3 X 800 MW NLC TALABIRA TPP

TECHNICAL SPECIFICATION
FOR
INDUCED DRAFT COOLING TOWER

BOOK 1 OF 2

(MECHANICAL, ELECTRICAL AND C&I SPECIFICATION)

SPECIFICATION No. **PE-TS-511-165-W001**
REV NO. 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

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PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

NLC India Ltd. (NLCIL) formerly Neyveli Lignite Corporation Limited is a 'Navratna', Government of India Enterprise engaged in mining of lignite and generation of power through lignite based thermal power plants. NLCIL was established by Government of India in 1956, following the discovery of lignite deposits in Neyveli, Tamil Nadu. NLCIL currently operates four open cast lignite mines in Neyveli (Tamil Nadu) and Barsingsar (Rajasthan) of total capacity of 30.6 Million Tonnes per Annum (MTPA). The company operates five pithead thermal power stations at the above locations with a total installed capacity of 3640 MW. NLCIL, through its subsidiary NTPL, has also recently commissioned a 1000 MW coal based power plant at Tuticorin (Tamil Nadu), 1001.56 MW solar plants and 51 MW wind power plant at Kazhuneerkulam (Tamil Nadu), thus bringing the total installed capacity of the company to 5581.56 MW**.**

In addition, another 3X660 MW coal based thermal power project at Ghatampur, U.P. in joint venture with U.P. is under execution

NLCIL have now taken up implementation of Coal based pit head type NLC Talabira Thermal Power Project, consisting of three (3) supercritical units of 800 MW capacity each, near Kumbhari & Tareikela villages in Jharsuguda District, Odisha. Development Consultants Private Limited (DCPL) has been appointed as the Consultant for the project.

2.00.00 LOCATION

The plant and township of the project proposed to be located near Kumbhari and Tareikela villages on south west of Brijraj Nagar town on Sambalpur Rourkela highway in Jharsuguda district and ash disposal area is located near Thelkolai village in Sambalpur district. The main plant area is defined by the following coordinates:

Description	Latitude	Longitude
North Extreme	21° 46’ 56.11’’ N	83° 59’ 30.59’’ E
East Extreme	21° 46’ 52.95’’ N	84° 00’ 20.72’’ E
South Extreme	21° 45’ 16.80’’ N	83° 59’ 9.36’’ E
West Extreme	21° 46’ 34.18’’ N	83° 58’ 50.54’’ E

3.00.00 ACCESS

The project site is approachable from Sambalpur – Jharsuguda highway after crossing Bedhan River via state PWD road. Two separate 4 lane roads from Sambalpur – Jharsuguda highway have been envisaged for main approach to the project site. The nearest airports are at Bhubaneswar at a distance of 350 km and Raipur airport is at a distance of approx. 290 km. Nearest railway station at Jharsuguda on Howrah- Nagpur main (trunk) section is at a distance of 11 kms.

4.00.00 WATER

The consumptive water is proposed to be drawn from the location downstream of Hirakud reservoir (under separate package upto the terminal point at plant boundary) and shall be pumped to the in-plant raw water reservoir.

Total consumptive water requirement for the Project (3x800 MW units) is estimated as 7200 cu-m/hr. with ETP recovery and COC 5.

The chemical analysis of raw water to be used in the Plant is attached in Section-XV of this Volume II-A**.**

5.00.00 FUEL

The primary fuel for this plant is Coal.

Coal requirement of the project shall be met from Talabira -II & III captive mines of NLC India Limited located nearby. Coal requirement is estimated to be 11.37 MTPA considering a GCV of 3700 Kcal/kg, and PLF of 85%. The coal shall be transported from the linked mines through Belt Conveyor system from coal stock at mine end up to transfer point and thereafter by Pipe conveyor for crossing Bedhan River up to crusher house located in plant area..

The characteristics of Coal to be used in the Plant are attached in Section-XV of this Volume II-A.

LDO/HSD shall be used as start-up fuel and flame stabilizing fuel.

Fuel oil (LDO/HSD) will be transported by road tankers from the nearest oil depot.

The properties of Fuel oil (LDO/HSD) to be used in the Plant are attached in Section-XV of this Volume II-A.

6.00.00 POWER EVACUATION

The power generated from the project will be evacuated through adequate no.of 765 kV& 400kV Transmission Lines Two (2) nos. of (765/√3) / (400/√3) / 33 kV Interconnecting Transformer shall be provided between 765kV& 400kV GIS. Unit start-up power requirement shall be met by back charging 765 kV GIS and 400 kV GIS through ICTs. Unit start-up power requirement will be drawn from 400 kV bus through 400/11.5/11.5 kV Station Transformer

7.00.00 IMPLEMENTATION SCHEDULE

The Project is planned to be executed through single EPC Contract. The scheduled key milestones of the Project (late finish), counted from the date of issue of NTP to the EPC Contractor for single EPC Package are as follows

a) Completion of Trial operation of Unit no. I : 52th Month from NTP

b) Completion of Trial operation of Unit no. II : 58th Month from NTP

c) Completion of Trial operation of Unit no. III : 64th Month from NTP

8.00.00 METEOROLOGICAL DATA

The meteorological station nearest from the site is Jharsuguda. Salient meteorological data of site is given below:

a)	Mean Ambient temperature	:	33.1 ºC maximum 20.7 ºC minimum 27.5 ºC average
b)	Extreme Ambient temperature	:	48.0 ºC maximum 6.0 ºC minimum
c)	Mean wet bulb temp	:	26.3 ºC
d)	Mean relative humidity	:	
	(I) At 8.30 hrs.		66%
	(ii) At 17.30 hrs.		50%
e)	Annual Rainfall	:	1445 mm
f)	Wind load	:	Wind Load in accordance with IS-875, for a basic wind speed of 44 m/s, up to a height of 10 meters above mean ground level.
g)	Seismic Zone	:	Zone III as per IS:1893 latest edition.
h)	Altitude	:	203 M above MSL

SCOPE

BROAD SCOPE OF THIS PACKAGE COVERS THE FOLLOWING:

SL.NO	PARAMETERS	REQUIREMENT
1	Supply Including Design, Engineering, Manufacturing and assembly of	
a)	Design & Engineering	YES
b)	Main Supply	YES
c)	Commissioning Spares	YES
2	Painting (including site painting)	YES
3	Inspection & Testing	YES
4	Transportation, delivery, unloading / handling at site and storage at Site	YES
5	Civil & structural works (including piling if any)	YES
6	Erection & Commissioning	YES
7	Supervision of Erection & Commissioning	NO
8	Mandatory Spares	YES
9	O & M Service & O&M Spares	NO
10	Performance Gaurantee	YES

DETAILED SCOPE

Each Cooling Tower shall be complete with following:	
The scope of supply, services & civil works for cooling tower, complete with hot water distribution system, cold water basin and outlet channels, sludge pit, staircase from ground level to deck and all other equipment and accessories as mentioned herein after is in Bidder's scope. It is not the intent to list all details herein.	
1	Complete packing / fill material and drift eliminators for all cooling towers.
2	Complete Hot water Distribution System consisting of:-
2.1	CW pipes to carry hot water from BHEL's terminal point to cooling tower including its supporting arrangement.
2.2	Manually operated butterfly valve at inlet to each cell of cooling towers.
2.3	Hot water distribution systems along with water spray nozzles for each cooling tower.
3	Design and fabrication of anchors, hangers and supports wherever required.
4	Drain sump and sludge disposal system for cooling towers, including sludge sump, associated pipe work, sludge pumps 02 nos. of 150 cum/hr capacity for each sludge sump, valves, accessories and piping up to BHEL's terminal point. Suitable portable type tripod arrangement for handling of sump pumps to be considered in bidder's scope.
5	Inlet air louvers (as applicable) for each cooling tower.
6	Complete air moving equipment consisting of fans, reduction gear unit, transmission equipment, lubricating system and electrical motors with rain hood arrangement etc.
7	Screens and Stop log gates along with guides embedded in concrete shall be provided at the outlet of cold water basin
8	Mechanical and electrical equipment Handling system and maintenance facilities for drive system gear reducers, fans, motor, stop logs (at the Cold Water Channel) for each cooling tower.
9	Cross over facility, as required, over hot water pipes as per layout requirement.
10	Provision of six numbers of Isolation (Gate valve) Valves (in the stub connections) for each unit at the locations (in purchaser's scope of CW Piping) where flow measurement is to be carried out by means of pitot tubes.
11	All steel / cast iron inserts, plates, bolts, nuts, sleeves etc. to be grouted in concrete work and used to hold/ support the equipment/ system being supplied and erected under this specifications.
12	Counter flanges, bolts, nuts & gaskets for all piping connections in the scope of bidders and also at terminal points.
13	Any additional system/ equipment required to make the system complete.
14	The performance test of one of the Cooling Tower shall be carried out by the Successful Contractor through CTI approved/listed testing agency in presence of Owner. The testing agency proposed by the Successful Contractor shall be subject to Owner approval. The tower to be tested through CTI testing agency shall be decided / chosen by Owner. For the balance cooling tower the performance test shall be conducted by the Successful Contractor for demonstration purpose only.
15	The following are also included in bidder's scope:

15.1	One set of special tools & tackles required for maintenance of equipment & accessories in the cooling towers.
15.2	Various drawings, datasheets, calculation, test reports/ certificates, operation & maintenance manuals including “As built drawings” etc. as specified & as necessary.
15.3	Supply of first fill of lubricants for all equipment under this package including second fill/ replenishment as necessary after commissioning & handing over of the plant.
15.4	Supply of commissioning spares on as required basis.
16	**Exclusions from bidder’s scope:**
16.1	DCS Panels for Complete Cooling Tower. However, LCP for Sludge pumps and any other equipment’s (as required) shall remain in bidder’s scope
16.2	Vibration Monitoring system along with its cabling is in BHEL scope (bidder to provide the vibration pad and key notch for mounting of BHEL supplied VMS sensors / probes in their scope). However, all other accessories like cable trays are in bidders scope as per scope demarcation mentioned in Electrical Scope Split..
16.3	Cooling Tower MCCs and MCC Building shall be provided by BHEL near each IDCT
17	**Equipment & Services to be provided by Purchaser:**
17.1	Supply and erection of incoming hot water piping up to bidder’s terminal point
17.2	Chlorine di-oxide dosing to control biological/ algae is envisaged in purchaser’s scope.
17.3	Supply & erection of sludge discharge piping beyond the bidder’s terminal point.
17.4	Cold-water outlet channel for cooling tower beyond the bidder’s terminal point.
17.5	For Electrical, C&I and Civil works refer respective sub-sections.
17.6	Cement and Reinforcement steel (Refer Terms and conditions for free issue items being given along with NIT)
18	**Terminal Points:**
18.1	Hot water header: 10M away from edge of CT Basin wall and at elevation as mentioned in the Technical Data Part- A.
18.2	Cold Water Outlet: 10M from edge of the CT basin wall and at elevation as mentioned in the Technical Data Part- A.
18.3	Power Cables, Control cables and Screened control Cables: As per Electrical scope split.
18.5	Cable Trench/cable Tray: As per Electrical scope split.

	GENERAL TECHNICAL REQUIREMENT
1	The equipment shall comply with all applicable safety codes and statutory regulations of India where the equipment is to be installed.
2	The Design, Manufacture, Inspections/ Tests and Performance of Cooling Tower complete with all accessories, shall generally conform to the latest editions of the applicable standards.
3	Latest codes and standards shall be applicable as on date of bid submission
4	In the event of any contradictions between the requirements of two clauses of this specification, documents or requirements of different codes and standards specified, stringent requirement as interpreted by BHEL / Owner shall apply.
5	Bidder to note that drawing/ document submissions shall be through web based Document Management System. Bidder would be provided access to the DMS along with adequate training for drg/doc submissions. Bidder to ensure proper net connectivity at their end.
6	The first submission/ revised submissions of drawings/ documents by vendor shall be complete in all respects . Incomplete drawings submitted shall be treated as non- submission with delays attributable to vendor’s account. For any clarification/ discussion required to complete the drawings, the bidder shall depute his personal at BHEL / Customer’s place as per the requirement for across the table submissions / discussions/ finalizations of drawings.
7	Drawing / documents to be submitted by bidder shall be as per "Documentation Requirement" given in this specification.
8	The scope of supply/ works including civil works between terminal points includes all works which are stated or unstated or required as per system as part of complete turnkey package. Only the items specifically mentioned in the exclusion list of works are not in bidder's scope.
9	Scope of works also includes preparation of design and drawings, obtaining necessary approvals, materials, execution as per codes, specification, best engineering practices and to the satisfaction of BHEL/ Owner for all mechanical, architectural, civil structural, building electrification, etc. BHEL will not bear any liability for any extra work, which might not have been perceived by the bidder but functionally required. The cost of such work will be entirely borne by the bidder.
10	The omission of specific reference to any component / accessory which is necessary for completion of the system and for the proper performance of the equipment / Cooling Tower shall not relieve the bidder of the responsibility of providing such facilities to complete the supply / erection / commissioning etc. of Cooling Tower package with in quoted prices. In case this is not clear to bidder, the bidder may seek clarifications for same, failing which the specification intent shall be binding on bidder.

11	**Cement and reinforcement steel for Cooling Towers are excluded from Bidder's scope and shall be free issue as per NIT. Terms and Conditions for free issue items is provided in the NIT.**
12	Bidder shall visit and apprise himself fully with existing site conditions including soil condition, rainfall data, availability of all construction materials including backfill, graded material etc. and other aspects for construction of plant, building structures etc. No extra claim whatsoever on any account shall be entertained by BHEL.
13	The materials of construction for various components specified are the minimum requirements. Superior materials suitable for fluid handled is also acceptable subject to Customer/BHEL approval. Materials of construction for components not specified shall be similarly selected by the bidder for the intended duty and subject to Customer/BHEL approval.
14	Cost of Piling (if any) shall be included by bidder's in their quoted price.
15	The quality of water in CW system shall be Clarified water. The COC in CW System shall be '5'. Water analysis is enclosed in 'Compliance drgs'.
16	The location, orientation, wind rose, scope demarcation etc. for the cooling tower shall be as per the sketch enclosed in 'Compliance drgs' as Annexure-A.
17	Size of Branch & Cell isolation Butterfly Valves shall be same as that of pipe size.
18	The sizing of the hot water distribution system shall be done by limiting the velocity through the pipes to a maximum of 2.0 m/sec.
19	Piping upto 150 NB shall be carbon steel as per IS-1239 'HEAVY' Grade.
20	Piping 200 NB & above shall be Carbon steel rolled and Welded as per IS 3589 from CS plates as per IS:2062.
21	Minimum pipe thickness for overground piping shall be as follows: • 5.4 mm for pipe size upto 150 NB • 6.0 mm for pipe size from 200 NB and upto 600 NB • 7.0 mm for Pipe size 700 NB • 8.0 mm for pipe size 800 NB & 900 NB. • 10 mm for Pipe size 1000 NB & 1200 NB. • 12.5 mm for pipe size for 1400 NB. • 14.2 mm for pipe sizes from 1600NB upto 1800NB • 16 mm for pipe size for 2000 NB. • 18 mm for pipe size for 2200 NB. • 20 mm for pipe size from 2500 NB upto 3600 NB. All pipes shall be adequately supported.

22	Burried CW pipe- RCC box culvert (or) RCC encasing with suitable design requirement considered in selection of piping like axle loads etc. along with the earth cover shall be provided for each road/rail crossing for buried CW pipes. Concrete encasement shall be of min 500 mm thick with square shape outside. RCC encasement of grade M25 shall be adopted. Top of CW duct encasement shall be min. 1.5 m below FGL.
23	The minimum thickness of concrete encased steel pipes shall be as follows including corrosion tolerance of 2 mm: • Upto 1800 mm dia. - As per thickness of above ground piping indicated above. • For pipes above 1800 mm upto and including 2300 mm dia. - 12 mm • For pipes above 2300 mm upto and including 3200 mm dia. - 14 mm • For pipes above 3200 mm upto and including 3600 mm dia. - 16 mm However, for concrete encased steel pipes running below road, minimum thickness of CW pipe shall be 20 mm.
24	Following shall be considered for design of C.W. concrete encased CW Pipes: (a) Maximum design water pressure (b) Surge or water hammer pressure of 5.0 Kg / Sq.cm. (c) Vacuum of 0.1 kg/cm² (abs). (d) Soil overburden (e) Surcharge Pressure of 2T/Sq.m (f) The effect of concrete encasement shall not be considered in the design of CW duct.
25	The completed CW pipe shall be tested for water tightness, for the pressure equal to twice the working pressure or 1.5 times the design pressure whichever is higher and shall be generally water tight to BHEL/NLC's satisfaction. The testing pressure shall be held for minimum period of 30 minutes without any signs of leakage or failure of weld. Any in flow / leakage of water from the duct shall be sealed / repaired at Contractor's cost. However, tests in part of length of duct may be permitted with prior approval only.
26	Manholes of minimum 1000mm clear opening shall be provided in each CW pipe at a spacing of 200M (approx.) to facilitate maintenance / dewatering of CW pipes. At least one manhole shall be provided at the deepest point.
27	Under each valve, flange joint & such other items prone to gland/ joint leakage, suitable trays/ channels shall be provided so that any leakage water does not spread on the surroundings. This is also applicable for any air release valve that has to be mounted on hot water riser top. Erection of such air release valves is also to be done by the bidder.
28	The hot water distribution piping and valves shall be designed for the design pressure as indicated in the Technical Data Part-A.
29	Manual operated B.F. valves shall be provided in hot water distribution piping such that each cell can be isolated without affecting the operation of other cells.

30	Special tools & tackles, if any, shall be included in scope of supply by the bidder. A list giving description of such tools & tackles shall be furnished by vendor.
31	The Cooling Tower shall be designed for continuous operation to cool not less than the design flow of water from specified inlet temperature to outlet temperature at the design ambient wet bulb temperature.
32	All the components shall be capable of safe, proper and continuous operation at all cooling water flows upto and including those specified under Technical Data Part-A and shall be designed with regard to ease of maintenance, repair, cleaning and inspection.
33	No wood/ timberwork shall be used in any component of the cooling tower.
34	The Cooling Tower structure shall be of adequate strength to withstand the wind load and the effect of earthquake on the structure. Design wind pressure and horizontal / vertical seismic coefficient shall be taken as mentioned in the specification for civil works enclosed to this specification.
35	The exit air velocity of the fan recovery stack outlet shall not be less than 6m/s.
36	Maximum air Inlet velocity should be 5m/s.
37	The maximum efficiency of the stack for velocity recovery to be considered for calculation of fan power consumption shall be 75%.
38	Fan shall be manufactured as per the processes listed below: 1.Hand Moulded Seamless FRP fan blades using ballooning method. The method of hand moulding with parting plane is not acceptable. 2.Hand moulded FRP fan blades with PU foam core and hot forming. 3.Pultruded FRP fan blades.
39	Stack shall be provided to eliminate air turbulence in the throat area. Blades, shanks and hubs shall be suitably insulated to prevent electrolytic corrosion.
40	Fan for each cooling tower cell shall be sized (fan design point at test block) to have at least 5% margin on flow and min 10% margin on total head over and above the maximum cooling tower fan air flow and total head required (cooling tower fan duty point), to meet the specified / guaranteed cooling tower performance. Bidder shall submit detailed cooling tower fan calculation, characteristic curves etc. for the fan sizing as per the above.
41	It is mandatory for the bidder to submit along with the bid, the deviations if any – whether major or minor in the schedule of deviations only. In the absence of deviations listed in the “Schedule of deviations, the offer shall be deemed to be in full conformity with the specification, “not-withstanding” anything else stated elsewhere in bidder’s offer. The implied/indirect deviations shall not be binding on the purchaser.

42	**BID EVALUATION CRITERIA:**
42.1	The bids shall be evaluated based on the Cooling Tower prices quoted by the bidder and quantity of Cement and Reinforcement steel used in Cooling Tower.
42.2	Bidder shall furnish the quantity of Cement and Reinforcement steel in the Price offer. The evaluation rate for Cement and reinforcement steel shall be as per the rates given in the Price Schedule/NIT.
42.3	During civil design while furnishing the drawing/ design for BHEL's review / approval, bidder shall also furnish the design quantities of Cement and reinforcement steel in the drawings.
42.4	If the total quantity of Cement and reinforcement steel during contract execution is found to be more than the quantities quoted at tender stage, the additional cost for excess quantity of Cement and reinforcement steel shall be deducted from the bidder's payments as per the rates specified in the NIT.
42.5	No benefit will be given to Bidder, in case of reduction in actual quantity of Cement and reinforcement steel with respect to the quantities considered in bid evaluation.
43	**ELECTRICAL:**
	Please refer electrical portion.
44	**CONTROL AND INSTRUMENTATION:**
	Please refer C&I portion.
45	**3D MODEL REQUIREMENT:**
1	Following file formats are acceptable: 1..dwg 2..dgn 3..ifc 4..nwd 5..dxf
2	Relevant portion of 3D requirement is attached.

8.07.00 3D Model

a) Submission of 3D Model for Purchaser's Review

All the plant layouts shall be made in computerised 3D modelling system. The Purchaser reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Purchaser's review shall be fully dimensioned and extracted from 3D model after interference check.

Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include , Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, Coal Handling Plant , Limestone / Gypsum Handling Plant , DM PT plant, pipe & cable racks and any other facility located within plant boundary.

Contractor shall prepare 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc), which is extracted from intelligent 3D model, for Purchaser's review as & when desired by Purchaser. However, all piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.) and structural arrangement drawings shall necessarily be extracted from the aforesaid 3D model and submitted for Purchaser's review along with the 3D review model to enable Purchaser to review and approve these drawings.

The Contractor shall prepare the 3D model indicating the control & instrumentation equipments, devices such as location of LIE,LIR, flow elements, instrument tappings, thermowell stubs, JBs , cable trays, Flame scanners, Flame viewing cameras, ASLD, Acoustic Pyrometer, Control valves & actuators, Coal bunker level instruments along with approach / maintenance platform, provided for all these equipment's/devices. The LIE & LIR shall be placed in such a way that the doors can be opened freely from front & back side for ease of maintenance. The cable tray layout shall be implemented in such a way that the fouling to the pipes, ducts and other structures can be avoided.

These above drawings are to be extracted from the said 3D model and submitted for Purchasers review and approval along with the 3D model. After the completion of engineering of respective area i.e. TG building/ Boiler/ ESP etc., the corresponding complete 3D review model shall be handed over to the Purchaser for its reference.

VOLUME: II-IA

SECTION-IV

COOLING TOWER

1.00.00 GENERAL INFORMATION

1.01.00 This section covers the general performance and design requirements of Induced Draft Cooling Tower. For specific requirements of the Cooling Towers applicable for this Project, attached Annexure - I, shall be referred to.

In case of any contradiction between this section and stipulations of Annexure-I enclosed, stringent criteria shall prevail.

Distance between adjacent towers / orientation/construction of Cooling Towers shall meet the requirement of CTI. & CEA

1.02.00 Codes and Standards

The design, construction and performance testing of Three (3) nos.(1 no. for each unit) Induced Draught Cooling Towers (IDCT) and its associated equipment and accessories, shall comply with all currently applicable Statutes, Regulations and the safety codes in the locality where the equipment will be installed and shall conform wherever applicable to the latest codes/standards of:

a) Bureau of Indian Standards (IS: 11504)

b) British Standards (BS:4485 Part-I to IV)

c) American Society for Testing and Materials

d) American Society of Mechanical Engineers

e) Cooling Tower Institute, USA, ATC-105: “Acceptance Test code”.

f) Cooling Tower Institute, USA, ATC-128: “Code for measurement of sound from Water cooling tower”.

g) Cooling Tower Institute, USA, ESG-144: “CTI fastener material guideline”.

1.03.00 In case of any contradiction between the aforesaid Standards and stipulations as per this section as specified hereinafter, the stringent stipulation shall prevail.

2.00.00 SCOPE OF SUPPLY

2.01.00 Scope

The detailed scope of works under this section shall be as below. Items not specifically mentioned but deemed necessary to make the system completely reliable and efficient shall also be included.

2.01.01 Three (3) nos (1 no. for each unit) counter flow type Induced Draft (ID) cooling towers with double row arrangement each complete with hot water distribution basin with covers and nozzles, cold water basin and outlet channels, sludge pit, stair case from ground level to top deck at both ends of each tower and all other equipment and accessories as mentioned hereinafter and as also asked in the Data Specification Sheet, Annexure-I of this section.

a) Fans each complete with drive shaft lubrication system as specified with gear box, coupling, coupling guards, drive motor and base plate. Rain hood for drive motor and permanent grating/other suitable approach from stack door at tower level to fan gearbox.

b). Suitable maintenance handling arrangements for fan, gear box and motor etc.

c). Incoming hot water piping, including vertical run, supports for piping, isolating butterfly valves where necessary, distribution pipe network, nozzles, film type (fills) and orifices (if necessary) in hot waterdistribution system.

d) Inlet louvers, Tower fill and drift eliminators, including all supporting structures, fastening arrangements and accessories.

e) Gates and Screens, along with guides embedded in concrete, for cold water outlet sump.

f) Two (2) nos.2T capacity (minimum) manual hoists each, for each tower, complete with chain and hooks for lifting of the screens and stop log gates

g) The lifting arrangement for stop log gate & coarse screen shall be manual hoists + trolley with chain and hook and runway beams extended 1m or more as per requirement either side of the cold basin channel.

h) Deleted.

i) Valves in sludge pits complete with extension spindles upto operating level and pedestal type manual operator. Also pipe spools embedded in the wall to which valve shall be connected.

j) Pipe spools to be embedded in sludge pit walls and terminated with flanged end at suitable distance from outer face of respective wall.

k) Hanger supports and anchoring materials for all piping coming under the scope of supply of this section.

l) Flanges, bolts, nuts and gaskets at all piping connections.

m) Two (2) nos. vertical sludge pump complete with electric motor, discharge valves, piping supports, hangers, clamps, with auto start-stop facility through level switch etc. for the cooling tower basin draining/ dewatering. The discharge of this sludge pump shall be designed for a head and capacity upto central monitoring basin.

2.01.02 For electrical system/component refer Volume-II-F/1 & F/2.

2.01.03 Control & Instrumentation systems shall be complete with all required instruments, which shall not be limited to the followings :

(a) Pitot tube at each hot water inlet-piping header to measure the flow for performance guarantee test.

(b) Vibration monitors & Vibration sensors in X-Y direction on the gearbox of each CT fan for on line vibration monitoring, alarm and trip.

(c) Oil level indicator & oil level switch for monitoring and alarm.

(d) Motor & Gearbox bearing temperature RTD for monitoring and alarm.

(e) For other detail refer section-I of this volume and volume-II E of this specification.

2.01.04 Base plates, foundation plates, anchor bolts, sleeves and inserts, in concrete work for electrical and mechanical equipment and accessories.

2.01.05 Excavation, shoring , dewatering, backfilling and all concrete work including RC foundations, RC shell, RC support frame work for fill support, cold water outlet sump and sludge pit for basin section, staircase from grade level upto top of cooling tower, all other staircase /ladders, doors and their frames, platform walkways, hand railing, water-proofing, finishing and all other incidental civil works including earthwork for grading, removal of surplus soil to a place decided by the Engineer, shuttering and steelwork for reinforcement etc.

2.01.06 Doors for entrance into cooling tower and fan stack. All access doors, as necessary shall also be supplied.

2.02.00 For general guidelines regarding detailed scope of services, Volume-IIA of this specification shall be referred to.

2.03.00 For detailed scope of Civil and structural items, please refer Section-V of Volume-II-G/1.

3.00.00 GENERAL PERFORMANCE REQUIREMENTS

3.01.00 The Induced draft cooling towers shall be capable of permitting normal plant operation at the highest anticipated cooling water temperature and design inlet air wet bulb temperature without any reduction in output of 800 MW units.

3.02.00 The cooling tower shall be designed for continuous operation to cool not less than the design temperature rise for the design flow rate of hot water returning from the condensers and other auxiliary equipment and shall be sized for the design heat load and all other corresponding heat loads. Design ambient wet bulb temperature, design inlet wet bulb temperature and approach shall be taken as per Annexure enclosed with this section. Two (2) spare cells shall be provided with each tower.

3.03.00 The maximum cooling tower flow capacity to be considered for design of the hot water distribution header shall be based on the criteria stipulated under clause no 4.01.05 of Section-I of this Volume.

3.04.00 The cooling tower may have to be operated for prolonged hours with one (1) operating cell remaining as a standby. If specified in the Attachments, the balance cells of the tower shall be capable of cooling the design flow rate of water through all corresponding heat loads. With such condition, the Contractor shall clearly indicate in his proposal the following:

a) For the design wet bulb temperature, the actual value of approach that can be achieved without adjusting the fan blade pitch.

b) The fan drive motor kW required for achieving the rated approach with design wet bulb temperature by making necessary adjustment of the fan blade pitch.

c) The Contractor shall also indicate the minimum approach that can be achieved with the cooling tower offered, by adjustment of fan blade pitch, when all the cells are working, for the total design cooling water flow rate and corresponding maximum cooling range and also the motor kW required in such condition.

d) The Contractor shall also indicate in his proposal, the maximum kW rating of the fan motor that can be used with offered equipment and shall also indicate the lowest approach that can be achieved by adjusting blade pitches and thus utilising maximum of the fan motor rating under conditions stipulated in Clause nos. 3.02.00, 3.03.00 and 3.04.00 above.

3.05.00 Cold water outlet channels from IDCT will be designed for outlet velocity not exceeding 0.9 m/s at minimum water level in the channel

3.06.00 The hot water distribution piping of the cooling tower shall be designed to withstand a pressure not less than the shut-off head of CW pump.

3.07.00 Drift loss of the cooling tower expressed in % of design capacity shall be limited to the value as specified in the enclosed Annexure. Make-up amount to cater for evaporation, drift and blowdown losses in the cooling towers shall be catered from CT make-up System.

3.08.00 In case the Data Specification Sheet, Annexure-I does not specify the "Design Inlet Air Wet Bulb Temperature", the Contractor shall design the cooling tower of sufficient capability to absorb the effects of the increased wet bulb temperature (corresponding to the design ambient wet bulb temperature data specified in the Data Specification Sheet) due to recirculation as applicable to the offered equipment..

3.09.00 For arriving at the air properties such as enthalpy, density etc., no correction for altitude shall be considered. All properties shall be taken from the data provided on CTI or BS code corresponding to sea level.

