vol.Seal)	India
6.	Azbil Corporation	Japan
7.	Delta Controls Ltd.	U.K
8.	Nagano Keiki Seisakusho	Japan
9.	SOR Inc.	U.S.A
10.	United Electric Controls Co.	U.S.A
Transparent/ Reflex / Bicolor Mag.Level Gauges		
1.	ABB India Ltd.	India
2.	Bliss Anand Private Ltd.	India
3.	Chemtrols Samil(India) Pvt Ltd.	India
4.	Flowtech Instruments services	India
5.	LEVCON INSTRUMENTS PVT. LTD.	INDIA
6.	Nisan Scientific Process Equipments Pvt. Ltd	India
7.	Pune Techtrol Pvt. Ltd. (= < 300#)	India
8.	Technomatic (India) Pvt. Ltd.	India
9.	V-Automat Instruments Pvt. Ltd. (upto 300#)	India
10.	Clark-Reliance Corp.	U.S.A
11.	CesareBonetti	Italy
12.	Jerugson Gauge & Valve Co.	U.S.A
13.	Nihon Klingage Co. Ltd.	Japan

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14	Richard Klinger Ag	Austria
15	Technomatic Spa	Italy
Level Switches (Float & Displacer Type)		
1.	ABB India Ltd.	India
2.	Bliss Anand Private Ltd.	India
3.	Chemtrols Samil(India) Pvt Ltd.	India
4.	Pune Techtrol Pvt. Ltd.	India
5.	SBEM Pvt. Ltd.	India
6.	Siemens Ltd.	India
7.	V.Automat & Instruments (P) Ltd.	India
8.	ISA Controls Limited	U.K.
9.	KDG. MOBREY Ltd.	U.K.
10.	Magnetrol International N.V	Belgium
11.	SOR Inc.	U.S.A
12.	Vega Grieshaber KG	Germany
Displacer Type Level Transmitters		
1.	Chemtrols Industries Limited (Eckdardt Make Electronics)	India
2.	Dresser Valve India Pvt Ltd (Rating <= 600#)	India
3.	Dresser Masoneilan	France
4.	Foxboro EckardtGmbh	Germany
5.	Magnetrol International N.V. (Lvdt)	Belgium
6.	Parcol Spa (Pneumatic Transmission Only)	Italy
Tank Level Instruments		
1.	ABB India Limited	India
2.	Emerson Process Management (i) Pvt. Ltd.	India
3.	Pune Techtrol Pvt. Ltd.	India
4.	Siemens Ltd. (Radar level Transmitter, guided wave Radar)	India
5.	SBEM Pvt. Ltd.	India
6.	EnrafSingaporePte. Ltd.	Singapore
7.	Endress + Hauser Gmbh& Co., (Non-Contact & Servo)	Germany
8.	Krohne (Non-Contact Type)	Germany
9.	L& J Technologies	U.S.A
10.	Toyo Keiso Co. Ltd.	Japan
Ultrasonic Level Transmitter		
1.	Forbes Marshall	India
2.	Siemens Ltd.	India
3.	Vega Grieshaber KG	Germany
4.	EIP Enviro level controls private limited	India
Tank Farm Management		
1.	Endress + Hauser (India) Pvt. Ltd. (Servo,Radar)	India
Guided wave Radar / High Frequency Radar		
1.	Endress + Hauser (India) Pvt. Ltd	India
2.	Forbes Marshall	India
3.	Magnetrol	India
4.	Vega Grieshaber KG	Germany
5.	EIP Enviro level controls private limited	India
Temperature Elements (Thermocouple, Rtd)		
1.	Altop Industries Ltd.	India
2.	ABB India Ltd.	India
3.	Detriv Instrumentation & Electronics Ltd.	India

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4.	Electrical & Electronics Ltd.	India
5.	Eleind Engineering Pvt. Ltd.	India
6.	Endress + Hauser (India) Pvt. Ltd.	India
7..	Exotherms Instruments	India
8.	General Instruments Consortium	India
9.	Goa Instruments Industries Ltd.	India
10.	Industrial Instrumentation	India
11.	Precision Mass Products Pvt. Ltd.	India
12.	Pyro Electric Instruments Goa Pvt. Ltd.	India
13.	Tempsens Instruments (I) Pvt. Ltd.	India
14	Thermal Instruments India Pvt. Ltd.	India
15	Unicontrols Instruments Pvt. Ltd.	India
16	Azbil Corporation	Japan
17	Okazaki Manufacturing Co.	Japan
18	Sensycon	Germany
19	Thermo Electric Co.Ltd.	Holland
20	W.C.Heraeus GMBH	Germany
Bimetallic Thermometer		
1.	A N Instruments Pvt. Ltd.	India
2.	Ashcroft India(P) Ltd.	India
3.	Baumer Technologies India Pvt. Ltd.	India
4.	General Instruments Consortium	India
5.	Goa Instruments Industries Ltd	India
6.	H.Guru Industries	India
7	Krohne Marshall Pvt. Ltd.	India
8	Precision Mass Products Pvt. Ltd.	India
9	Nagano Keiki Seisakusho	Japan
10	Rueger SA	Switzerland
11	Technomatic SPA	Italy
12	Trend Instrument Inc.	U.S.A
Vibration Fork/ RF Capacitance type Level Switches		
1.	ABB India Ltd.	India
2.	Protocontrol Instruments (I) Pvt. Ltd. (non-critical)	India
3.	Endress + Hauser	Germany
4.	EIP Enviro level controls private limited	India
Dial Thermometer (Hg In Steel/Glass)		
1.	A N Instruments Pvt. Ltd.	India
2.	Ashcroft India(P) Ltd.	India
3.	Baumer Technologies India Pvt. Ltd.	India
4.	General Instruments Consortium,	India
5.	Goa Instruments Industries Ltd	India
6.	H.Guru Industries	India
7.	Precision Mass Products Pvt. Ltd	India
8.	Pejee Engg Works	India
9.	Walchand Nagar Industries Ltd.	India
Radiation Pyrometer		
1.	Tempsens Instruments Pvt. Ltd.	India
2.	C.C.R Technico	Italy
3.	Chino Corpn.	Japan
4.	Land Infrared	U.K.



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5.	Siemens AG	Germany
6.	Wahal Instruments	U.S.A
Temperature Transmitters		
1.	ABB India Limited	India
2.	Emerson Process	India
3.	Endress+ Hauser (India) Pvt. Ltd.	India
4.	Siemens Ltd.	India
5	Yokogawa	India
Gate/Plug Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	BHEL(Valves Division)	India
3.	Chemtrols Engineering Limited (Plug Valves)	India
4.	Flowserve India Control Pvt. Ltd.(Plug Valve upto 12"300# upto 6" 600#)	India
5.	Ksb Pumps Limited (Valves Divn)	India
6	NU Tech Controls (MOV Gate :1/2" to 8" 2500#, 10" to 14",300#)	India
7.	Samsons Contols Pvt. Ltd. (Upto 34", 300#)	India
8.	Valve Tech Industries (Mov -8" upto 2500#)	India
9.	Velan Inc.	Canada
10	Weir Bdk Vlaves	India
11	Bel Valves	Japan
12	CesareBonetti	Italy
13	Fasani S.P.A	Italy
14	MalbraqueS.A.	France
15	Matsura H. P Machine works co. Ltd.	Japan
16	Petrol Valves S.R.L	Italy
17	CAIR EUROMATIC AUTOMATION PVT.LTD	India
Globe / Angle Valves		
1.	AST S.P.A (Upto 8"900#)	India
2	Chemtrol Industries Ltd.	India
3	Circor Flow Technologies India Pvt. Ltd.	India
4	Dresser Valve India Pvt. Ltd.(Rating =<600#,size 3/4" to 6")	India
	Emerson Process Management India Ltd	India
5	Emet Controls Pvt. Ltd.(Globe Valve up to 4",300# angle valve upto 1-1/2",2500#)	India
6	Flowserve india control pvt. Ltd. (globe valve upto 30" 600# upto 24" 900#, upto 16" 2500# upto 4" 4500#)	India
7	Koso fluids controls pvt. Ltd. (globe valves: upto 8" 2500# 10 to 18" 300# angle valves upto 8" 300#)	India
8	Instrumentation Ltd. (Palakkad)	India
9.	Mil Controls Limited	India
10.	NU Tech Controls	India
11	Pneucon valves Pvt. Ltd. (upto 6" 300#) noncritical)	India
12	Samson Control Pvt Ltd(upto 6" &=<600#)	India
13	Tecnik valves pvt Ltd. (air & water service upto 4" 150#)	India
14	Valve-Tech Inductries (non-critical)	India
15	Azbil Corporation (=< 2500#)	Japan
16	Arca Regler GMBH	Germany
17	Dresser Masoneilan	France
18	Flowserve (=<2500#)	U.S.A



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19.	Fisher Xomox (=< 2500#)	Singapore
20.	Parcol Spa	Italy
21	Nippon Fisher Co. Ltd. (=<2500#)	Japan
22	Severn Glocon (1 to 12" 600#)	U.K.
Ball Valves		
1.	Tyco Valves & Controls (I) Ltd (=< 150 #)	India
2.	Virgo Engineers Ltd. (=<600# With Maccair Actuators)	India
3.	Anand teknow aids engineering india limited (upto 6",600# (ON-OFF)	India
4.	Bray Controls India Pvt. Ltd.(upto 4",300#)	India
5.	Emerson	India
6	EMET controls pvt. Ltd.(upto 8",150# for air service)	India
7	Fisher Xomox Sanmar	India
8	Flowserve India controls Pvt. Ltd. (upto 16" 600#)	India
9	Intervalve ponnawalla limited (uptp 10",150#)	India
10	Koso Fluid Controls pvt. Ltd. (upto 8 " ,2500# ,10" to 18" 900#)	India
11	NU Tech Controls (14",600# for non-critical purpose)	India
12	Pentair Valves and controls India Pvt. Ltd. (<=150#)	India
13	Pneucon valves pvt. Ltd. (upto 6",150# non-critical)	India
14	Samson Control Pvt Ltd(upto 24" &=<1500#)	India
15	Valve tech industries ltd. (18",150# non critical)	India
16	Weir Bdk Vlaves (upto 16",150#)	India
17	G.T.C. Italia S.R.L(=<300#)	Italy
18	Metso Automation (=<2500#)	Singapore
19	Orbit Valves PLC (=<2500#)	Singapore
20	Petrol Valves S.R.L	Italy
21	PERRIN Gmbh (size 1/2" to 12",& rating 150# to 2500#,size 14"to 18", rating 150# to 1500# ,size 20"to 24" rating 150# & 300#)	Germany
22	Pibiviesse S.P.A. (Rating Upto 2500 #)	Italy
23	Rotex manufacturers & Engineers Pvt. Ltd. (upto 6" 600#, 6" to 10" 150#)	India
24	Velan Inc. (ball valves on/off size: 1/4" to 6" (rating upto 2500#) size 8"to 16" (rating upto 900#) size 18" to 30 " (rating upto 300#)	Canada
25	CAIR EUROMATIC AUTOMATION PVT.LTD	India
Butterfly Valves		
1	Advance valves pvt. Ltd.(size 2"to 24" upto 600#)	India
2	Bray controls india pvt. Ltd. (upto 300#)	India
3	Dresser Masonelian Valves	India
4	Emet controls pvt. Ltd. (upto 4",900#, 6",150# to 16",150# double eccentric)	India
5	Flowserve india control pvt. Ltd. (upto 30",300# upto 12" 600#)	India
6	Fisher	India
7	Intervalve ponnawaala ltd. (2" to 48",150#)	India
8	Instrumentation Ltd. (Palakkad) (=< 300#)	India
9	Koso fluid controls (pvt.) ltd. (=< 150#)	India
10	Nu tech controls (16",300# for non-critical services)	India
11.	Pneucon valves pvt. Ltd. (upto 8",150# non critical)	India
12.	Samson controls pvt. Ltd.	India
13	Tyco Valves & Controls (I) Ltd (=< 150 #)	India
14	Valve tech industries (non-critical services)	India
15	Virgo Engineers Ltd. (=<300#)	India
16	Weird BDK valves (upto 16",300#0)	India
17	Bray Controls(=<300#)	U.S.A

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18	Keystone (Upto 2500#)	Singapore
19	Leeds valve ltd.	UK
20	Korea Unicom Valve Co. Ltd.	Korea
21	Parcol Spa (= < 2500# Urea Service Also)	Italy
22	Pentair Valves and controls India Pvt. Ltd. (<=150#)	
23	Metso Automation (Upto 2500#)	Singapore
24	Orton S.r.l. (upto 2500#)	
25	CAIR EUROMATIC AUTOMATION PVT.LTD	India
PRDS & SPRAY NOZZLE, VENT VALVES upto 2500#		
1.	ARCA (Forbes Marshal) (Mech. Spray nozzle type desuperheater only)	India
2.	Chemtrols Industries Ltd. (PRDS Combine & Split)	India
3.	Circor Flow Technologies India Pvt. Ltd. (1" to 20", upto 150#, 1 to 10" upto 1500#, 1" to 8", upto 2500#)	India
4	Control components INC	India
5	FisherControls	India
6.	Samson Controls Pvt. Ltd. (upto 6", 150#)	India
7.	CCI Valve Technology AB	Sweden
8	KOSO India	India
Electric Actuator		
1.	Biffi Italia S.R.L	Italy
2.	Limitorque, U.S.A	U.S.A
3.	Rotork Control (Deutschland) Gmbh	Germany/INDIA
4.	Auma,	U.S.A/INDIA
5.	CAIR EUROMATIC AUTOMATION PVT.LTD	India
Air Filter cum Pressure Regulator		
1.	ABB India Limited	India
2.	Divya Control Elements Pvt. Ltd.	India
3.	Dresser	India
4.	Emerson Process Management	India
5.	Mil Controls Limited	India
6.	Placka Instruments & Controls Pvt. Ltd.	India
7.	Shavo Norgren (India) Pvt Ltd.	India
8.	Schrader Duncan Ltd. (1/4" to 2" port size)	India
Valve Actuator (Pneumatic/Rotary)		
1.	Bray Control India Pvt. Ltd.	India
2.	EL-O-Matic India Pvt. Ltd.	India
3	Rotex Manufacturers & Engineers Pvt Ltd	India
4	Schrader Ducan Ltd.	India
Self actuated pressure control valve		
1	FisherControls	India
2	Nirmal Industrial controls private limited (size 1/2" to 6 " & rating : < =300#)	India
3	Nu tech Controls (upto 10", 600#)	India
4	Pneucon Valves Pvt.Ltd. (upto 4", 150#)	India
5	Samsons Controls Pvt. Ltd. (upto 2", 150#)	India
Electropneumatic Positioner		
1.	FisherControls	India
2	Siemens Ltd.	India
Desuperheaters		
1.	Circor Flow Technologies India Pvt. Ltd (upto 24", 300# upto 28", 150#, multinozzle 3" to 4", upto 2500#)	India

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2.	Chemtrols	India
3	CCI	India
4	EMET Controls Pvt. Ltd.(Desuperheating Control Valves 1-1/2", 600# * 3",2500#)	India
5	Fisher	India
6	Tyco	India
Pressure reducing Station		
1.	Circor Flow Technologies India Pvt. Ltd (1" to 20",upto 150# ,1 "to 10", upto1500#,1"to 8 " upto 2500#))	India
Pressure Regulator		
1.	Chemtrol Industries Ltd.	India
Safety Valves & Thermal Relief Valves Upto 2500#		
1.	AST S.P.A	India
2.	Bliss anand private limited (8" * 10" 300#, 6" * 8 " 600# ,4 * 6" 1500#)	India
3.	FaingerLeser Valves (P) Ltd. (Upto 600#, 1/2" To 6")	India
4.	Instrumentation Ltd. (Palakkad)	India
5.	Keystone	India
6	Pentair Sanmar Ltd.	India
7	Nu tech controls (upto 2",300# * 3",150#)	India
8	Valve Tech Industries	India
9	Weir Bdk Valves	India
10	BOPP & Reuther Messtechnik GMBH	Germany
11	Crossby valve & Engg. Company Ltd.	U.K
12	Dresser Industries Incorporated	U.S.A
13	Dresser Valve & Controls	Canada
14	Farris	U.K
15	Itochu Corporation	Japan
16	Parcol Spa (For Urea Service Also)	Italy
17	Sapag Gec Alsthom	France
18	Tai Milano S.P.A	Italy
19	Teledyne Fluid Systems	Thailand
20	Nirmal Industries Control	India
Vaccum Breakers		
1.	Fainger Engineering	India
2.	Potego India Pvt. Ltd.	India
3.	Braunschweiger Flammenfilter	
4.	Itochu Corporation	Japan
5.	Parcol Spa	Italy
6.	Safety Systems UK Ltd.	U.K
7.	Tai Milano S.P.A	Italy
8.	Whesoe Varec Limited	U.K
Rupture Discs		
1.	Bs&B Safety Systems (India) Limited	India
2.	Fainger Engineering	India
3.	Tyco Sanmar	India
4.	Continental Controls Inc.	U.S.A
5.	Fike Europe	Belgium
6.	Sapag GEC Alsthom	France
7.	Teledyne Fluid Systems	Thailand
Pilot relief valves		