4.00.00 DESIGN AND CONSTRUCTION

4.01.00 General Design

4.01.01 The equipment shall be capable of safe, proper and continuous operation at all cooling water flows and the corresponding heat loads.

4.01.02 Vibration, noise, mechanical and thermal stresses of various parts and the complete unit shall not be greater than the values in similar plant of good design and workmanship operating under similar conditions.

4.01.03 All the equipment shall be designed with regard to ease of maintenance, repair, cleaning and inspection.

4.02.00 Each cooling tower shall be of induced draft counter flow type having multiple cells with film type fill material. Double row arrangement of cells shall be adopted to limit the length of the cooling towers. The maximum permissible length of the cooling tower and its basin shall be within the limits mentioned in the Data Specification Sheet

4.03.00 In case the material of construction for various parts of cooling tower like shell etc. is specified in the enclosed Annexure the Contractor shall not take any deviation in choosing the material for those parts.

Cooling tower structure shall be of adequate strength to withstand the wind load and the effect of earthquake on the structure.

4.04.00 **Partitions**

4.04.01 Partitions shall be provided in between the cells so that one or more cells can be taken out of service, without affecting the operation or capacity of other cells.

4.04.02 If specified in Data Specification Sheet or if required, a longitudinal partition at the centre line of tower extending from basin water level to the top of louvers shall be provided to prevent the wind blowing through the louvers on one side from carrying the circulating water out through the louvers on the opposite side.

4.05.00 **Louver** (as applicable as per OEM design for the site condition) **and Casing**

4.05.01 Louvers shall be designed for air entry to the tower with low velocity for minimum pressure drop and less chance of recirculation of moist air.

To eliminate splash out, louvers shall have slope to shed water inwards.

4.05.02 The louvers and casing may be made of reinforced concrete. The concrete casing wall, shall be supported by the basin through reinforced concrete. Hinged access door with platforms shall be provided for entry into the tower.

4.06.00 **Fill**

4.06.01 Cooling tower fill shall be made of material as specified in Annexure enclosed with this section. The fills shall be of film type.

4.06.02 The virgin PVC/PP film type fill shall be durable and fire retardant quality. The Contractor shall furnish details of Virgin PVC/PP fill along with his offer indicating fire retardant properties, ageing effect, vibration caused by water and wind effects. The virgin PVC/PP fills shall be of proven quality and the make and its properties shall be subject to Owner's approval.

4.06.03 Design and facing of the fills shall be such as to expose high air/water surface with minimum air pressure drop. Air velocity through the fills shall be uniform.

4.06.04 The fill material shall promote a high rate of heat transfer, provide low resistance to air flow and maintain uniform water and air distribution throughout the fill volume. The fill material should be highly resistance to deterioration and shall be fire retardant. Virgin PVC/PP fill shall be of proven quality. The make & its properties shall be subject to Owner /Consultant's approval. Contractor shall furnish details of virgin PVC/PP fill regarding fire retarding properties (flame spread rating is to be less than 25 as per ASTM E-84), ageing effect, vibration caused by water and wind effects. Virgin PVC/PP Fill shall be white/cream/light grey. Black fills are not acceptable. In case of Virgin PVC/PP material, the material should be ultra violet ray stabilized and only virgin PVC/PP. The type of fill to be supplied shall be of proven design. The performance of the fill should have been established for the specified/ higher duty conditions. Necessary supporting data for this shall be enclosed along with the bid.

The properties of PVC/PP material used for the fill shall conform to CTI bulletin STD-136. The properties of the PVC raw material shall be tested at the testing laboratories before the manufacture of fill. The result of the tests conducted shall be submitted to Owner /consultant directly from the testing laboratories for approval.

4.07.00 **Fill Supports**

4.07.01 Film type fills shall be supported suitably on the grids with suitable intervals, to minimise sag, possibility of dislodgement, and damage to fill materials as a consequence of induced vibration in the fill.

4.07.02 Material of fill support shall be as specified in Annexure I.

4.07.03 Suitable anchoring, with SS316L material, of the fill materials must be done at the bottom to restrain the swaying of the fill material.

4.08.00 **Drift Eliminators**

4.08.01 Zig-Zag path type Multipass Drift eliminators (minimum two pass) shall be provided so as to limit the drift loss to that specified in earlier sections or as in the enclosed Annexures.

4.08.02 Drift eliminators shall be of PVC-UV stabilized. The sizing of drift eliminator shall meet the design requirement of drift loss % as in annexure.

4.08.03 The eliminator frame shall be of rugged construction and shall be firmly secured to arrest vibration.

4.09.00 **Hot Water Distribution System**

4.09.01 The distribution system shall be designed for flexible and satisfactory operation at all reasonable loads.

4.09.02 Hand operated regulating type distribution valves shall be provided so that each cell/sub-cell can be isolated without affecting the operation of other cells/sub-cells. Valve material shall be as per Manufacturer's recommendation in absence of any preference in the enclosed Data Specification Sheet of this section.

4.09.03 The hot water distribution piping and valves shall be designed for a working pressure as specified in the enclosed Annexure-I of this section.

The distribution of water shall be in Troughs/Pipes of approved material. The entire water distribution system shall be self-draining and non-clogging type.

4.09.04 As regards the sizing of the hot water distribution system etc., the maximum flow as guided in earlier clauses shall be considered. In this connection Clause no. 3.03.00 shall be referred to.

4.09.05 Splash boxes shall be provided at the discharge of each distribution valve to minimise splashing and to facilitate even distribution of water.

4.09.06 The nozzles shall be spaced to give even distribution of water over the entire space occupied by top row of fills.

The nozzles and splash plates shall be made of high density Polyethylene or PP.

4.09.07 The pipes and valves etc. used shall be designed and arranged to take care of the possible thermal stress due to temperature variation. The pipes and fittings upto 150 NB will be of heavy grade as per IS-1239-part-1.

4.09.08 Ready accessibility to the different parts like distribution valves etc. shall be provided and as required necessary platform/ walkway and ladder shall be provided for this purpose.

4.09.09 All pipes shall be adequately supported/anchored. Required minimum wall thickness for miscellaneous piping shall be as follows:

a) 150 NB-600 NB - Thk. 6.3 mm.
b) 650 NB-800 NB - Thk. 8.0 mm
c) 850 NB-1200 NB - Thk. 12.0 mm

4.09.10 Under each valve, flange joint and such other items prone to gland/joint leakage, suitable trays/channels shall be provided so that any leakage water can effectively flow into the hot water distribution area, without spreading on the tower roof or to the surroundings. This is also applicable for any air release valve that has to be mounted on the hot water header top.

4.09.11 All flanged connections for hot water pipes shall be complete with bolts, nuts and gaskets.

4.10.00 **Access**

4.10.01 Staircase shall be provided external to the cooling tower along with stairways, landings, walkways, handrails and access doors in such number and location as necessary to give safe and convenient access to the top and the interior parts of the tower.

4.10.02 Suitable arrangement for supporting walkways inside the cooling tower shall be made and such arrangement shall be independent of the fill material. The access to reach nozzles for maintenance/replacement between top layer of fill and distribution piping from the walkway inside CT may also be provided.

4.10.03 Whether specifically mentioned in the Annexure or not, steel components and fittings used in walkways, handrails and access doors shall be hot dip galvanized to 610 gm/sqm after fabrication.

4.11.00 **Fans & Accessories**

4.11.01 Fans shall be vertical, multi bladed axial flow type and the blade shall be individually fastened to a common hub. The fan shall be designed with adequate margins so as to meet the rated performance at speed corresponding to 48.5 Hz frequency of power supply.

4.11.02 The number of blades shall not exceed twelve (12) and the blade tip velocity shall not exceed 65 m/sec. All the rotating parts of fans shall be statically and dynamically balanced as per ISO 1940, Gr-6.3.

4.11.03 Unless otherwise stated in the enclosed Data Specification Sheet each fan blade shall have with provision of pitch adjustment upto +5 degree from the normal setting. The blades shall provide uniform velocity from hub to tip with low noise and vibration.

Blades shall be made of FRP. Fan hub shall be of high tensile steel hot dip galvanised/spray painted or Cast aluminium alloy, as specified in the Data Specification Sheet.

4.11.04 Bolts, nuts etc. for fan assembly and mounting shall be of adequate design for the duty envisaged and shall be of stainless steel.

4.11.05 The fan shall be connected to the drive shaft of the gearbox through heavy duty flexible coupling. Suitable coupling guard shall be provided.

4.12.00 **Fan Drive System**

4.12.01 Each fan shall be driven through a right angle speed reduction unit, especially designed for cooling tower service. The gearbox shall be of heavy duty, double helical type, industrial design and shall adopt a service factor of minimum 2, over fan rated BHP, unless otherwise specified in the Data Specification Sheets. Besides, the gearbox shall be capable of transmitting the rated power of the drive motor continuously keeping the temperature rise within 20°C or within safe working limit of the lubricating oil, whichever is lower, for the maximum ambient temperature specified.

The gearbox enclosure shall be totally enclosed weather-proof design of heavy cast iron construction with outside ribs for rigidity & heat dissipation. Adequate heavy duty thrust bearings, roller bearings and oil seals shall be provided. The gearbox oil shall be equipped with oil-breather vent and shall have an oil level indicator at an accessible location.

4.12.02 Suitable means for the water free lubrication of the gear reducer and the bearings together with suitable filler, sight glass etc. shall be provided. The lubricating oil should be non-hygroscopic in nature, so that, its lubricating properties are not lost, even if the same become contaminated with water vapour.

If forced lubrication system is provided, the Contractor shall include in his scope of supply complete lubrication system with oil pumps and drives with motor, oil coolers and cooling water pumps and drives with motor and the associated piping, valves and specialties with provision for 100% standby.

4.12.03 In case of forced feed lubrication system, the external oil piping shall be galvanised steel pipe conforming to IS:1239, Part-I, heavy grade. The connection between the gearbox and the external oil piping shall be through wire reinforced flexible hose assemblies, having adequate number of union fittings to facilitate complete disassembly.

4.12.04 The drive motors for fans shall be mounted outside the air stream, Maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations taking into account the design condition of operation as detailed in Cl. No. 3.04.00.

4.12.05 The drive motors shall be fan cooled and shall have IP-55 enclosure. The design and construction of the drive motor shall be in accordance with Volume: II-F/1 & F/2 (Specifications for Electrical Equipment & Accessories) of this specification. To protect the CT fan motor from cooling tower drift etc., suitable canopy shall be provided.

4.12.06 The drive motor shall be connected to the gearbox input shaft through a floating drive shaft and coupling assembly, properly supported. The drive shaft assembly shall be statically and dynamically balanced.

The drive shaft shall be made of EN-8 steel or better material as specified in the enclosed Data Specification Sheet and shall be hot dip galvanised and specially designed for cooling tower service.

Heavy duty flexible coupling with coupling guard shall be provided at shaft ends along with supporting bearings for the drive shaft.

4.12.07 Each drive motor shall be provided with space heater unless otherwise specified in the enclosed Data Specification Sheet.

4.13.00 Cooling Tower Basin & Outlet Sumps

4.13.01 Cooling tower basin, if asked for in the enclosed Annexure, shall be supplied/constructed along with all civil parts, base plates, anchor bolts, nuts, and other accessories, pipe sleeves, inserts, etc. as per Annexure and as required to complete the work in all respects.

4.13.02 The construction material for basin shall be as per enclosed Annexure. The work shall include excavation/backfilling as necessary, all concrete/steel/ wood work, cold water outlet sump and sludge pit for each basin, cable trench, waterproofing and all other works.

4.13.03 Basin dimensions and other parameters shall be suitably chosen and indicated by Contractor. The basin and cold water discharge channel shall be capable of handling 120% of design flow without any over flow". The slope angle (1:80) from the centre towards sludge sump inside basin shall be maintained.

4.13.04 Basin shall be partitioned into two individual chambers such that one section can be taken out for maintenance.

4.13.05 Sludge pit with isolating valves and spool pipe having flanged ends shall be provided for individual basin chambers for connection to drainage pipe.

4.13.06 For each basin chamber, there shall be a cold water outlet sump. In the connection between basin chamber and cold water sump there shall be screen and stop log gate.

4.13.07 Each basin chamber shall have overflow arrangement at sludge pit end.

4.13.08 For concrete basin, other aspects of design shall be as per Volume-II-G/1 of this specification.

4.14.00 **Screens & stop log gates in Cold Water Outlet Sumps, Valves & Pipes in Sludge Pits and Accessories**

4.14.01 Required nos. stop log gates of suitable opening size conforming to IS: 5620 complete with guide frame (embedded parts) of SS 316L, , gate conforming to IS: 2062 Gr. B, side seal of EPDM Musical Note, bottom seal of EPDM, all other accessories and hardware necessary to install and operate the system as per specifications and drawings complete in all respects.

4.14.02 Required nos. Coarse Screens with guide frame to be suitably installed in the cold water channel and made of 6 SWG wire mesh of SS 316L having 20 mm x 20 mm openings with trash tray and embedded parts of SS 316L, screen frame of SS-316L, guide frame of SS 316L and all other accessories and hardware necessary to install and operate the system, complete in all respects.

4.14.03 50 mm diameter MS rungs, hot double dip galvanized as per IS: 4759 with 610 gm/sq.m coating and complete with all accessories as per specifications.

4.14.04 MS structural supports in trusses for HW pipe with all bracings, brackets, cleats, gusset plates etc. as per detailed drawings or as directed including cutting, fabricating, hoisting, erecting, fixing in position, welded connections and painting with red oxide Zinc Chromate primer etc. complete as per specifications.

4.14.05 Stop log gates in cold water outlet sumps shall be as per appropriate class of IS: 3042.

All mild steel parts shall be painted with epoxy enamel primer & paint. The gate shall be rectangular cross-section.

The stop log gates shall be complete with manual chain pulley for manual operation.

4.14.06 Flow area through each gate and screen shall be such as to maintain a flow velocity through them within 0.9 m/sec (under minimum water level) during the rated flow from cooling tower, with the minimum water level in the cold water basin.

4.14.07 Isolating valves in sludge pits shall conform to appropriate class of IS: 14846.

Each valve shall be complete with pedestal type manual operator, with rising spindle and valve position indicator.

4.14.08 The pipe spools to be embedded in sludge pit for piping connection shall be G.I. pipe as per IS: 1536, Class-LA, unless otherwise mentioned elsewhere.

4.15.00 **Handling Facilities**

4.15.01 Handling facilities of approved make in Cold Water Channel including fabrication, erection complete with all the necessary accessories, embedded parts, hardware, etc. hot double dip galvanized as per IS: 4759 with 610 gm/sq.m of zinc coating as per specifications complete in all respects. For handling screens, required set of monorail with supporting structure and chain pulley hoist complete with lifting chain and push type trolley for mounting the hoist shall be furnished, if asked for in the enclosed Annexure, for cooling tower.

The chain pulley hoist shall be manually operated and shall conform to IS:3832, Class-2.

4.15.02 Monorails for Stop log gates and Screens shall be ISMB 300 (min). Monorail trolleys (manual type) moving over I-beams. Chain pulley block (3.0Ton capacity (min) with 5 m chain) conforming to !S:3832, with 5m load chain conforming to IS: 3109 complete with necessary accessories such as hooks, slings etc with hardware as per specifications or as directed by Engineer-in-charge, complete in all respects.

4.15.03 For maintenance of drive equipment (Fan, motor, gear reducer, etc.), following arrangements shall be furnished.

a) Suitable capacity Handling equipment to handle equipment of two numbers of cells simultaneously during maintenance at the Roof floor of each CT. Also one mono rail hoist to be provided to lift equipment handled during maintenance at roof of CT from ground level to tower top and vis-a-vis and accordingly the lift shall be provided. The capacity of handling equipment for the fan/motor assembly at roof level / this mono rail hoist for handling the component / equipment from ground level to roof level of CT shall be equal to the heaviest portion of the fan motor assembly with minimum of 25% margin subject to minimum of 2 MT" The selection of hoist (electrical/manual) shall be as per the criteria in the specification for hoists. In addition to the above a hand trolley which is sized to carry the heaviest and largest single piece of equipment shall also be provided for the cooling tower. This trolley will be used on the fan deck to transport equipment from each

cell to and from the end of tower where the monorail hoist is located to lift equipment from ground level to tower top. For cross flow type of tower care shall be taken so that the equipment to be lifted does not need to be carried over the distribution basin.

b) Suitable platforms/ scaffoldings (for at least 2 fans) for doing maintenance work in situ for gear reducer, fan and motor shall also be provided.

c) Alternative arrangements are also acceptable, if the arrangement provided is adequate to carry out maintenance on at least two cells of the tower simultaneously. In such a case the complete equipment for easy removal of equipment from fan flume and bringing it down to ground level shall be furnished.

4.16.00 **Butterfly Valves**

All the butterfly valves shall be complete with graduated position indicator, arrow indicating the flow direction. The valves shall be suitable for erection in any position (Horizontal or Vertical, etc.). The operating mechanism shall be mounted directly on or supported from valve body. All the butterfly valves shall be provided with hand wheel. Butterfly valves of size 350 NB and above shall be provided with reduction gear units. Valves shall close in clockwise direction. The pulling force required on the hand wheel-rim shall not exceed 30 Kg. when operating the valve under full flow and max. operating pressure. Necessary platform of adequate size with ladders, handrails and toe guards required to be fabricated and erected at site to operate the valve locally.

4.17.00 Not used.

4.18.00 **Hardware**

All nails and fastening bolts, nuts & washers used in the cooling tower shall be hot dipped galvanised steel, brass or stainless steel, as specified in the Annexure.

4.19.00 **Painting & Coating**

Please refer section-XII of lead specification (Volume-II A).

5.00.00 COOLING TOWER, CIVIL AND ALLIED WORK

The civil design and construction of the cooling tower shall be in accordance with the requirements detailed in Volume-II-G/1 of this specification.

6.00.00 ELECTRICAL ITEMS

Complete Electrical system for safe and reliable operation shall be provided. Volume – II F/1 & F/2 (Specifications For Electrical Equipment and Accessories) of this specification shall be referred for detailed technical requirement.

7.00.00 INSPECTION AND TESTING

7.01.00 The Contractor /manufacturer shall conduct the following minimum specific tests to ensure that the equipment shall conform to the requirements of this section and in full compliance with the requirements spelt out in applicable codes and standards.

7.01.01 Material identification and testing of gear reducers, regulating valve assemblies, screen assemblies, fan blades and hubs, all supporting structural assemblies, all nuts and bolts, sluice valves, fan shafts, gear sets, nozzles and all other applicable components constituting each cooling tower.

7.01.02 Oil leakage and oil temperature rise, backlash, noise level and amperage at full load torque with reduced speed shall be checked for each gear reducer assembly.

7.01.03 Dynamic balancing of drive shaft assembly, fan assembly and all other rotating components. Acceptable limit should be in good zone.

7.01.04 Measurement of proof strength and contour for each fan blade.

7.01.05 Static balancing test, checking of fan blade moment weight, pitching, blade tip variation and blade track variation of fan blades.

7.01.06 Hydrostatic testing of hot water distribution piping regulating valves and all other pressure parts at a pressure and duration as spelt out in Volume-IIA of this specification.

7.01.07 Visual, dimensional checking of all components of cooling tower.

7.01.08 Tests for hoists, chain pulley blocks and all other lifting tackle shall be carried out as per relevant Indian/equivalent international standards.

7.01.09 Material testing of all components, hydrostatic testing of all pressure parts at a pressure and duration in compliance with Volume : IIA of this specification, static and dynamic balancing tests of all rotating components such as pump shaft, line shaft, impeller etc. and complete performance testing as minimum for each sludge pump in cooling tower.

7.01.10 Any other test deemed necessary for safe, reliable and satisfactory operation of the equipment.

7.02.00 Tests at Site

7.02.01 After completion of erection and commissioning of the cooling tower, performance test of the cooling tower shall be carried out by supplier in accordance with Cooling Tower Institute Bulletin No. ATC-105 "Acceptance Test Procedure for Industrial Cooling Tower" or ASME (USA) performance test code PTC: 23 or other equivalent mutually agreed method.

7.02.02 Necessary correction curves required for correcting the test results for any difference between test and guarantee design conditions shall be furnished by the supplier for approval along with the proposed test procedure. Correction curve for wind speed is applicable and the operating conditions for PG test is as per CTI.

7.02.03 All mounting and calibrating instruments required for site performance tests shall be arranged by the Contractor without any extra cost.

8.00.00 PERFORMANCE TEST PROCEDURE

8.01.00 Performance test for Cooling Tower

The performance test of one of the Cooling Tower shall be carried out by the Successful Contractor through CTI approved/listed testing agency in presence of Owner. The testing agency proposed by the Successful Contractor shall be approved by the Owner. The tower to be tested through CTI testing agency shall be decided / chosen by Owner. For the balance cooling tower the performance test shall be conducted by the Successful Contractor for demonstration purpose only.

8.02.00 To ascertain the fulfillment of Guarantees of the Cooling Towers, the test results of the tower tested through CTI approved testing agency shall be considered for PG test evaluation and based on the test result, the liquidated damage if applicable shall be levied for all the Cooling Towers. The indicative procedure to be followed and other conditions shall be as given below.

8.03.00 Test Procedure

Acceptance test procedure shall cover the determination of the thermal capability and verification of all the guarantees of the cooling tower (s) for the project. The detailed test procedure shall be submitted by the Contractor in consultation with the CTI approved/ listed agency and approved by the Owner.

8.04.00 Codes

The following codes and standards shall be applicable for conducting test unless agreed to between the Owner and the Successful Contractor:

a) Code ATC-105 - Acceptance test code for water cooling towers. (latest Version)

b) B S-4485 - Specification for water cooling towers.

c) BS-1042 - Methods for the measurement of fluid flow in pipes.

d) BS-3435 - Measurement of electrical power and energy in acceptance testing.

e) ASME 19.5- Supplements on instruments and apparatus.

8.05.00 Conditions of Test

i) Test shall be conducted by accredited representatives of CTI approved test agency in presence of the Owner/Consultant. The detailed test procedure shall be submitted by the successful Contractor in consultation with the CTI approved/listed agency and approved by Owner.

The Successful Contractor shall be given permission to inspect the tower in advance and ready it for the test. Successful Contractor's representatives shall witness all phases of the test and record the data jointly with the Owner's representative in the formats mutually agreed.

ii) Test Instruments

a) The responsibility for conducting the test will be with the successful Contractor.

b) Calibration of instruments to be used in the test shall be carried out by an approved independent agency. Calibration of instruments should be carried out previous to, but not more than six months before the test. The calibration certificate of the instruments should be valid for the period of test

c) List of instruments to be arranged by the successful Contractor along with the calibration certificates of the instruments to be used and psychrometric charts and tables should be submitted to the Owner for approval at least one month prior to commencement of PG test.

iii) PG test shall be carried out by the successful Contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified in this section.

iv) The tower performance shall be ascertained based on the performance curves of the towers showing variation in the performance with change in approach to wet bulb temperature, cooling range, water loading of the tower etc. submitted during Contract.

v) In case the test cold water temperature as determined from the PG Test is higher than the predicted value (based on the performance

curves), Owner reserves the right to reject/accept the Tower after assessing the liquidated damages as specified.

vi) A maximum tolerance in the cold water temperature allowed to take care instrument inaccuracies shall be as per relevant code. No other tolerances will be permitted.

8.06.00 General Conditions

8.06.01 Conditions of Equipment

i) At the time of the test the tower shall be in good operating condition. Tower may be inspected and repaired, (if necessary) by the successful Contractor before the test to ensure the following:-

ii) Water distribution system shall be essentially clear and free of foreign materials which may obstruct the normal water flow.

iii) Drift eliminators shall be essential clear and free of algae and other deposits which may impede normal air flow.

iv) Fill shall be essentially free of foreign materials such as oil, tar. scale or algae.

v) Water level in cold water basin shall be at normal operating elevation and shall be maintained substantially constant during the test.

8.06.02 Operating Conditions

The test shall be conducted within the following limitations:

i) Every effort shall be made to run the test under design conditions or as close to design conditions as possible. The variations from design conditions shall be permitted as per provision of ATC.

ii) The water distribution to all parts of the tower shall be as envisaged in the design.

iii) The ambient wind velocity shall be measured in accordance with the provision of ATC.

8.06.03 Duration of test

After reaching steady state conditions the duration of the test run shall not be less than one hour. If thermal lag time is greater than five minutes the time for the tests period shall be at least one hour plus thermal lag time. For calculation of thermal lag time refer to ATC.

8.06.04 Frequency of observations

Readings shall be taken at regular intervals & recorded in the units and to the number of significant figures as shown in the following tabulation:-

Sl. No.	Measurement	Minimum number in each hour /station	Unit	Record to nearest
1.	Wet bulb temperature	12	Deg. C	0.05
2.	Dry bulb temperature *	12	Deg. C	0.05
3.	Cold water temperature	12	Deg. C	0.05
4.	Hot water temperature	12	Deg. C	0.05
5.	Wind Velocity	6	KMPH	
6.	Circulating Water Flow**	3	Cu.M/hr	_

Note:

* If applicable.

** Single center point readings for comparison with full traverse reading taken before test (when measurement is made by Pitot Tube). One full traverse shall be made immediately preceding the test and a minimum of three center point readings shall be taken during the test.

8.06.05 Constancy of test condition

For a valid test, variations in the test conditions shall be within the following limits:-

a) Circulating water flow shall not vary by more than 2%.
b) Heat load shall not vary by more than 5%.
c) Range shall not vary by more than 5%.
d) Instantaneous air temperature readings may fluctuate, but variations in the averages during the test period shall not exceed 1 deg C per hour for Wet bulb temperature and 3 deg C per hour for Dry bulb temperature (if applicable).

8.06.06 Test Instruments, their Location & Method of Measurements

A) Wet Bulb Temperature

i) The wet bulb temperature shall be measured with mechanically aspirated instruments, each meeting the following requirements:-

a) The indicator shall be graduated in increments of not more than 0.05 deg. C.

b) The temperature sensitive element shall be accurate to ± 0.05 deg. C.

c) The temperature sensitive element shall be shielded from direct sunlight or from other significant sources of radiant heat. Shielding devices shall be substantially at the dry bulb temperature.

d) The temperature sensitive element shall be covered

with a wick that is continuously fed form a reservoir of distilled water.

e) The temperature of the distilled water used to wet the wick shall be at approximately the wet bulb temperature being measured. This may be obtained in practice by allowing adequate ventilated wick between the water supply and the temperature sensitive element.

f) The wick shall fit snugly over the temperature sensitive element and extend at least two centimeters past the element over the stem. It shall be kept clean while in use.

g) The air velocity over the temperature sensitive element shall be maintained between 290 and 320 meters per minute.

ii) Number of stations and their location

a) Ambient wet bulb temperature

The ambient wet bulb temperature shall be determined as the arithmetical average of measurements taken at not less than three locations approximately 1.5 meters above basin kerb elevation, not less than 15 meters or more than 100 meters to windward of the equipment, and equally spread along a line substantially breaking the flow of air to the tower. If such location is inaccessible or the area surrounding the tower contains elements which can affect the ambient wet bulb temperature, a suitable location shall be mutually agreed upon.

b) Inlet wet bulb temperature

For measurement of inlet wet bulb temperature, the instrument shall be located within 1.5 M of the air intakes(s). A sufficient no. of measurement stations shall be designated to ensure that the test average is an accurate representation of the true average inlet wet bulb temperature. The minimum number of stations for each air intake side may be determined from the equation :

n =0.517 (A) 0.4

Where,

n = is the minimum no. of stations for each side of air intake.

A = is the area to be traversed in sq. meter.

(The area to be traversed applies to each individual air inlet area on each side of the cooling tower, rather than the total area applicable for the cooling tower). Each intake should be divided into `n' number of imaginary rectangles and one wet bulb measurement station shall be located in the mid point of each rectangle.

iii) The average of three (3) successive readings taken at 10 second intervals at each station shall be considered as wet bulb temperature at that time at that instrument station. The station averages shall be averaged to obtain the effective wet bulb temperature for that run. Such runs shall be made every 5 minutes during the test period and the arithmetic average of these runs shall be considered the ambient or inlet wet bulb temperature, as the case may be, and shall be used for the evaluation of results.

B) Dry Bulb Temperature : (If applicable)

i) The ambient dry bulb temperature shall be measured with instruments each meeting the following requirements:

a) The indicator shall be graduated in increments of not more than 0.05 deg. C.

b) The temperature sensitive element shall be accurate to ± 0.05 deg. C.

c) The temperature sensitive element shall be shielded from direct sunlight or from other significant sources of radiant heat. Shielding devices shall be substantially at the dry bulb temperature.

ii) For the measurement of ambient dry bulb temperatures, instrument location, the number of station, the frequency of readings and the reading and the averaging procedures shall be same as that of the procedure described in previous clauses for wet bulb temperature.

C) Cold Water Temperature

i) The indicator of the thermometer used for measurement shall be graduated in increments of not more than 0.05 deg. C.

ii) The re-cooled water temperature can be measured directly at the point where the circulating water is discharged from the basin, the average cold water temperature being determined by simultaneous test reading where possible across the selected sections.

D) Hot Water Temperature

i) The indicator of the thermometer used for measurement shall be graduated in increments of not more than 0.1 deg. C.

ii) Hot water temperature measurement shall be made in the tower risers or at the discharge of inlet risers into the flume or distribution system or for a multi-cell tower in the supply header just upstream of the first riser. If the source is a mixture of two or more streams of different temperatures, complete mixing must be ensured at the point of measurement.