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1.	AST S.P.A (inlet size upto 3", upto 1500#, outlet size upto 4", upto 300#,inlet size upto 4",upto 300# ,inlet size upto 6", upto 150#,outlet size upto 8", upto 150#)	India
2.	Bliss Anand Private Limited (Size 1"* 2" 2500#)	India
Low pressure relief valve		
1.	Protego India Pvt. Ltd. (less than 1 BAR with flame arrestor)	India
Flame arrestor		
1.	Protego India Pvt. Ltd	India
Control Panel		
1.	Electronics corporation of india ltd.	India
2.	Ex protecta	India
3.	Hulasi metals pvt. Ltd.	India
4.	Industrial control appliances (p) ltd.	India
5.	Jaisun & hutchisun control ltd.	India
6.	Prima automation (india) pvt. Ltd.	India
7.	Pyrotech electronics pvt. Ltd.	India
8.	Tan swa technologies INC	India
9.	United electric co (delhi) pvt. Ltd,	India
10.	Yokogawa india limited	India
11.	Instromet international N.V.	Holland
Programable Logic Controller- Package		
1.	ABB India Limited	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Ge Fanuc Systems Prvitate Limited	India
4.	Honeywell Automation India Limited	India
5.	Rockwell Automation India Ltd.	India
6.	Siemens Ltd.,	India
7.	Yokogawa	India
8.	GE fanuc automation north America INC (fault tolerant TMR)	U.S.A
9.	Hima paul Hiildebrandt Gmbh +Co KG (fail safe)	Germany
10.	Marconi italiana (non fail safe)	Italy
11.	Omron corporation (Relay)	Japan
12.	RTP Control system	U.S.A /India
13.	Triconex (fault tolerant TMR)	Singapore
14.	Triconex (Schenider)	Singapore
Distributed Control System		
1.	ABB India Limited	India
2.	Emerson process management India Pvt. Ltd.	India
3.	Foxboro	India/Intl.
4.	Honeywell Automation India Limited	India
5.	Siemens Ltd.	India
6.	Yokogawa Limited	India
7.	Bailey controls company	U.S.A
8.	Emerson process management Singapore ltd.	Singapore
9.	Honeywell Inc.	U.S.A
10.	Invensys	Holland
11.	Siemens AG	Germany
12.	Yokogawa Electric Corporation	Japan
ESD SHUT- DOWN SYSTEM		
1	HONEYWELL	

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2	HIMA CONTROLS	
3	PAUL HILDEBRANDT (HIMA)	
4	RTP Control system	
5	Rockwell automation pvt. Ltd.	
6	SIEMENS AG	
7	TRICONEX / IMPROTEC	
8	YOKOGAWA	
Multiplexer / Remote I/O		
1.	Mtl Instrument Limited	India
2.	Pepperl + Fuch	India
3.	M.system Co. Ltd. (Remote I/O; Model No.R3)	Japan
4	M.T.L., U.K.	U.K
5	Pepperl + Fuchs Pte Ltd.	Singapore
6	Stahl-Und Apparatebau Hans LefferGmbh	Germany
Receiver Instruments (Indicator,Controller,Recorder)		
1.	ABB India Limited	India
2.	Chino-Laxsons (India) Limited (Only Recorder)	India
3.	Eurotherm Del India Limited	India
4.	Honeywell Automation India Limited	India
5.	Masibus Automation & Instrummentation Pvt.Ltd. (Receiver Instruments except recorder)	India
6.	Moore Controls Ltd.	India
7.	Yokogawa Limited	India
8	ChinoCorp.	Japan
9.	Heraeus Electro-Nite International N.V.	Japan
10.	Honeywell Inc.	U.S.A
11	Siemens Ag, Germany	Germany
12	Yokogawa Electric Corporation	Japan
Alarm Annunciator		
1.	Industrial Instruments & Controls	India
2.	Shree Electronics	India
3.	M.T.L., U.K.	U.K
4.	Rochester Instrument Systems Ltd.	U.K
5.	Riley Panalarm	U.S.A
6.	Ronan Engg. Co.	U.S.A
Temperature Scanner		
1.	Industrial Instrumentation	India
2.	Protocontrol Instruments (I) Pvt. Ltd.	India
Cctv / Access System		
1.	Honeywell Automation India Limited	India
2.	Yokogawa Limited	India
Miscellaneous Items (Rtu / ScadaEtc)		
1	ABB India Limited	India
2.	Rockwell Automation India Pvt. Ltd.	India
3.	Siemens Ltd. (Simatic WINcc)	India
Energy meter		
1.	M.system co. Ltd.(Model No. 53U)	India
Surge Protection Devices		
1.	Phoenix Contact (India) Pvt. Ltd.	India

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Wiring Ducts		
1.	Trinity touch Pvt.Ltd.	India
DIN Rail		
1.	Trinity touch Pvt.Ltd.	India
Interface Module		
1.	Trinity touch Pvt.Ltd.	India
Cable connector		
1.	Phoenix contact (India) Pvt. Ltd.	India
Advance Process Control System		
1.	Yokogawa India Limited	India
Speed Indicator		
1.	Bentley NevadaLlc	U.S.A
2.	Jacquet	Switzerland
3.	Pepperl + Fuch	Germany
4.	Pepperl + Fuchs Pte Ltd.	Singapore
5.	Shinkawa Electric Co.	Japan
Burner Management System		
1.	Siemens (TMR/QMR)	
2.	Triconex (TMR/QMR)	
3.	Honeywell (TMR/QMR)	
4.	Yokogawa (TMR/QMR)	
5.	Rockwell Automation Pvt. Ltd. (TMR/QMR)	
Instrument Power & Control Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	Centurion Power Cables Limited	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India
8.	Suyog Electrical ltd.	India
9.	Paramount Cable Corporation	India
10.	T C Communications Pvt Ltd	India
11.	Thermo Cables Limited	India
12.	Toshniwal Cables	India
13	Udey Pyro Cables Pvt Ltd	India
14	TC WIRE & CABLES PVT. LTD	India
Extension & Compensating Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	General Instruments Consortium,	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India
8.	Paramount Cable Corporation	India
9.	ThermopadsPvt. Ltd.	India
10.	Toshniwal Cables	India
11	TC WIRE & CABLES PVT. LTD	India
12	T C Communications Pvt Ltd	India

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13	Suyog Electrical Ltd.	India
Cable Trays & Accessories (Al./GI/FRP)		
1.	D-Y Engineers	India
2.	Globe Electrical Industries	India
3.	Sumip Composite	India
4.	Indiana Engg Works Pvt Ltd	India
5.	Metalite Industries	India
6.	Parekh Engineering Company	India
7.	Sadhana Engineering Corporation	India
8.	Steelite Engineering Limited	India
Multi Transit Inlet System		
1.	Hawke International	U.K
2.	MctBrattbergAktiebolag	Sweden
3.	RoxtecAb	Sweden
Junction Box & Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Ceag Flameproof Control Gears Pvt.Ltd.	India
3.	Ex-protecta	India
4.	Flameproof EquipmentsPvt. Ltd.	India
5.	Flexpro Electicals Pvt. Ltd.	India
6.	TAN SWA technologies Inc (Junction Box)	India
7.	Trinity Touch Pvt. Ltd. (Only cable Glands upto size 25M)	India
8.	Stahl-Und Apparatebau Hans LefferGmbh	Germany
CS Seamless Pipes –As per Piping list		
1	Indian tube Co.(Tata Div of tubes & pipes)	India
2	ISMT limited	India
3	Maharashtra seamless limited	India
4	Dalmine SPA	Italy
5	ETS Trouvay & Cauvin	France
6	Horst kurvers Gmbh	Germany
7	Hyundai Corporation	Korea
8	IBF seamless pipes SPA	Italy
9	Mannesmann Hnadel AG	Germany
10	Marubeni Itochu Steel	Japan
11	Nippon steel corporation	Japan
12	Nissho IWAI Corporation	Japan
13	Okura & Co. Ltd.	Japan
14	Sojitz Corporation	Japan
15	Sumitomo metal industries Ltd.	Japan
16	Phoceenne	France
17	Vomal International Limited	UK
SS Seamless Pipes-As per piping list		
1	Choksi tube company limited	India
2	Maxim tubes company pvt. Ltd.	India
3	Nuclear fuel complex	India
4	Ratnamani metals & tubes limited	India
5	Remi edelstahl tubular ltd.	India
6	Dalmine SPA	Italy
7	Phoceenne	France
8	TPS technitube Röhrenwerke	Germany

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9	T.T.I tubecex tubos inoxidables S.A. (1/2" NB SS pipe)	Spain
SS Tubes		
1.	Choksi Tube Company Ltd.	India
2.	Matim Tubes Company Pvt. Ltd.	India
3.	Nuclear Fuel Complex	India
4.	Ratnamani Metals & Tubes Limited	India
5.	Sandvik	India
6.	Itochu Corporation (Rep.KubotaCorpn.)	Japan
7.	Nishitani& Co. Ltd.	Japan
8	Sumitomo Metal Industries Ltd.	Japan
Pipe Fittings		
1.	Eby industries	India
2.	Excel hydropneumatics pvt. Ltd.	India
3.	Micro precision products pvt. Ltd.	India
4	Precision engineering industries	India
5	Tecnomatic (india) pvt. Ltd.	India
6	Wesmec engineering pvt. Ltd.	India
7	Celleir	France
8	Cesare bonetti SPA	Italy
9	Dewrance & Co. Ltd.	U.K.
10	Hopkinsons Ltd.	U.K.
11	Siemens AG PGI	germany
12	Sumitomo metal industries ltd.	Japan
13	Thysen krupp stahlunion GmbH	germany
14	Tecnomatic SPA	Italy
Instrument Miniature Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	Aura Inc	India
3.	Bhel (valves division)	India
4.	Chemtrol Industries Ltd	India
5.	Chemtrols Samil(India) Pvt Ltd	India
6.	Comfit & Valves Pvt. Ltd.	India
7.	Excel Hydro-Pneumatics Pvt Ltd,	India
8.	Excelsior Engg Works	India
9.	Hyd- Air Engineering works Lonavla	India
10.	Ksb Pumps Limited (Valves Divn)	India
11	Panam Engineers	India
12	Tecnomatic (India) Pvt. Ltd.	India
13	Anderson Greenwood & Co.	U.S.A
14	BFE boneey forge valve License	Italy
15	Celleir S.A.	France
16	Crane Company International Sales	U.S.A
17	Dewrance & Co. Ltd.	U.K.
18	Euromisure Cremona	Italy
19	Hopkinsons Ltd.	U.K.
20	Kosei Sanyog Ltd.	Japan
21	Swagelok company/creximco	U.S.A
22	Sumitomo metal industries ltd.	Japan
23	Technomatic SPA	Italy
24	Velan engineering Co. Limited	U.K.

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25	Wesmec engineering pvt. Ltd	India
Purge rotameter		
1	Eureka industrial equipments Pvt. Ltd.	India
2	Instrumentation engineers pvt. Ltd.	India
3	Placka instruments & engineers pvt. ltd	India
AIR HEADER/ADPOT		
1	Wesmec engineering pvt. Ltd.	India
Condensate pot		
1	HYDROPNEUMATICS	India
2	MICRO-PRECISION PRODUCTS	India
3	TECHNOMATIC (I) P. LTD.	India
4	Wesmec engineering pvt. Ltd.	India
Valve manifolds		
1	Comfit & Valves Pvt. Ltd.	India
2	EXCEL HYDROPNEUMATICS PVT. LTD.	India
3	HYDER	India
4	INSTRUMENTATION LTD.	India
5	MICRO PRECISION	India
6	NORDIVAL (SWAGELOC)	
7	PARKER	India
8	TECHNOMATIC	India
9	Wesmec engineering pvt. Ltd.	India
Calibration equipment & services		
1	Tempsens instruments (i) pvt. Ltd.	India
2	Fluke	Singapore
3	Omega Engineering	US
Enclosures		
1	Trinity touch pvt. Ltd. (weatherproof size 80 * 80 mm)	India
Instrument contractor for inst. Construction /erection works		
1	Blue star	India
2	Bells control ltd.	India
3	Godrej & Boyce mfg. co. ltd	India
4.	ICB Contractor Pvt. Ltd.	India
5.	Jasubhai Industries	India
6.	Koso india pvt. Ltd. (kent introl control valve divn.)	India
7.	L&T (construction contracts Divn.)	India
8.	Miraj instrumentation service (upto 0.5 crores)	India
9.	Narayan engineering (< Rs. 5 lacs (small project))	India
10.	Pace process control pvt. Ltd.	India
11	Peron engg. Construction ltd.	India
12.	Protect control pvt. Ltd.	India
13	Technimont ICB ltd.	India

G.CIVIL

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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SL. NO.	ITEM	NAME
1.0	<u>FLOOR FINISHING</u>	
1.1	CEMENT TILES (FLOOR/WALL)	a) EUROCON b) ALTRA TILE PVT. LTD. c) DAZZLE
1.2	TERRAZZO TILES	A) NITCO B) HINDUSTAN TILES
1.3	CERAMIC TILES	a) SOMANY CERAMICS b) H&R JOHNSON CERAMICS c) KAJARIA CERAMICS d) ORIENT CERAMICS
1.4	HEAVY DUTY FLOOR TILES	A) BHARAT TILES B) RESTILE CERAMICS C) PELICAN CERAMIC INDUS. D) PAVIT E) SONA TILES
1.5	INDUSTRIAL FLOOR HARDENER ADMIXTURE	a) PIDILITE INDUSTRIES b) SIKA c) CICO.
1.6	PVC ROLLS	A) PREMIER VINYL B) ARMSRONG INARCO C) RMG POLYVINYL
1.7	PVC TILES	A) ARMSTRONG
1.8	PVC TILES/ROLL ANTISTATIC	A) PREMIER VINYL B) RMG POLYVINYL C) ARMSTRONG
1.9	ACID RESISTANT TILES(BATTERY ROOM)	A) H&R JOHNSON OR APVD. EQUIV.
1.10	MOSSAIC TILE	A) ITALIS B) SPECIFIC GLASS MUSSAIC INDIA LTD.
2.0	WOODWORK	
2.1	FLUSH DOOR	A) GREEN B) CENTURY DOORS C) KITPLY PRODUCTS

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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2.2	PLY WOOD/BLOCK BOARD	A) CENTURY B) KITPLY PRODUCTS C) GREEN PLY
2.3	PARTICLE BOARD (EXTRA GRADE)	A) BHUTAN BOARD B) NOVAPAN INDIA LTD.
2.4	MDF BOARD/MD PARTICLE BOARD (EXTRA GRADE)	A) NUCHEM LTD. B) MANGALAM TIMBER PRODUCTS LTD. C) WESTERN BIO SYSTEMS LTD.
2.5	DECORATIVE LAMINATES	A) CENTURY B) GREENPLY INDUS. LTD. C) MERINO D) ARCHID
2.6	MARINE PLYWOOD	A) CENTURY B) GREENPLY INDUS. LTD. C) MERINO D) ARCHID
2.7.0	DOORS & WINDOWS FITTINGS	
2.7.1	MORTICE LOCKS WITH HANDLES	A) GODREJ & BOYCE B) EVERITE AGENCIES (P) LTD. C) DOORSET
2.7.2	CYLINDRICAL PIN TUMBLER LOCK WITH KNOBS	A) GODREJ & BOYCE B) EVERITE AGENCIES (P) LTD. C) DOORSET
2.7.3	HYDRAULIC DOOR CLOSER (OVER HEAD/ FLOOR)	A) OZONE B) EVERRITE AGENCIES (P) LTD. C) HARDWYN
2.7.4	MISC. DOOR FITTINGS HINGLE, TOWER BOLTS, LATCHES, SOPPER, STAYS, ALDROPS ETC.	A) EVERITE AGENCIES (P) LTD. B) EBCO DINSUTRIES D) OZONE E) HARDWYN
2.7.5	THREE WAY BOLTING LOCKING DEVICE HANDLE	A) SRIMA SALES & SERVICES B) DHIMAN INDUSTRIES
2.7.6	PANIC BAR LATCH (FOR EMERGENCY DOOR)	A) SRIMA SALES & SERVICE
2.7.7	UPVC WINDOWS	A) FENESTA B) ENCRAFT C) WINDOW MAGIC
2.7.8	FASTENERS	A) HILTI INDIA PVT. LTD. B) FISCHER
3.0	STEEL / ALUMINIUM DOORS, WINDOWS & VENTILATOR	
3.1	PRESSED STEEL DOORS WINDOWS & SECTION DOORS WINDOWS/ROLLING SHUTTER	A) RAYMUS ENGINEERS B) DHIMAN STEEL C) RDG ENGINEERING D) SUPER STEEL WINDOW CO.