E) Circulating Water Flow

i) Wherever adequate upstream and downstream straight lengths are available, suitable pitot probes, shall be used for the flow measurement. Pitot probes shall conform either to ASME (19.5) Section 4 (latest revision) or ISO 3966-1977. The probes shall be provided with calibration carried out in a laboratory approved by Owner. Pitot Tube not conforming to the above codes but fabricated by Indian Institute of Technology Bombay, Delhi/Indian Institute of Science, Bangalore with recent calibration certificate could be used after obtaining prior approval of Owner.

ii) In case adequate upstream and downstream straight lengths are not available, the probe should conform to ISO-3966-1977. In addition for velocity measurement, a `Yaw-probe' shall be required as per ISO-7194-1983 for the measurement of swirl angle. Alternatively, special probe developed by IIT/IISC for simultaneous measurement of velocity and swirl angle can be used.

iii) For obtaining swirl free and fully developed flow condition the minimum upstream and downstream straight lengths at the measuring cross section shall be 20 pipe diameter and 5 pipe diameter respectively. To meet the above criteria, it will be necessary to provide the stubs along with the isolating valves in the underground portion of the circulating water pipe/ducts leading hot water to the tower. It is proposed to provide the stub connections in hot water duct coming in Owner's scope of supply. Provision shall be made for traversing two diameters, at right angles to each other.

iv) In case it is not possible to comply with the straight length requirement the stubs shall be located in hot water pipes where maximum straight length is available. The flow shall be asymmetric and traversing of 3 or 4 diameters shall be necessary depending upon the available straight length and the type of disturbance.

v) For the measurement of differential pressure, Inclined manometer with low density liquid shall be used to minimise the reading error. In case special probe developed by IIT/IISc is used, another manometer with low density liquid shall be required for orienting the probe in the flow direction.

F) Wind Velocity

i) Wind Velocity shall be measured by a rotating cup type anemometer.

ii) Measurement shall be made in an open and unobstructed location within 30 meters of and to windward of the tower at a point 1.5 meters above the basin curb elevation. This location shall apply to check the requirement specified in para titled "Operating conditions" in previous

iii) Correction curve for wind speed shall be as per the stipulation covered in CTI.

8.06.07 Computation of Water Flow

The water flow for each radius traversed shall be determined separately by graphical integration method. The curves shall be plotted between (radius) versus (radius x velocity) on millimeter graph-sheets on large scale (not less than 1:5) to minimise the computation error. The water flow is computed from the following equation: -

Water flow (M^3/S) = 2π x Area under the curve.

The average flow of all radii traversed is the actual flow throughout the pipe. The computed area by graphical integration shall be cross checked with calculated area by numerical integration method. The area obtained by the two methods, may differ depending upon the smoothening carried out while drawing the curves.

8.07.00 Calculation of Tower Performance

8.07.01 Determination of predicted Cold Water temperature

The cold water temperature shall be read from the performance curves for 80%,90%, 100% and 110% of rated flows at test wet bulb temperature range and relative humidity (for natural draught tower only). The four points thus obtained from performance curves are plotted to obtain a cross plot which is a relation between water flow and cold water temperature. From the cross plot obtained above the predicted cold water temperature shall be read at test water flow.

8.07.02 Acceptance Criteria

If the cold water temperature is less than or equal to predicted cold water temperature as detailed above the tower is deemed to have met the guarantee

9.00.00 DRAWINGS, DATA, CURVES AND INFORMATION REQUIRED

9.01.00 The Contractor shall submit the following with his formal proposal besides the different documents/information required under this section.

9.02.00 Contractor shall furnish the following in support of tower design and performance:

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a) Heat balance calculations.

b) Justification for the outlet air temperature. This could be in the form of operating experience on existing towers or laboratory test on actual fill shape, material and configuration as offered. In the case of laboratory test, Contractor shall indicate correction / scaling factor applied to predict performance of full size tower under field conditions.

9.03.00 General arrangement drawing for cooling tower, incorporating all relevant dimensions, materials of construction of different parts, scope of supply of piping and civil works basin details indicating overflow and dislodging arrangement, arrangement of staircase, ladders, platforms, illumination of cooling tower, etc.

9.04.00 Predicted performance curves, showing wet bulb Vs. cold water temperatures for design cooling range, 90% cooling range and 110% cooling range. Such curves shall be furnished for 90%, 100%, 110% flow. In case more than one operating point is mentioned, all above details/curves are to be furnished corresponding to all additional operating points also.

9.05.00 Cooling Tower Manufacturer's detailed literature including drawing and diagram for:

a) Tower fill with supporting arrangement.

b) Drift eliminator.

c) Complete distribution system including regulating type water distribution valves, distribution basin/pipes, orifices/ nozzles, etc.

9.06.00 Electrical power distribution as required.

9.07.00 The successful Contractor shall furnish the following drawings shall be submitted within a reasonable time after placement of order:

a) General arrangement of the cooling towers, indicating all principal dimensions, extent of platforms, walkways, handrails, stairs, doors, illumination, arrangement of cooling tower structure and limits of supply and erection of piping, electrical and civil works.

b) Arrangement drawing of the cold water sumps and sludge pits for of the cooling towers, incorporating also arrangements of screens, stop log gates, valves, piping, and monorail chain pulley block installation, terminal details of outgoing piping connection.

c) Final performance curves as described in Clause No. 8.01.02.

d) Calculations to show the adequacy of tower height to provide the required Draught.

e) Calculations for tower duty coefficient and performance coefficient.

f) Sketch showing fill arrangement which should clearly indicate the total depth, horizontal and vertical spacing.

g) Following drawings on mechanical equipment, their drives and accessories:

i) Fabrication and piping erection drawing.

ii) Outline and sectional drawings of valves of each category indicating also material of construction.

iii) Sludge pump motor detail drawings.

iv) Drawing on fill, drift eliminator and its support systems and fastening arrangement complete with data on material of construction.

v) Drawing on splash boxes, nozzles in hot water basin, with data on material of construction.

vi) Drawings on screens & gates with material of construction.

h) Electrical drawings and data

i) Cable tray & trench layout.

ii) Drawings on illumination system of cooling tower structure.

iii) Drawing on grounding system inclusive of lightning protection system.

i) Drawings, data and calculation on civil works

i) Design calculations for strength and suitability showing justification for size of members chosen for all structural components of the cooling towers inclusive of pre-stressed concrete fill where applicable.

ii) Load drawings setting out clearly and concisely the various loads taken into consideration for design.

iii) Civil drawings for cold water basin, sludge sumps, connecting channels, partitions, hot water distribution basin, its covering, staircase, platforms, cable trenches, etc. all complete.

iv) Bar bending details for all reinforced concrete structures.

v) Insert details, anchor bolt details.

vi) Final painting schedule.

vii) Other drawings & data as necessary.

9.08.00 The Documents to be submitted before dispatch of Equipment for approval

a) Material Test Certificate for mechanical equipment.

b) Test certificates on each electrical equipment, cables & accessories.

ANNEXURE-I

DATA SPECIFICATION SHEET FOR INDUCED DRAFT COOLING TOWERS

GENERAL INFORMATION

No. of Cooling Towers Required	:	Three (3)
Location	:	Outdoor
Duty	:	Continuous

SITE CONDITION

Refer to Volume : II-A (Lead Specification) of this specification.

DRIVE DATA

Refer to Volume-II-F/1, F/2 (Specifications for Electrical Equipment & Accessories) of this specification.

ANNEXURE-I

DESIGN WORKING CONDITIONS

Hot water inlet temperature	:	To be indicated by Contractor
Design Ambient air wet bulb temperature	:	27.0^0C
Design Cooling range	:	Shall be equal to temperature rise across condenser plus one Deg C
Design inlet air wet-bulb temperature (including recirculation margin)	:	28.0^0C
Design Approach to inlet air Wet bulb temperature	:	5.0^0C
Design Re-cooled Water temperature at CT Basin	:	33^0C
Wind load		
Seismic Co-efficient		
Horizontal		Refer to relevant Volume on Civil and Structural Works.- Volume-II-G/1 & G/2
Vertical		
Allowable total bearing pressure on soil: Water table :		
Type of soil expected on excavation	:	Refer to relevant Section on Civil and structural works
Liquid Handled	:	Clarified Water
Required head of hot circulating water at the centre line of distribution pipe with respect to maximum/normal water level in cooling tower basin	:	* To be computed and informed by the Contractor.
* Note : This shall include static head, velocity head and frictional head (with C = 120) for the cooling tower.		

ANNEXURE-I

PARAMETER REQUIREMENT FOR THE PERFORMANCE OF COOLING TOWER			
	Rated Cooling Water flow including ACW flow	:	Shall be equal to design CW flow.
	Maximum permissible drift loss	:	0.002% of design cooling tower flow.
	Design pressure for hot water distribution system	:	Shall be not less than the shut-off head of CW pump.
	Whether following design conditions have to be considered	:	(1) : Yes (2) : Yes (3) : Yes
1)	One cell stand-by and Flow rate	:	Design flow rate of each cooling tower.
	Cooling range	:	As decided by Contractor.
	Design Inlet air wet bulb temperature	:	28°C.
	Fan blade pitch	:	Not adjusted.
	Approach	:	To be indicated by the Contractor. (Maximum permissible Approach in this condition : 5°C)
2)	One cell stand-by and Flow rate	:	Design flow rate of each cooling tower.
	Cooling range	:	As decided by Contractor.
	Design Inlet air wet bulb temperature	:	28°C.
	Fan blade pitch	:	Adjusted.
	Approach	:	5°C
3)	All cells working and Flow rate	:	Design flow rate of each cooling tower.
	Cooling range	:	As decided by Contractor.
	Design Inlet air wet bulb temperature	:	28°C.
	Fan blade pitch	:	Adjusted.
	Approach	:	To be indicated by the Contractor
SPECIAL FEATURES			
	Max. No. of cells in each tower	:	Contractor to decide based on maximum cooling tower length as 280 m with two (2) cells spare. Double row cell arrangement shall be used.
	Max. plan size for each cooling tower, Length and width	:	Shall be suitable for accommodation within the space shown in Plot Plan
	Whether fan blades to have adjustable pitch	:	Yes.

	Type of Fill	:	Film type.
	Whether fills are removable type	:	Yes.
	Fills supported by nailing acceptable	:	No.
	Longitudinal partition required	:	Yes (in case of two (2) fans per cell).
	Gear box service factor	:	2 (Min.).
	Type of Gear Box	:	Spiral Bevel-Cum-Helical Type.
	Whether space heater required for each drive motor	:	Yes.
	Noise level	:	Noise level shall be as per the stipulation laid down in the lead specification Volume-II A and the Contractor demonstrate the noise level at site during the PG test of cooling towers.
	BASIN		
	Type		Sectionalized
	Depth from basin kerb level to sump floor		The basin shall be designed for a water depth of at least 1.0 m from minimum water level with free board of at least 0.50 m above maximum water level. Minimum 10 minutes storage at rated capacity of tower shall be ensured between min. and max. water level. The basin outlet shall be sized for a water velocity not exceeding 1.0 m/sec at minimum water level.
	Partition wall thickness		Contractor to design
	Drain valve for basin sump		300 NB sluice valve (min)
	Drain pipe		300 NB (min) CI pipe as per IS: 1536/ IS:3589 (ERW Pipe)
	Whether fills are removable type	:	Yes
	Fills supported by nailing acceptable	:	No
	COLD WATER BASIN DETAILS		
	Lowest water level		

	Difference between lowest water level and level at top of mud sill at the basin cold water outlet		Contractor to indicate in his offer.
	Height of mud sill from neighboring basin floor level		
	Minimum permissible slope of basin floor towards sludge pit		1:80
	Hot water riser pipe through the centre of the basin		Not acceptable.
	Depth of sludge pit from neighboring basin floor		
	Width of each sludge pit		
	Elevation at the top of weir for overflow through each sludge pit		
	Number of sludge pits		
			Contractor to indicate in his offer.
	Number of drain outlet pipes per sludge pit		
	Size of each drain outlet pipe		
	Number of cold water outlet channels		
	Number of gates per cold water outlet channel		
	Max. allowable velocity through gates under minimum water level condition	:	0.9 M/Sec.
	Number of screens per cold water outlet channel	:	Two (2). (minimum)
	Max. allowable velocity through screens under minimum water level condition	:	0.9 M/Sec.
	Width of each cold water outlet channel	:	Contractor to indicate in his offer.
	Depth of cold water outlet channel measured from lowest basin water	:	Contractor to indicate in his offer.

	level		

COOLING TOWER PLATFORM AND STAIR CASE DETAILS			
	Minimum clear space required between any two fan stacks on adjacent cells	:	2.0 M
	Minimum clear corridor width required all along the cooling tower roof for equipment handling	:	2.0 M
	Required number of stair cases from ground level to Fan roof deck level	:	RCC staircase at both the ends of IDCTs

HOT WATER SUPPLY HEADER			
	HOT WATER PIPEWORK		
	No. of hot water riser	:	Contractor to indicate.
	Pipe size (mm)		Contractor to indicate.
	Design pressure		Contractor to indicate.

ANNEXURE-I

SCOPE OF SUPPLY			
	Cooling Tower Basin, outlet channels/sumps and sludge pits	:	Yes
	Fans with Drives & Motors	:	Yes
	Guards for rotating parts	:	Yes
	Hot water piping to distribution basin	:	Yes
	Gear operated manual Isolating Butterfly Valves on hot water distribution pipelines (Risers)	:	Yes
	Flow control valves on hot water distribution lines for each cell	:	Yes
	Flanges with bolts, nuts & gaskets for piping connections	:	Yes
	Screen & guide for each cold water outlet sump/ channel	:	Yes
	Stop log gate with guides and sealing device for each cold water outlet sump/channel.	:	Yes
	Isolating valves in sludge pit	:	Yes
	Drain piping from sludge pit	:	Yes
	Suitable lifting and handling arrangement for handling each fan hub, gear reducer and motor up to one end of cooling tower top deck and for lowering from there to ground level	: :	Yes
	Manual hoist with chain Pulley block with travelling trolley for lifting each screen in cold water outlet sump/channel	:	Yes
	All necessary supports, hangers	:	Yes
	Baseplates, foundation plates, anchor bolts, sleeves, inserts,	:	Yes

ANNEXURE-I

	bolts, nuts for all equipment supplied		
	Electrical		
	All power supply & distribution system	:	Yes
	Complete grounding system	:	Yes
	Complete lighting system	:	Yes
	Lightning protection system with grounding connection	:	Yes
	Vibration cut-out switch		Yes
	Erection Work	:	Yes
	All related civil works included	:	Yes
MATERIAL OF CONSTRUCTION			
	Hot Water Header		Carbon steel to IS:2062 with coating as mentioned in Section-I of this Volume.
	Cold water basin, outlet channel/sump & sludge pit		RCC
	Casing & superstructure		RCC
	Cell partition walls		RCC
	Cooling tower roof (top deck)		RCC
	Fan stack		RCC
	Louvers (as applicable as per OEM design for the site condition)		**RCC**
	Drift Eliminator		UV stabilized virgin PVC/PP
	Fill		UV stabilized virgin PVC / PP
	Fill supports		RCC
	Staircase		RCC
	Fan blades		FRP
	Fan hub		Hot Dipped Galvanised Steel / Cast Al. Alloy
	Gears		Alloy steel/Equivalent.
	Gearbox and fan hub supporting structure		RCC/Hot Dipped Galvanised Steel
	Fan drive shaft		SS-304 /Carbon Fibre
	Fan drive shaft coupling		SS-304
	Any other hardware such as fasteners, clamps, supports etc in direct contact with water		SS 316L

ANNEXURE-I

	Hot water distribution pipe		Industrial grade UPVC pipe as per ASTM-D having thickness of schedule 40.
	Sludge Isolation Valve		Body-2% Ni CI IS 210, FG 260 with appropriate anti-corrosive protection.
	Any other carbon steel parts used in cooling tower or its vicinity		Heavily galvanized (610 gm/ sq.m) in accordance with IS: 2629. Surface preparation in accordance with IS 2629
	Nozzles/splash cups Nozzle Header		Polypropylene /PVC PP/PVC
	Surge shaft		Surge shaft shall be provided at the top most elevation of the hot water header to IDCT. Also for IDCT, vent pipe shall be provided in each cell for surge protection.
	Screens with lifting arrangement		Please refer section-VII of this Volume
	Stop log Gates with lifting arrangement		------Do ----------
	Stair cases up to Fan roof deck level		RCC staircase at both the ends of IDCTs from ground level to Fan roof deck level.
	Ladder up to top of CT		Four (4) No. per tower – GI (610 gm/ sq.m) in accordance with IS: 2629.
	Lightning conductors		Complying to IS 2309
	Earthing		Min 40 mm dia circular earth mat for each CT
	Illumination		Illumination will be provided along the staircase, above hot water duct location and near the butterfly valve of Hot Water riser including peripheral Road lighting.
	Electrical building to accommodate Panels and Accessories		

ANNEXURE-I

INSPECTION & TESTING

Quality surveillance by	:	Manufacturer and Owner
Material testing and identification	:	Required
Stage inspection to be witnessed by Owner	:	Yes
Hydrostatic test for piping & valves required	:	Yes
Hydrostatic test to be witnessed by Owner	:	Yes
Dynamic balancing test for each drive shaft required	:	Yes.
Static balancing test for each fan and drive shaft required	:	Yes.
Balancing test to be witnessed by Owner	:	Yes.
Field performance test of individual items and the cooling tower as a whole required	:	Yes
Field performance test to be done by	:	Contractor
Fan performance test at shop required	:	Yes.
Fan performance test at shop to be witnessed by Owner	:	Yes.
All testing instruments by supplier	:	Yes.
Commissioning at site by	:	Contractor in the presence of Owner and Owner's representative.

ANNEXURE-II

DATA SPECIFICATION SHEETS FOR BUTTERFLY VALVES, HOIST, STOP LOG GATE AND SCREEN

A. BUTTERFLY VALVE

	DESCRIPTION	MATERIAL OF CONSTRUCTION
1.0	Type of operation	Manual Gear operated, Double eccentric, bubble tight shut-off
1.1	Pressure class	Min. PN-6/class 75A as per BS-EN-593/AWWA C504. or shut-off head of CW Pump, whichever is higher
1.2	Body and disc	2% Ni Cast Iron IS:210 Gr. FG 260
1.3	Valve spindle	18-8 type Stainless Steel to ASTM A479 type 316
1.4	Bearings	Teflon
1.5	Valve Seat	18-8 type 316 Stainless Steel/ ASTM A-351 Gr.CF8M
1.6	Disc seal and O-rings	Renewable Nitrile rubber 70 to 75A shore hardness
1.7	Gland	Mild Steel IS:226 or Grey Cast Iron
1.8	Gland packing	Teflon
1.9	Seal retaining ring	18-8 type 316 Stainless Steel/ (retaining segment) ASTM A-351 Gr.CF8M
1.10	Internal pins, screws	Stainless steel type 316 and other hardware
1.11	External Bolts, nuts	High Tensile Steel, Cadmium and washers etc. plated
1.12	Motor actuator	Refer Volume II-F/1
1.13	Clutch plate (if any)	Stainless Steel type 316
1.14	Pins screws & hardware	Stainless Steel type-316
1.15	Counter flange	Fabricated from IS:2062, as per AWWA C-207 or BS-EN-1092, equivalent to valve pressure class
1.16	Design Code	AWWA C-504/BS-EN-593

B. HOIST (for Stop log Gate and Screen)

1.0	Type of hoist	: Manual hoist with Trolley
2.0	Location	: Cold water basin outlet channels
3.0	Lifting capacity	: 2 MT (Minimum)
4.0	Quantity	: 2 (Two)/tower
5.0	Range of lift	: Suitable to layout requirement
6.0	Design code	: IS: 3832
7.0	Duty class	: Class 2
8.0	**Material of Construction**	
8.1	Load chain	: IS 6216 GR 80
8.2	Hand chain	: IS: 3109 Part-II Grade M4
8.3	Drive chain (for trolley drive)	: IS: 2429 Part-I –L3
8.4	Wheels	: IS: 1030 Gr. 230-450N/IS-2004 Gr.3/ Equiv.
8.5	Cast iron component	: IS: 210 Gr. FG 260
8.6	Hook	: As per IS: 3815
9.0	Maximum chain pull for Hoisting	: 15 Kg.
10.0	Maximum chain pull for trolley motion	: 15 Kg.
11.0	Type of bearing	: Ball or roller
12.0	Lubrication	: Oil/grease
13.0	Supply of Accessories and Services	
13.1	Monorail beam	: Yes
13.2	Length of each Monorail Beam	: Suitable
13.3	Tools and tackle	: Yes
13.4	All other accessories	

	as required	: Yes
13.5	Spare parts (For 3 years operation)	: Yes
13.6	Painting	: Yes
13.7	Erection	: Yes
14.0	**Inspection and Testing**	
14.1	Quality Surveillance by	: Owner
14.2	Material testing and identification	: Required
14.3	Proof load test required	: Yes
14.4	Field performance test required	: Yes
15.0	ISI certification mark	: Required

C. STOP LOG GATE

1.0	Type of Gate	:, Wall mounted, Single Faced, vertically lift type.
2.0	Location / Quantity	: Cold water basin outlet channels/ 2 (Two) per tower
3.0	Design code	: IS: 5620
4.0	Gate Size	: Contractor to indicate
5.0	Design class	: Class 1
6.0	Material of constructions	
6.1	Gate (including supporting frame)	: IS 2062 Gr. B
6.2	Guide frame (Embedded in Concrete).	: MSHDG with SS 316 L sealing surface
6.3	Slide plates of gate	: SS-316L
6.3	Slide Seal	: EPDM Musical note confirms to IS:11855
6.4	Bottom Seal	: EPDM confirms to IS: 11855

6.5	Anchor fastener, Spindle , Nut & Bolts	: SS-316L

6.6 Painting

a) Surface preparation as per IS:5905-1989
b) MS components exposed to water-Zn rich coated, DFT 150 Micron Min.
c) Eaching primer and dipping in bitumen black after Zn rich coating.

D. SCREEN

1.0	Type of Screen	: Coarse Screen
2.0	Location	: Cold water basin outlet channels
3.0	No. of screen guides/ frame with secondary embedment	: Contractor to indicate
4.0	Mesh Size	: 20 mm X 20 mm square opening with 6 SWG wire
5.0	Design Criteria	Screen panels and all its accessories shall be designed for a maximum differential water head at 50% clogged condition at maximum design flow.
6.0	Material of constructions	
6.1	Screen wire	: A 312 SS 316L
6.2	Supporting frame	: IS-2062 with coal tar epoxy coating.
6.3	Guide frame (embedded in concrete)	: IS-2062 with coal tar epoxy coating
6.4	Bolts, nuts & fasteners for fastening screen wire to the basket frame	: SS-316L
6.5	Painting	

a) Surface preparation as per IS:5905-1989
b) MS components exposed to water-Zn rich coated, DFT 150 Micron Min.
c) Eaching primer and dipping in bitumen black after Zn rich coating.

ANNEXURE-III

DATA SPECIFICATION SHEET FOR COOLING TOWER FANS

SL NO	DESCRIPTION	
1.0	Type of fan	Axial Propeller type.
2.0	Fan Capacity	Contractor to decide based on design criteria of Cooling tower.
3.0	Maximum no of blades per Fan	12
4.0	Maximum tip speed of Fan	65 m/sec
5.0	Fan sound level	< 85 dB(A) at a distance of 1 m from source.
6.0	Type of Drive & speed	Electric Motor/ 1500 RPM
7.0	Material of Construction	
a)	Fan Blades	FRP
b)	Fan hub	Hot Dipped Galvanised Steel / Cast Al. Alloy
c)	Fan drive shaft	SS-304 /Carbon Fibre
d)	Fan drive shaft coupling	SS-304

	TECHNICAL SPECIFICATION INDUCED DRAFT COOLING TOWER 3 X 800 MW NLC TALABIRA TPP	PE-TS-511-165-W001 Rev. No. 00 Date : 05.08.2024

TECHNICAL DATA - PART - A (MECHANICAL)

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Acceptance Test Code for Industrial Water Cooling tower.		Cooling Tower Institution of USA, Bulletin ATP-105
1.2	Performance Test Code for Atmospheric Water Cooling equipment.		PTC-23:ASME
1.3	Specification for Water Cooling Towers.		BS-4485.
1.4	Design of FRP components of cooling tower		CTI STD- 131 and CTI ESG-152.
1.5	Fiberglass Pultruded Structural Products for use in Cooling Towers		CTI STD-137
1.6	Structural Design of FRP components		CTI STD-152
1.7	Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products.		ASTM D-4385
1.8	Practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition.		ASTM D-3647
1.9	Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Putlruded Shapes.		ASTM D-3917
1.10	Definitions of Terms Relating to Reinforced Plastic Pultruded Products.		ASTM D-3918
1.11	Property of PVC/PP fill		CTI 136: 2010
2.0	**DESIGN /SYSTEM PARAMETERS FOR EACH COOLING TOWER**		
2.1	No. of Cooling Towers required	Nos.	One (01) per unit viz. Total three (03) nos for station
2.2	Duty	-	Continuous
2.3	Type	-	RCC Induced draught Cooling tower
2.4	Air & Water Flow pattern	-	Counter Flow
2.5	Fill Type	-	Film Fill (with minimum flute size 19mm)
2.6	Design Cooling water flow	M3/hr	73500
2.7	Design Ambient Wet bulb temp	Deg C	27
2.8	Recirculation allowance	Deg C	1
2.9	Design Inlet wet bulb temp	Deg C	28
2.10	Design Cold water temperature	Deg C	33
2.11	Hot water inlet temperature	Deg C	43.94
2.12	Cooling Range	Deg C	11.94
2.13	Design Ambient Relative Humidity	%	50
	Fill zone KaV/L can be enhanced to @2% per 1 Metre of air inlet to account for contribution of rain zone subject to maximum limit of	%	15

2.14	Liquid Handled	-	Clarified water with COC 5 (Annexure-1)
2.15	Maximum CW Pumping head permissible, viz. static head plus frictional losses as below: - Static head w.r.t. FGL - Frictional losses within bidder's T.P. with 10% margin	MWC	14.0
2.16	Minimum elevation of top of water level in hot water distribution duct with respect to FGL	M	12.5
2.17	Maximum limit on total power consumption per cooling tower for the cooling tower fans at fan motor inlet terminals	KW	2000
2.18	No. of working Cells	Number	As per bidder's design
2.19	No. of spare Cells	Number	two (2)
2.20	Evaporation loss.	%	Bidder to inform
2.21	Maximum permissible drift loss	%	0.002
2.22	Design pressure for hot water distribution system	kg / cm2(g)	5
2.23	Maximum permissible Cooling Tower Plan dimensions at 'FGL' (Excluding staircase & pavement)	M x M	200 X 36
2.24	Minimum Fill Plan area (including standby cells)	SqM	5700
2.25	Maximum Cooling tower flow capacity to be considered for design of hot water distribution and cold water channel	%	120
2.26	Finished ground level (FGL)	M	EL (-) 1.0 M (RL 202.0 M)
2.27	Maximum water level	M	EL (-) 1.0 M
2.28	Normal Water Level	M	EL (-) 1.8 M
2.29	Min. Water level	M	EL (-) 2.65 M
2.30	Min. Free board above Maximum water level	M	0.5 M
2.31	Invert level of CT Basin	M	EL (-) 3.65 M
2.32	Invert level of CW channel near CT Outlet	M	EL (-) 6.25 M
2.33	Depth of Sludge pit	M	Suitable for complete dewatering of CT basin.
2.34	Submersible Type sludge pumps	No.	2 nos. Vertical Sludge Sump (of min cap 150 cub M/ Hr.)
2.35	Number of sludge pits	No.	One
2.36	Number of cold water outlet channels		One no. CW Cold water outlet channel & shall match with Purchaser's channel at TP (Annexure-II)
2.37	Number of screens and gates in common outlet channel/Basin each) (Minimum)	No.	Two (2)
2.38	Maximum allowable effective velocity through Cold water Outlet Channel	M/sec	0.9

2.39	Length of CW Header pipe from edge of CW Basin in CT vendor's scope	M	10 (Annexure-III)
2.39	Length of CW Outlet/Channel from edge of CW Basin in CT vendor's scope	M	10 (Annexure-III)
3.0	**CONSTRUCTION FEATURES FOR EACH COOLING TOWER**		
3.1	Whether fan blades to have adjustable pitch		Yes
3.2	Whether fills are easily installable & removable		Yes
3.3	Fills supported by nailing acceptable		No
3.4	Type of Gear box		Spiral bevel cum Helical type
3.5	Gear box service factor (minimum) on motor rating		2
3.6	Factor of Safety for drive Shaft over the torque to be transmitted at design duty (minimum)		2
3.7	Fan Motor rating Selection		Fan motor shall be at least 15% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations taking into account the design condition of operation.
3.8	Minimum clear space required between any two fan stacks on adjacent cells at deck level	M	1.5
3.9	Min. clear corridor width required all along the cooling tower roof for equipment handling	M	2.0
3.10	Required number of stair cases from ground level to cooling tower fan deck	Nos.	Two(2) viz. one at each end.
4.0	**Material of construction**		
4.1	**For RCC Induced Draught Cooling tower**		
4.1.1	Cold water basin, outlet channel/ sump & sludge pit.		R.C.C.
4.1.2	Casing & Superstructure		R.C.C
4.1.3	Cell partition walls		R.C.C
4.1.4	Cooling tower roof (top deck)		R.C.C
4.1.5	Fan Cylinder/ recovery stack		R.C.C
4.1.6	Staircase		R.C.C
4.1.7	Supporting structures		R.C.C.
4.3	Hot water distribution nozzles		PVC/ Polypropylene
4.4	Hot water distribution pipes for counter flow cooling tower		Industrial grade UPVC pipe as per ASTM-D having thickness of schedule 40.
4.5	Ladder upto top of CT		Four (4) No. per tower – GI (610 gm/ sq.m) in accordance with IS: 2629
4.6	Hand rail		Hot dip galvanized to 610 gm/sqm
4.7	Fills		UV stabilized virgin PVC/PP
4.8	Fill support		RCC

4.9	Louvers (as applicable as per OEM design for the site condition)		RCC
4.10	Drift eliminators		UV stabilized virgin PVC/PP
4.11	Fan blades		FRP
4.12	Fan hub		Hot Dipped Galvanised Steel / Cast Al. Alloy
4.13	Gears		Alloy Steel/ Equivalent
4.14	Gearbox and fan hub supporting structure		RCC/Hot Dipped Galvanised Steel
4.15	Fan drive shaft		SS-304 /Carbon Fibre
4.16	Fan drive shaft coupling		SS 304
4.17	Bolts, buts etc. for fan blades		SS-304
4.18	BF Valves		Design as per AWWA C-504/BS-EN-593 Body & disc – 2% Ni Cast Iron IS:210 Gr. FG 260 Valve Spindle - 18-8 type Stainless Steel to ASTM A479 type 316
4.19	Other Valves		Body & bonnet : ASTM A 216 Gr. WCB / ASTM A 105 Trim: ASTM A 182 Gr. F6 or Equivalent
4.20	Sludge pit isolation valves - Body		Body-2% Ni CI IS 210, FG 260 with appropriate anti-corrosive protection.
4.21	Sludge pit isolation valves -Spindle & Trim		13% Cr. Steel.
4.22	Sludge outlet pipe (300 NB minimum)		CI pipe as per IS: 1536/ IS:3589 (ERW Pipe)
4.23	Stop Log gate in Cold water Outlet Basin		IS 2062 Gr. B
4.24	Guideframe for Stop Log gates		MSHDG with SS 316 L sealing surface
4.25	Screen		A 312 SS 316L Supporting frame - IS-2062 with coal tar epoxy coating.
4.26	Guideframe for Screen		IS-2062 with coal tar epoxy coating
4.27	Bolts, buts & other hardware		SS 316L
4.28	Submesible Sludge Pumps - Casing		2.5 Ni% Ni-Ci to IS 210 Gr. FG-260
4.29	Submesible Sludge Pumps -Impeller		ASTM A351 CF8M
4.30	Submesible Sludge Pumps - Shaft/Sleeves		SS-316/SS-410
4.31	Carbon /Mild steel parts or structures used in Cooling Tower or its vicinity		Heavily Galvanised (610gm/Sqm in accordance wth IS 2629 with corrosion resistant protective coating Surface preparation in accordance with IS:6129)
4.32	Material of construction for items not specified		As per purchaser's approval during detailed engineering.
5.0	**PERFORMANCE PARAMETERS**		
5.1	Cold-water temperature	DegC	33
5.2	Fan Auxiliary power consumption	kW	2000

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package	Remarks
	vii) Intermediate/line shafts with fasteners	2 sets	
	viii) Shaft coupling (Pump / motor) with fasteners	2 sets	
	ix) Shaft sleeves and fasteners	3 sets	
	x) Gaskets of all joints of pump up to discharge flange	3 sets	
	xi) Gland packing applicable for one pump	3 sets	
	xii) "O" rings applicable for one pump	3 sets	
	xiii) Bolts, Nuts and washers for Line shaft couplings of one pump	2 sets	
	xiv) stuffing box	2 sets	
	xv) Ratchet assembly for arresting reverse rotation	1 set	
	Electro-hydraulic actuators		
	Complete actuator excluding the oil tank, accumulator cylinders, counter weight and power pack	1 no	
	Complete power pack	1 set	
3.10.02	**IDCT**		
	i) Spray nozzles	10% of total quantity used for one (1)Tower	
	ii) Set of fills (Film type)	10% of total quantity used for one (1) Tower	
	iii) Drift Eliminator	5% **of total quantity used for one (1) Tower**	

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package	Remarks
	iv) Valves other than BFVs for CW system up to condenser water box and from condenser outlet to IDCT scheme	1 No. for each type, Class and size	
	v) Complete Gear Box Assembly :	1 no	
	vi) Bearings for Gear Box	2 set	
	vii) Oil Seal for Gear Box :	2 set	
	viii) Fan Blades Assembly	1 set	
	ix) Bonded neoprene rubber inserts complete with cap screws, nuts and lock washers for drive shaft assembly	1 set	
	x) Motors	1 no. of each type & rating	
	xi) Motor Bearings	1 set (DE+NDE) each type/rating	
	xii) Not used	Not used	
	xiii) Lightning fixture	1 lot	
	xiv) Set of shaft keys	1 set	
	xv) Set of assorted shims, gasket	1 set	
	xvi) Set of bolts, nuts & washer of fan blade	1 set	
	xvii) Sluice gate couple set (as applicable)	1 set	
	xviii) Shaft along with couplings	1 set	
3.10.03	**For CW system and IDCT sub package) Butterfly valves (for each type/size)**	(for each type/size).	