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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		E) SKS STEEL INDUS.
3.2	ALMUNIUM / DOORS/ WINDOWS SECTIONS	A) JINDAL ALUMINIUM LTD. B) HINDALCO INDUSTRIES C) INDAL
3.3	FIRE-PROOF DOORS(APPROVED)	A) NAVAIR INTERNATIONAL B) RDG ENGINEERING
3.4	PVC DOORS / WINDOWS	A) SINTEX OR APPVD EQUIV.
3.5	PVC WATER TANKS	A) SINTEX OR APPVD EQUIV.
4.0	PLASTERING	
4.1	WATERPROOFING/ COMPOUND IN CEMENT PLASTER	A) CHRYSO INDIA-SAINT GOBAIN B) PIDILITE INDUSTRIES C) SIKA D) KRISHNA CONCHEM
5.0	ROOF TREATMENT (WATER PROOFING)	
5.1	BRICK BAT COBA	A) INDIA WATER PROOFING CO. B) OVERSEAS WATERPROOFING CORPN.
5.2	ACRYLIC BASED CEMENTATIOUS PRIMER COATING FOR ROOF WATERPROOFING	A) CHRYSO INDIA-SAINT GOBAIN. B) SIKA QUALCRETE LTD. C) PIDILITE INDUSTRIES D) KRISHNA CONCHEM
5.3	APP MODIFIED POLYMERIC WASTER PROOFING MEMBRANE	A) PIDILITE INDUSTRIES LTD. B) SIKA
5.4	PU BASED WATERPROOFING	A) PIDILITE INDUSTRIES LTD. B) SIKA C) BASF D) FOSROC
6.0	PAINING WORKS	
6.1	PLASTIC EMULSION (INTERIOR/EXTERIOR)	A) ICI INDIA LTD. B) BERGER PAINTS LTD. C) ASIAN PAINTS LTD. D) SHALIMAR PAINTS E) KANSAI NEROLAC PAINTS LTD. F) M/s. Johnson & Nicholson
6.2	DRY OILBOUND DISTEMBER	A) ASIAN PAINTS LTD. B) KANSAI NEROLAC PAINTS LTD.
6.3	INDUSTRIAL / EPOXY/ ALIPHATIC ACRYLATE/ SYNTHETIC ENAMEL PAINTS	A) ICI/AKZO NOBEL INDIA B) BERGER PAINTS LTD. C) ASIAN PAINTS LTD. D) SHALIMAR PAINTS E) INTERNATIONAL MARINE COATINGS PVT. LTD. F) KANSAI NEROLAC PAINTS LTD.

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
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		G) BOMBAY PAINT H) KRISHNA CONCHEM
6.4	WATERPROOFING CEMENT PAINT	A) KILLICK NIXON LTD. B) RAJDOOT PAINTS
6.5	WOOD MELAMINE POLISH	A) ASIAN PAINTS B) SHALIMAR PAINTS C) WEMPLY PAINTS
6.6	WATERPROOFING TRANSPARENT EXTERIOR WALL COATING (OVER PAINTED SURFACE)	A) PIDILITE INDUSTRIES B) SIKA C) KRISHNA CONCHEM
6.7	FIRE PROOF COATING	A) NAVAIR INTERNATIONAL OR APPVD. EQUIV.
7.0	ROOFING SHEETS & ACCESSORIES	
7.1	ASBESTOS SHEETS	A) ETERNIT EVEREST LTD. B) CHARMINAR INDUSTRIES C) VISAKA
7.2	C.G.I. SHEETS	A) ISPAT INDUSTRIES LTD. B) STEEL AUTHORITY OF INDIA C) TATA STEEL D) JINDAL
7.3	PRECOATED G.I. PROFILE SHEETS FOR ROOFING & WALL CLADDING	A) ISPAT INDUSTRIES LTD. B) LLOYD INSULATION (I) LTD. C) STEEL AUTHORITY OF INDIA D) TATA STEEL E) JINDAL
7.4	ALUMINIUM SHEET (PLAIN/PROFILE)	A) INDIAN ALUMINIUM CO. LTD. OR APPROVED EQUIVALENT
7.5	FIBRE GLASS SHEETS & PANELS (MACHINE MOULDED)	A) SIMBA FRP (P) LTD. B) GE INDIA C) DUROPLAST
7.6	PROOFING J/L HOOKS, BOLTS & OTHER ACCESSORIES (POLYMER COATED)	A) KATALIST CONSULTANT (P) LTD. B) ADVANCED MACHINE
8.0	SANITARY PLUMBING FITTINGS & FIXTURES	
8.1	SANITARY FITTINGS (W.C. WASH BASIN, URINAL ETC.)	A) HINDUSTAN SANITARY WARE & INDUS. LTD. B) PARRYWARE SANITARY WARE C) MADHUSUDAN CERAMICS D) NYCER CERAMICS

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
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8.2	PLUMBING FITTINGS & FIXTURES	A) JAGUAR B) CERA C) HINDWARE
8.3	GLASS/MIRROR (SHEET/ FLOAT/ TOUGHENED/ LAMINATION	A) GUJARAT GUARDIAN LTD. B) SAINT GOBAIN C) ASAHI FLOAT
8.4	GI PIPES	A) JINDAL B) SURYA C) PRAKASH D) SWASTIK
9.0	FALSE CEILING, FALSE FLOORING & UNDERDECK INSULATION	
9.1	FLASE CEILING / WALL CLADDING (ALUMINIUM STRIP/ TRAY TYPE)	A) INTERARCH BUILDING PRODUCTS (P) LTD. B) HUNTER DOUGLAS C) MASCOT OVERSEAS
9.2	FALSE FLOORING	A) MULTI INTERIORS PVT. LTD. B) BESTLOCK SYSTEM & CONCEPTS C) LLOYD INDUSULATION (I) LTD. D) UNITED INSULATION E) A.R. & BROTHERS
9.3	UNDERDECK/WALL HEAT INSULATION	A) BAKELITE HYLAM LTD. B) U.P. TWIGA F.G. LTD. C) LLOYD INDULATION (I) LTD. D) SUPEREME E) PIDILITE
9.4	OVERDECK HEAT INSULATION	A) LLOYD INSULATION (I) LTD. B) BEST PLASTRONICS LTD. C) PIDILITE INDUSTRIES LTD
9.5	GYPSUM BOARD TILES (FIBRE GLASS REINFORCED)/ PRIMA BOARD ARMSTRONG FALSE CEILING	A) SAINT GOBAIN
10.0	SPECIALITY PRODUCTS (CEMENT ADDITIVES/ ADMIXTURES / CORROSION INHIBITORS / SBR LATEX & ACRYLIC POLYMERS / EPOXY LATEX POLYMERS / FOOD GRADE EPOXY SURFACE TREATMENT/ EPOXY & CEMENTITIOUS GROUT/ EPOXY BONDING AGENTS & ANCHORS / SEALING / COATING	A) PIDILITE INDUSTRIES B) SIKA C) KRISHNA CONCHEM D) FOSROC E) BASF

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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10.1	EPOXY FLOOR COATING (BATTERY ROOM)	A) SIKA B) FAIRMATE C) CIPY POLYURETHANE D) KRISHNA CONCHEM
10.2	EPOXY PHENOLIC CHEMICAL RESISTANT COATING & MORTAR(SCREED) FOR FLOOR & WALLS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) CIPY POLYURETHANE
10.3	CONCRETE REPAIR & REHABILITATION PRODUCTS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE
10.4	PREMIXED CEMENTITIOUS MORTARS & MICROCONCRETE	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE
10.5	GLASS/CARBON FIBRE WRAPPING FIBRE / LAMINATE / EPOXY	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF
10.6	CORROSION PROTECTION ANODES & CAPLETS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF
11.0	MISCELLANEOUS ITEMS	
11.1	WOOD PRESERVATIVE	A) ASCU HICKSON LTD.
11.2	WALL SURFACE TEXTURED COATING	A) JOTUN B) SPECTRUM PAINTS C) BAKELITE HYLAM D) OIKOS
11.3	EXTERNAL ACRYLIC WALL COATINGS	A) KRISHNA CONCHEM B) SIKA C) FOSROC D) BASF E) PIDILITE F) ASIAN G) BERGER
11.4	PVC PLUMBING FITTINGS	a) SUPREME b) POLYPAC c) ASTROL
11.5	REINFORCED FIBRE GLASS	A) SIKA

	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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	WATERPROOFING FELT	B) U.P. TWIGA F.G. LTD.
11.6	ANTI TERMITE TREATMENT	A) PCI OR APPRVD EQUIV.
11.7	MATERIAL TEST HOUSE	A) IIT MADRAS B) GOVT APPROVED AGENCY
12.0	CEMENT	A) ACC B) J K CEMENT C) BINANI CEMENT D) JP CEMENT E) GUJARAT AMBUJA F) ALTRA TECH CEMENT G) BIRLA CORPN. LTD. H) GRASIM I) SHREE
12.1	SULPHUR RESISTANT CEMENT	A) SAURASHTRA CEMENT LTD. B) SHREE DIGVIJAY CEMENT
13.0	RCC DESIGN MIX	AP GOVT APPROVED AGENCY
14.0	WRAPPING COATING (I/C TAPE & PRIMER) IWL OR APPROVED EQUIPMENT	A) IWL OR APPROVED EQUIVALENT
15.0	FIRE PROOFING MATERIAL	A) CAFCO B) CARBOLINE
16.0	STRUCTURAL STEEL / CS PLATE	HEAVY SECTIONS MORE THAN 150 MM A) SAIL B) TATA STEEL C) RINL D) SHYAM METALICS AND ENERGY LTD. LIGHT SECTIONS LESS THAN 150 MM E) JINDAL F) ESSAR G) ISPAT INDUSTRIES H) SHYAM METALICS AND ENERGY LTD.
16.1	MS PIPES (HAND RAIL APPLICATION)	a) SURYA b) PRAKASH c) JINDAL
17.0	TMT BAR / REBAR	A) SAIL B) TATA STEEL C) RINL D) SHYAM STEEL INDUSTRIES LIMITED E) ELECTROSTEEL STEELS LTD F) SHRI RATHI STEEL LTD. G) SRMB SRIJAN PRIVATE LIMITED H) SHYAM METALICS AND ENERGY LTD.
18.0	GRATINGS/HANDRAILS	A) INDIANA GRATINGS B) WESTCOAST ENGINEERING C) GREATWELD GRATING

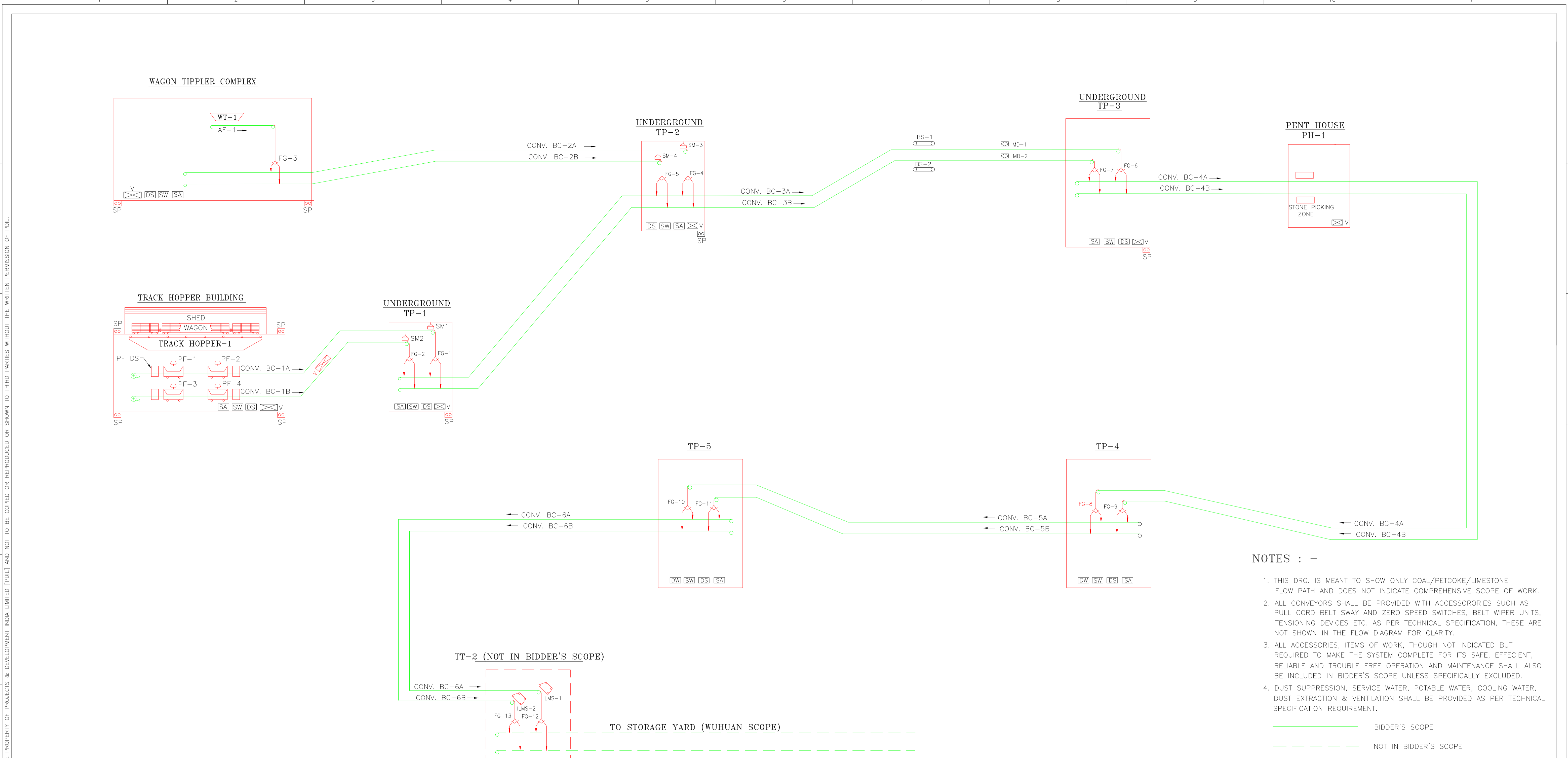
	COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD TALCHER FERTILIZERS LTD VENDOR LIST	PC0183/4018/Sec VI/10.0	0	
		DOCUMENT NO	REV	
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		D) KANADE ANAND UDYOG
19.0	WELDING ELECTRODE	A) ADOR B) ESAB C) D & H D) HANOVAR

Note: Bidder/Contractor shall evaluate and decide present financial, performance credential and Shop loading conditions of the vendors.

Any addition to vendor list shall be reviewed and approved by Owner subject to submission of back-up credentials with proven & reliable record of performance for similar or comparable plant design capacity by contractor.

In addition to Vendor mentioned, LSTK own fabrication shop is also allowable.