Sl. No.	Equipment/Package Name	Quantity to be supplied for the Package	Remarks
	i) Valve discs and its fixing fasteners	1 set	
	ii) Gland packing	1 set	
	iii) Shaft	1 no.	
	iv) Bearing	1 set	
	v) Seals, O-rings & Gaskets	1 set	
	vi) Gear box units for valve (if applicable)	1 set	
	vii) Bearing & 'O'rings for gear box unit (if applicable)	1 set	
	viii) Nuts & bolts	1 set	
3.10.04	**Rubber Expansion Joints**		
	i) Control rod	1 set	
	ii) Stretcher Plate	1 set	
	iii) Bellow	1 set	
	iv) Fasteners	1 set	
3.10.05	**EOT & Semi Gantry Crane (CW Pump House) (Each type/capacity) separate set of mandatory spares to be supplied**	**Refer ANNEXURE-I Sl No. 7.00.00**	
3.10.06	**Electric Hoists (CW system)**	**Refer ANNEXURE-I Sl No. 7.00.00**	
3.10.07	C&I Items	**Refer ANNEXURE-I Sl No. 7.00.00**	
3.10.08	**VVVFD System - (For Cranes & Hoists)**	**Refer ANNEXURE-I Sl No. 7.00.00**	
3.10.09	**VFD System -**	One Complete VFD unit - (To be	

C&I Mandatory Spares - IDCT Package		
1	Electronic Transmitters (Pressure, temp., level, DP etc)	10% or minimum 2 nos. for each type and model no. whichever is high
2	Different type of Switches (Pressure Switch, Temp Swiitch, Level Switch etc)	10% or minimum 2 nos. for each type and model no. whichever is high
3	Temperature Elements (RTD, PT-100 etc.) and Thermowells (With head assembly, terminal block and nipple)	10% or minimum 2 nos. for each type and model no. whichever is high
4	Local Gauges (Pressure, Level, temperature etc.)	10% or minimum 2 nos. for each type, range and model no. whichever is high
5	Limit Switches (for Pneumatic Valves and Manual valves)	2 no. of each type

PAINTING REQUIREMENT

Sl no	Condition	Surface Preparation	Primer Coat	No. of Coats	DFT (in Microns)	Intermediate Coat	No. of Coats	DFT (in Microns)	Final Coat	No. of Coats	DFT (in Microns)	Total DFT
EXTERNAL SURFACE - OVER GROUND PIPING												
1	Clarified Water	Surface preparation shall be done by means of sand blasting, which shall conform to SSPC SA10/NACE 2/SA2½ Standard.	Primer coat shall consist of one coat (Minimum DFT of 100 Microns) of Epoxy Resin Based Zinc Phosphate Primer.			Intermediate coat (or under coat) shall consist of one coat (Minimum DFT of 100 Microns) Epoxy Resin Based Paint Pigmented with Titanium Dioxide.			Top coat shall consist of one coat (Minimum DFT of 75 Microns) of Epoxy Paint of approved shade and colour with glossy finish. Additional one coat (Minimum DFT of 25 Microns) of finish coat of Polyurethane shall be provided.			Total DFT of paint system shall not be less than 300 microns.
INTERNAL SURFACE (FOR PIPE 450 NB AND ABOVE)												
2	Clarified Water	Surface Preparation by Means of Sand Blasting Which Shall Conforms to SSPC SP10/NACE2/SA2½ Standard.	-	-	-	-	-	-	Internally coated with coal tar epoxy coating	With minimum two (2) coats.	250	Minimum 500 microns
BURRIED CW PIPING												
3	All underground pipe shall be provided with wrapping and coating as per IS- 10221 / anticorrosive protection Coal-tar tapes as per IS15337 (however, thickness shall be as per IS10221), along with Cathodic protection depending of soil resistivity. A minimum soil cover of 1.5 m shall be provided for underground pipes. Wherever road crossings are encountered for pipelines, RCC box culverts (or) RCC encasing with suitable design requirement considered in selection of piping like axle loads etc. along with the earth cover mentioned elsewhere in this specification.											

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SECTION-I

LARGE DIAMETER LOW PRESSURE PIPING ~~AND FABRICATED TANKS~~

Note : Relevant portion for Piping & Valve details applicable for IDCT package scope to be referred in this section.

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SECTION-I

LARGE DIAMETER LOW PRESSURE PIPING AND FABRICATED TANKS

1.00.00 GENERAL INFORMATION

This specification is intended to cover the design, supply of steel plates, structural steel and all accessories as required, paints and protective paintings as specified and as required, fabrication, erection, painting, testing of the following items with accessories as specified and associated civil works for large diameter low pressure piping and tanks.

1.01.00 Large Diameter Piping, having sizes 450 NB and above, including but not limited to the following:

a) Inplant Raw Water Intake Piping from terminal point to raw water reservoir

b) Raw Water Supply Piping

c) Circulating Water (CW) Piping

d). Auxiliary Cooling Water (ACW) Piping

e) Cooling Tower Make-up (CTMU) Piping.

1.02.00 The different steel storage tanks are :

a) Condensate Storage tanks.

b) Demineralised Cooling Water make up tanks

c) NaOH solution tanks

RCC storage Tanks

a) Service Water Tanks- located at Power house building

b) Potable Water Tanks- located at Power house building

1.03.00 Rubber Expansion Joints

1.04.00 Butterfly valves

1.05.00 Spring supports for CW pipes.

1.06.00 Large Diameter Non return valves

2.00.00 CODES AND STANDARDS

In addition to the requirements spelt out in Vol.-IIA (Lead Specification), the equipment to be supplied under this section shall conform to the following Codes and Standards as required.

2.01.00 Large diameter piping

2.01.01	Material of pipe	:	IS-2062 - Code for Structural Steel.
2.01.02	IS-3589	:	Steel pipes for water and sewage (168.3 mm to 2540 mm outside diameter)
2.01.03	AWWA-C-200	:	Steel water pipe six (6) inches & larger.
2.01.04	AWWA-C-203	:	Coal tar protective coatings & linings for steel pipe.
2.01.05	AWWA-C-207	:	Steel pipe flanges.
2.01.06	AWWA-C-208	:	Dimensions of fabricated steel water pipe fittings.
2.01.07	AWWA MANUAL M-11	:	Steel pipe – A guide for design and installation.
2.01.08	IS-817	:	Code of practice for Training and testing of metal arc welders.
2.01.09	IS-1367	:	Technical supply conditions for threaded steel fasteners.
2.01.10	IS-816	:	Code of practice for use of metal arc welding for general construction in mild steel.
2.01.11	IS-822	:	Code of procedure for inspection of welds.
2.01.12	IS-9595	:	Code of procedure for manual metal arc welding of mild steel.
2.01.13	IS10221	:	Coating & wrapping of under ground mild steel pipes
2.01.14	IS15337	:	Coal tar based anti- corrosion taps for protection of under ground mild steel pipes
2.01.15	IS7193	:	Specification for glass fiber base bitumen felts

2.01.16	IS-5822	Code of Practice for Laying of Electrically Welded Steel Pipes for Water Supply

2.02.00 Steel Storage Tanks

The design, manufacture and testing of tanks shall comply with the requirements of one or more of the following standards as applicable.

2.02.01	IS - 803	:	Code of practice for design, fabrication, and erection of vertical mild steel cylindrical welded oil storage tank.
2.02.02	IS - 804	:	Rectangular pressed steel tank.
2.02.03	IS - 805	:	Code of practice for use of steel in gravity water tank.
2.02.04	IS - 816	:	Code of practice for use of metal arc welding for general construction in mild steel.
2.02.05	IS - 823	:	Code of procedure for manual metal arc welding of mild steel.
2.02.06	IS-2825	:	Code for unfired pressure vessels.
2.02.07	API-12D	:	Large welded production tanks.
2.02.08	API-12F	:	Small welded production tanks.
2.02.09	API-620	:	Recommended rules for design and construction of large welded, low pressure storage tanks.
2.02.10	API-650	:	Welded steel tank for oil storage.
2.02.11	BS-1564	:	Pressed steel tank.
2.02.12	BS EN 12285	:	Carbon steel welded horizontal cylindrical tank.

2.03.00 Rubber Expansion Joints

The design, material requirement, manufacture, testing and performance requirements of the Expansion Joints shall generally conform to one or more of the following codes and standards/documents:

2.03.01 Expansion Joints Manufacturers Association (EJMA), USA, Standards.

2.03.02 Fluid Sealing Association, U.S.A.: Technical Handbook-Rubber Expansion Joints and Flexible pipe connectors.

2.03.03 Other International Standards, equivalent to above.

2.04.00 Butterfly Valves

2.04.01 AWWA-C-504 : Rubber Seated Butterfly valves, 3 in. (75 mm) through 72 in (1800 mm).

2.04.02 BS-EN-593 : Metallic Butterfly valves for General Purposes.

2.05.00 Large Diameter Non Return Valves

2.05.01 API-594 : Check Valves: Flanged, Lug, Wafer, and Butt-welding

2.05.02 API-598 : Valve Inspection & Testing.

2.06.00 The technical requirements of the various equipment shall be guided by the design criteria and the Data specification sheets. In case of any contradiction between the aforesaid standards and stipulations of the design criteria and data specification sheets, the stipulations of design criteria and the data specification sheets shall prevail.

3.00.00 SYSTEM DESCRIPTION & SPECIFIC REQUIREMENTS

3.01.00 The different large diameter piping systems are as follows:

3.01.01 The consumptive water is proposed to be drawn from the location downstream of Hirakud reservoir (under separate package till terminal point at plant boundary) and shall be pumped from terminal point to the in-plant raw water reservoir by the EPC contractor.

3.01.02 RW piping from the discharge of raw water supply pumps, located in RW Pump House, upto the stilling chambers of PT clarifiers and DM clarifier of Water Pre-Treatment/ Clariflocculation plant laid underground. Underground Ash handling plant make-up line from raw water pump house to ash water pump house also to be provided.

3.01.03 CT make-up water piping shall be used for supplying make-up water to the C.W. forebay through control station from the Clarified Water (CLFW) reservoir by means of CTMU pumps located in CLFW Pump House. These pipes shall be laid underground upto control station (as shown in the contract drawing). In addition to this, a tapping from CT make-up line shall be extended for CW line initial filling.

3.01.04 The Circulating Water Piping shall be used for supplying water (Clarified Quality) for condenser cooling from the CW pump house sump by C.W. Pumps to the condenser and also for taking out the hot water from the outlet of condenser to the inlet of hot water distribution system of cooling towers. The scheme of C.W. piping has been shown in relevant Contract drawing.

3.01.05 Auxiliary cooling water (Clarified Quality) piping will be used for supplying cooling water from CW pipe by Auxiliary Cooling Water pumps (Booster pumps) to the Turbine vacuum pump coolers and for cooling the closed cycle cooling DM water through Plate Heat Exchangers for Steam Turbine-Generator

& auxiliaries and Steam Generator & auxiliaries. ACW piping shall also be used for taking out the hot water from these coolers and rejecting to the CW return header. The scheme of Auxiliary C.W. piping has been shown in relevant contract drawing.

3.02.00 The details of Miscellaneous steel tanks for storage of water at atmospheric pressure to be fabricated and erected under this section of specification are given as follows

3.02.01 One (1) Condensate storage tank for each Boiler Turbine Generator (BTG) unit (i.e. total 3 nos.) will store D.M. water at atmospheric pressure. Condensate storage tank will be located outdoor.

3.02.02 The Demineralised Cooling water (DMCW) make-up tanks one (1) each for SG & TG separately for each BTG unit will store demineralised water for supplying make-up quantity to the demineralised closed cooling circuit of the Steam Turbine Generator (STG) package. These tanks will be located at an elevated level, in the Power House building.

3.02.03 The NaOH solution tanks (6 Nos), One for each DMCW tank will be provided above the DMCW tank in the power house, for ensuring gravity flow.

3.02.04 RCC Service Water tanks (6 Nos), two for each unit, shall be provided on the deaerator floor of the power house.

3.02.05 RCC Potable Water tanks (3 Nos), one for each unit, shall be provided on the deaerator floor of the power house.

3.03.00 Rubber Expansion Joints

3.03.01 Rubber Expansion Joints shall be installed at the C.W. Pumps discharge, Raw water Intake pump discharge, Raw water supply pump discharge and CW makeup pumps discharge. These expansion joints shall be used to take care of axial and lateral movement of the equipment and pipes. The expansion joints shall also be designed to absorb equipment vibration. Pressure balance rubber Expansion Joints / two (2) nos (one (1) is horizontal pipe & another one (1) is vertical pipe) Inline tied expansion joints will be used on C.W Pipes at inlet and outlet of each condenser to absorb relative movement between C.W Pipes and condenser. Tied rubber Expansion joint will be installed at the ACW pumps discharge if required. The expansion joints shall also be designed to absorb equipment vibration.

3.03.02 The tied expansion joints shall be designed for the maximum pressure that may appear in the ACW system considering shut-off, water hammer, back wash and other operating conditions. They shall also be designed for full vacuum condition.

3.04.00 Spring supports shall be provided for supporting M.S fabricated C.W pipes at inlet to and outlet from the condenser. These will be justified by stress analysis.

3.05.00 Butterfly valves at Condenser Inlet/Outlet (CW system) and ACW system, at inplant raw water intake system, raw water supply system and CW makeup system as shown in the contract drawings.

3.06.00 Non return valves in inplant raw water intake system, raw water supply system and cooling water makeup system as shown in the contract drawings.

4.00.00 SCOPE OF WORK

4.01.00 Large Diameter Piping

4.01.00 The equipment and materials to be supplied under this section shall include but not be limited to the following:

a) Supply and Installation of all piping system as mentioned against Clause 3.01.00 above, and shown in relevant Contract drawings in Volume-II L of the specification, complete with all interconnections including connections with pump flanges and condenser/ equipment flanges wherever required, bends, reducers, tees, distant pieces etc. of all sizes and shapes as required for complete installation of the piping system . The nominal size of various pipes in different sections to be fabricated from steel plates/weld pipes are 450 mm N.B and above.

b) Matching pipes, matching pieces like reducers/expanders etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc. for all terminals of other packages as required.

c) Erection of all vents, drains, instrument tapping points with stubs up to root valves and thermometer well etc.

Drains, vents, thermometer wells and instrument stubs up to root valves etc. Connected with the above pipelines may be erected from straight length of piping. All bends, reducers, distant pieces, tees, etc. of all shapes and sizes shall, however, have to be fabricated as necessary. All materials required for the same shall be supplied by the Contractor.

d) Valves, Flanged butterfly valves, strainers, flanges, root-valves other accessories shall be provided. Butterfly valves at condenser inlet and outlet, Auxiliary C.W. pump discharge shall be provided with Power actuators. Over and above, those specified above, the Contractor shall provide additional valves/strainers etc. if required for safe and trouble-free operation of the systems. All the slip-on type counter flanges, blank flanges, caps, etc. necessary for the piping, shall be fabricated and installed by the Contractorto make the installation complete in all respect. All materials for the same shall be supplied by the Contractor. All necessary bolts, nuts & gaskets required for installation of the system shall also be supplied by the Contractor.

For details of Motor Actuators, Volume-II-F/1 (Specification for Electrical equipment & Accessories) of this specification shall be referred.

e) All flanged manhole and manhole covers, flanged tees with blank flanges appearing on above piping are included in the scope of work. Also all flanged tees and blank flanges for tapping water supply from these pipelines to meet the necessity of Owner's other equipment are included. All materials required for the same shall be supplied by the Contractor.

f) Steel hanger, supports, saddles, clamps etc. required for all the pipes at locations as indicated in the attached drawings and as required will be designed, fabricated and erected by the Contractorafter approval of the relevant drawings. Supports, clamps etc. for pipeline in pipe trenches, if any and other places are also to be designed by the Contractorand fabricated and erected by Contractorafter approval of his relevant fabrication drawings. All materials required for the same and also the trenches shall be made by the Contractor.

g) All angle rings and annular rings that are to be welded in the piping for grouting in the wall openings are included. All necessary seating plates for all pipe supports with anchoring arrangement including steel straps, wearing plates to be welded to the piping system etc. are included. The concrete pedestal, thrust blocks etc. where required, shall have to be provided by the Contractor. The seating plate shall also be grouted by the Contractor. Necessary anchor bolts, nuts, sleeves etc. shall be supplied by the Contractor.

i) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.

j) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required for entire low pressure piping system.

k) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided.

l) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches of the Power Station.

m) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings as well as for terminal points.

n) All flanged manhole and manhole covers, flanged tees with blank flanges appearing on above piping are included in the scope of work.

o) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

p) All field instruments stub connections shall be provided as per P & ID and Operation & Control Philosophy in Volume-II E of this specification.

4.08.00 **Rubber Expansion Joints**

The scope of supply under this specification shall be as below. Items not mentioned but deemed necessary by the Contractorfor making the system completely reliable and efficient shall also be included.

4.08.01 Expansion joints with retaining rings and requisite nos. of fixing bolts, nuts, washers gaskets connection, bellow with the companion/equipment flange.

4.08.02 Various accessories like companion flanges, control rod/unit assembly including stretcher plates, limit rods, washers nuts, bolts etc.

4.09.00 **Spring Supports**

4.09.01 Required number of spring supports shall be supplied wherever applicable.

4.10.00 **Butterfly Valves**

4.10.01 Butterfly valves shall be provided at the condenser inlet/outlet for the CW system and at ACW system as shown in the contract drawings. The Motor operated butterfly valve shall have a closing time as decided by surge analysis for the CW system to be performed by the Contractor.

4.10.02 Butterfly valves shall be provided in inplant raw water intake system, raw water supply system and cooling water makeup system. The Motor operated butterfly valve shall have a closing time as decided by surge analysis for the inplant raw water intake system to be performed by the Contractor.

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 Large Diameter (LD) Piping - General Guidelines

5.01.01 The size of CW supply and return headers, CW pump discharge & branch line to condenser/ cooling tower shall be designed for the velocity of CW flow not more than 2.0m/sec. However, the pipe sizes other than the above shall be selected as per the velocity guidelines indicated in Annexure-I of Volume-II-IB/1 Section-I. Also the thickness of CW piping shall be as per AWWA M-11 for 100% vacuum condition or as per the outcome of Surge analysis , whichever is stringent.

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5.01.02 Pipe thickness shall be calculated as per ANSI B-31.1 and AWWA-M11. The higher value shall be selected.

5.01.03 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation. Minimum 200 NB combined vacuum / air release valve in C.W. pipeline at highest point shall be provided.as per the approved recommendation of transient analysis.

If required combined vacuum / air release valve in plant raw water intake pipelines shall be provided as per the approved recommendation of transient analysis.

5.01.04 Hydraulic transient analysis shall be carried out for the entire CW piping.

5.01.05 Manholes shall be provided wherever required and the sizes shall be as indicated below:

Pipe size 1200 NB to 1800 NB - 800 NB manhole.
Pipe size 1800 NB and more - 1000 NB manhole.

All manholes shall be provided with flanged covers buried handle, gasket, bolts, nuts etc. Manhole pits shall be provided for buried piping at regular intervals of 100 m. Valve pit, if required shall be provided for buried piping system for accessibility and maintenance of the valves. The design of the valve pit shall be approved at the detail Engineering Stage.

5.01.06 For road crossings of CW pipelines, RCC box culverts (or) RCC encasing with suitable design requirement considered in selection of piping like axle loads etc. along with the earth cover motioned elsewhere in this specification. All other buried pipes (except CW pipe) at rail/road crossing shall be taken through RCC box culvert. Box culverts shall be designed and constructed in accordance with civil specification in Volume-II-G/1 & G/2.

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5.01.07 All fabricated piping under this section shall be made of tested quality mild steel plates conforming to IS-2062 (latest revision) or equivalent having thickness not less than that specified below:

	Plate Thickness (in mm.)	
Pipe Dia. (O.D)	**Above Ground Pipes**	**Below Ground Pipes**
450 NB to 600 NB	8.0	8.0
650 NB to 800 NB	10.0	10.0
850 NB to 1200 NB	12.0	12.0

The above thickness values are indicative minimum requirement, Contractorshall furnish calculation to justify thickness required as per system requirement during detail engineering and provide the same if it is more than the indicative minimum values mentioned above.

. The thickness of inplant raw water intake piping shall be calculated as per ANSI B-31.1 and AWWA-M11. The higher value shall be selected.

5.01.08 Flanges should be machined on both faces. Fabrication of flanges from segment plates should be avoided. However, if under special circumstances flanges from segment plates are to be provided, on specific instructions of the Owner/Consultant, such flanges should be completely stress relieved after welding and all welds shall be subject to dye penetration test. These flanges should also be machined.

5.01.09 All welds are to be continuous single V butt weld with finished head of size equal to thickness of plate. All welding shall be as per IS- 817 (latest revision).

5.01.10 The pipe circumferential weld shall be done in such a way that the longitudinal welds become staggered in any two consecutive sections.

5.01.11 Pipe sections in straight lengths delivered at erection site shall be of suitable length to minimise field joints as far as possible. End preparations shall be done at the fabrication yard to facilitate site welding.

5.01.12 Welding shall be carried out as per provisions laid down in IS-816 (latest revision). Welding shall be done by experienced and good operators who have been qualified by tests as specified in IS-817 (latest revision).

5.01.13 Welding sequence shall be done in such a way so as to minimise the distortion due to welding shrinkage. Any distortion will be duly rectified by the Contractor.

5.01.14 Welding shall not be carried out when the surface of the parts to be welded are wet for any cause and during periods of rain and strong winds unless the welder and work are properly shielded.

5.01.15 The piping shall be prepared cold rolled to true cylindrical shapes in a number of passes in a plate bending machine so that no undue stresses are developed. Hydraulic Press shall be used for end preparation of plates before cold rolling.

5.01.16 Gaskets shall be 3 mm thick full-face rubber.

5.01.17 Bolts and nuts shall be hexagonal head conforming to IS-1367 (latest revision).

5.01.18 The pipe sections shall be carefully placed on the sand bed prepared as specified before and then welded. The method of holding the pipe sections in position for welding during erection shall be approved by the engineer. All joints before welding shall be thoroughly cleaned and requisite welding gap maintained.

5.01.19 The unpainted ends of pipe surface shall be painted after completion of jointing. Precaution shall be taken to prevent any crack or damage in the external coating during installation.

Pipes shall be laid in trenches excavated along the route and the over-ground portion shall be installed as per final layout drawings furnished to the Contractor.

5.01.20 On completion of all welding in the pipe lines, the same shall be tested hydrostatically and after successful testing, shall be covered by sand wrapping and backfilling with earth as specified elsewhere in this specification.

5.01.21 Installed pipe shall be closed up at both ends at the end of each day by watertight plug or other means approved by the Owner to prevent debris/animals/ human beings from entering the pipe.

5.01.22 All underground pipe shall be provided with wrapping and coating as per IS-10221 **/ anticorrosive protection Coal-tar tapes as per IS15337 (however, thickness shall be as per IS10221)**, along with Cathodic protection (CP for CW/ACW system piping, inplant Raw water supply/AHS makeup piping, inplant raw water intake piping, CW makeup piping including CW system initial filling line), depending of soil resistivity. A minimum soil cover of 1.5 m shall be provided for underground pipes. Wherever road crossings are encountered for CW pipelines, RCC box culverts (or) RCC encasing with suitable design requirement considered in selection of piping like axle loads etc. along with the earth cover mentioned elsewhere in this specification. All other buried pipes (except CW pipe) at rail/road crossing shall be taken through RCC box culvert.

5.01.23 The out of roundness of the finished CW pipe shall be limited to 5% as per standard acceptance criteria. Acceptable ovality of a pipe shall be determined as per following formula.

$$\text{Ovality \%} = \frac{(\text{Max OD} - \text{Min OD})}{(\text{Nominal OD})} \times 100$$

Considering the difficulties in transporting large diameter CW pipe, shop/site fabrication may be permitted. If the Contractorprefers site fabrication, then the taxes and duties as applicable for the site fabrication for CW pipe is to be borne by Contractorduring erection.

5.01.24 If the chloride content in the makeup water is more than 100 ppm, internal coating is to be provided for entire CW/ACW, raw water piping, AHP makeup piping, CT makeup piping and blow down piping for dia 1000NB & above. Internal coating shall be with coal tar epoxy coating with minimum two (2) coats. Overall DFT shall be minimum 500 microns.
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5.02.00 **Steel Storage Tanks**

5.02.01 Tanks shall be suitably constructed for safe, proper and continuous storage of liquid described. The design code, material standard, minimum plate thickness, size and other details shall be as per the specified Codes and Standards as applicable.

5.02.02 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature. For rectangular pressed steel tank, the plates shall be heated uniformly in a furnace and formed in a press, each of which is capable of taking the whole part at a time. Alternatively, the plates may be pressed cold, the flanges made by V-die and the corners welded provided no cracks are developed.

5.04.00 Spring Supports

5.04.01 The spring rate for the springs to be adopted shall be around 40 Kg/mm. The no. of springs and their initial compression for each type of support shall be selected accordingly. The above details shall be furnished along with the offer.

5.04.02 Each spring selected shall not be loaded more than 60% of its maximum rated load while carrying the load.

5.04.03 The spring supports shall be taken from the ground floor and the method of attachment shall be detailed by the Contractor.

5.04.04 The material of construction of component parts shall be equal to or superior than the following:

a)	Spring	:	Spring steel conforming to IS-1570 Gr.50 Cr.1 V-23 or equal.
b)	Spring housing	:	Carbon Steel to IS-2062.
c)	Base plate, anchor	:	Carbon Steel Hot dip galvanised bolts, nuts, etc.
d)	Saddle	:	Carbon Steel to IS-2062.
e)	Support Table	:	Carbon Steel to IS-2062.

All other materials used shall be compatible with the service requirement and shall be of tested quality. In case resilient seating is found necessary, details of same with hardness, material etc. shall be indicated in the bid.

5.04.05 All the mounting plates, base plates, along with foundation bolts, nuts, washers etc. as required shall be supplied by the Contractor. All items required for completing the installation of the spring assemblies shall be supplied under this section.

5.04.06 The support saddles shall be welded to the respective C.W. pipe at site by the Contractor. Contractorshall ensure that the supports can be placed in their respective position with the C.W. pipes already installed.

5.04.07 The spring assemblies shall be set at shop for loads when filled up with water. The design shall however, permit that at site load adjustment to an extent of $\pm$ 10% of specified loads shall be possible and even after this adjustment, the system will allow free movement of C.W. pipes under load and empty conditions. The offer shall clearly indicate method of adjustment proposed.

5.04.08 The locking device to be provided for the spring assemblies should be such that it is possible to easily unlock the springs even when there is certain amount of unbalance between the load applied on the springs and the spring reactions. This is very important as there might always be certain difference between the theoretically calculated load for which the springs will be pre-

compressed at shop and the actual load that will be applied on the springs during operating conditions.