- NOTES : -**
- THIS DRG. IS MEANT TO SHOW ONLY COAL/PETCOKE/LIMESTONE FLOW PATH AND DOES NOT INDICATE COMPREHENSIVE SCOPE OF WORK.
 - ALL CONVEYORS SHALL BE PROVIDED WITH ACCESSORIES SUCH AS PULL CORD BELT SWAY AND ZERO SPEED SWITCHES, BELT WIPER UNITS, TENSIONING DEVICES ETC. AS PER TECHNICAL SPECIFICATION, THESE ARE NOT SHOWN IN THE FLOW DIAGRAM FOR CLARITY.
 - ALL ACCESSORIES, ITEMS OF WORK, THOUGH NOT INDICATED BUT REQUIRED TO MAKE THE SYSTEM COMPLETE FOR ITS SAFE, EFFICIENT, RELIABLE AND TROUBLE FREE OPERATION AND MAINTENANCE SHALL ALSO BE INCLUDED IN BIDDER'S SCOPE UNLESS SPECIFICALLY EXCLUDED.
 - DUST SUPPRESSION, SERVICE WATER, POTABLE WATER, COOLING WATER, DUST EXTRACTION & VENTILATION SHALL BE PROVIDED AS PER TECHNICAL SPECIFICATION REQUIREMENT.

————— BIDDER'S SCOPE
 - - - - - NOT IN BIDDER'S SCOPE

ISSUED FOR
TENDER PURPOSE ONLY

PH	PENT HOUSE	1	
DFDS	DRY FOG DUST SUPPRESSION SYSTEM	1	
AF-1	APRON FEEDER WITH DRIBBLE CONV	1	1500 TPH
SP	SUMP PUMP	6	
BC 3A/3B	CONVEYOR 1400 MM WIDE	2	1500 TPH
BC 2A/2B	CONVEYOR 1400 MM WIDE	2	1500 TPH
BC 1A/1B	CONVEYOR 1400 MM WIDE	2	1500 TPH
BC 5A/5B	CONVEYOR 1400 MM WIDE	2	1500 TPH
BC 2A/2B	CONVEYOR 1400 MM WIDE	2	1500 TPH
BC 1A/1B	CONVEYOR 1400 MM WIDE	2	1500 TPH
MD	METAL DETECTOR	2	1500 TPH
SM	SUSPENDED MAGNET	4	1500 TPH
FG	FLAP GATE	13	1500 TPH
BS	BELT WEIGH SCALE	2	1500 TPH
ILMS 1-C	IN LINE MAGNETIC SEPARATOR ALONG WITH TRAMP IRON CHUTE	2	1500 TPH
PF 1-4	PADDLE FEEDER	4	1200 TPH
EQPT. DESIGN.	EQUIPMENT	QTY.	DESIGN CAPACITY

LEGEND		LEGEND	
DS	DRY FOG DUST SUPPRESSION SYSTEM	BS	BELT SCALE
SW	SERVICE WATER SYSTEM	DS	DUST SUPPRESSION PF
DW	DRINKING WATER SYSTEM	ILMS	MAGNETIC SEPARATOR (IN LINE)
SP	SUMP & SUMP DRAINAGE PUMPS	MD	METAL DETECTOR
—	BELT CONVEYOR	PF	PADDLE FEEDER
FG	FLAP GATE	V	VENTILATION
SM	SUSPENDED MAGNET	SA	SERVICE AIR

REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
0	14.03.23	Issued for Tender Purpose	KAD	NS	AM

CLIENT : **Talcher Fertilizers M/s. TALCHER FERTILIZER LIMITED**

LOCATION : **TALCHER, ANGUL DISTRICT, ODISHA(INDIA)**

TITLE : **MATERIAL FLOW DIAGRAM**
COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD
INTEGRATED COAL BASED FERTILISER COMPLEX

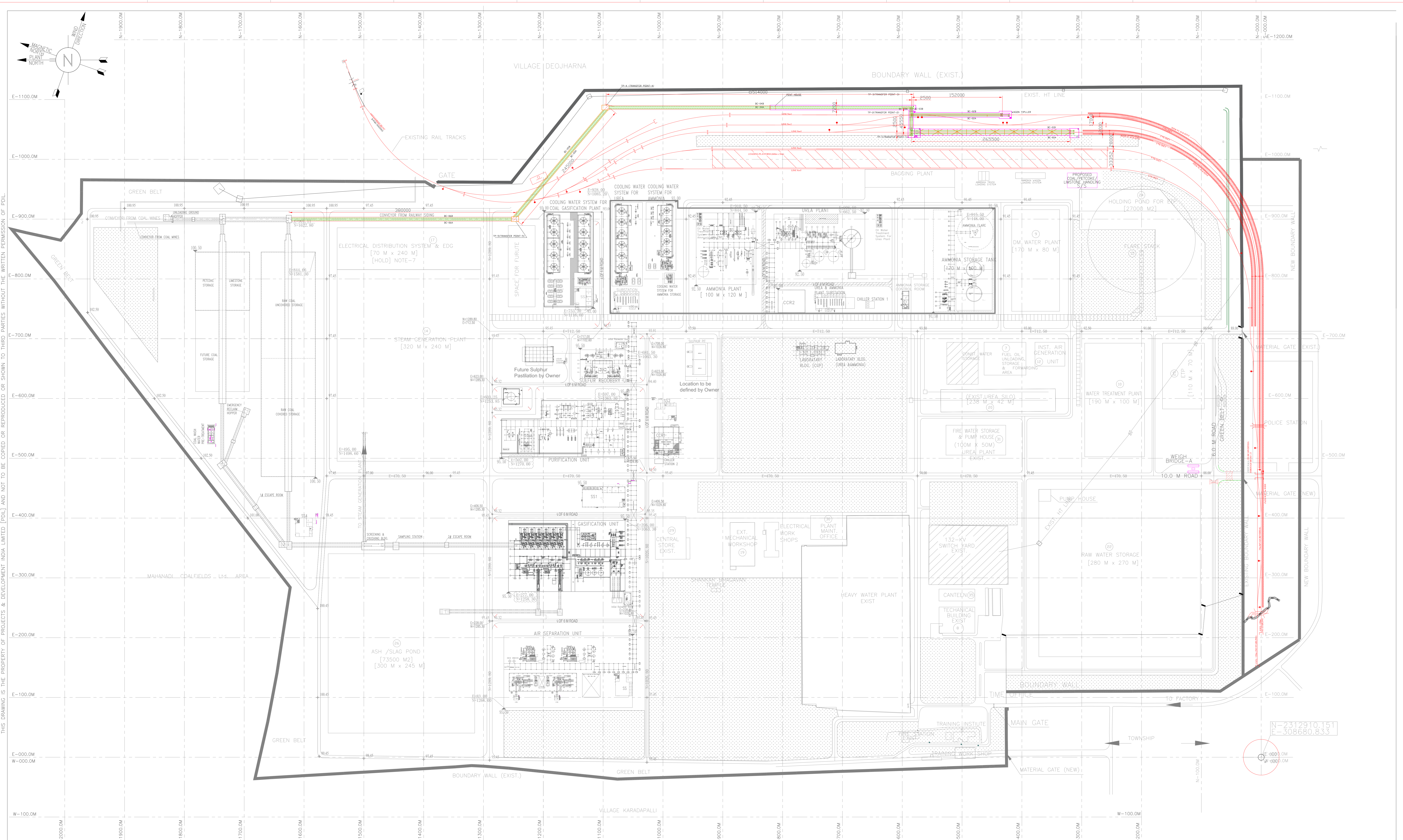
SCALE : 1 : 1

DRG. No. **PC0183-1400-0001**

FILE : **PC0183-1400-0001**
Rev.0

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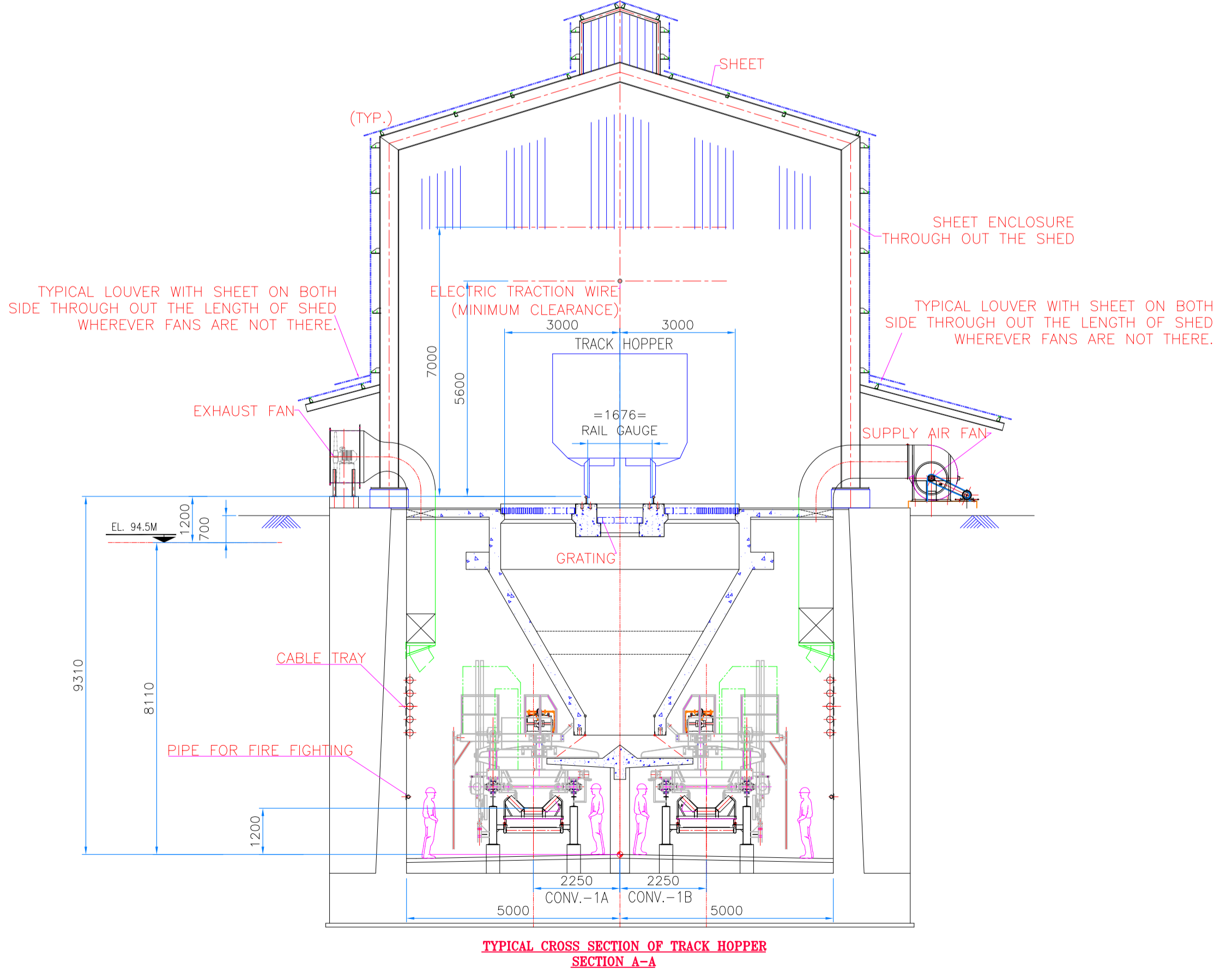
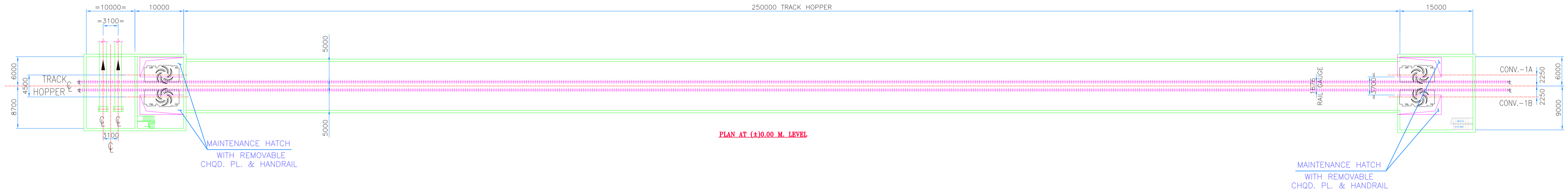
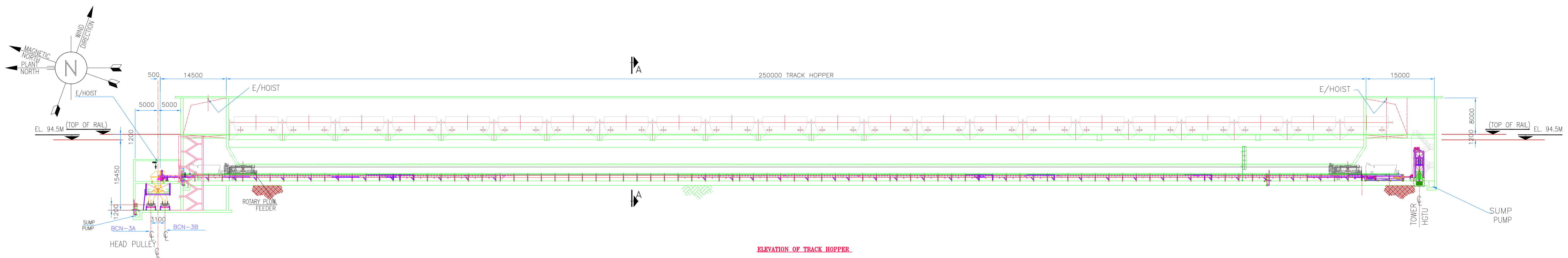
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0	14.03.23	Issued for Tender Purpose only	AS	NS	PK
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :			REV.	0	
M/s. TALCHER FERTILIZER LIMITED			SHEET 1 OF 1		
LOCATION :			SCALE :		
TALCHER, ANGUL DISTRICT, ODISHA(INDIA)			1 : 2000		
TITLE :			DRG. No.		
CONVEYOR LAYOUT			PC0183-1400-0002		
COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD			FILE :		
INTEGRATED COAL BASED FERTILISER COMPLEX			PC0183-1400-0002		
			Rev.0		

PROJECTS & DEVELOPMENT INDIA LTD.
 NOIDA

NOTE-
 1. ALL DIMENSIONS AND COORDINATES ARE IN METERS.
 2. THE INDICATED DESIGN GROUND LEVEL IS PRELIMINARY, MIGHT BE UPDATED LATER.