5.04.09 After installation of the spring supports at site with pre-compressed springs in locked condition, the C.W. pipes will be filled up with water and then the springs will be released by unloading the springs. If water in C.W. pipe is required to be drained out for any repairs/maintenance works, the springs will be locked first and then the water from the pipes will be drained out so as to avoid undue upliftment of the pipe because of loss of weight due to draining of water from the pipe. The system will be restored after repair/maintenance works by filling up the pipes with water and then releasing the locks of the springs.

The above operation of the spring supports shall have to be demonstrated by the Contractor at site.

5.04.10 It shall be possible to take out the whole spring assembly for maintenance. Arrangement for lubrication of springs and other frictional parts shall also be provided to reduce frictional resistance. The spring box housing shall have drain plugs to allow draining of accumulated water/other liquid etc.

5.05.00 Butterfly Valve

5.05.01 Butterfly valve and its operator shall be of heavy duty construction and shall be designed to withstand all working conditions i.e. shall be able to open/close or hold from/at any intermediate disc position, as required, without any difficulty under different combinations of flow and pressure.

5.05.02 The design of the valve shall take into consideration the Water Hammer effect for accidental closure of the valve disc.

5.05.03 Shaft of butterfly valves may be of single piece extending completely through the valve disc or in two pieces, stubbed into the disc hubs. The shaft diameter shall take into consideration the maximum differential pressure across the valve disc when the valve is closed and the shock load due to accidental closure of the valve disc.

5.05.04 Disc of butterfly valve shall have no external ribs transverse to the direction of flow. The disc shall be of a design that permits removal and replacement at site. The external ribs shall be securely clamped on the body or disc of the valve.

5.05.05 Each butterfly valve shall be fitted with two (2) sleeve type shaft bearings, contained in the hubs of the valve body. Bearings shall be of self-lubricated type and shall not have any harmful effect due to handling fluid.

5.05.06 Shaft seals for butterfly valves shall be provided both at drive and non drive end of the shaft to prevent fluid flow to valve bearings.

5.05.07 Design of the gear reducers for butterfly valves shall conform to AWWA/BS standard.

5.05.08 Butterfly valves to be used for flow regulation/control shall be designed to accommodate extra velocity through the valve passage to ensure normal service life. The design shall consider of the pressure drop across the valve disc due to control of fluid flow and shall take care of the erosion and cavitation effect on the body and the disc due to such operation.

For detail specification refer Annexure-II of this section.

5.06.00 Design & Construction for the control & Instrumentation shall be as per the P & ID applicable for respective systems enclosed in Vol. II L, Operation & Control philosophy in section-I of Volume-II-IA and volume II-E (Specifications for Control & Instrumentation) of this specification

6.00.00 EXCAVATION AND BACKFILLING

6.01.00 Scope

This specification covers excavation in pipe trenches in all types of soil (including rock) including shoring, dewatering, back filling under pipes, transportation of earth, backfilling the excavated trenches with selected soils, RCC Box culvert, compaction of fills and approaches, protective fencing, lighting and other safety measures as may be applicable, removal of surplus soils to selected areas etc. and other works for underground pipe installations. The scope of work also covers protection of adjacent structures and protection, maintenance or removal of other pipes and conduits.

6.02.00 General

Unless noted otherwise, AWWA-M11: Steel Water Pipe: A Guide for Design and Installation, shall be used as guideline for earthwork in excavation and back filling for pipe laying work.

6.02.01 Materials to be used

Earth to be used for filling under pipes shall be clean, graded and free from harmful and deleterious material. Borrow material, if required, for backfilling the excavated trenches, shall be excavated from approved locations and levels, and shall consist of granular material free from roots, vegetation, decayed organic matter, harmful salts and chemicals, free from lumps and clods.

Materials for shoring shall be of best commercial variety and accepted by the Consultant. Shoring materials required for the work under this clause shall be arranged by the Contractor.

6.03.00 Execution

6.03.01 Setting out & levels

On receiving the approval from the Consultant on working drawings the Contractorshall set out the work from the control points furnished by the

Consultant and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Consultant and certified by him after which the Contractorwill proceed with the work. The Contractorshall provide the Consultant/Owner with men, materials, tools & instruments for checking purpose. This checking by the Consultant/Owner prior to start of the work will in no way absolve the Contractorof his responsibility of carrying out the work to true lines and levels and grades as per drawings and subsequent corrections'

The clearance for starting excavation work in different areas within the work may be given separately by the Consultant in co- ordination with other Project work. As such prior approval of the Consultant shall be obtained by the Contractorin each individual case.

6.03.02 Cleaning and Grubbing etc.

The area to be excavated shall be cleared out of fence, trees, logs, stumps, bush, vegetation, rubbish, slush etc. and levelled up. Trees up to 300 mm girth shall be up-rooted.

6.03.03 Depth

Trenches should be dug to grade as shown in the profile. Where no profile is provided, the minimum cover should be generally selected to protect the pipe from transient loads where the climate is mild.. The profile should be selected to minimize high points where air may be trapped.

6.03.04 Width

Where the sides of the trench will allow reasonable side support, the trench width that must be maintained at the top of the pipe, regardless of the depth of excavation, is the narrowest practical width that will allow proper densification of pipe-zone bed- ding and backfill materials. If the pipe-zone bedding and backfill require densification by compaction, the width of the trench at the bottom of the pipe should be determined by the space required for the proper and effective use of tamping equipment, but it should never be less than the pipe OD plus 20 in. (508 mm).

To avoid imposing excessive external loads on the pipe, the trench width should be kept to the minimum width consistent with the back-fill-compaction equipment and the type of joint used.

6.03.05 Bottom Preparation

Flat-bottom trenches should be excavated to a minimum depth of 2 in. (51 mm) below the established grade line of the outside bottom of the pipe. The excess excavation should then be filled with loose material from which all stones and hard lumps have been removed. The loose subgrade material should be graded uniformly to the established grade line for the full length of the pipe. Steel pipe should not be set on rigid blocks on the trench bottom that would cause concentration of the load on small areas of pipe coating or cause deformation of the pipe wall.

Where the bottom of the trench is covered with solid, hard objects that might penetrate the protective coating, a bedding of sand, 3-6 in. (75-152 mm) thick, should be placed under the barrel of the pipe. Screened earth also has been used successfully for such a bedding, where it will remain dry during pipe installation and backfill. It may be advantageous to shape the trench bottom under large steel pipe for full arc contact.

6.03.06 Over excavation and Special Subgrade Densification

When required, the trench should be over excavated to a depth of at least 6 in. (152 mm) below the bottom of the pipe where the trench bottom is unstable, or where it includes organic materials, or where the subgrade is composed of rock or other hard and unyielding materials. The over excavation should be replaced with well-densified material to a depth of approximately 2 in. (76 mm) below the bottom of the pipe, and the remaining subgrade should be completed with loose material. Voids formed by the removal of boulders and other large interfering objects extending below normal excavation limits should be refilled with material as described above.

6.03.07 Regulations

All applicable local, state laws and regulations should be carefully observed including those relating to the protection of excavations, the safety of persons working therein, and provision of the required barriers, signs, and lights.

6.03.08 Dewatering

All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractorshall remove by pumping or other means approved by the Consultant any water inclusive of rainwater and subsoil water accumulated in excavation and keep the trench dewatered until the installation and backfilling work are complete. All pumps, cables and other materials required for dewatering shall be arranged by the Contractor.

6.03.09 Testing and Acceptance Criteria for Backfilling work

The degree of compaction required will be as per the stipulation laid down in IS:4701. The density of soil in field shall be determined in accordance with IS:2720 (Part-XXVIII) or IS:2720 (Part-XXIX). The work of backfilling will be accepted after the Owner is satisfied with the degree of field compaction achieved. The Owner at his discretion may ask the Contractorfor performing the Standard compaction tests at some specified locations for determining the degree of compaction. The Contractorshall do the testing at some approved laboratory at his own cost and forward test results, in triplicate, to the Owner.

6.03.10 Disposal of Surplus Spoil

Surplus material from excavation, which is not required for backfilling, will be disposed of in designated disposal areas. The spoils shall be dumped in a

systematic manner and spread in layers not exceeding 150 mm thick and consolidated with the help of compacting equipment.

7.00.00 CIVIL WORKS

All Plain and Reinforced Concrete work covered in this section shall generally conform to Guidelines for Cement Concrete (Plain & Reinforced) Section-VI of Volume-II-G/2, Part-A of this specification, unless noted otherwise.

8.00.00 TESTING AND INSPECTION

8.01.00 Large Diameter Piping

8.01.01 After pipe lines have been laid and joined, the same shall be tested hydrostatically as specified in this section.

8.01.02 All the longitudinal and circumferential welded seams shall be subjected to chalk and kerosene test / penetrant test prior to hydraulic testing. This shall be done at the presence of the Owner. In addition to this, test coupons shall have to be provided for each longitudinal seams for mechanical tests (tensile and bend), if considered necessary by the Owner. The test coupons are to be broken in presence of the Owner. Contractor shall satisfy the Owner that work is being carried out in accordance with the specification drawings and other conditions. Owner shall have full access to the Contractor's working area.

8.02.00 Performance Tests for Steel Storage Tanks

8.02.01 Vertical Cylindrical Storage Tanks shall be tested generally as per IS:803 including the following :

a) Spot radiography, if joint efficiency factor of 0.85 is considered.

b) Bottom plate testing by air or vacuum box.

c) Shell testing by filling with water.

d) Fixed roof testing by air.

8.02.02 Horizontal cylindrical tanks manufactured in accordance with BS EN 12285-1 & BS EN 12285-2, shall be tested hydraulically at 0.7 bar at the top of tank, unless otherwise specified.

8.02.03 Pressed steel tanks shall be hydraulically tested by filling with water up to the top of tank as per IS:804.

8.02.04 Radiography & hydrostatic tests shall be guided by IS:2825 for pressure vessels.

8.02.05 Hydraulic & other performance tests shall be conducted on all accessories of the tank as per the codes specified in this section.

8.02.06 All tanks shall be leak tested twice, after completion of fabrication and after application of anti-corrosion painting/ lining. The tanks shall be filled up with water in stages as directed by the Owner. The duration of leakage test shall not be less than eight (8) hours.

8.03.00 Shop Inspection and Testing for Expansion Joints

8.03.01 The manufacturer shall conduct all tests requirement to ensure that all the component parts of the Expansion Joints offered conform to the requirements of specified codes and standards.

8.03.02 Dimensional inspection

Each Expansion Joint shall be inspected for dimensional accuracy acceptance limits of which shall be mutually agreed upon.

8.03.03 Hydrostatic pressure test & leakage test

All Expansion bellows shall be subjected to internal hydrostatic pressure test at a value of one and a half (1.5) times the design pressure for a period of 30 min. under each of the following conditions:

a) Free position of the bellow

b) With permitted (design) elongation & lateral deflections and

c) With design contraction and lateral deflection.

After the hydro test is over, the bellow shall be dimensionally inspected to check deformation, if any.

During the test, the control assembly shall be suitably adjusted to obtain the test conditions of the bellow.

8.03.04 Vacuum Test

All Expansion Joints shall be subjected to vacuum test at a pressure of 700 mm of Hg for a period of 10 min. under each of the three conditions mentioned in Clause 8.03.03 above.

8.03.05 Chemical Analysis

Test for chemical composition of the bellow material, split retaining ring, control rod assembly shall be carried out.

9.00.00 PAINTING

Please refer relevant sections of Volume-IIA, Lead Specification.

10.00.00 DRAWINGS, CURVES & INFORMATION REQUIRED

10.01.00 The Contractorshall submit with his formal proposal the following

10.01.01 A complete list of all large Diameter piping and fittings of various sizes with their quantities and details e.g. nominal size, O.D, I.D (as applicable), thickness, design pressure, design temperature, material of construction/ code/standards etc.

10.01.02 A complete list of all L.D piping valves with their type, quantities and ratings.

10.01.03 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

10.01.04 Outline and fabrication drawings of the tanks indicating plate thickness, details of structural support, stiffeners and details of connections provided.

10.01.05 Illustrative literature and drawings for the accessories supplied with tanks.

10.01.06 General Arrangement and Sectional drawings with data on weight and material of construction for each category of Expansion Joints with control rod assemblies.

10.01.07 A comprehensive write-up or brochure on the manufacturing and testing facilities in the shop for the manufacturer of rubber expansion joints.

10.02.00 After finalization of contract, various drawings, data and instruction manual shall be submitted for review/approval of Owner and afterwards for final distribution in quantities following the procedure as set up in the applicable clauses in General Conditions of Contract.

The various drawings/data to be furnished shall include the following :

10.02.01 Detailed fabrication drawing showing the sizes, materials and weld edge preparation etc. The fabrication drawings shall give all necessary information for fabrication; erection and painting of steel work in accordance with provisions of this specification. Welding symbols used shall be in accordance with the requirements of IS:813 - latest revision and shall be consistent throughout. Weld lengths called on the drawings shall be net effective lengths.

10.02.02 The Contractorshall submit working drawing for excavation and backfilling purpose as mentioned earlier. Detailed drawings for R.C.C. and other

civil/structural works shall be submitted in accordance with the stipulations made in Civil specification.

10.02.03 The Contractorshall also submit detailed calculations in support of the final pipe thickness adopted during detail engineering stage

10.02.04 Instruction Manuals covering maintenance, repair and replacement of equipment fabricated and supplied by them.

10.02.05 Details of welding procedure and weld roots to be used.

10.02.06 Design calculations for plate thickness etc., considering all applicable loads, seismic effect, wind load etc.

10.02.07 Test procedures for tanks and test certificates.

10.02.08 General Arrangement drawing of each size and type of Rubber Expansion Joint with control rod assembly giving principal dimensions and weights.

10.02.09 Cross-sectional assembly drawing of each size and type of Rubber Expansion Joint complete with data on materials of construction, control rod assembly etc.

ANNEXURE-II

SPECIFICATION OF BUTTERFLY VALVE

1.00.00	Valve operation	:	Hydraulic/ Actuator Motor operated
1.01.00	Closing/opening duration		Contractor to indicate based on transient analysis report
2.00.00	Basic Design Code	:	AWWA-C-504/ BS-EN-593
3.00.00	Pressure	:	To be suitably chosen by the Contractor according to requirement, but not less than class 75A as per AWWA-C-504 or PN-6 as per BS-EN-593.
4.00.00	Construction	:	Double eccentric, Bubble tight shut-off, Cast Body and Disc
5.00.00	Material		
	a) Body	:	2% Ni Cast Iron as per IS-210 Gr. FG260.
	b) Valve Disc	:	-Do-
	c) Valve Shaft	:	Stainless Steel ASTM-A-479 type 304
	d) Seat ring	:	Clamping ring Stainless Steel ASTM-A-479 type 304
	e) Shaft Bearing	:	Bronze backed PTFE
	f) Gland Packing	:	Impregnated Teflon
	g) Seal	:	Nitrile Rubber
6.00.00	End preparation	:	Flanged, Drilled as per ANSI B16.1/BS-EN-1092-2. Necessary counter flange nuts, bolts, gaskets are to be provided with each valve.
7.00.00	Testing	:	As per AWWA-C-504/ BS-12266-1. However valve disc strength for both forward reverse flow is to be carried out as per BS5155. Certificate for proof of design test for similar type of valve is to be furnished.

4.19.00 Control & Instrumentation

Design & Construction for the control & Instrumentation shall be as per the P & ID, Operation & Control philosophy in Volume II-E (Specifications for Control & Instrumentation) of this specification.

5.00.00 BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING

5.01.00 All fittings including "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves shall have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

5.02.00 Adjustments such as removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and the Contractor is required to carry out such work as per instruction of Owner, which shall include specified heat-treatment procedures, etc. also wherever required.

5.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the Contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

5.04.00 Suspension for piping, pressure parts, etc., shall be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.

5.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Owner before erecting the same and also during pre- commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Contractor during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational flexibility shall be part of erection work.

5.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the Owner before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.

5.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection, which shall be carried out by the Contractor. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.

5.08.00 Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Contractor shall take prior approval from Owner. Further, any cutting or alteration of member of the structure or

platform or other equipments shall not be done without specific prior approval of Owner.

5.09.00 Where piping erected by the Contractor is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.

5.10.00 a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.

b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.

c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Consultant. In such special case, the piping may be arranged in trenches, or buried and properly protected as per IS-10221 Standards.

d) Overhead piping shall have a minimum overhead clearance of 2.5 meters above walkways and working areas and 8 meters above roadways unless otherwise accepted by the Owner/Consultant.

e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective Bids drawings or not. The pipelines shall be sloped towards the drain points.

f) For field run piping the Contractor shall fabricate and erect all hangers and supports as required with due regard to general arrangement, layout of other pipes, hangers, cable trays ducting structural members etc. and in consultation with and to the approval of Consultant.

g) Necessary ladders with platforms shall be provided by the Contractor at locations whenever required for approach to different maintenance prone areas on the pipelines and, in particular, valves.

5.11.00 All drips and drains for piping and equipment whether shown in the Bid drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. Leading such drains up to station drainage is also the responsibility of the Contractor.

6.00.00 INSPECTION AND TESTING

Inspection and testing shall be carried out as per relevant code and approved Quality Assurance Plans. A brief guideline is being furnished below. However the manufacturer shall have to carry out all other tests as required by the relevant codes and standards.

Sl. No.	Tests/Check Items / Components	Material test	DPT/MPI	Ultrasonic Test	WPS / WQS / PQR	Balancing	Hydro / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional /	Performance test	Other tests	All tests as per relevant Std	Adhesion / Spark Tests	Remarks
1.	Pipes & Fittings and Metered Bends	Y a	Y b		Y		Y			Y			Y 1 5			
2.	Diaphragm Valves	Y a					Y 5			Y				Y6		
3.	Butterfly Valves(Low Pressure)															
a)	Casted Butterfly Valves						Y		Y	Y	Y		Y 7			
i.	Body (Cast)	Y a	Y b													
ii.	Disc (Cast)	Y a	Y b													
iii.	Shaft	Y a	Y	Y C												
b)	Fabricated Butterfly Valves															R ef er n ot e 1 4
4.	Gate/ Globe/Swing Check Valves	Y a	Y b	Y C			Y 5	Y	Y	Y	Y		Y 8			
5.	Dual Plate Check Valves	Y a	Y b	Y C			Y	Y	Y	Y	Y		Y 4			
6.	Rolled & Welded Pipes	Y a	Y 3		Y		Y 1			Y						
7.	Coating & Wrapping of Pipes	Y 2											Y 2			
8.	Tanks & Vessels	Y a	Y b		Y		Y						Y 1 1			

Sl. No.	Tests/Check Items / Components	Material test	DPT/MPI	Ultrasonic Test	WPS / WQS / PQR	Balancing	Hydro / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional /	Performance test	Other tests	All tests as per relevant Std	Adhesion / Spark Tests	Remarks
9.	Strainers	Y a	Y b				Y									
10.	Rubber Expansion Joints	Y a					Y 12		Y				Y 13			
11.	Rubber Lining of Pipes	Y a	X		X		Y			Y				Y9	Y	
12.	Hangers & Supports	Y a								Y						
13.	Fasteners	Y a		X				X								
14.	Site Welding		Y 10		Y		Y									

Notes:

1) Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.

2) Spark Test, Adhesion Test and Material Test for primer and enameled& Coal Tar Tapes as per AWWA-C-203-91

3) DPT on route run and after back gouging and on finish welds.

4) Dry Cycle Test (Dual Plate Check valve) for one lakh Cycles shall be carried out as a type test.

5) Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.

6) Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles.

7) Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with latest edition of AWWA-C-504 in presence of Employer's representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions.

8) Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard. Maximum

allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes

9) Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material

10) Dry film thickness check, humidity check, pipe temperature check, adhesion check and Holiday Detection test shall be done.

11) 10% of welds shall be subjected to DPT (100% DPT for compressed air line and boiler & deaerator fill line.)

12) Pressure drop across the strainer for each type and size as a special test shall be carried out. In case of already carried out, the test report shall be submitted for review and acceptance by Client/Consultant.

13) During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.

14) Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.

15) In addition of all tests as indicated for Cast Butter Fly valve being applicable for fabricated butterfly valves, following test shall be done for fabricated butter fly valve:

- UT as per ASTM A-435 on plate material for body and disc shall be carried out for plate thickness 20mm and above.
- 100% RT and DPT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc. 10% DPT on other welds shall be done.
- Post weld heat treatment as per ASME, Section-VIII, Division-I on butt joints of body and disc if thickness is more than 30mm.
- Welders and WPS shall be qualified as per ASME- section IX.

(a) One per heat/heat treatment batch/lot.
(b) On machined surfaces only for castings and on finished butt welds.
(c) For shaft/spindles > or = 50 mm

1. **If applicable:** Segmented flange exceeding 30 mm thickness shall be stress relieved and not more than 4 segments is allowed. For stainless segmented flanges and stainless steel fabricated fitting, 100% radiography of all weld seams including mother pipe weld seam shall be employed.

   If applicable: For pressure vessel welds RT shall be done as per design code requirements.

ANNEXURE-III

SPECIFICATION OF VALVES

		A. Cast Iron Body Gate/ Globe/ Check Valve	B.Stainless Steel Body Gate/ Globe/ Check/Ball/ Butterfly Valve	C.Steel Body Gate/Globe/ Check Valves	D. Steel Body Ball/Check Valves	E. Cast Iron Body Butterfly Valve
1.00.00	Basic Design Code					
	a) Gate	a)	a) ANSI-B-16.34	a)		
		i) IS-14846 for 50 – 300 NB		i) API 600 for 50 NB and above/ ANSI-B-16.34		
		ii) for 350 NB & above as per MSS-SP-70		ii) API 602 for size below 50 NB/ ANSI-B-16.34		
	b) Globe	b) MSS-SP-85	b) ANSI-B-16.34	b) BS 1873/ ANSI-B-16.34		
	c) Check	c) IS-5312/ MSS-SP-71	c) ANSI-B-16.34	c) BS 1868/ ANSI-B-16.34	c) BS 1868/ ANSI-B-16.34	
	d) Ball		d) BS EN ISO 17292		d) ANSI B-16.34	

ANNEXURE-III

		A. Cast Iron Body Gate/ Globe/ Check Valve	B.Stainless Steel Body Gate/ Globe/ Check/Ball/ Butterfly Valve	C.Steel Body Gate/Globe/ Check Valves	D. Steel Body Ball/Check Valves	E. Cast Iron Body Butterfly Valve
	e)Butterfly		e) AWWA C 504/ BS-EN-593			e) AWWA C 504/ BS-EN-593
2.00.00	Pressure Class	To be suitably chosen considering the pressure requirement. Refer specification clause No. 4.01.09 in this regard				
3.00.00	Construction	Cast body and bonnet/cover	Forged body upto 50 NB and Cast body above that size.	Forged body upto 50 NB and Cast body above that size.	Forged body upto 50 NB and Cast body above that size.	Cast body
4.00.00	Material					
4.01.00	Body & Bonnet/ Cover	IS 210 Gr. FG 260	ASTM-A-182 F304 for ≤ 50 NB; ASTM A351 CF8 for ≥ 65 NB	ASTM-A-216 Gr. WCB for ≥ 65 NB & ASTM-A-105 for ≤ 50 NB	ASTM-A-216 Gr. WCB (Galvanized) for ≥ 65 NB & ASTM-A-105 (Galvanized) for ≤ 50 NB	IS 210 Gr. FG 260/ ASTM-A 126 Class B

ANNEXURE-III

		A. Cast Iron Body Gate/ Globe/ Check Valve	B.Stainless Steel Body Gate/ Globe/ Check/Ball/ Butterfly Valve	C.Steel Body Gate/Globe/ Check Valves	D. Steel Body Ball/Check Valves	E. Cast Iron Body Butterfly Valve
4.02.00	Disc.	IS 210 Gr. FG 260	ASTM-A-182 F316 for ≤ 50 NB; ASTM A351 CF8 for ≥ 65 NB	ASTM-A-216 Gr. WCB for ≥ 65 NB & ASTM-A-479 Type 410-2 for ≤ 50 NB	ASTM-A-351 CF8	IS 210 Gr. FG 260/ ASTM-A 126 Class B
4.03.00	Stem/Spindle	SS-410	SS-410	SS-410	SS-410	SS-410
4.04.00	Seating surface	13% Cr. Steel as per IS-1570	For Ball valves PTFE seats and seals	13% Cr. Steel as per ASTM-A-182 Gr. F6.	13% Cr. Steel as per ASTM-A-182 Gr. F6.	Rubber
5.00.00	End Preparation	Flanged	Socket welded for ≤ 50 NB and Flanged for ≥ 65 NB		Flanged RF for ≥ 65NB and Screwed for ≤ 50 NB	Flanged
6.00.00	Testing :					
	a) Gate	a) i) As per IS 14846 for 50 NB – 300 NB ii) IS-14846 for sizes equal to and above 350 NB	a) As per ANSI B-16.34	a) API-598		

ANNEXURE-III

		A. Cast Iron Body Gate/ Globe/ Check Valve	B.Stainless Steel Body Gate/ Globe/ Check/Ball/ Butterfly Valve	C.Steel Body Gate/Globe/ Check Valves	D. Steel Body Ball/Check Valves	E. Cast Iron Body Butterfly Valve
	b) Globe	b) Hydrostatic Test as per MSS-SP-85	b) As per ANSI B-16.34	b) BS-1873		
	c) Check	c) IS 5312/ MSS-SP-71	c) As per ANSI B-16.34	c) BS-1868	c) BS-1868	
	d) Ball		d) As per ANSI B-16.34		d) ANSI B-16.34	
	e) Butterfly		e) AWWA C 504/ BS-EN-12266-1			e) AWWA C 504/ BS-EN-12266-1

ANNEXURE-IV

SPECIFICATION OF SLUICE VALVES WITH EXTENDED SPINDLE

TYPE OF VALVE		GATE VALVE
General Requirements	1. Service	CT basin sump Drain valve/Sludge pipe isolation valve
	2. Size	As per approved P&ID
	3. Pressure Rating	PN 1.0
	4. Design & Testing Standard	IS:14846
	5. Type of valve	Double flanged, Non-Rising stem, Full-way type with extended Spindle
	6. Type of Operation	Manual
	7. Frequency of valve operation	Intermittent
	8. Location	Outdoor
Design & Construction Features	1.End Connection	Flanged, flat faced as per ASME B-16.1, Class 125#
	2. Stem	Screw & yoke
	3. Bonnet	Bolted bonnet
Material of Construction	1. Body/Bonnet/Wedge/Cover Body	IS-210 Gr. FG 260
	2. Disc/Ball	IS: 210, Gr. FG 260
	3.Stem	13% chromium steel
	4. Packing	PTFE
	5. Seating Surafces & rings	13% chromium steel
	6. Back seat	13% chromium steel
	7. Hand Wheel/Lever	Cast Iron/Malleable Iron
	8. Companion Flange	Slip on flat faced flanges of Carbon Steel to AMSE B 16.5, Class 150, material to IS: 2062 Gr. B.
	9. Nuts & Bolt	Carbon Steel, IS:1367, Prop. Class 4.6
	10. Gaskets	CAF

ANNEXURE-IV

TYPE OF VALVE		GATE VALVE
Inspection & Testing	1. Hydraulic Test Pressure : Body	1.5 MPa(g)
	2. Hydraulic Test Pressure : Seat & Back seat	1.0 MPa(g)
	4. Other Test	As per Approved QAP
Additional features		1. (a) Hand wheel shall move in clock-wise direction to close. (b) All valves shall have indicators or direction clearly marked.
		2. The following accessories shall be provided in addition to the standrad items: a) Hand wheel b) Manual gear reduction unit operator for valves 200 NB and above. c) By-pass (equilising) valve d) Draining arrangement wherever required. e) Position indicator
		3. Back seating bush shall be provided to facilitate gland renewal during valve full open condition.
		4) The valves shall have permanent SS metal tag attached to the valve indicting the following: a. Valve size. b. Hydrostatic test pressure. c. Seat test pressure. d. Pressure class. e. Maximum flow.Weight of valve & valve actuator. f. Tag no. g. Year of manufacture.

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

1.1 Scope for supply, and erection & commissioning of various equipment forming part of electrical system for this package shall be as per Annexure-I "ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR".

1.2 BHEL will provide 240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract.

2.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

2.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated.

2.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

3.0 LIST OF ENCLOSURES

3.1 Electrical scope between BHEL & vendor (Annexure-I).
3.2 Technical specification - Motors (Annexure-II)
3.3 Technical specification/drawings- Cabling material (Annexure-III)
3.4 Technical specification- Lighting (Annexure-IV)
3.5 Technical specification/drawing- Above Ground Earthing and Lightning protection (Annexure-V)
3.6 Datasheets (Annexure-VI)

ANNEXURE-I

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR REV-0, DATE: 25.07.2024

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (3X800 MW) EPC PACKAGE
PACKAGE: COOLING TOWER (INDUCED DRAFT)
SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, **ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Cabling material (Cable trays, accessories & cable tray supporting system)	Vendor	Vendor	1. Layout details between vendors supplied equipment & installation dwgs by vendor. 2. BHEL will provide cable trench/cable racks/cable pedestals along with cabling material up to the terminal point approx. 10 m away from cooling tower. Further cabling (supply and E&C) shall be in vendor's scope.
6	Cable glands ,lugs, and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty Lugs. Aluminium lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.
7	Equipment grounding (including electronic earthing) & lightning protection	Vendor	Vendor	Material and sizes shall be as per specification and subject to BHEL approval during detailed engineering stage. Refer note no. 4 for electronic earthing.
8	Below grade grounding	BHEL	Vendor	MS Rod material shall be provided by BHEL. All other materials/ consumables are in vendor's scope.
9	LV Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
10	Lighting System	Vendor	Vendor	In addition to other lighting system items, vendor shall consider Lighting panels

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (3X800 MW) EPC PACKAGE
PACKAGE: COOLING TOWER (INDUCED DRAFT)
SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, **ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				(LP) & timer control as per requirement. Further wires, any other material required for lighting system shall also be considered by vendor in their scope. BHEL will provide the power supply along with LDB at one location near Cooling Tower for feeding cooling tower vendor LPs/other lighting loads. Further distribution including material is in vendor scope.
11	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their civil assignment drawing.