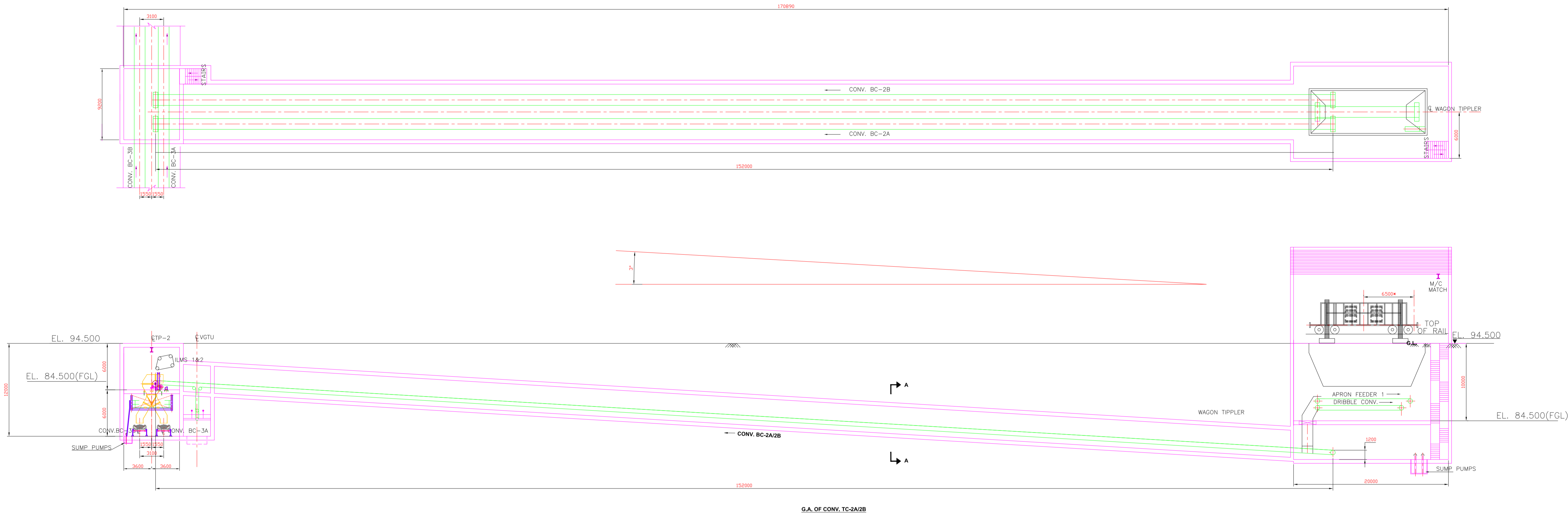
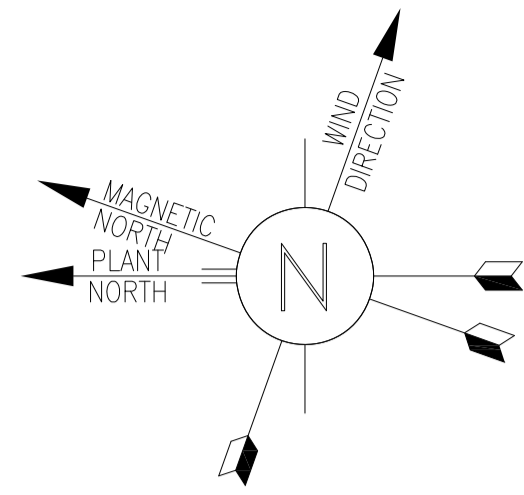
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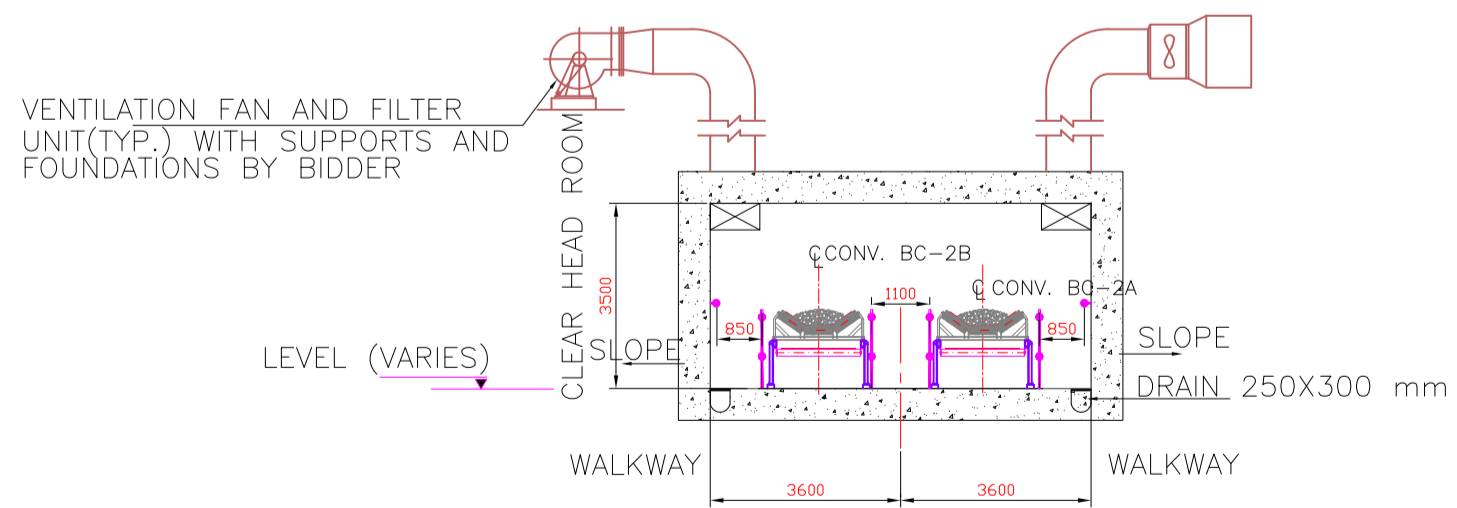
- NOTES:**
- 1) ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS UNLESS OTHERWISE SPECIFIED.
 - 2) REQUIRED FLOORS/HANDLING ARRANGEMENT AND ALL OTHER REQUIRED ACCESSORIES ARE IN BIDDER'S SCOPE. THESE ARE NOT SHOWN FOR CLARITY.
 - 3) FOR GENERAL NOTES REFER DRG. NO PC0183-1411-0007
 - 4) THIS DRG. SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRGS.
 - 5) THE DIMENSIONS OF TRACK HOPPER I.E. INVERT FLOOR LEVEL, WIDTH & LENGTH ARE THE MINIMUM REQUIREMENTS FOR THE BIDDERS. THE BIDDERS SHALL TAKE CARE OF THESE REQUIREMENT WHILE FINALIZING EQUIPMENT & LAYOUT.
 - 6) HANDRAILS SHALL BE PROVIDED ON EITHER SIDE OF EACH WALKWAY.
 - 7) ALL FOUNDATIONS AND STRUCTURES FOR VENTILATION FANS, MONORAIL PROJECTIONS ARE IN BIDDER'S SCOPE ALL VENTILATION FANS FOUNDATION SHALL HAVE PAYING ALL AROUND.
 - 8) VENTILATION DUCTS AND DS/SW WATER PIPING, FIRE FIGHTING PIPING SUPPORTING STRUCTURES, INSERTS/ANCHOR BOLTS IN BIDDER'S SCOPE.
 - 9) COMPLETE DUST SUPPRESSION(S) SYSTEM FOR THE TRACK HOPPER IS IN BIDDER'S SCOPE AND NOT SHOWN FOR CLARITY.
 - 10) WALKWAY SHOWN IN THE TRACK HOPPER AND TACK HOPPER TUNNEL SHALL BE WITHOUT ANY INFRINGEMENT WHATSOEVER.
 - 11) FORCED VENTILATION SYSTEM USING SUPPLY & EXHAUST AIR FANS SHALL BE PROVIDED FOR TRACK HOPPER & TUNNEL.
 - 12) ALL MONORAILS SHALL BE PROJECTED OUT OF THE BUILDING BY 3M FROM THE EDGE THE CLADDING /WALL.
 - 13) NO COLUMNS SHALL BE PROVIDED INSIDE MACHINERY HATCHES.
 - 14) DIMENSIONS WITH "*" MARK, TO BE CONFIRMED BY THE BIDDER.
 - 15) HANDLING ARRANGEMENT FOR TAIL PULLEYS OF CONVEYOR, SUMP PUMPS AND TAKEUP FOR CONVEYOR IN TRACK HOPPER NOT SHOWN, ARE IN THE SCOPE OF BIDDER.
 - 16) EQUIPMENT HANDLING AREA IN THE MAINTENANCE WELLS SHALL BE PROVIDED WITH REMOVABLE GRATINGS.
 - 17) HOIST MAINTENANCE PLATFORMS TO BE PROVIDED AT ALL LOCATIONS.
 - 18) INSERT PLATE FOR FIXING CABLE SPOOLS (ON BOTH SIDES) AND PIPE SLEEVES FOR INCOMING CABLES FOR PADDLE FEEDER (MIN 250NB) ALONG WITH CABLE TRAYS OF MIN. 300mm HEIGHT FOR THE LENGTH OF THE TRAVEL ARE TO BE PROVIDED.

0	14.03.23	Issued for Tender Purpose only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :		M/s. TALCHER FERTILIZER LIMITED	REV.	0	
LOCATION :		TALCHER, ANGUL DISTRICT, ODISHA(INDIA)	SHEET	1	OF 1
TITLE :		GA OF TRACK HOPPER AND BELT CONVEYER BC-01A & BC-01B COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD INTEGRATED COAL BASED FERTILISER COMPLEX	DRG. No.	PC0183-1411-0001	
			FILE :	PC0183-1411-0001	Rev.0
PROJECTS & DEVELOPMENT INDIA LTD. NOIDA					

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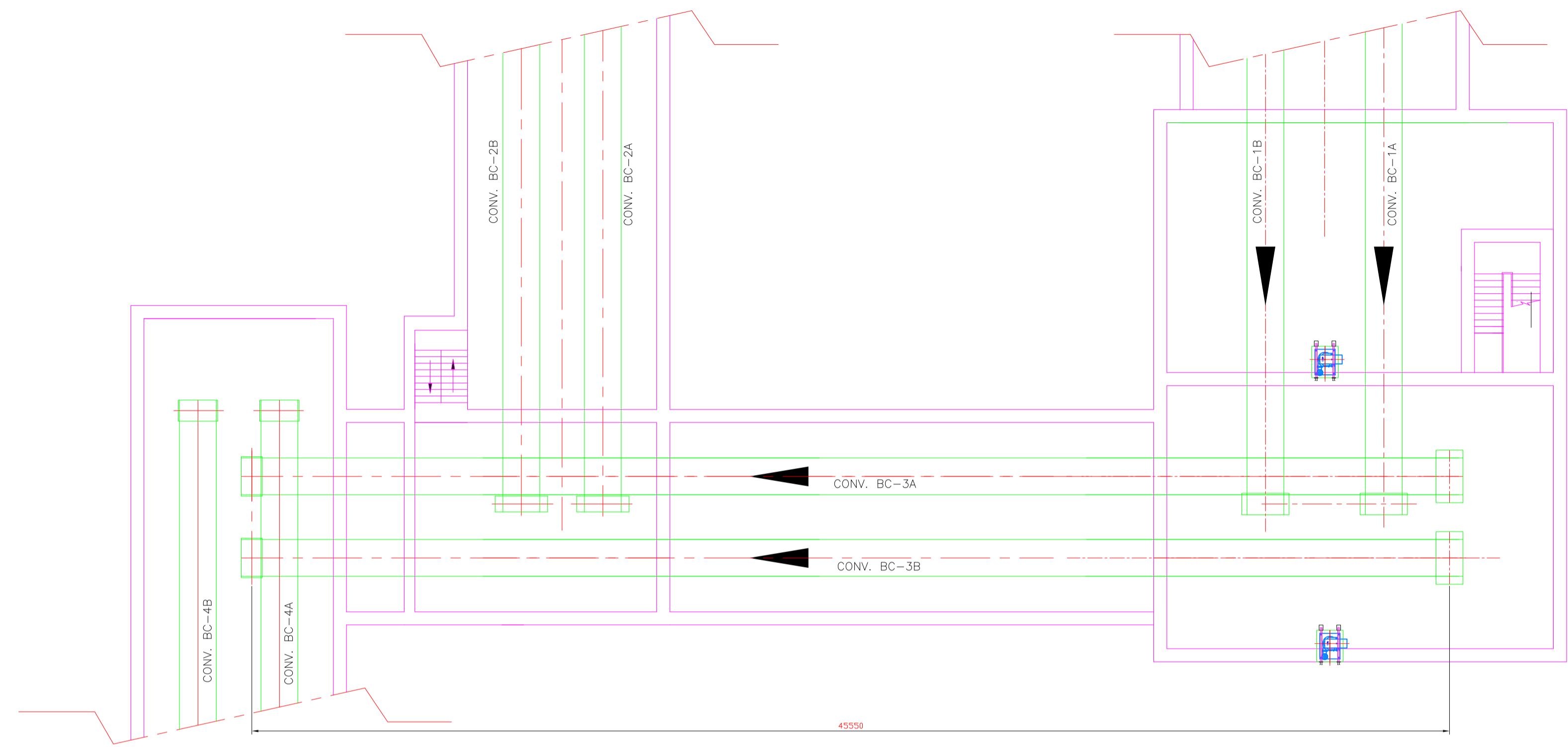
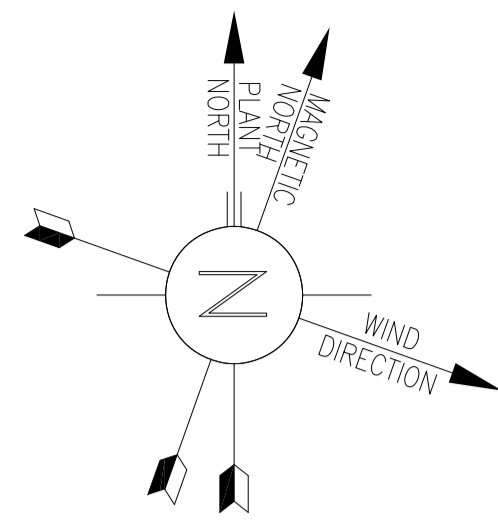
G.A. OF CONV. TC-2A/2B



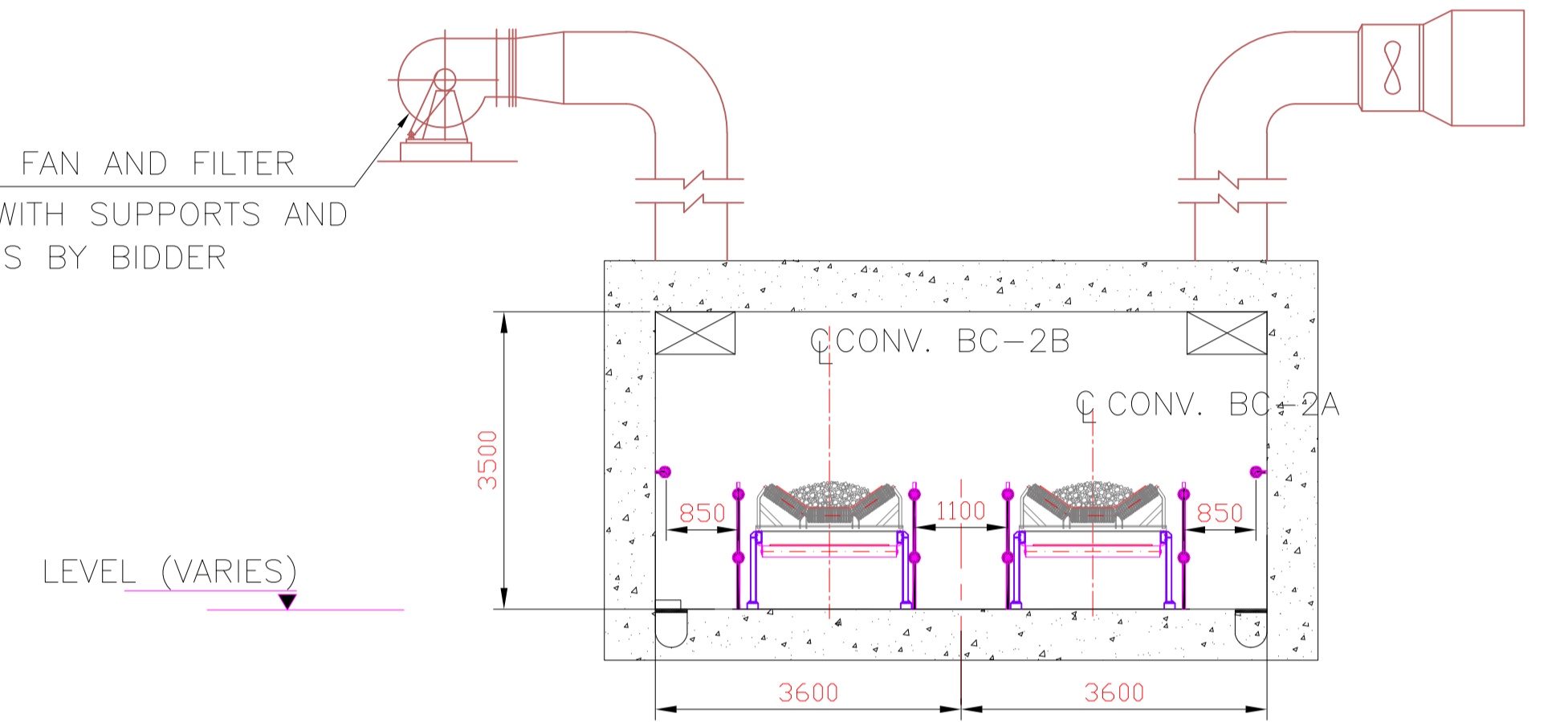
SECTION A-A

- NOTES:
- 1) ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS UNLESS OTHERWISE SPECIFIED.
 - 2) REQUIRED FLOORS/HANDLING ARRANGEMENT AND ALL OTHER REQUIRED ACCESSORIES ARE IN BIDDERS SCOPE. THESE ARE NOT SHOWN FOR CLARITY.
 - 3) FOR GENERAL NOTES REFER DRG. NO PC0183-1411-0007
 - 4) THIS DRG. SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRGS.
 - 5) THE DIMENSIONS OF TRACK HOPPER i.e. INVERT FLOOR LEVEL, WIDTH & LENGTH ARE THE MINIMUM REQUIREMENTS FOR THE BIDDERS. THE BIDDERS SHALL TAKE CARE OF THESE REQUIREMENT WHILE FINALIZING EQUIPMENT & LAYOUT.
 - 6) HANDRAILS SHALL BE PROVIDED ON EITHER SIDE OF EACH WALKWAY.
 - 7) ALL FOUNDATIONS AND STRUCTURES FOR VENTILATION FANS, MONORAIL PROJECTIONS ARE IN BIDDER'S SCOPE ALL VENTILATION FANS FOUNDATION SHALL HAVE PAYING ALL AROUND.
 - 8) VENTILATION DUCTS AND DS/SW WATER PIPING, FIRE FIGHTING PIPING SUPPORTING STRUCTURES, INSERTS/ANCHOR BOLTS IN BIDDER'S SCOPE.
 - 9) COMPLETE DUST SUPPRESSION(DS) SYSTEM FOR THE TRACK HOPPER IS IN BIDDER'S SCOPE AND NOT SHOWN FOR CLARITY.
 - 10) WALKWAY SHOWN IN THE TRACK HOPPER AND TACK HOPPER TUNNEL SHALL BE WITHOUT ANY INFRINGEMENT WHATSOEVER.
 - 11) FORCED VENTILATION SYSTEM USING SUPPLY & EXHAUST AIR FANS SHALL BE PROVIDED FOR TRACK HOPPER & TUNNEL.
 - 12) ALL MONORAILS SHALL BE PROJECTED OUT OF THE BUILDING BY 3M FROM THE EDGE THE CLADDING /WALL.
 - 13) NO COLUMNS SHALL BE PROVIDED INSIDE MACHINERY HATCHES.
 - 14) DIMENSIONS WITH "*" MARK, TO BE CONFIRMED BY THE BIDDER.
 - 15) HANDLING ARRANGEMENT FOR TAIL PULLEYS OF CONVEYOR, SUMP PUMPS AND TAKEUP FOR CONVEYOR IN TRACK HOPPER NOT SHOWN, ARE IN THE SCOPE OF BIDDER.
 - 16) EQUIPMENT HANDLING AREA IN THE MAINTENANCE WELLS SHALL BE PROVIDED WITH REMOVABLE GRATINGS.
 - 17) HOIST MAINTENANCE PLATFORMS TO BE PROVIDED AT ALL LOCATIONS.
 - 18) INSERT PLATE FOR FIXING CABLE SPOOLS (ON BOTH SIDES) AND PIPE SLEEVES FOR INCOMING CABLES FOR PADDLE FEEDER (MIN 250NB) ALONG WITH CABLE TRAYS OF MIN. 300mm HEIGHT FOR THE LENGTH OF THE TRAVEL ARE TO BE PROVIDED.

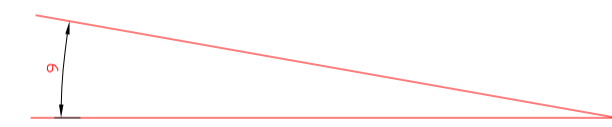
0	14.03.23	Issued for Tender Purpose only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :			REV.	0	
M/s. TALCHER FERTILIZER LIMITED			SHEET 1 OF 1		
LOCATION :			SCALE : 1 : 200		
TALCHER, ANGUL DISTRICT, ODISHA(INDIA)			DRG. No.		
TITLE :			PC0183-1411-0002		
GA OF WAGON TIPPLER AND BELT CONVEYER BC-02A & BC-02B			FILE :		
COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD			PC0183-1411-0002		
INTEGRATED COAL BASED FERTILISER COMPLEX			Rev.0		



VENTILATION FAN AND FILTER UNIT(TYP.) WITH SUPPORTS AND FOUNDATIONS BY BIDDER

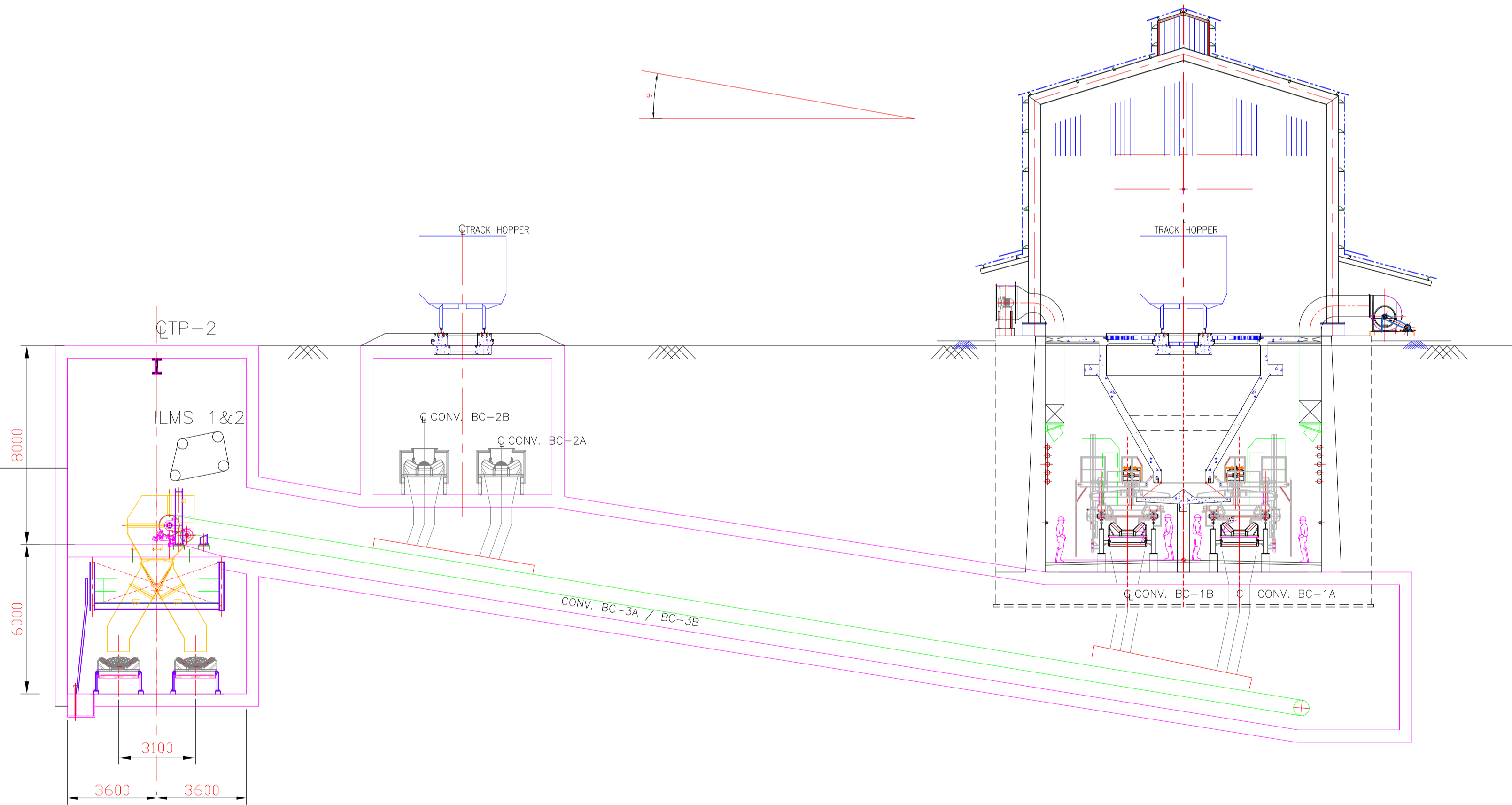


TYPICAL CROSS SECTION



EL. 94.500

EL. 84.500(FGL)

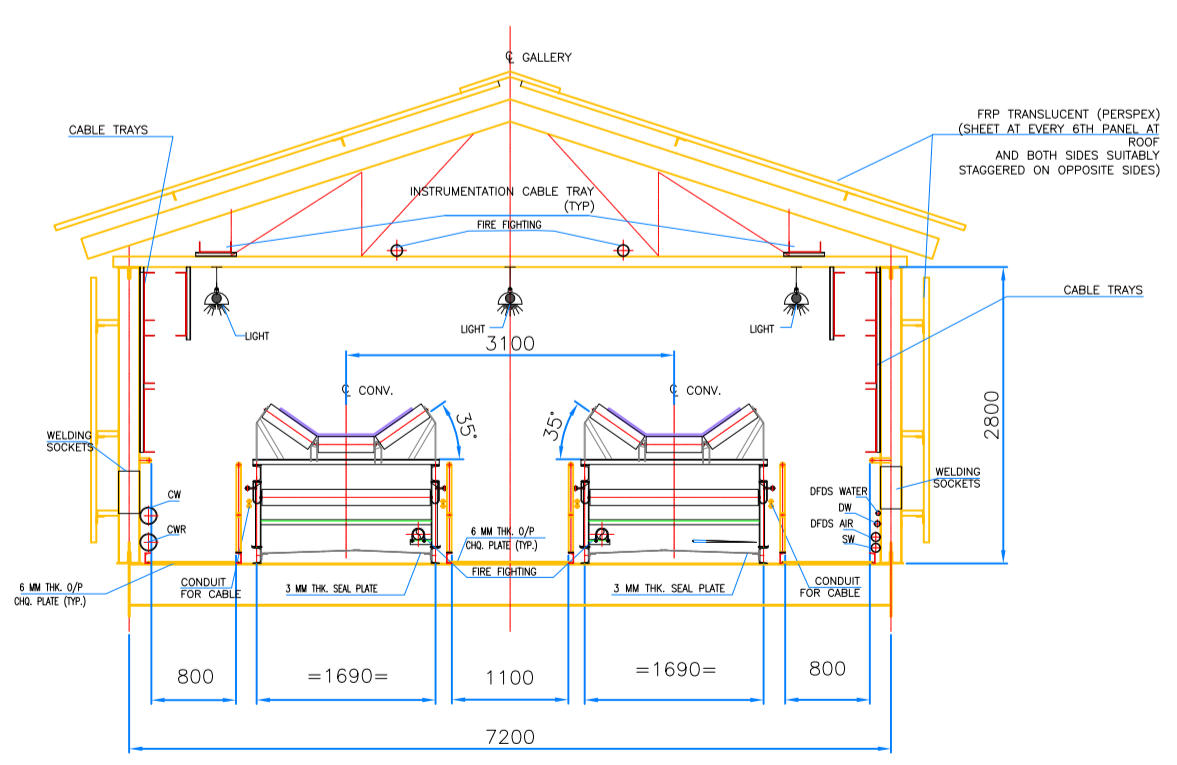
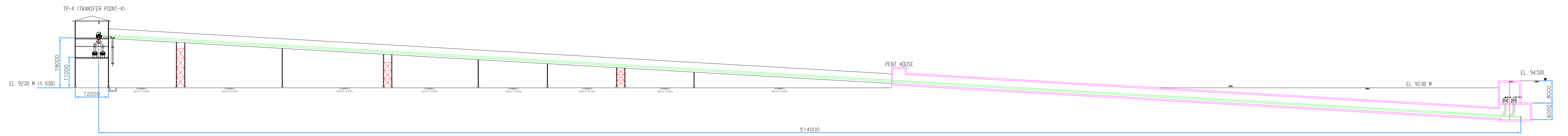
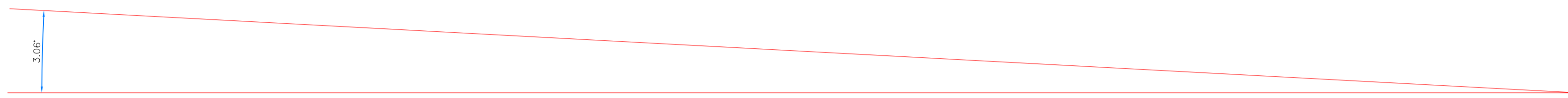
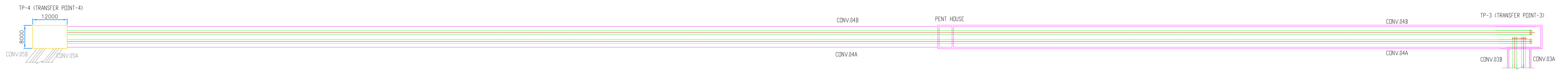
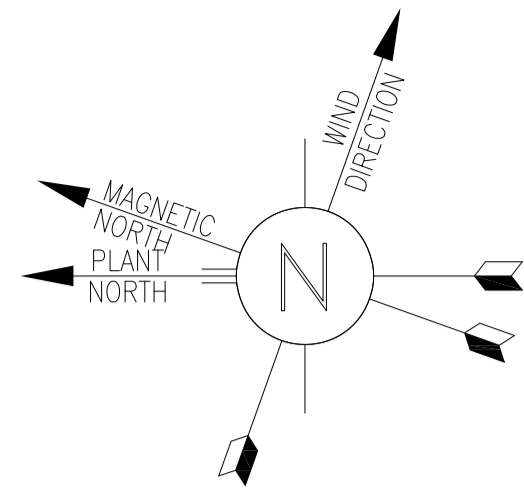


NOTES:

- 1) ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS UNLESS OTHERWISE SPECIFIED.
- 2) REQUIRED FLOORS/HANDLING ARRANGEMENT AND ALL OTHER REQUIRED ACCESSORIES ARE IN BIDDER'S SCOPE. THESE ARE NOT SHOWN FOR CLARITY.
- 3) FOR GENERAL NOTES REFER DRG. NO PC0183-1411-0007
- 4) THIS DRG. SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRGS.
- 5) THE DIMENSIONS OF TRACK HOPPER i.e. INVERT FLOOR LEVEL, WIDTH & LENGTH ARE THE MINIMUM REQUIREMENTS FOR THE BIDDERS. THE BIDDERS SHALL TAKE CARE OF THESE REQUIREMENT WHILE FINALIZING EQUIPMENT & LAYOUT.
- 6) HANDRAILS SHALL BE PROVIDED ON EITHER SIDE OF EACH WALKWAY.
- 7) ALL FOUNDATIONS AND STRUCTURES FOR VENTILATION FANS, MONORAIL PROJECTIONS ARE IN BIDDER'S SCOPE ALL VENTILATION FANS FOUNDATION SHALL HAVE PAVING ALL AROUND.
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- 9) COMPLETE DUST SUPPRESSION(DS) SYSTEM FOR THE TRACK HOPPER IS IN BIDDER'S SCOPE AND NOT SHOWN FOR CLARITY.
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- 18) INSERT PLATE FOR FIXING CABLE SPOOLS (ON BOTH SIDES) AND PIPE SLEEVES FOR INCOMING CABLES FOR PADDLE FEEDER (MIN 250NB) ALONG WITH CABLE TRAYS OF MIN. 300mm HEIGHT FOR THE LENGTH OF THE TRAVEL ARE TO BE PROVIDED.

0	14.03.23	Issued for Tender Purpose only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :		M/s. TALCHER FERTILIZER LIMITED	REV.	0	
LOCATION :		TALCHER, ANGUL DISTRICT, ODISHA(INDIA)	SHEET 1 OF 1		
TITLE :		GA OF BELT CONVEYER BC-03A & BC-03B COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD INTEGRATED COAL BASED FERTILISER COMPLEX	DRG. No.	PC0183-1411-0003	FILE :
					PC0183-1411-0003 Rev.0
PROJECTS & DEVELOPMENT INDIA LTD. NOIDA					



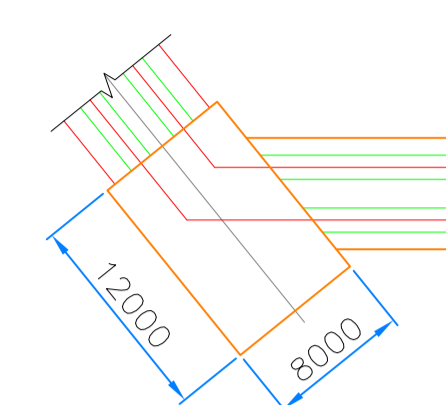
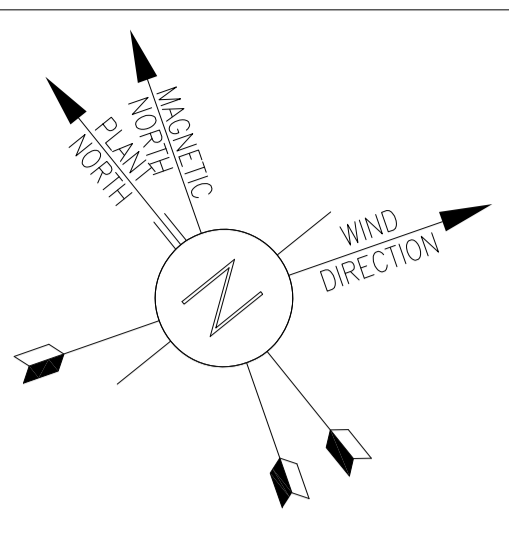


TYPICAL GALLERY CROSS SECTION FOR DOUBLE CONVEYOR (1400 BELT WIDTH)

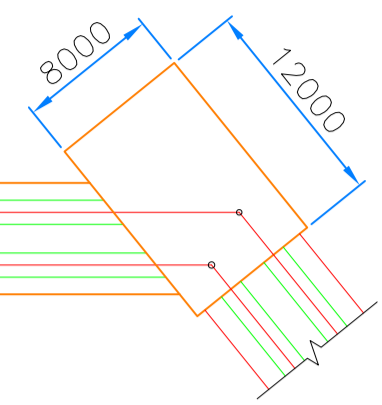
- NOTES:
- 1) ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS UNLESS OTHERWISE SPECIFIED.
 - 2) REQUIRED FLOORS/HANDLING ARRANGEMENT AND ALL OTHER REQUIRED ACCESSORIES ARE IN BIDDER'S SCOPE. THESE ARE NOT SHOWN FOR CLARITY.
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 - 4) THIS DRG. SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRGS.
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 - 18) INSERT PLATE FOR FIXING CABLE SPOOLS (ON BOTH SIDES) AND PIPE SLEEVES FOR INCOMING CABLES FOR PADDLE FEEDER (MIN 250NB) ALONG WITH CABLE TRAYS OF MIN. 300mm HEIGHT FOR THE LENGTH OF THE TRAVEL ARE TO BE PROVIDED.