ANNEXURE-II

	TECHNICAL SPECIFICATION IDCT NLC TALABIRA THERMAL POWER PROJECT (3X800 MW) EPC PACKAGE	PE-TS-XXX-YYY-HZZZ Issue No: 01 Rev. No. 00 Date :

TECHNICAL DATA - PART - A

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Three phase induction motors :		IS15999, IEC:60034, IS: 12615, IS: 325
1.2	Energy Efficient motors		IS 12615, IEC:60034-30
1.3	Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity		IS 12075/IEC 60034-14
1.4	Designation of Methods of Cooling of Rotating Electrical Machines		IS 6362
1.5	Designation for types of construction and mounting arrangement of rotating electrical machines		IS 2253
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	Rated voltage	V	415
2.2	Frequency	Hz	50
2.3	Permissible variations for		
a)	Voltage	%	+/-10
b)	Frequency	%	(+)5 to (-)5
c)	Combined	%	10 (absolute sum)
2.4	System fault level at rated voltage for 1 sec	kA	50
2.5	Short time rating for terminal boxes for 0.25 sec	kA	50
2.6	Type of motors		Squirrel cage induction motor
a)	Non-VFD		Suitable for direct on line starting
b)	VFD (if applicable)		Suitable for inverter duty
2.7	Efficiency class		
a)	Output rating (at 50 deg.C ambient temperature)		IE3
2.8	Rating		
a)	Motor duty		Continuously rated-S1
b)	Design margin over continous max. demand of the driven equipment (min)		10%
3.0	**CONSTRUCTION FEATURES**		
3.1	Winding		Electrolytic grade copper conductor
3.2	Enclosure Details		
a)	Degree of protection		
	i) Indoor application		IP 55
	ii) Outdoor application		IP 55 (External FRP canopy to be provided)
b)	Method of ventilation		Totally enclosed fan cooled (TEFC) type
3.3	Insulation		
a)	Class		'F' with temperature rise limited to class 'B'
b)	General Characteristics		Non-hygroscopic, oil resistant, flame resistant
c)	Special Characteristics		VPI insulation for VFD motors
3.4	Bearings		
a)	Horizontal motors		Greased ball, roller and/or sleeve bearing

b)	Vertical motors		Grease lubricated ball or roller bearings or combined thrust and guide beaing (Refer Motor specification)
3.5	Main terminal box		
a)	Type		Detachable type
b)	Location		In accordance with Indian Standards clearing the motor base-plate/ foundation
c)	Terminals		Stud or lead wire type, substantially constructed and thoroughly insulated from the frame
d)	Markings		Phase markings on terminals and direction of rotation marked on the non-driving end
e)	DOP		Same as motor
f)	Position when veiwed from the non driving end		Left hand side
g)	Rotation		90 Deg.
h)	Space heater (for ratings 30 kW and above)		Suitable for 240V, 50Hz 1 ph AC. Separate terminal box provided for space heaters.
f)	Cable glands/lugs/gland plates		
i)	Size		As per cable size used
ii)	Lugs		Solderless crimpting type heavy duty (Aluminium lugs for Aluminium cables and copper lugs for copper cables)
iii)	Glands		Double compression Ni-Cr plated brass glands
iv)	Gland plate thickness		3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables)
3.6	Earthing points		
a)	No. of points on motor body		Two earthing points on opposite sides with two separate and distinct grounding pads complete with tapped holes, GI bolts and washers.
b)	No. of points on motor terminal box		One earthing point complete with tapped holes, GI bolts and washers.
c)	Earthing Flat size		
i)	LT Motors above 90 KW		50 x 6mm GS flat
ii)	30 KW to 90 KW		25 x 6mm GS flat
iii)	5KW to 30 KW		25 x 3mm GS flat
iv)	Up to 5 KW		8 SWG GS Wire
3.7	Painting		Corrosion proof epoxy based paint with suitable additives to be used.
a)	Paint shade		RAL 5012 (Blue)/ As per Motor spec.
b)	Thickness of paint		The thickness of finish coat shall be minimum 50 microns (minimum total DFT 100 microns).
4.0	**PERFORMANCE PARAMETERS**		
4.1	Starting requirement		
a)	Minimum permissible voltage as a percentage of rated voltage, at start to bring the driven equipment upto rated speed		80% of rated voltage for Motors up to 4000 kW
b)	Maximum locked rotor current		As per IS 12615
c)	Starting duty		Two hot starts in succession, with motor initially at normal running temperature.

d)	The locked rotor withstand time		Speed switches mounted on the motor shaft shall be provided in cases where below requirements are not met.
	Starting time of motors at minimum permissible voltage during starting		The locked rotor withstand time under hot condition at highest voltage limit
i)	upto 20 secs.		atleast 2.5 secs. more than starting time
ii)	more than 20 secs. and upto 45 secs		atleast 5 secs. more than starting time
iii)	more than 45 secs.		more than starting time by at least 10% of the starting time
4.2	Torque		
a)	Accelerating torque at any speed with the lowest permissible starting voltage		at least 10% motor full load torque
b)	Pull out torque at rated voltage		at least 205% of full load torque
4.3	Noise level (max.)		85 dB(A)
4.4	Vibration limits		As per IS 12075
5.0	**INSPECTION/TESTING**		
5.1	The type test(s) should have been conducted within 10 yrs prior to supply under this contract. In absence of type tests reports or in case reports are not found to be meeting the specification/standards requirements, vendor shall conduct all such type tests without any commercial/delivery implication to BHEL according to the relevant standards and reports shall be submitted to the owner for approval.		
5.2	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and “No design Change”. Minor changes if any shall be highlighted on the endorsement sheet.		
5.3	All acceptance and routine tests as per the specification and relevant standards shall be carried out.Charges for these shall be deemed to be included in the equipment price.		
5.4	For motor rating upto 50 KW, BHEL QP No. PE-QP-999-Q-006 Rev 02; & for motor rating >50 KW, BHEL QP No. PE-QP-999-Q-007 Rev 04 are to be followed.		

VOLUME: II-F/1

SECTION-II

A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment. Motors for special application like crane, lift, submersible pump etc. individual equipment specifications shall be read in conjunction with this specification.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC & CBIP Publication except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

Code	Name of standard
IS : 900	Code of Practice for installation and maintenance of induction motors
IS : 996	Single phase AC motors
IS : 1231	Dimensions of three-phase foot-mounted induction motors
IS : 1271	Thermal evaluation and classification of electrical insulation.
IS : 2223	Dimensions of flange mounted ac induction motors.
IS : 2254	Dimensions of vertical shaft motors for pumps
IS : 3043	Code of practice for earthing.

IS : 3177	Crane duty motors
IS : 4029	Guide for testing three phase induction motors.
IS : 4691	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	Specification for rotating electrical machinery.
IS : 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	Guide for selection of electrical equipment for hazardous areas.
IS : 6362	Designation of Method of Cooling of Rotating electrical machines.
IS : 8223	Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	Values of performance characteristics for three phase induction motors.
IS : 12065	Noise level of motors.
IS : 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	Induction motors - Energy efficient, three-phase, squirrel cage – Specification
IS : 12802	Temperature rise measurement of rotating electrical machines.
IS : 12824	Type of duty and classes of rating assigned.
IS : 14222	Requirements and method of Impulse withstand test
IEC: 60034	Rotating electrical machines.
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance
NEMA, MG-1	Motors and Generators
DIN/IEC/IS	RTD
BS 5308 part II	RTD triad Cable
IS : 15999	Rotating Electrical Machines

3.00.00 SERVICE CONDITIONS

3.01.00 The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.

3.02.00 Unless otherwise noted, electrical equipment / system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three / single phase, induction type.

4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA). However, motors rated 3000KW and above can be Closed air circuit water cooled (CACW). Temperature rise shall be limited to 70 deg.C by resistance method for class F insulation.

4.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity. However, hoist, crane and elevator motors shall be rated for (S4) duty i.e. 40% cyclic duration factor squirrel cage motor or VFD motors.

4.01.04 All LT motors of S1 duty cycle shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively. However, this is not applicable for geared motors (motors completely integrated with driven equipment) which are specifically designed to suit the driven equipment duty.
Locked rotor current & running Power factor for Mill motors & CWP motors shall be designed to suit the system requirements.

4.01.05 Maximum continuous motor ratings at 50°C shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation, unless stated otherwise in driven equipment specification or in general electrical specification. For S4 duty motors 10% margin on maximum load demand of the driven equipment shall be considered.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.01.07 All HV & MV motors shall be provided with vibration pads for mounting vibration detectors.

4.02.00 **AC motor for VFD application**

4.02.01 Inverter duty motors are designed according to the requirements of IEC 60034 Part-17 & Part-25 or NEMA MG-1, Part-30, Part-31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be derated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.

4.02.08 The motor shall be provided with insulated bearing on one side (or) Insulation shall be provided between bearing and frame on one side to prevent the flow of circulating currents through Bearing.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VFD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D.C. Motors**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 **Low Voltage Running**

Motor shall be capable of running satisfactorily at seventy-five (75) percent nominal voltage for five (5) minutes.

5.01.03 **Momentary Low Voltage Withstanding**

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

5.02.00 Starting Requirements

5.02.01 Motor shall be designed for direct on line starting.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.

5.02.04 **Motor Starting:**

Motor shall be suitable for two hot starts (3 starts for conveyor motors) in succession with motor initially at normal running temperature.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.02.06 **Break-away Starting Current**

Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below: -

- Motors above 160kW upto 1000KW - 600% subject to IS Tolerance of 20%
- Motors (above 1000KW up to 3000KW) - 600% and not subject to any positive tolerance
- Motors above 3000KW - 450% and not subject to any positive tolerance

- LT motors locked rotor current shall be as per IS: 12615
- Locked rotor current of the VFD controlled AC motors shall be limited to 300% of the full load current subject to IS tolerance.
- For D.C. Motors the starting current shall be limited to 2 times full load current.

5.03.00 **Stress During Bus Transfer**

5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.03.03 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.

5.03.04 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.

5.03.05 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.

5.03.06 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 For motors with starting time up to 20secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5secs.

For motors with starting time more than 20secs and up to 45secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5secs.

For motors with starting time more than 45secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be needed to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity.

5.04.04 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.04.05 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

5.05.00 STARTING VOLTAGE REQUIREMENT

5.05.01 All Motors (except Mill Motors)
a) 80% of rated voltage for Motors up to 4000 kW
b) 75% of rated voltage for Motors above 4000 kW

5.05.02 For Mill Motors:

i) 85% of rated voltage for Motors above 1000 kW
ii) 90% of rated voltage for Motors below 1000 kW

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 **Enclosure**

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction. External FRP canopy shall be provided for all outdoor motors where possibility of accumulation of coal dust and fly ash are present.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.02.00 **Direction of Rotation**

As needed by driven equipment.

The 3-phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

Direction of rotation in motors shall be as per driven equipment requirement. In case they differ then the spare motors for both the direction of rotation shall be provided for the second.

6.03.00 **Cooling**

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed

air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.04.00 **Winding and Insulation**

6.04.01 All insulated winding shall be of copper.

6.04.02 HT and MV motors shall have Class F insulation with winding temperature limited to Class B. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.04.03 LT motors shall have Class F insulation with temperature limited to Class B.

6.04.04 The value of the polarization index for motors above 160kW should not be less than 2 when determined according to IS: 7816.

6.04.05 For the VFD operated drives, insulation shall be designed to take care of stresses due to high DV/DT. Motors shall be wound with dual coated winding wires and impregnated with VPI process. Further for such application, insulated bearings shall be provided to avoid circulating current caused by shaft induced voltages.

6.04.06 HT motors shall withstand 1.2/50 micro sec impulse Voltage wave of 4U+5 kV (U=Line voltage in kV). The coil inter-turn insulation shall be as per IEC-60034 – Part 15 followed by 1 min power frequency high voltage test of appropriate voltage on inter turn insulation.

6.05.00 **Tropical Protection**

6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.05.02 All fittings and hardware shall be corrosion resistant.

6.06.00 **Bearings**

6.06.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.06.02 Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 40000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.

6.06.03 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.06.04 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.06.05 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.06.06 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

6.06.07 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.06.08 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.06.09 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.06.10 HT motors shall have insulated bearings as required to prevent shaft current and resultant bearing damage.

6.07.00 **Noise & Vibration**

6.07.01 The noise level shall not exceed 85 dB(A) at 1.0 meters from the motor except for BFP motor for which the maximum limit shall be 90dB(A) from operating motor measured in accordance with IS: 12065.

6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.

6.08.00 **Motor Terminal Box**

6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.

6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90Deg. unless otherwise approved.

6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.

6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (1100V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part of integral to the motor, for easy termination of the cable. In the case of LT motors, local junction box for terminating main XLPE insulated armoured aluminium cable and copper cable to terminate at motor terminal box shall also be considered if the main cable number and size warrants the same for easy termination.

6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type/ Elastimold type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type for below 1000kW motor) with shorting links for star connection.

6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.08.10 Separate terminal boxes shall be provided for RTDs and space heaters.

6.08.11 The gland plate for single core cable shall be non-magnetic type.

6.08.12 Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.

6.08.13 11kV and 3.3kV motors can be offered with either elastomould termination or dust tight phase separated double walled (metallic as well as insulated barrier) cable boxes. In case elastomould terminations are offered, then protective cover and trifurcating sleeves shall also be provided. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4mm (non magnetic material for 1/C cables) shall be provided in case of cable boxes.

6.09.00 **Grounding**

6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	35 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire

6.09.03 The cable terminal box shall have a separate grounding pad.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

- Temperature rise in Deg.C under rated condition and method of measurement.
- Degree of protection (IP No)
- Bearing identification no. and recommended lubricant
- Location of insulated bearings

7.00.00 ACCESSORIES

7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30KW and above shall be provided with thermostatically controlled space heaters, suitably located for easy removal or replacement. Space heater exceeding 1200W shall be 3 phase.

7.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 Temperature Detectors

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100Ohms at 0°C.

7.03.04 Leads of all duplex or simplex type motor winding RTDs and motor bearing RTDs shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDs shall be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.04.00 Indicator/Switch

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

- 11000V and 3300V motor bearing temperature.

- Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers one for each phase shall be mounted in a separate compartment in the neutral side terminal box. The three phases shall be connected to form the star point after they pass through the CTs. The CTs shall be of relay accuracy and the CT characteristics shall be compatible with the differential relay. However, the motor vendor to furnish design data (CT specifications), number of CTs, dimensions and mounting arrangements at motor end to Switchgear supplier.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25kg or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Painting shall be envisaged as defined in Section – XII of Vol -IIA.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS/IEC. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Type test certificate for H.T & L.T. Motor shall be furnished for approval.

8.03.00 Valid Type test certificates on any equipment shall be furnished for owners review. In case of non-availability of valid test certificate, contractor shall conduct type tests as per IS / IEC without any additional commercial implication to prove the design.

8.04.00 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the Contractor for purchaser's approval:

1. Measurement of stator resistance (& rotor resistance on slip ring motors)
2. No load running of motor and reading of voltage, current, power input and speed
3. Locked rotor reading of voltage, current, power input and values of torque of motor.
4. Full load reading of voltage, current, power input and slip(subject to test bed constraint).
5. Temperature rise test.
6. Momentary overload test(subject to test bed constraint).
7. Test for vibration severity of motor.
8. Test for noise level of motor.
9. Stands Deleted .
10. Over speed test.
11. Stands Deleted .
12. Stands Deleted .
13. Stands Deleted

9.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.
c) Scheme & write up on forced lubrication system, if any
d) Type test report

9.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing
b) Foundation Plan & Loading
c) Cable end box details
d) Space requirement for rotor removal
e) Thermal withstand curves hot & cold
f) Starting and speed torque characteristics at 80% & 100% voltage
g) Complete motor data
h) Erection & Maintenance Manual
i) Efficiency curves.
j) List of motors.
k) Test reports

ANNEXURE – A

DESIGN DATA

1.0 SERVICE CONDITIONS

Refer Vol-IIA, S-II of Specification.

2.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000V, 3Ø, 3W, 50Hz, non-effectively earthed. Fault level 50kA symm. for 1sec	Motors above 1500kW
	3.3kV, 3Ø, 3W, 50Hz, non-effectively earthed. Fault level 40kA symm for 1sec	Motors above 160kW up to & including 1500kW
L.T. Supply	415V, 3Ø, 3W, 50Hz, effectively earthed. Fault level 50kA symm for 1sec	Motors above & including 370W up to & including 160kW
	240V, 1Ø, 2W, 50Hz, effectively earthed.	Motors less than 370W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed. Fault level 25*kA for 1sec	D.C. alarm, control & protective devices

* Indicative only; actual value shall be decided by the Contractor, after substantiating the same by calculation.

3.0 RANGE OF VARIATION

A.C. Supply

Voltage: ± 10% Frequency: ± 5%

Combined Volt & frequency: 10% (absolute sum)

D.C. Supply

Voltage: (+10% to -15%)

ANNEXURE-III

CABLING
NOTES & DETAILS

DWG. NO. 18A03-DWG-E-0400

A4_DD (9-96) [210x297]

NOTES:–

1. THE CABLING WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION.

2. THE CABLING WORK SHALL COMPRISE OF THE FOLLOWING AND/OR AS STIPULATED IN THE SPECIFICATION: –

   - ON TRAY : LAYING, DRESSING, CLAMPING OF CABLES ON TRAY, FIXING OF CABLE TAG INCLUDING THE SUPPLY OF CABLE CLAMPS, CABLE TAGS AND FIXING HARDWARES.

   - BURIED : EXACAVATION OF EARTH, FILLING BY SAND, PROVIDING BRICK PARTITION, LAYING AND DRESSING OF CABLE, FIXING OF CABLE TAG, SAND COVERING FOLLOWED BY FIXING OF PRECAST COVER, BACKFILLING BY GOOD EARTH FOLLOWED BY COARSE EARTH INCLUDING THE SUPPLY OF CABLE TAG, SAND, BRICK, PRECAST COVER.

   - SHALLOW TRENCH : LAYING, DRESSING, FIXING OF CABLE TAG, FILLING WITH SAND AND FIXING OF BRICK COLUMN INCLUDING SUPPLY OF SAND, BRICK AND CABLE TAG.

   - DUCT BANK : PULLING OF CABLE AND FIXING OF CABLE TAG.

3. TERMINATION WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION INCLUDING SUPPLY OF LUGS, GLANDS FOR CONTROL CABLE.

4. ARMOUR/SCREEN OF MULTI CORE CABLES SHALL BE GROUNDED AT BOTH END.

5. ARMOUR/SCREEN, IF ANY, OF SINGLE CORE CABLE SHALL BE GROUNDED ONLY AT SOURCE END.

6. ALL WALL/FLOOR OPENINGS FOR CABLE ENTRY SHALL BE SUITABLY SEALED WITH FIRE RATING OF 90 MINUTE AFTER CABLE ERECTION.

7. CLAMPING OF ADJACENT CABLES ON THE SAME RACK SHALL BE STAGGERED TO AVOID FOULING OF THE CLAMPING BOLTS.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

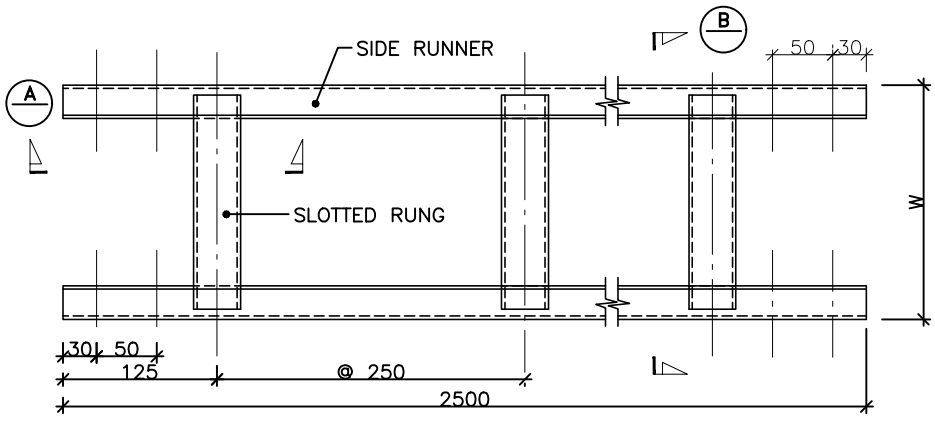
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
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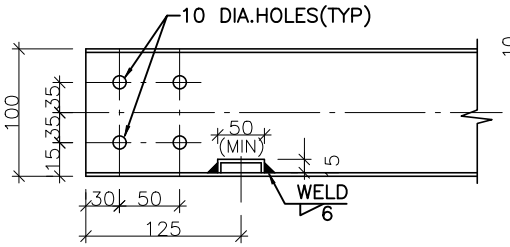
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APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0400		REV 0

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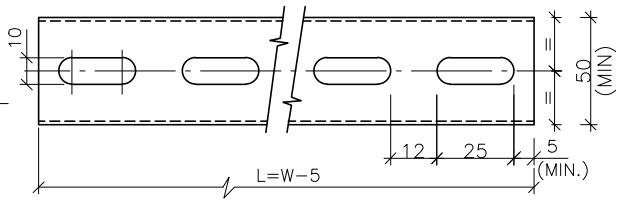
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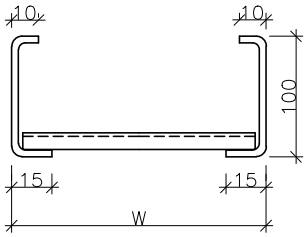
LADDER TYPE CABLE TRAY



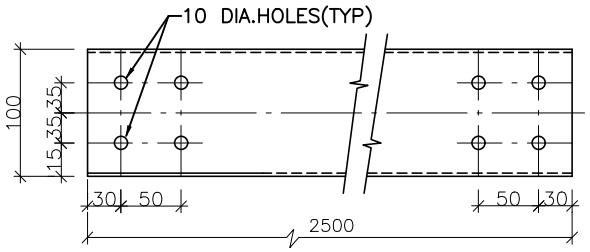
SEC – A



SLOTTED RUNG



SEC – B



SIDE RUNNER

MATERIAL : M.S. SHEET 14 SWG.(2mm.THK.)
FINISH : HOT DIP GALVANISED

W	300	450	600
L	295	445	595

NOTE :–

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
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PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

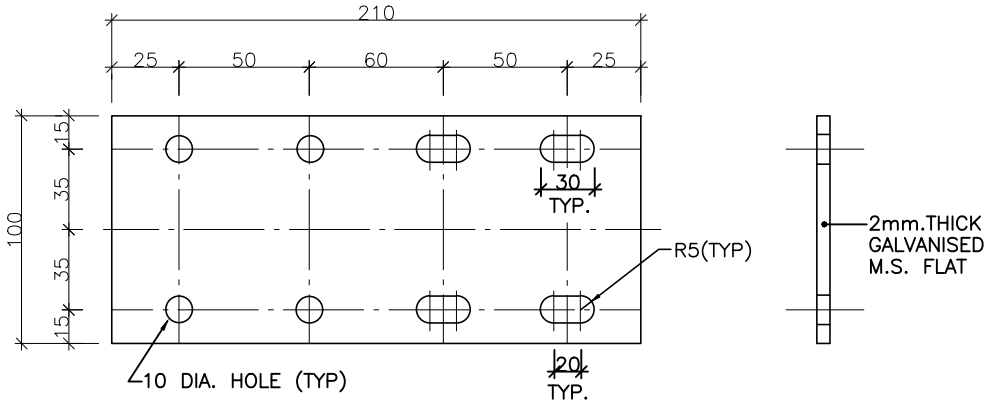
CABLING NOTES & DETAILS

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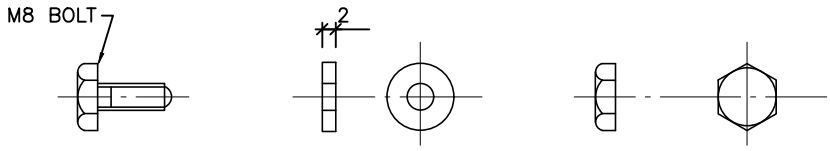
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A4_DD (9–96) [210x297]



SIDE COUPLER PLATE



M8 BOLT, WASHER & NUT

(FOR CABLE TRAY JOINT)

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

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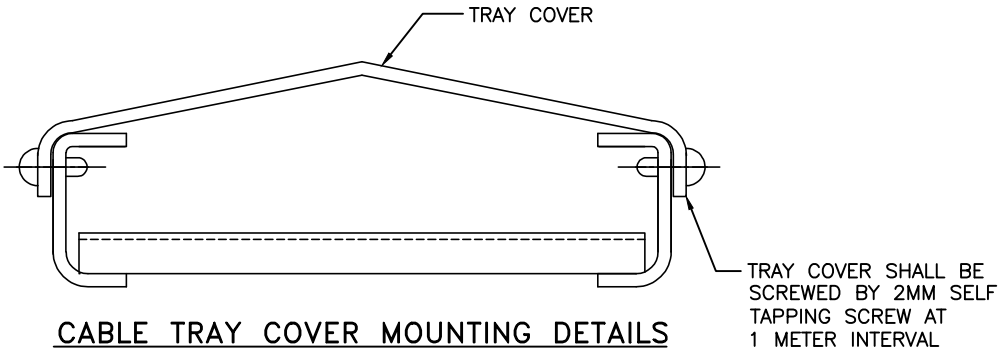
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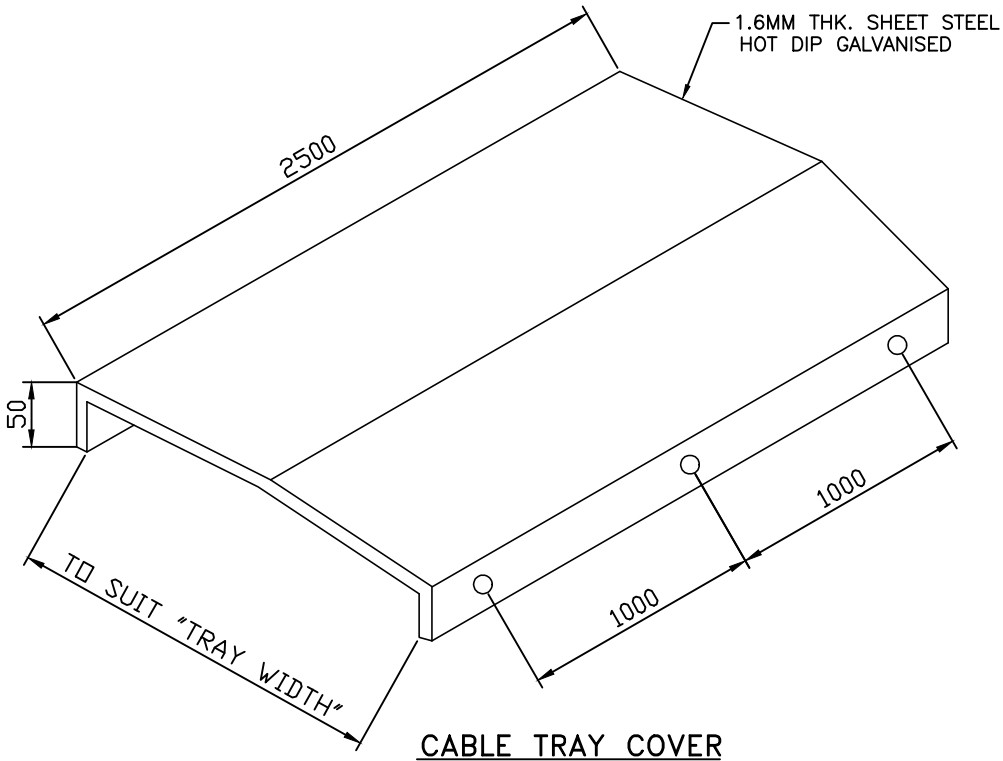
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APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 03 OF 28

A4_DD (9-96) [210x297]



CABLE TRAY COVER MOUNTING DETAILS



CABLE TRAY COVER

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. THE SPACER ASSEMBLY SHALL BE HOT DEEP GALVANISED.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

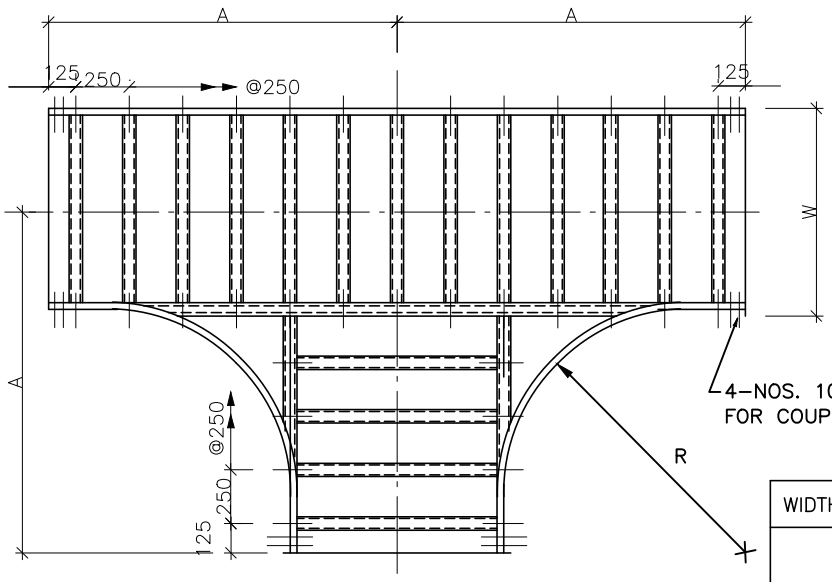
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

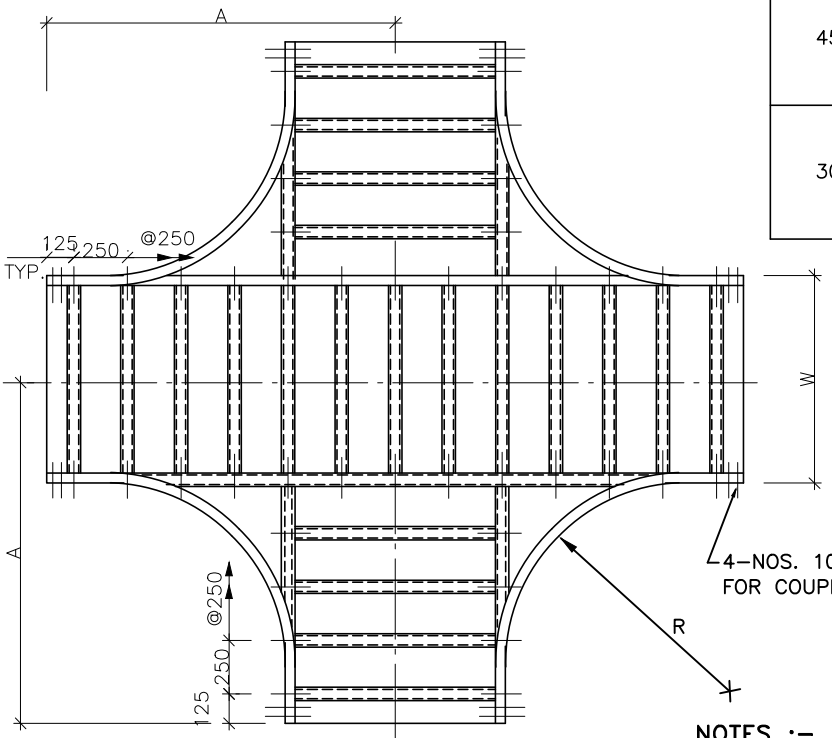
SHEET 04 OF 28

A4_DD (9-96) [210x297]



WIDTH (W)	RADIUS (R)	A
600	1050	1475
	600	1025
	450	875
	300	725
450	1050	1400
	600	950
	450	800
	300	650
300	1050	1325
	600	875
	450	725
	300	575

PLAN
HORIZONTAL TEE



PLAN
HORIZONTAL CROSS

NOTES :–

1. ALL DIMENSIONS ARE IN MM.
2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

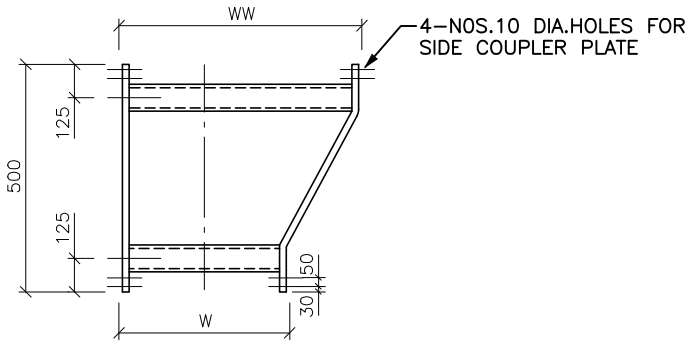
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

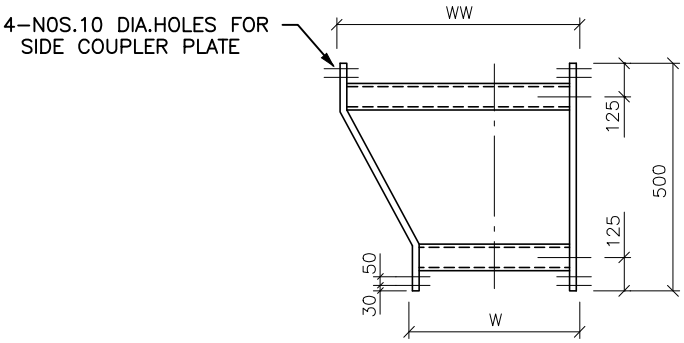
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0400		REV 0

SHEET 05 OF 28

A4_DD (9–96) [210x297]



PLAN
LEFT HAND REDUCER



PLAN
RIGHT HAND REDUCER

WIDTH	WW	600	600	450
	W	450	300	300

NOTE :–

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

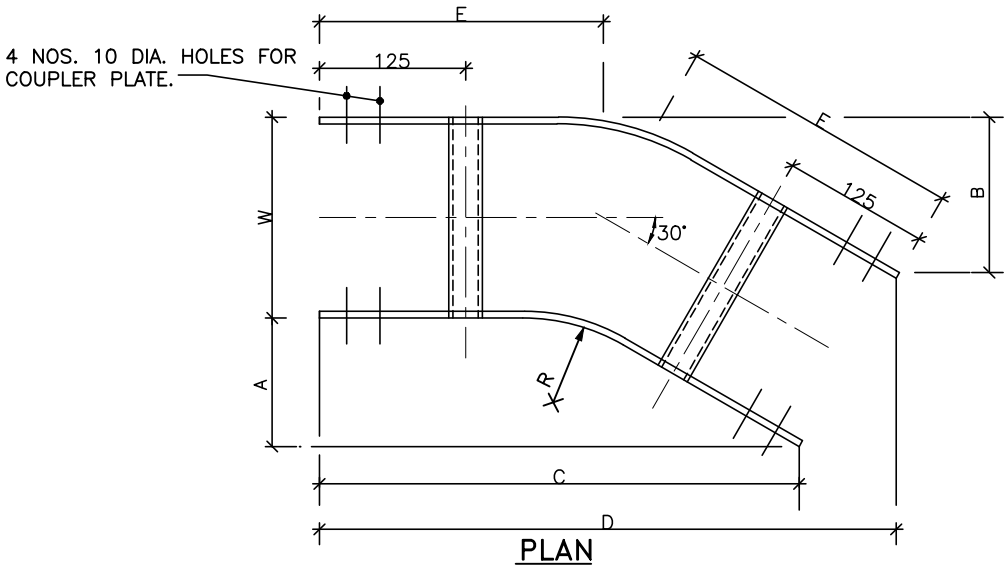
PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03	
CHECKED	AD	SCALE	NTS	
APPROVED	DS	DATE	08.10.20	REV 0
DWG. NO.	18A03–DWG–E–0400			SHEET 06 OF 28

A4_DD (9–96) [210x297]



PLAN

30° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	205	285	755	1055	485
	600	145	225	530	830	365
	450	125	205	455	755	325
	300	105	185	380	680	285
450	1050	205	265	755	980	465
	600	145	205	530	755	345
	450	125	185	455	680	305
	300	105	165	380	605	265
300	1050	205	245	755	905	445
	600	145	185	530	680	325
	450	125	165	455	605	285
	300	105	145	380	530	245

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

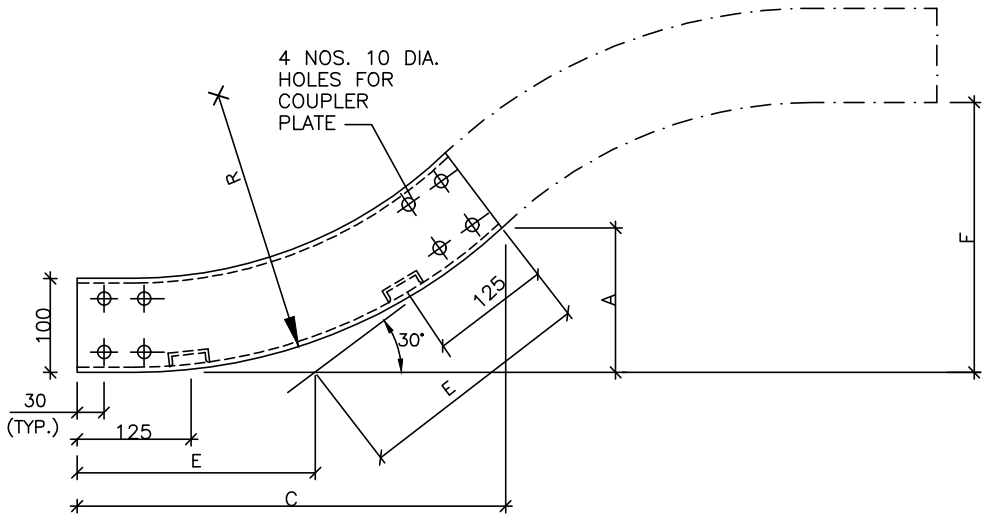
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
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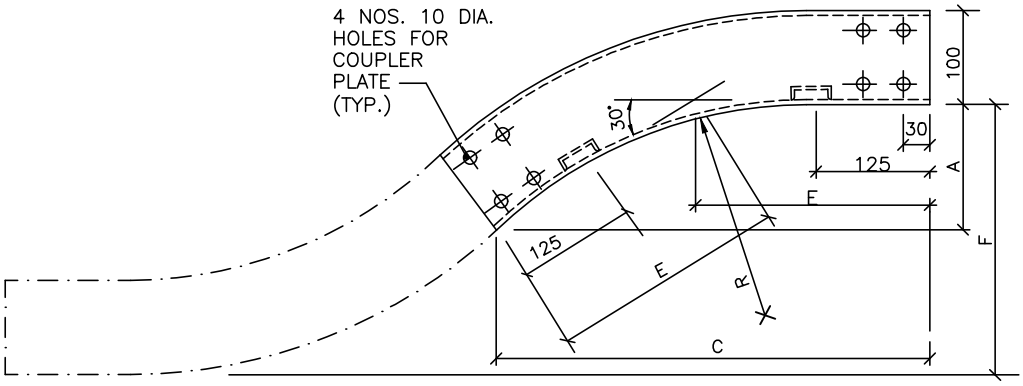
SHEET 07 OF 28

A4_DD (9-96) [210x297]



ELEVATION
30° VERTICAL ELBOW (INSIDE)

WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	205	760	410	410
	600	145	535	290	290
	450	125	460	250	250
	300	105	385	210	210



ELEVATION
30° VERTICAL ELBOW (OUTSIDE)

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

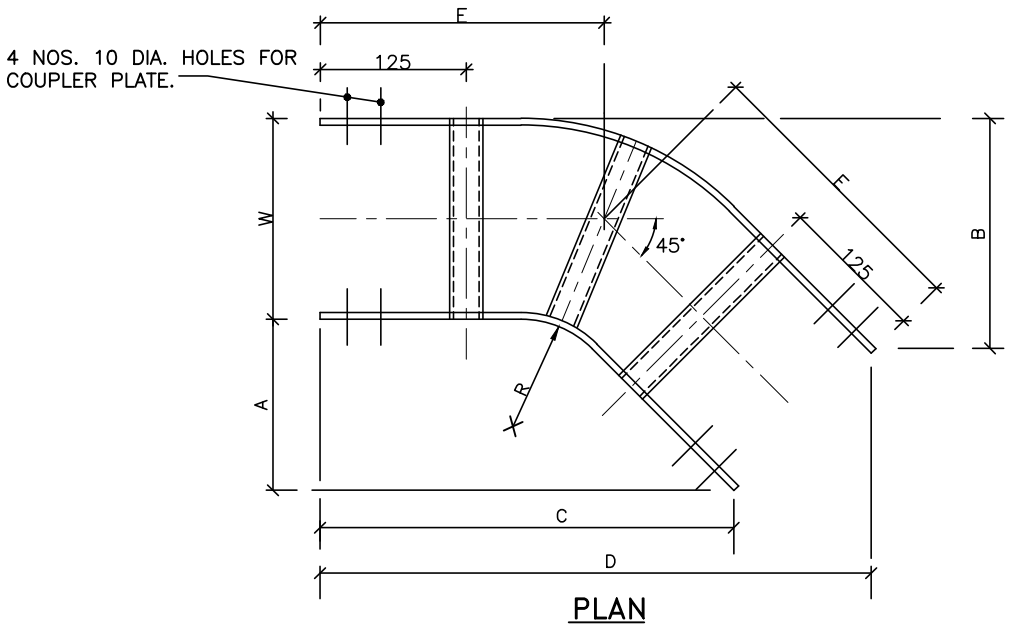
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
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SHEET 08 OF 28

A4_DD (9-96) [210x297]



PLAN
45° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	395	570	955	1380	685
	600	265	440	640	1065	535
	450	220	395	530	955	470
	300	175	350	425	850	410
450	1050	395	530	955	1275	690
	600	265	395	640	955	500
	450	220	350	530	850	440
	300	175	310	425	745	390
300	1050	395	485	955	1165	655
	600	265	350	640	850	470
	450	220	310	530	745	410
	300	175	265	425	635	345

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

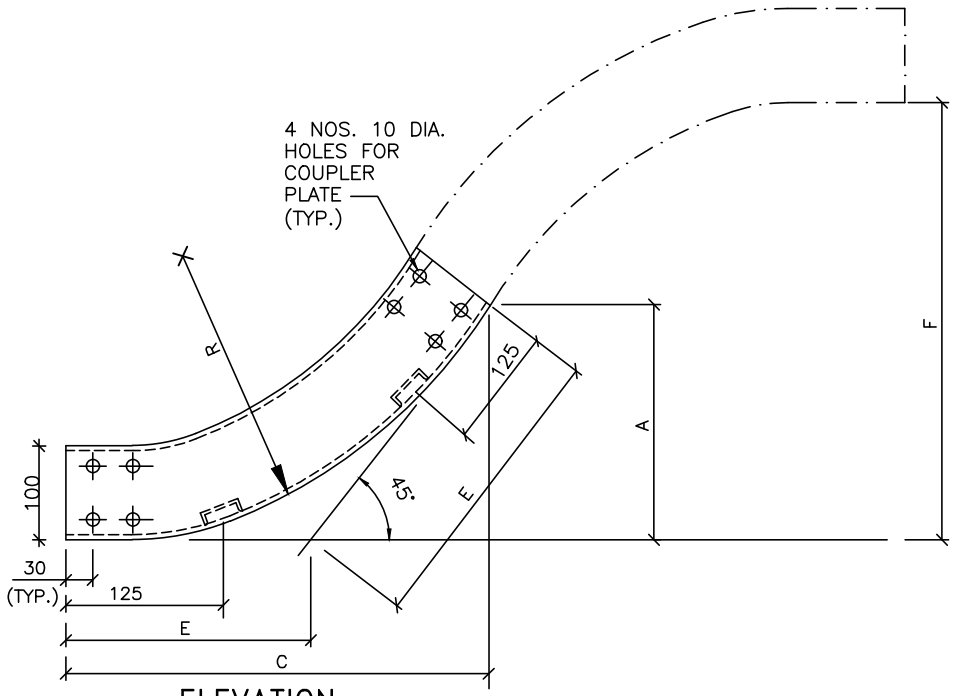
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
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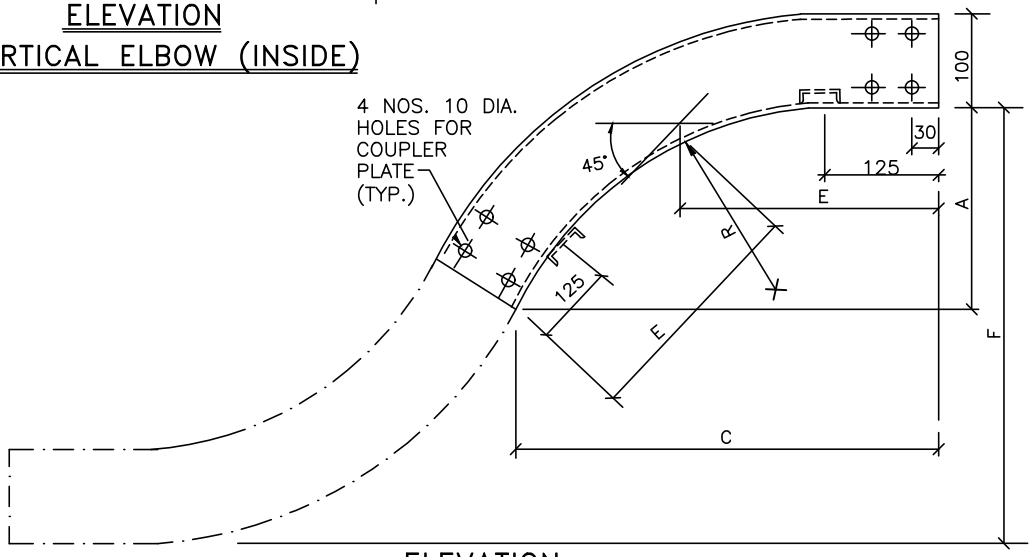
SHEET 09 OF 28

A4_DD (9-96) [210x297]



ELEVATION

45° VERTICAL ELBOW (INSIDE)



ELEVATION

45° VERTICAL ELBOW (OUTSIDE)

WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	395	955	560	790
	600	265	640	375	530
	450	220	530	310	440
	300	175	425	250	350

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
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REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

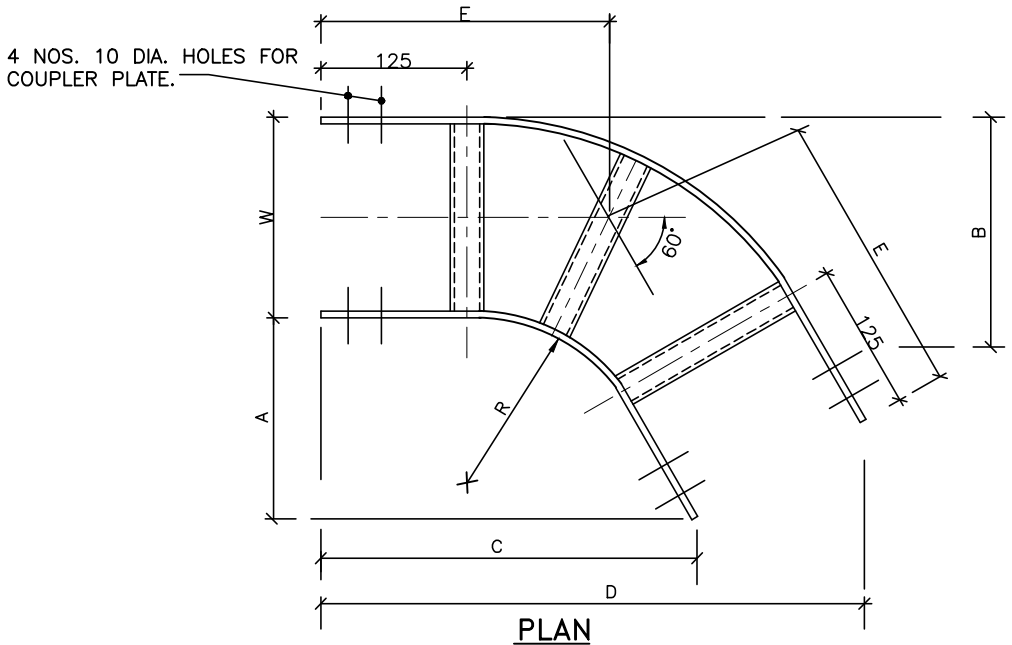
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 10 OF 28

A4_DD (9-96) [210x297]



PLAN

60° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	635	935	1095	1615	905
	600	410	710	705	1225	645
	450	335	635	575	1095	560
	300	250	550	450	965	470
450	1050	635	860	1095	1485	860
	600	410	635	705	1095	600
	450	335	550	575	965	515
	300	250	485	450	835	425
300	1050	635	785	1095	1355	815
	600	410	560	705	965	555
	450	335	485	575	835	470
	300	250	410	450	705	385

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

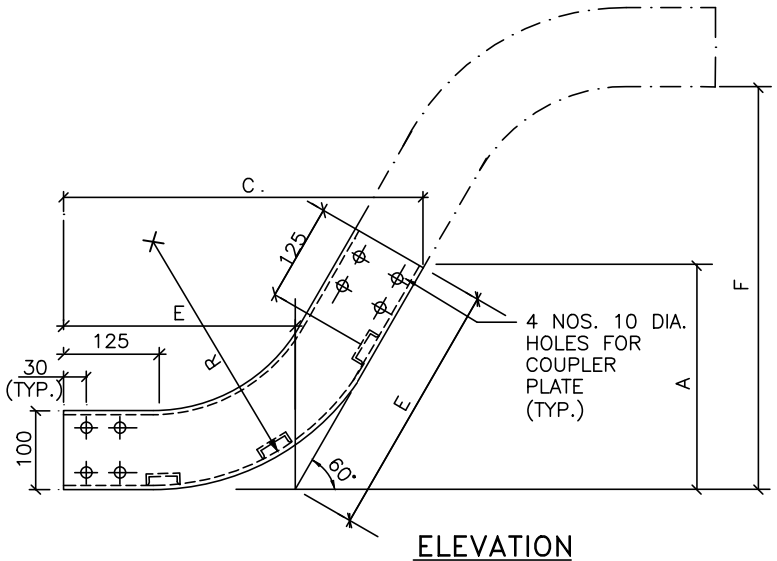
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
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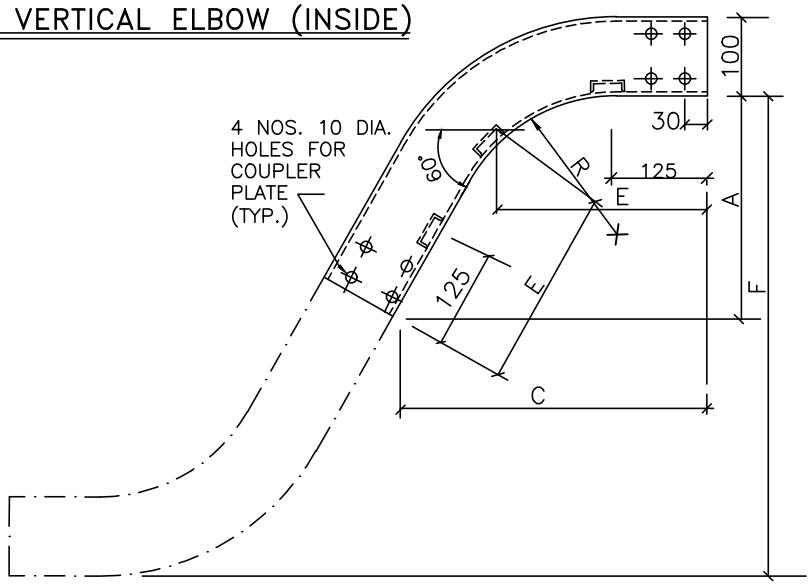
SHEET 11 OF 28

A4_DD (9-96) [210x297]



ELEVATION

60° VERTICAL ELBOW (INSIDE)



ELEVATION

60° VERTICAL ELBOW (OUTSIDE)

WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	635	1095	730	1270
	600	410	705	470	820
	450	335	575	385	670
	300	260	450	300	520

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
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REVISION STATUS

OWNER: NLC INDIA LIMITED
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PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

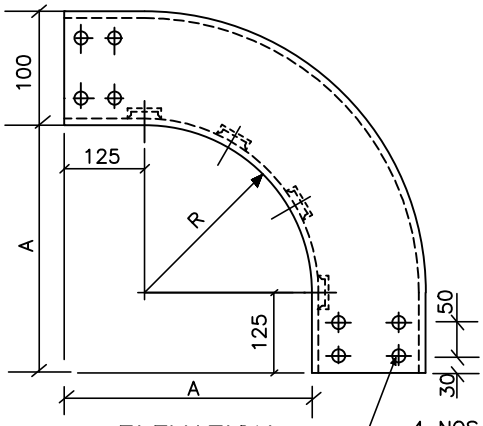
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

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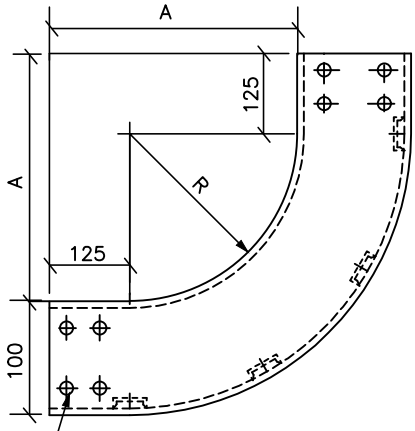
SHEET 12 OF 28

A4_DD (9-96) [210x297]



ELEVATION
90° VERTICAL ELBOW
(OUTSIDE)

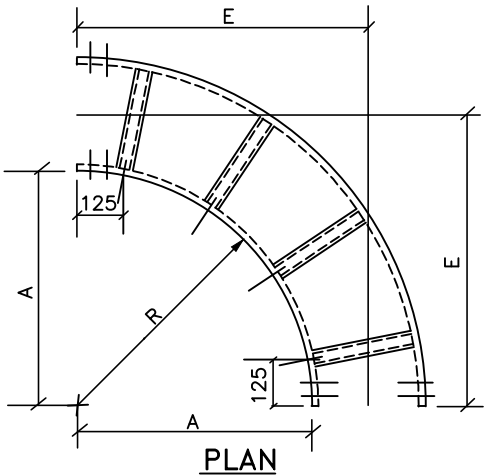
4 NOS. 10 DIA. HOLES
FOR COUPLER PLATE



ELEVATION
90° VERTICAL ELBOW
(INSIDE)

VERTICAL ELBOW		
WIDTH (W)	RADIUS (R)	A
600 450 & 300	1050	1175
	600	725
	450	575
	300	425

HORIZONTAL ELBOW			
WIDTH (W)	RADIUS (R)	A	E
600	1050	1175	1475
	600	725	1025
	450	575	875
	300	425	725
450	1050	1175	1400
	600	725	950
	450	575	800
	300	425	650
300	1050	1175	1325
	600	725	875
	450	575	725
	300	425	575



PLAN
90°HORIZONTAL ELBOW

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

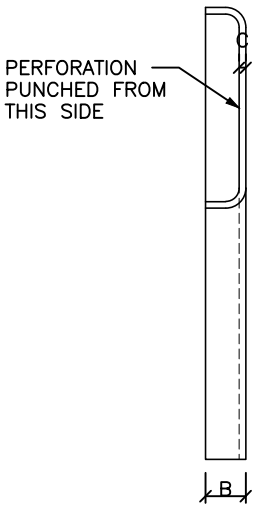
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

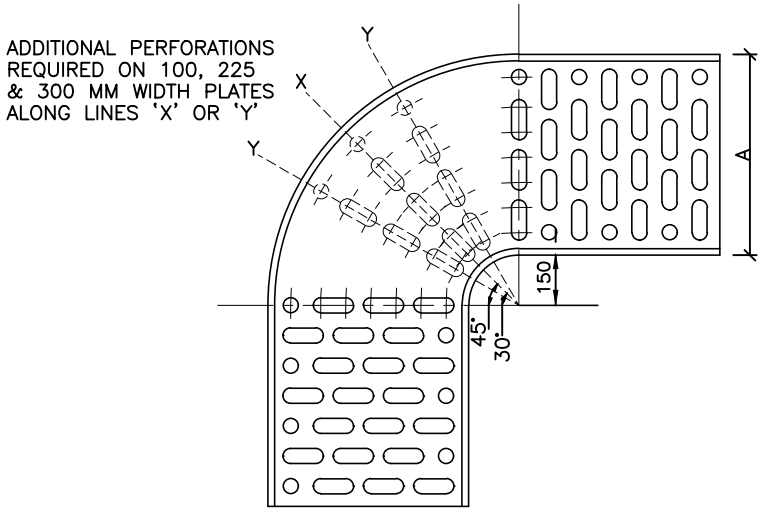
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APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

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A4_DD (9-96) [210x297]



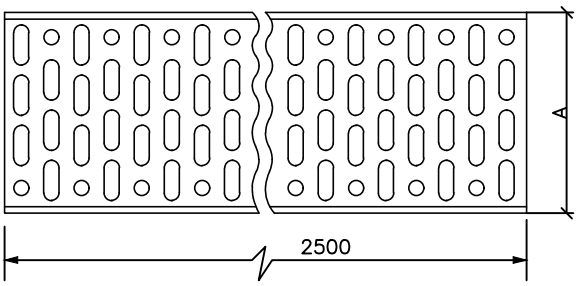
END ELEVATION



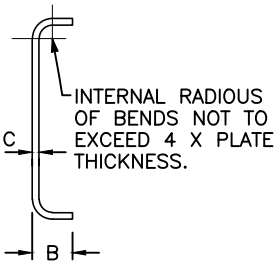
PLAN

90° HORIZONTAL ELBOW

DIMENSIONS IN MM	
WIDTH–A	DEPTH–B
100	50
150/225	
300	50

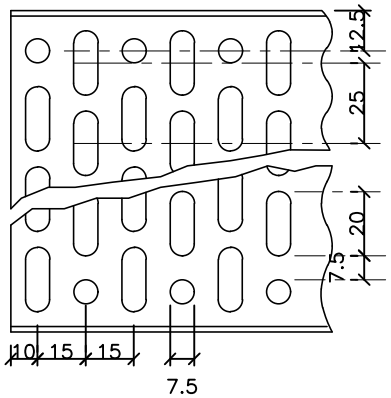


PLAN



END ELEVATION

STRAIGHT LENGTH



DETAILS OF PERFORATION

NOTES :

1. ALL CUTTING & FORMING OPERATIONS TO BE COMPLETED PRIOR TO GALVANIZING.
2. FINISHED TRAYS TO BE FREE FROM BURRS AND SHARP EDGES.
3. ALL DIMENSIONS ARE IN MM.