0	14.03.23	Issued for Tender Purpose Only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :			REV.	0	
M/s. TALCHER FERTILIZER LIMITED			SHEET 1 OF 1		
LOCATION :			SCALE : 1 : 500		
TALCHER, ANGUL DISTRICT, ODISHA(INDIA)			DRG. No.		
TITLE :			PC0183-1411-0004		
GA OF BELT CONVEYER BC-04A & BC-04B			FILE :		
COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD			PC0183-1411-0004		
INTEGRATED COAL BASED FERTILISER COMPLEX			Rev.0		

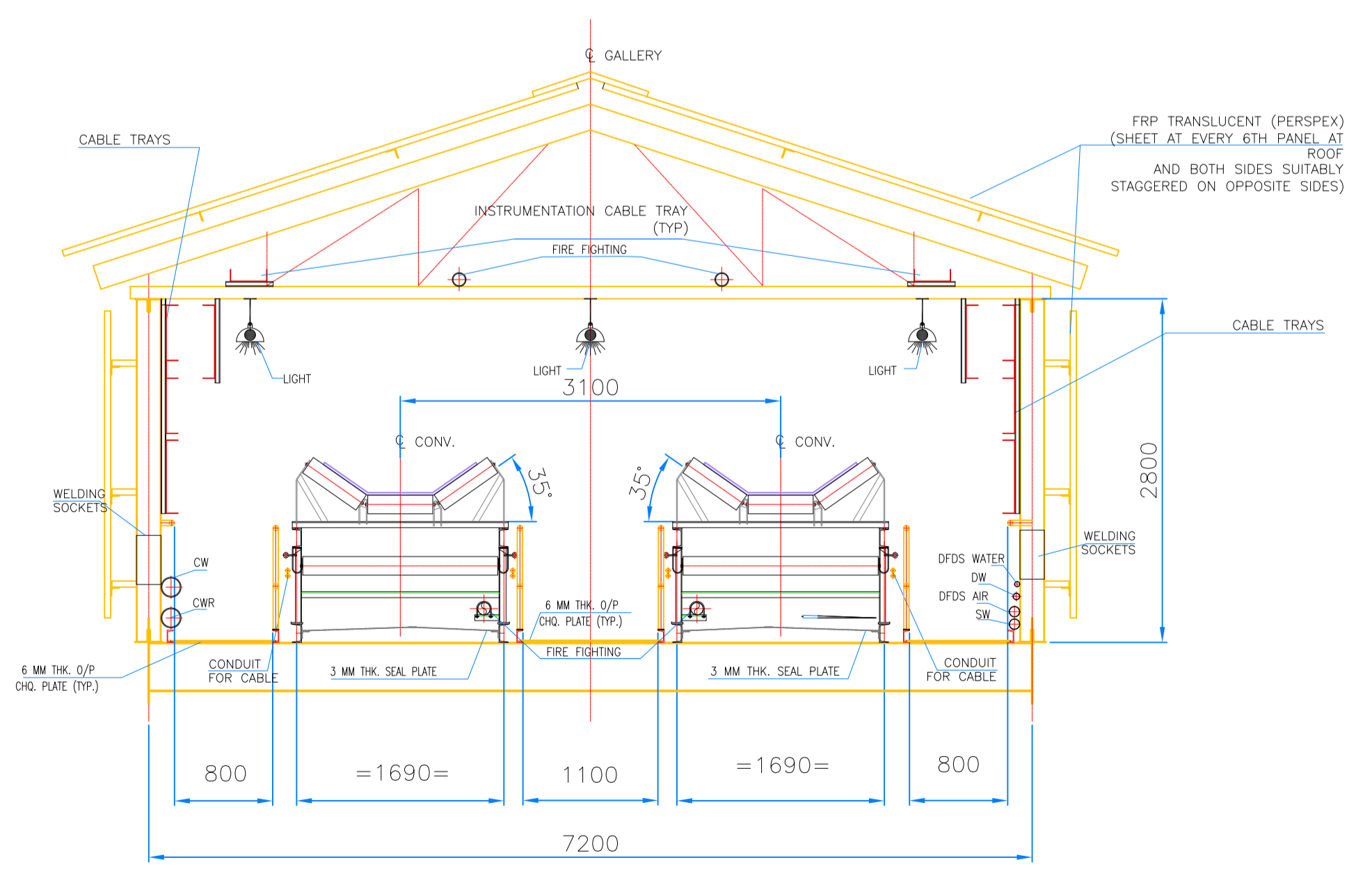
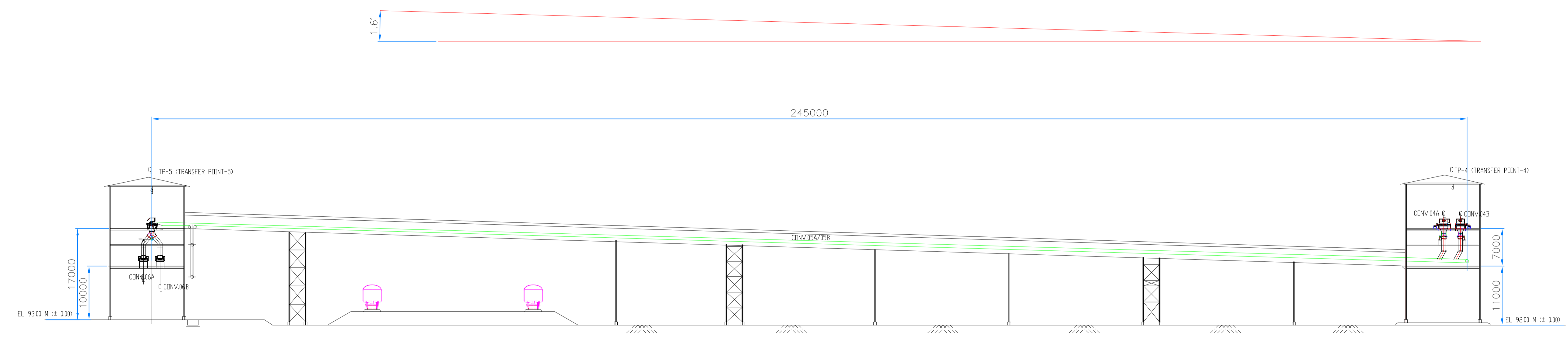
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TP-4 (TRANSFER POINT-5)



TP-4 (TRANSFER POINT-4)

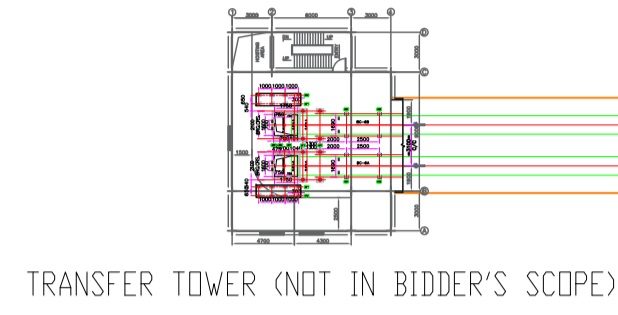
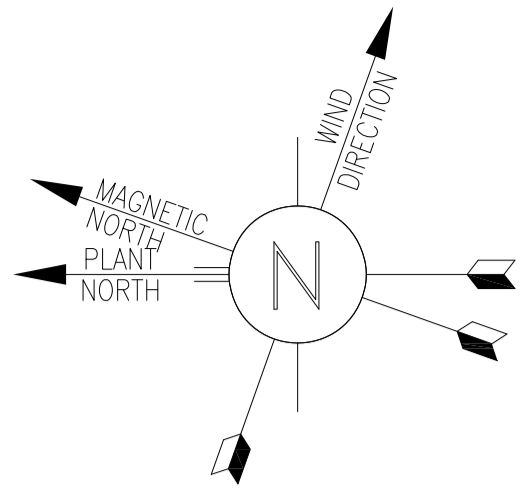


TYPICAL GALLERY CROSS SECTION
FOR DOUBLE CONVEYOR
(1400 BELT WIDTH)

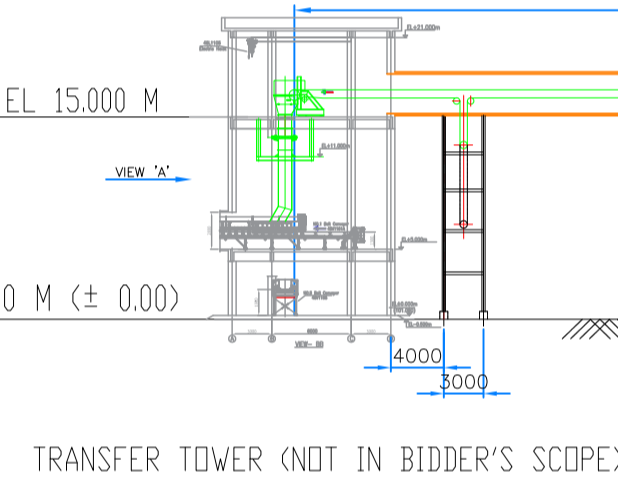
NOTES:

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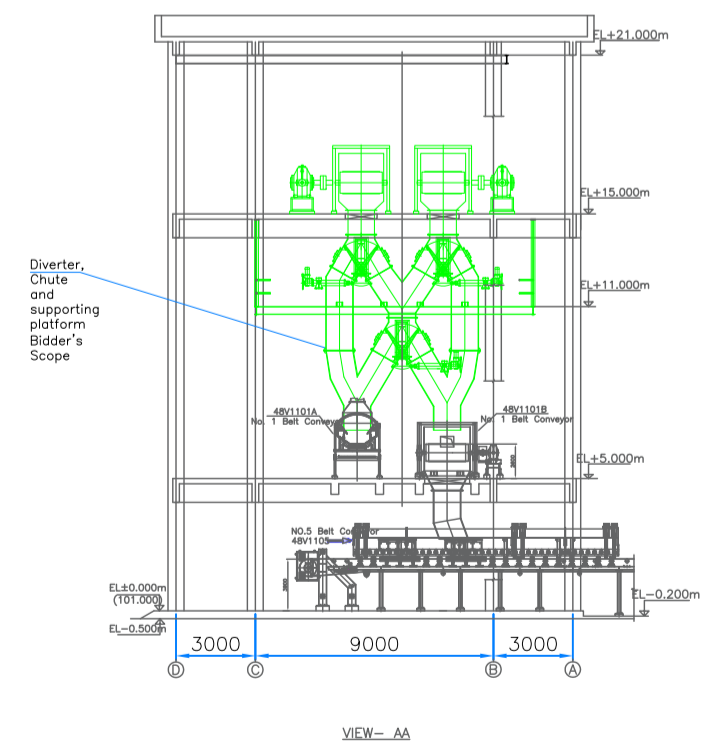
0	14.03.23	Issued for Tender Purpose Only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :		M/s. TALCHER FERTILIZER LIMITED	REV.	0	1
LOCATION :		TALCHER, ANGUL DISTRICT, ODISHA(INDIA)	SHEET 1 OF 1		
TITLE :		GA OF BELT CONVEYER BC-05A & BC-05B COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD INTEGRATED COAL BASED FERTILISER COMPLEX	SCALE : 1 : 300		
			DRG. No. PC0183-1411-0005 FILE : PC0183-1411-0005 Rev.0		
PROJECTS & DEVELOPMENT INDIA LTD. NOIDA					



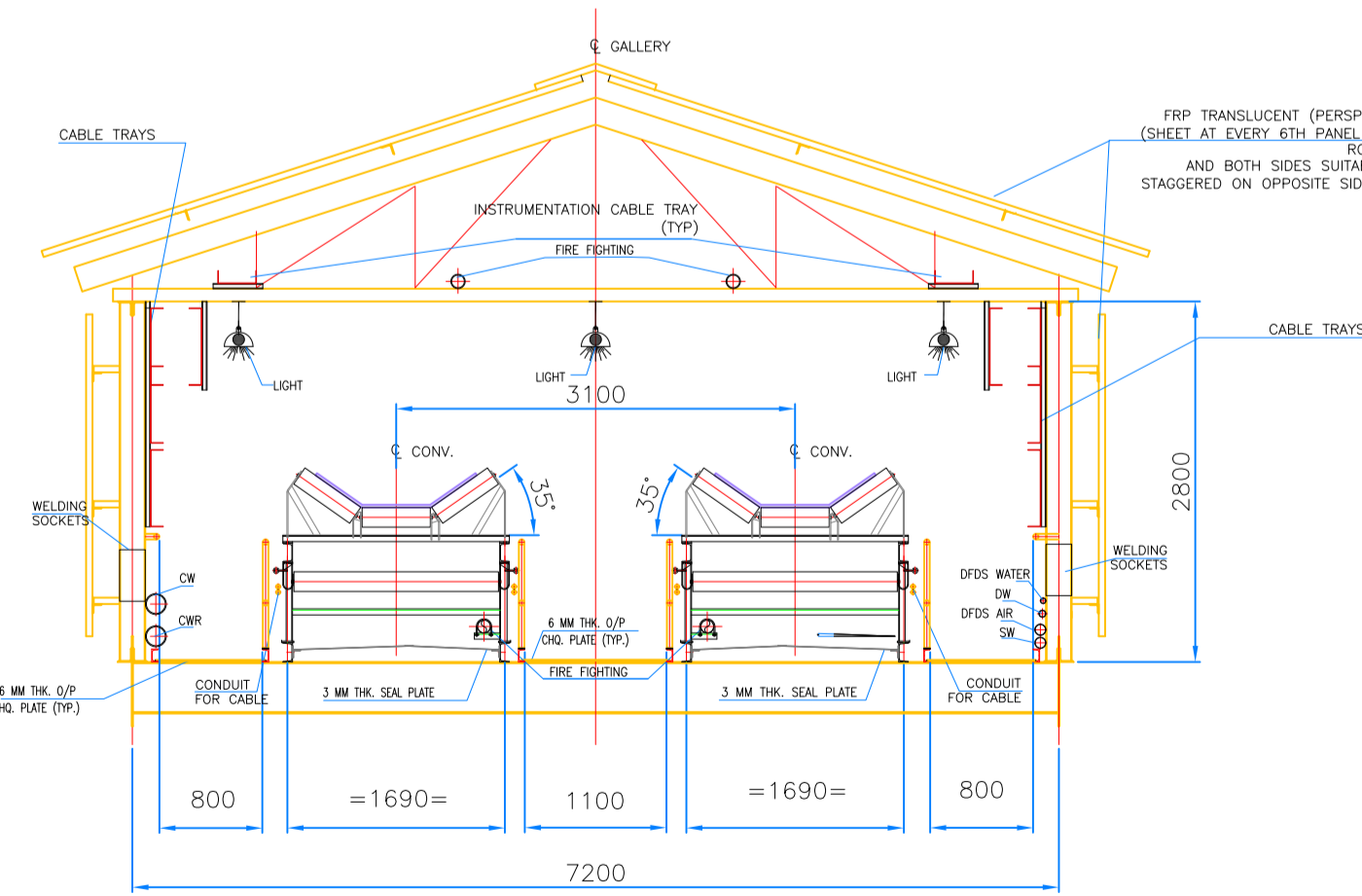
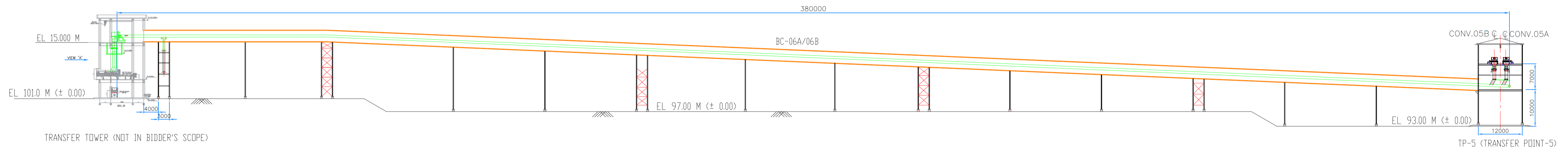
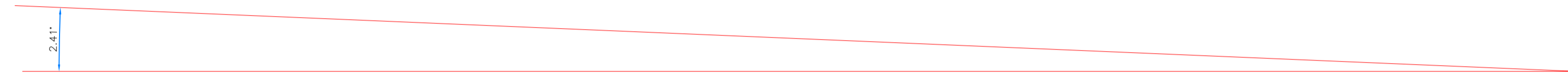
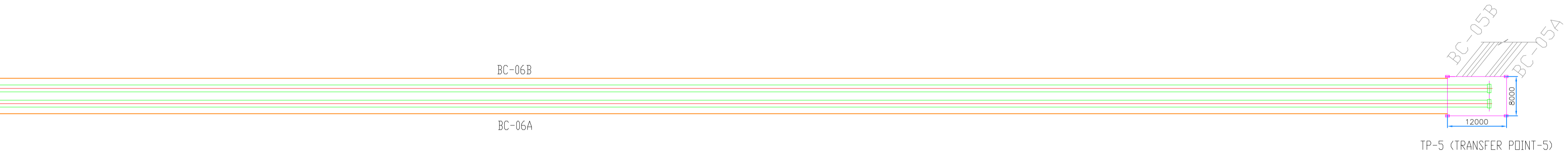
TRANSFER TOWER (NOT IN BIDDER'S SCOPE)



TRANSFER TOWER (NOT IN BIDDER'S SCOPE)



VIEW-AA



TYPICAL GALLERY CROSS SECTION FOR DOUBLE CONVEYOR (1400 BELT WIDTH)

- NOTES:
- 1) ALL DIMENSIONS ARE IN MM AND LEVELS IN METERS UNLESS OTHERWISE SPECIFIED.
 - 2) REQUIRED FLOORS/HANDLING ARRANGEMENT AND ALL OTHER REQUIRED ACCESSORIES ARE IN BIDDERS SCOPE. THESE ARE NOT SHOWN FOR CLARITY.
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 - 13) NO COLUMNS SHALL BE PROVIDED INSIDE MACHINERY HATCHES.
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 - 17) HOIST MAINTENANCE PLATFORMS TO BE PROVIDED AT ALL LOCATIONS.
 - 18) INSERT PLATE FOR FIXING CABLE SPOOLS (ON BOTH SIDES) AND PIPE SLEEVES FOR INCOMING CABLES FOR PADDLE FEEDER (MIN 250NB) ALONG WITH CABLE TRAYS OF MIN. 300mm HEIGHT FOR THE LENGTH OF THE TRAVEL ARE TO BE PROVIDED.

0	14.03.23	Issued for Tender Purpose Only	SAH	NS	AMAR
REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
CLIENT :			REV.	0	
M/s. TALCHER FERTILIZER LIMITED			SHEET 1 OF 1		
LOCATION :			SCALE : 1 : 400		
TALCHER, ANGUL DISTRICT, ODISHA(INDIA)			DRG. No.		
TITLE :			PC0183-1411-0006		
GA OF BELT CONVEYER BC-06A & BC-06B			FILE :		
COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD			PC0183-1411-0006		
INTEGRATED COAL BASED FERTILISER COMPLEX			Rev.0		
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NOTES:-

1. ALL DIMENSIONS ARE IN mm AND LEVELS ARE IN MITERS UNLESS NOTED OTHERWISE.
2. THE SCOPE OF WORK COVERED THIS CONTRACT INCLUDES EXCAVATION & FILLING/BACK FILLING WITH EITHER EXCAVATED MATERIALS OR SPECIALLY SELECTED MATERIALS AS DIRECTED BY THE EMPLOYER. THE EXCAVATED MATERIAL SHALL BE NEATLY STACKED AT PLACE DIRECTED BY THE EMPLOYER. SOME OF THESE EXCAVATED MATERIALS MAY BE REQUIRED TO BROUGHT BACK FOR BACKFILLING/FILLING PURPOSE AS DIRECTED BY THE EMPLOYER. THE SCOPE OF THIS CONTRACT ALSO INCLUDES THE FINAL DISPOSAL OF REMAINING EXCAVATED AND STACKED MATERIALS AT A DISTANCE UPTO 5 KMS BEYOND PLANT BOUNDARY AS DIRECTED BY THE ENGINEER.
3. WELDED WIRE FABRIC OF MINIMUM 1.6MM THICK WIRE (CONFORMING TO IS-4948) & HAVING 12mm X 30 mm MESH SIZE SHALL BE FIXED TO FRAMES FOR WINDOWS TO BE PROVIDE IN BOTH SIDES OF CONVEYOR GALLERY AS SPECIFIED.
4. WHEREVER COLOR WASHING OVER PLASTERED SURFACE IS SPECIFIED. THE NUMBER OF COATS TO BE APPLIED SHALL BE MINIMUM THREE OF MORE.
5. MINIMUM 20MM DIAMETER M.S. RUNGS SHALL BE PROVIDED IN LADDERS. FOR HEIGHT OF 10M & ABOVE, CAGE LADDERS SHALL BE PROVIDED LADDERS SHALL BE MINIMUM 250MM WIDE.
6. ALL DIMENSIONS & RELATIVE ELEVATIONS OF VARIOUS TRANSFER POINTS, STRUCTURES AND OTHER BUILDINGS AS SHOWN IN VARIOUS TENDER DRGS. ARE MINIMUM ACCEPTABLE TO THE EMPLOYER, CONTRACTOR SHALL SELECT SIZE OF VARIOUS TRANSFER POINTS, STRUCTURES AND OTHER BUILDING TO SUIT EQUIPMENT SELECTED/HANDLING REQUIREMENT BY HIM AND THE SAME IN ANY CASE SHALL NOT BE LESS THAN SIZES INDICATED IN VARIOUS TENDER DRGS. NO COMMERCIAL IMPLICATIONS SHALL BE ENTERTAINED FOR INCREASE IN BUILDING SIZES DURING DETAILED ENGG. ON ACCOUNT OF EQUIPMENT SELECTED BY CONTRACTOR.
7. PLINTH LEVEL OF ALL BUILDINGS & STRUCTURES SHALL BE 500mm ABOVE THE ADJACENT GROUND LEVEL ALL FLOOR LEVEL, ROOF LEVELS ETC., PROPOSED IN THE TENDER DRAWING ARE WITH RESPECT TO THIS PLINTH LEVEL.
8. ADEQUATE NO. OF MOND RAILS SHALL BE PROVIDED WITH HOISTS TO FACILITATE MAINTENANCE OF ALL COAL HANDLING EQUIPMENTS INCLUSIVE OF GTU/TAIL PULLEYS, FG ETC. THE LOCATION AND NO. OF MOND RAILS & HOISTS ARE NOT SHOWN IN DRGS. FOR CLARITY, HOWEVER, THESE SHALL BE FINALIZED DURING DETAILED ENGG. AND THE SAME IS SUBJECT TO EMPLOYER'S APPROVAL SIZES OF MONORAILS AND CAPACITY OF HOIST SHALL BE FINALIZED DURING DETAILED ENGG. TAKING CARE OF SPECIFICATION REQUIREMENT AND THE SAME IS SUBJECT TO EMPLOYERS APPROVAL.
9. THE WIDTH OF GALLERIES & TUNNELS INDICATED IN THE DRGS. IS MINIMUM REQUIRED. BIDDER MAY INCREASE THE WIDTH BASED ON HIS EQPT. SIZE KEEPING CLEAR WALKWAY DIMENSIONS AS SPECIFIED WITHOUT ANY COST IMPLICATION TO OWNER.
10. TECHNICAL SPECIFICATION REQUIREMENTS SHOWN IN TENDER DRGS. ARE NOT EXHAUSTIVE.
11. ALL CONVEYORS SHALL BE PROVIDED WITH ALL ACCESSORIES SUCH AS PULL CHORDS, BELT SWAY & ZERO SPEED SWITCHES, BELT SCRAPER UNITS ETC. AS PER TECH SPECS. THESE ARE NOT SHOWN IN TENDER DRAWINGS FOR CLARITY.
12. FOR CLARITY VARIOUS DETAILS SHOWN IN ONE VIEW HAVE NOT BEEN DUPLICATED IN ALL THE VIEWS.
13. FENCING WITH CAGES SHALL BE PROVIDED AROUND ALL VGTU TOWERS AT GROUND LEVEL. FURTHER SAND BED OF 600 mm DEPTH SHALL BE PROVIDED AT GROUND LEVEL TO TAKE THE IMPACT OF FALLING TAKE UP WEIGHT IN CASE OF BELT SNAPPING. NECESSARY ARRESTORS SHALL BE PROVIDED ON THE TAKEUP GUIDE POST AT DIFFERENT LOCATIONS TO ARREST FALL OF TAKEUP PULLEY & COUNTER WEIGHT DIRECTLY ON FLOOR OR GROUND IN CASE OF BELT SNAPPING.
14. ALL SEWER LINES COMING OUT FROM RESPECTIVE BUILDING SHALL BE CONNECTED TO THE EMPLOYER'S SEWER LINE. IN CASE THE EMPLOYER'S SEWER LINE IS MORE THAN 25M AWAY FROM THE OUTER EDGE OF THE BUILDING. THE SAME SHALL BE TERMINATED THERE WITH INSPECTION CHAMBER OF SUFFICIENT SIZE AT THE TERMINATION POINT.
15. TRAMP IRON CHUTE OF MIN. 1MX1M SIZE, 6mm THICK MS OR AS SPECIFIED IN THE TECH. SPECIFICATIONS, SHALL BE PROVIDED TO RECEIVE TRAMP METAL FROM ILMS AND DROP IT UPTO GROUND LEVEL. ONE NO. TROLLEY OF ADEQUATE CAPACITY SHALL BE PROVIDE IN THAT BUILDING. THE TRAMP IRON CHUTE ANGLE SHALL BE 50' MIN. FROM HORIZONTAL AND SHALL BE ROUTED INSIDE BUILDING UPTO GROUND. SUITABLE POKE DOORS SHALL BE PROVIDED IN THE TRAMP CHUTE AT EACH FLOOR FOR ATTENDING TO ENTRAPPED TRAMP WIRES, PIECE ETC.
16. FOR MONORAIL PROJECTING OUT OF BUILDING STEEL FRAME DOORS, PREFERABLY SLIDING TYPE OR OTHERWISE ENABLE TYPE SHALL BE PROVIDED. OPENABLE DOORS SHALL PREFERABLY BE COMPARTMENTALIZED. MONORAIL COMING OUT OF BUILDING SHALL BE PROJECTED BY CLEAR MIN. 3.0M OUTSIDE THE SHEETING.
17. DUST & DEBRIS DISPOSAL CHUTE OF 1MX1M SIZE 6MM THK. MILD STEEL PLATE SHALL BE PROVIDED FROM DRIVE FLOORS OF CONVEYORS UPTO GROUND FLOOR OF CRUSHER HOUSE AND ALL TRANSFER POINTS. ALL INTERMEDIATE FLOORS TO BE SUITABLY CONNECTED. FOR MAIN PLANT TP_s, DEBRIS CHUTE'S SHALL BE TERMINATED AT LAST OPERATING FLOOR, REFER TECH. SPECIFICATION.
18. TYPICAL DETAILS FOR GTU TOWER AS SHOWN IN TENDER DRAWING IS APPLICABLE FOR ALL CONVEYORS. INTERMEDIATE ACCESS PLATFORMS AT SUITABLE INTERVAL SHALL BE PROVIDED FOR GTU PULLEY ACCESS. SUITABLE ACCESS LADDERS SHALL BE PROVIDED FROM GROUND TO ALL PLATFORMS. SIMILAR DETAIL SHALL ALSO BE APPLICABLE FOR SINGLE CONVEYORS.
19. ACCESS PLATFORMS AND LADDER/STAIRS (NOT SHOWN IN TENDER DRG.) AS REQUIRED FOR ACCESS/SERVICING CHUTES, EQUIPMENT ETC. SHALL BE PROVIDED BY THE BIDDER.
20. ALL CHUTES SHALL BE PROVIDED WITH ADEQUATE DUST PROOF HINGED INSPECTION DOORS AT ALL FLOORS OF BUILDINGS FOR ROUTINE INSPECTION. INSPECTION DOORS SHALL ALSO BE PROVIDED AT SKIRT BOARD ALSO.
21. TRESTLE LOCATION AND TYPE SHALL BE AS PER TECH. SPECIFICATION.
22. SEPARATE PERSONNEL ENTRY AND EQUIPMENT HANDLING ACCESS POINTS SHALL BE PROVIDED ON GROUND FLOOR OF ALL TP_s.
23. THIS DRG. IS TO BE READ IN CONJUNCTION WITH OTHER TENDER DRGS.
24. ACCESS PLATFORMS WITH LADDERS ABOVE RCC FLOOR SHALL BE PROVIDED WHEREVER BOTTOM OF EQUIPMENT/PULLEY/DRIVE ETC. EXCEEDS 1.2M. CARE SHALL BE TAKEN TO PROVIDE PROPER ACCESS TO ALL CHUTES. HOISTS (AT PARKING PLACE). CONVEYOR DRIVES, PULLEYS ETC.
25. IN ADDITION TO CLEARANCE SHOWN IN INDIVIDUAL DRG. TRESTLES SHALL HAVE TO CLEAR ALL FACILITIES SHOWN IN GENERAL LAYOUT.
26. THE NO. & MONORAIL HOISTING SYSTEMS SHALL ALSO BE DECIDED CONSIDERING THE MOVEMENT OF THE EQUIPMENT BEING LIFTED OVER/BOTH SIDES OF OTHER EQUIPMENTS WITHOUT REMOVING THE LATTER. THE NECESSARY LEVELS OF FLOOR IN VARIOUS BUILDINGS SHALL BE DECIDED CONSIDERING THE ABOVE REQUIREMENT.
27. EXTERNAL FIRE STAIRCASE ALONG WITH INTERNAL STAIRCASE (WHEREVER APPLICABLE) SHALL BE PROVIDED FOR MCC/CONTROL ROOMS & CRUSHER HOUSE.
28. ALL TRANSFER HOUSES SHALL BE PROVIDED WITH EXTERNAL STAIRCASES. PROPER ROOF HOOD TO BE PROVIDED FOR PROTECTION FROM SUN/RAIN. FOR UNDER GROUND TRANSFER HOUSES AND UNDERGROUND PORTION OF TRANSFER HOUSES ONE NUMBER INTERNAL STAIRCASE TO BE PROVIDED.
29. ALL BEND PULLEYS, TAIL PULLEYS, FIXED TRIPPER PULLEYS ETC. SHALL BE PROVIDED WITH SUITABLE PROTECTION GUARD.
30. MINIMUM 100MM HIGH CURB SHALL BE PROVIDED AROUND ALL FLOOR OPENING IN EVERY CHP BUILDING.

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REV.	DATE	DESCRIPTION	PPD.	CKD.	APPD.
		CLIENT : Talcher Fertilizers M/s. TALCHER FERTILIZER LIMITED	REV. 0		
		LOCATION : TALCHER, ANGUL DISTRICT, ODISHA(INDIA)	SHEET 1 OF 1		
		TITLE : GENERAL NOTES COAL/PETCOKE/LIMESTONE HANDLING FROM RAILWAY SIDING TO STORAGE YARD INTEGRATED COAL BASED FERTILISER COMPLEX	SCALE : ~ NTS	DRG. No. : ~ PC0183-1411-0007	FILE : ~ PC0183-1411-0007 Rev.0
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