PERFORATED TYPE CABLE TRAY

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

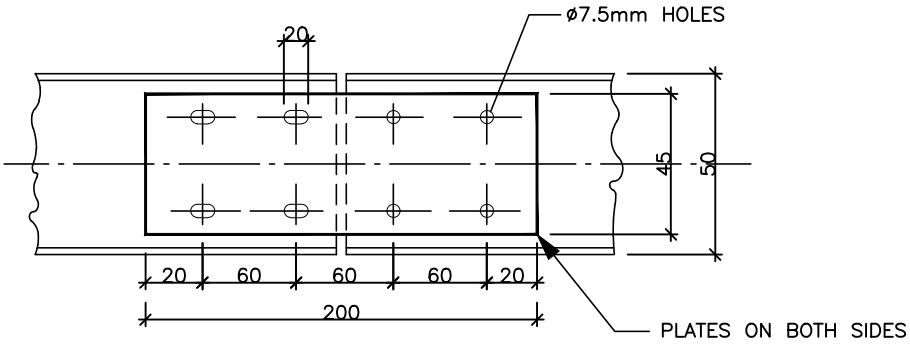
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

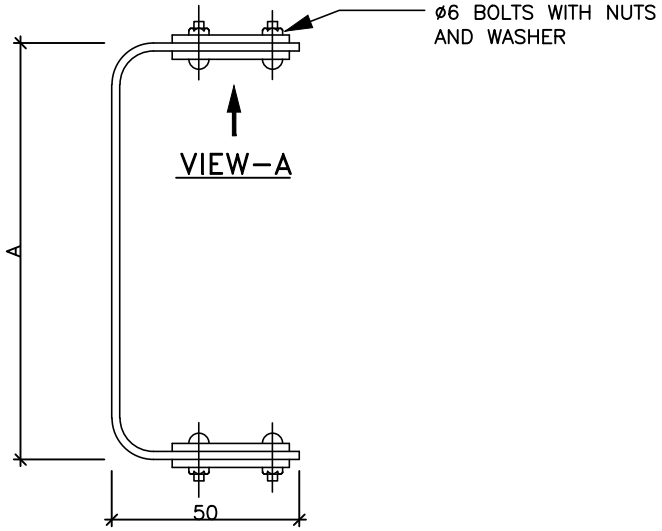
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APPROVED	DS	DATE	08.10.20
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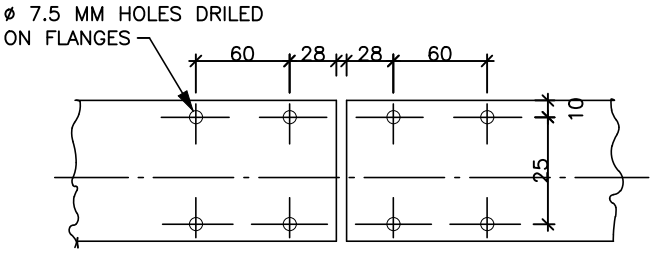
A4_DD (9–96) [210x297]



VIEW–A



END ELEVATION



COUPLING PLATE

PERFORATED TRAY JOINING BY COUPLING PLATES

NOTES:–

1. COUPLING PLATES 2 MM THICK M.S.
2. ALL DIMENSIONS ARE IN MM.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

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NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

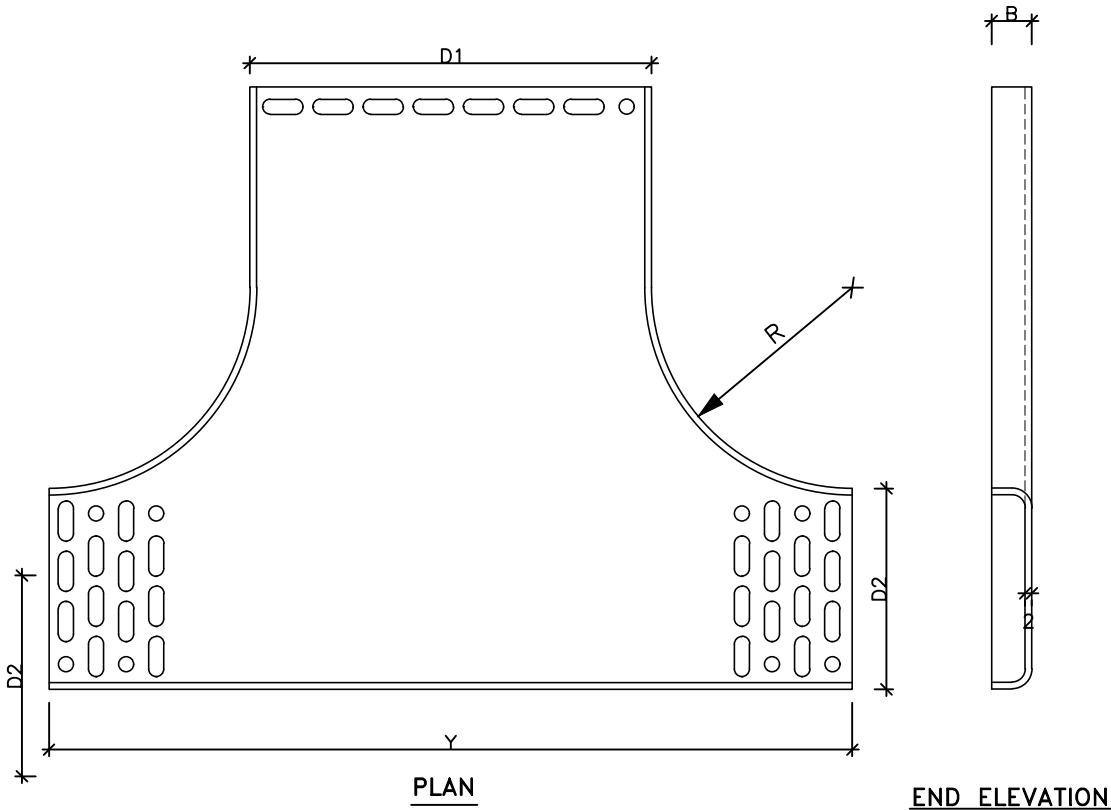
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0400		REV 0

SHEET 15 OF 28

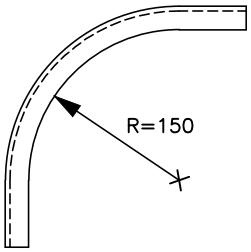
A4_DD (9–96) [210x297]



PLAN

HORIZONTAL TEE

END ELEVATION



VERTICAL ELBOW (90°)

TYPE	DIMENSIONS IN MM				
	D1	D2	B	R	Y
A	225	100	50	150	500
B	300	150	50	200	600

PERFORATED TRAY FITTINGS

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

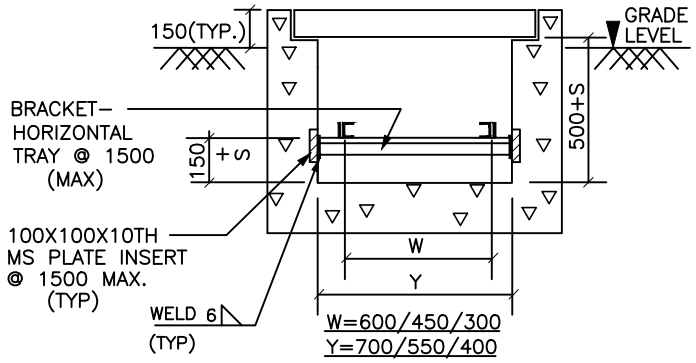
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 16 OF 28

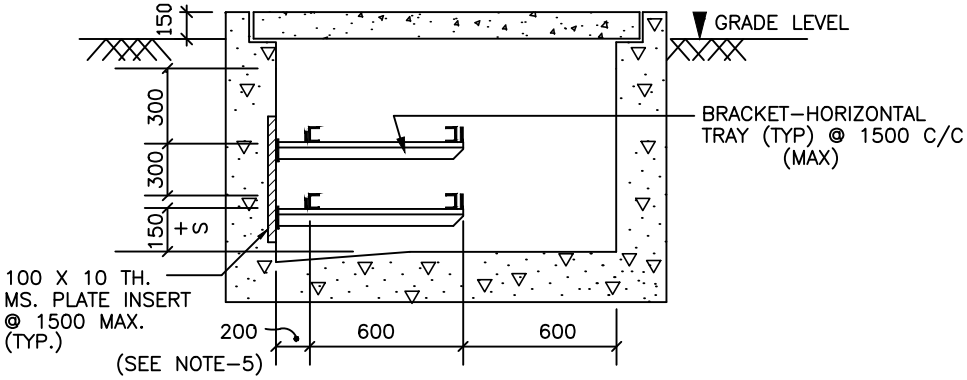
A4_DD (9-96) [210x297]

NOTES :-

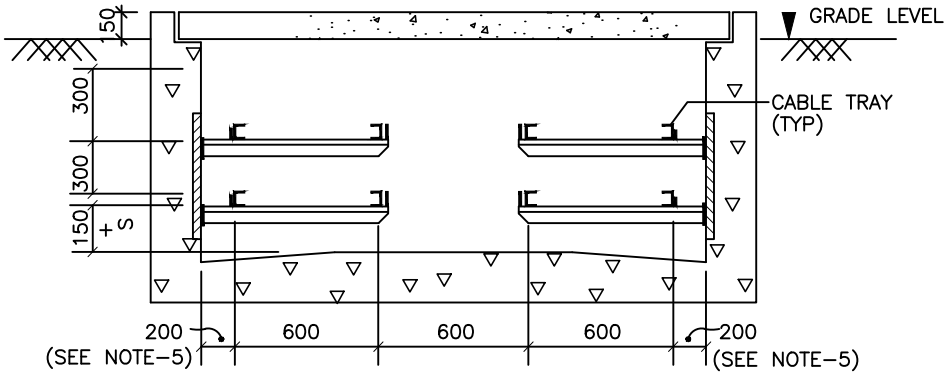
1. ALL DIMENSIONS ARE IN MM.
2. +S INDICATES DISTANCE TO MAINTAIN THE 'SLOPE' OF THE TRENCH.
3. MOUNTING ARRANGEMENT IN CABLE TRENCH TYPE-C,CC,DD ETC. SHALL BE SIMILAR.
4. FOR CABLE TRENCH GROUNDING REFER DWG.NO. 18A03 -DWG-E-0600.
5. FOR LONG TRENCH WITHOUT ANY INTERMEDIATE CABLE EXIT, THE GAP "200" MAY BE DISPENSED WITH. HOWEVER, THE SAME SHALL BE PROVIDED FOR AT LEAST 1500mm ON EITHER SIDE OF THE EXIT.
6. FOR INDOOR, TRENCH TOP SHALL MATCH WITH FFL.
7. SUITABLE EDGE ANGLE SHALL BE PROVIDED FOR TRENCHES.



TR – A



TR – B



TR – BB

MOUNTING ARRANGEMENT
(IN CABLE TRENCH)

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

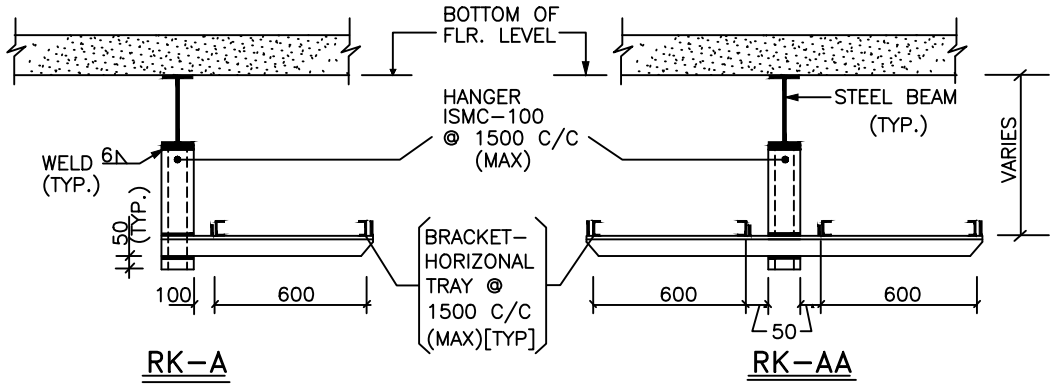
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 17 OF 28

A4_DD (9-96) [210x297]



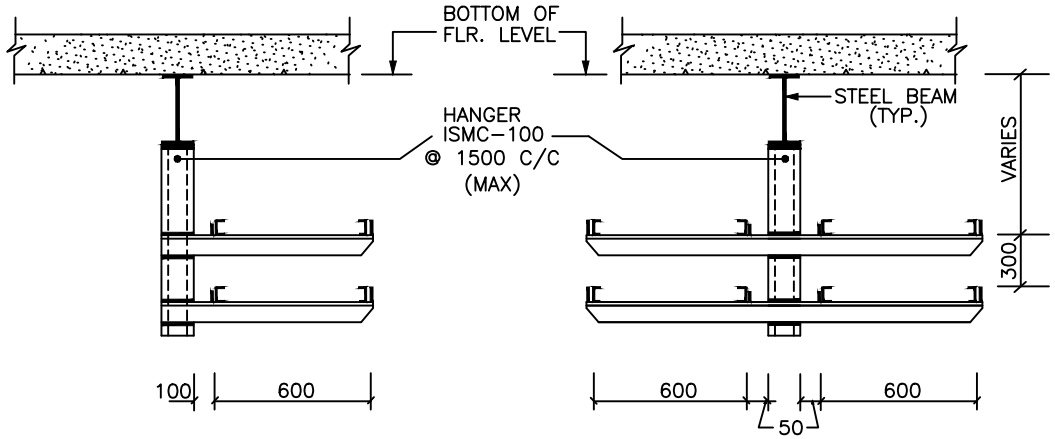


TABLE-1

RACK		NO. OF
TYPE	WIDTH	TIER
A1	450	1
B1	450	2
A2	300	1
B2	300	2

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. 18A03-DWG-E-0600
3. FOR RACK TYPE RK-C, RK-CC, RK-D, RK-DD ETC. THE ARRANGEMENT SHALL BE SIMILAR.

MOUNTING ARRANGEMENT

(FROM BEAM)

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP)
(3X800MW)

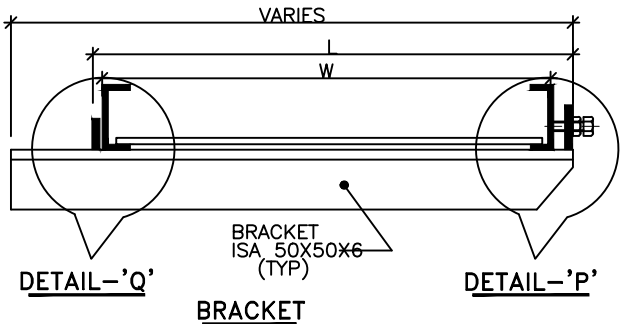
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

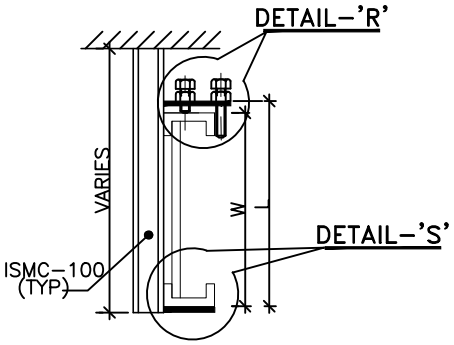
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 18 OF 28

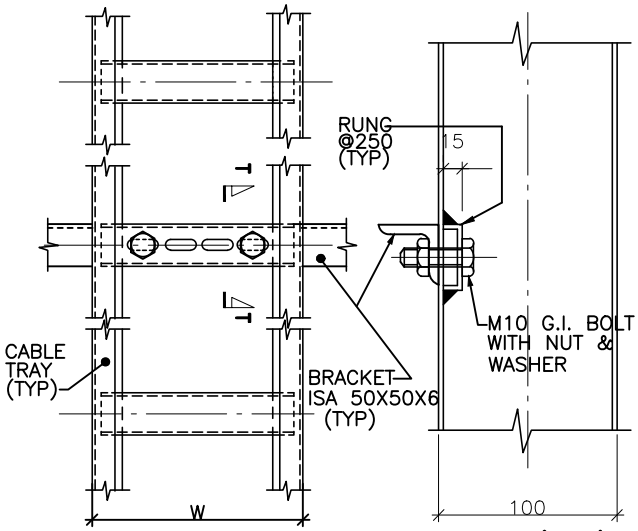
A4_DD (9-96) [210x297]



BRACKET
(HORIZONTAL CABLE TRAY)



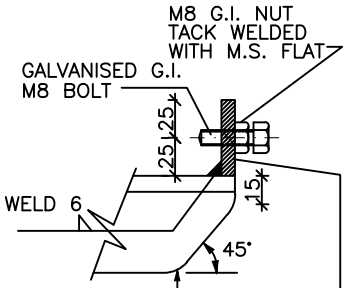
BRACKET
(VERTICAL CABLE TRAY)



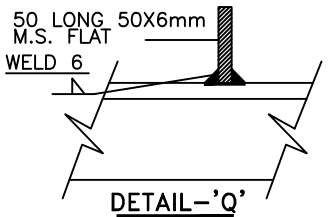
BRACKET
(VERTICAL CABLE SHAFT)

SEC.–'T–T'

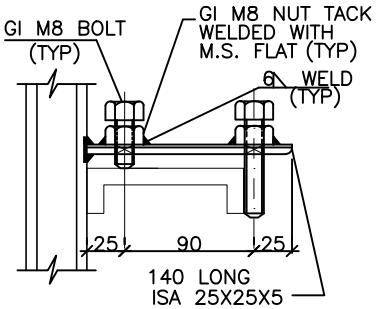
W	600	450	300
L	625	475	325



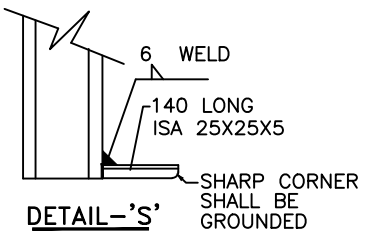
DETAIL–'P'



DETAIL–'Q'



DETAIL–'R'



DETAIL–'S'

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

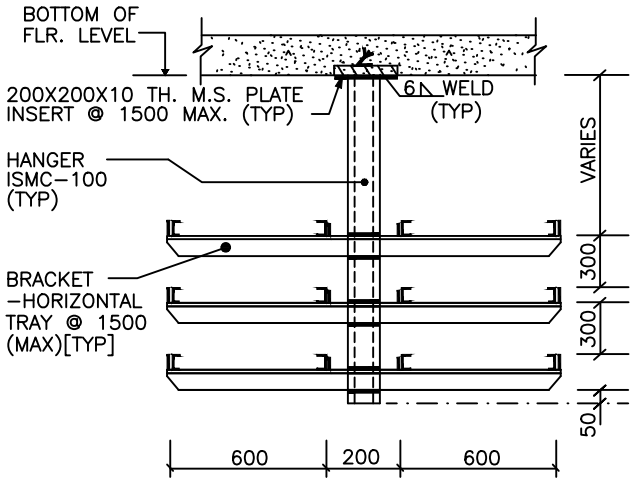
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	GD	JOB NO.	18A03
CHECKED	AC/MC	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–400		REV 0

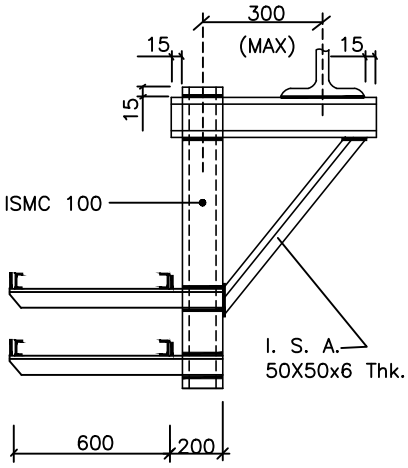
SHEET 19 OF 28

A4_DD (9–96) [210x297]



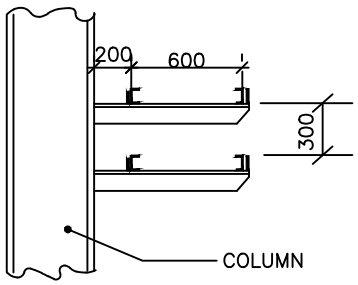
MOUNTING ARRANGEMENT

(FROM CEILING)



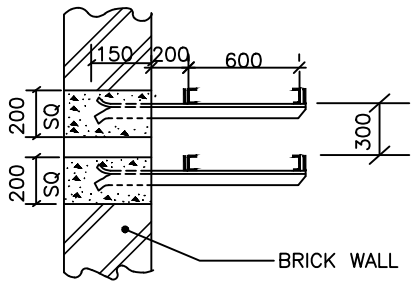
MOUNTING ARRANGEMENT

(FROM FLOOR BEAM)



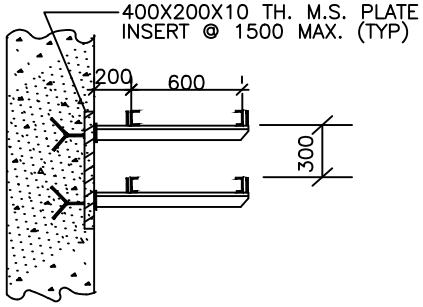
MOUNTING ARRANGEMENT

(FROM STEEL COLUMN)



MOUNTING ARRANGEMENT

(FROM BRICK WALL)



MOUNTING ARRANGEMENT

(FROM CONCRETE COLUMN)

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. THE NOS. OF TIER AND WIDTH OF EACH TRAY SHALL BE AS PER RACK TYPE NOS.
3. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. 18A03-DWG-E-0600

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

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NEYVELI, TAMILNADU

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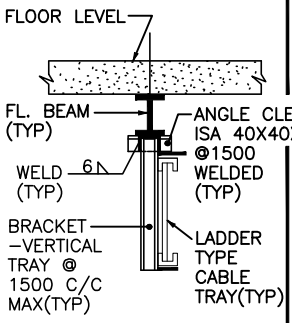
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

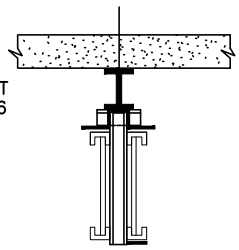
PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0400		REV 0

SHEET 20 OF 28

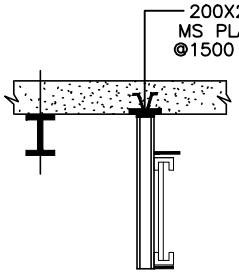
A4_DD (9-96) [210x297]



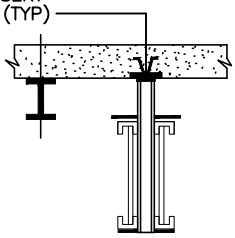
STYLE–1



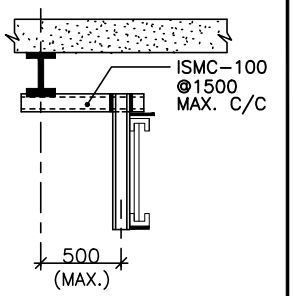
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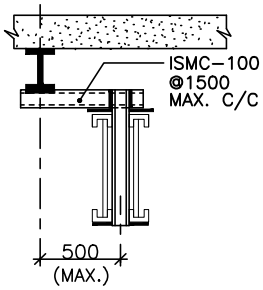
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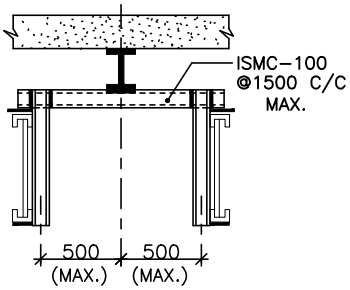
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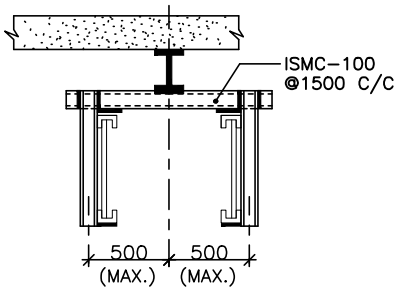
STYLE–5



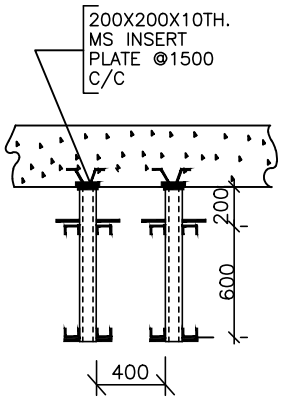
STYLE–6



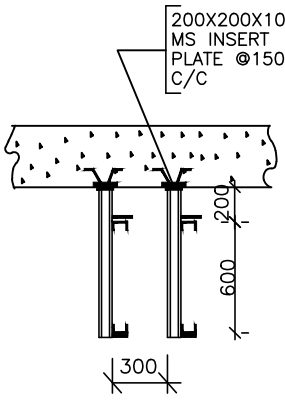
STYLE–7



STYLE–8



STYLE–9



STYLE–10

MOUNTING ARRANGEMENT

(VERTICAL CABLE TRAY)

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

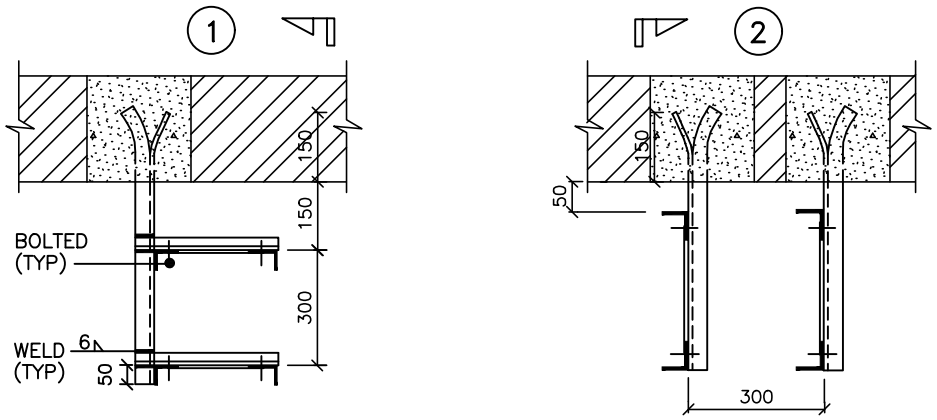
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0400		REV 0

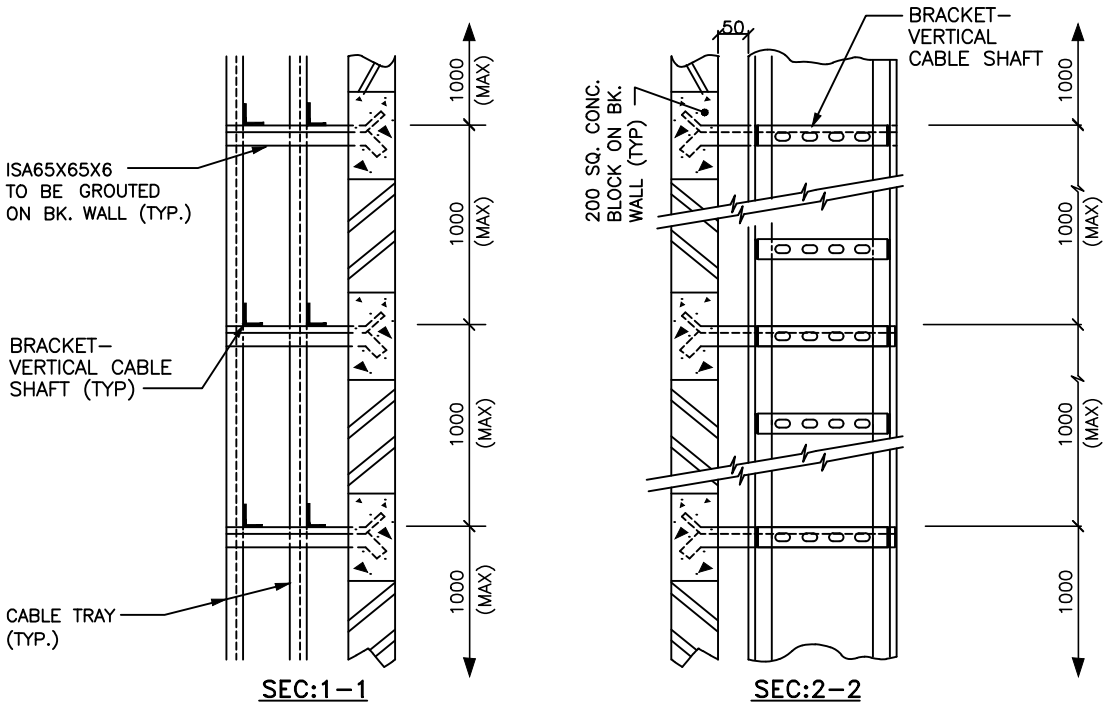
SHEET 21 OF 28

A4_DD (9–96) [210x297]



PLAN
ALT.1

PLAN
ALT.2



SEC:1–1

SEC:2–2

MOUNTING ARRANGEMENT
(CABLE SHAFT ON BRICKWALL)

NOTE

FOR CABLE SHAFT OF TYPE SH.–A, SH–C, THE ARRANGEMENT SHALL BE SIMILAR TO SH–B SHOWN HERE IN.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

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PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

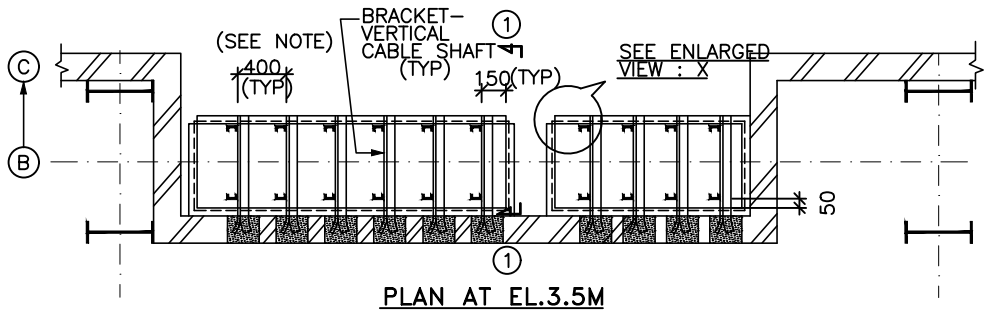
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

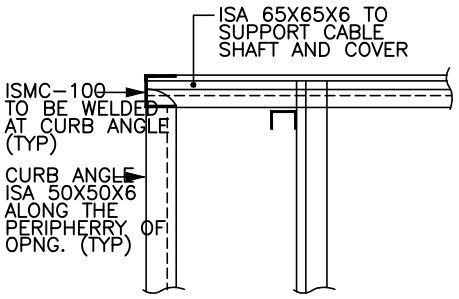
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0400		REV 0

SHEET 22 OF 28

A4_DD (9–96) [210x297]

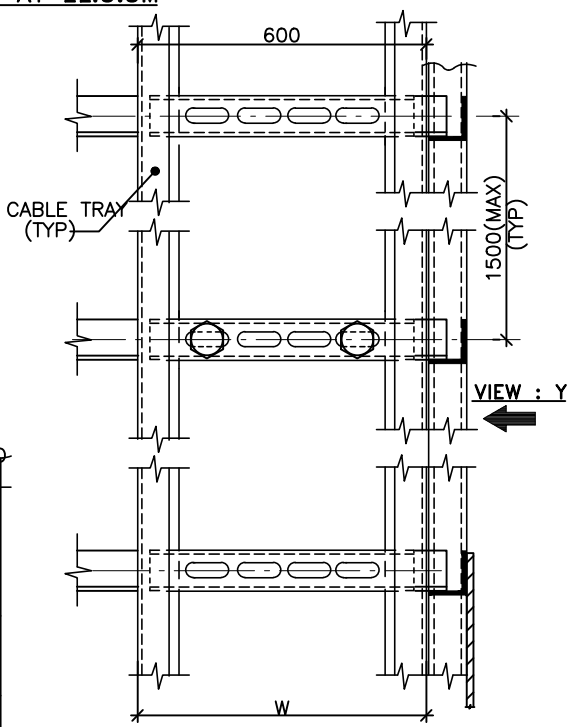


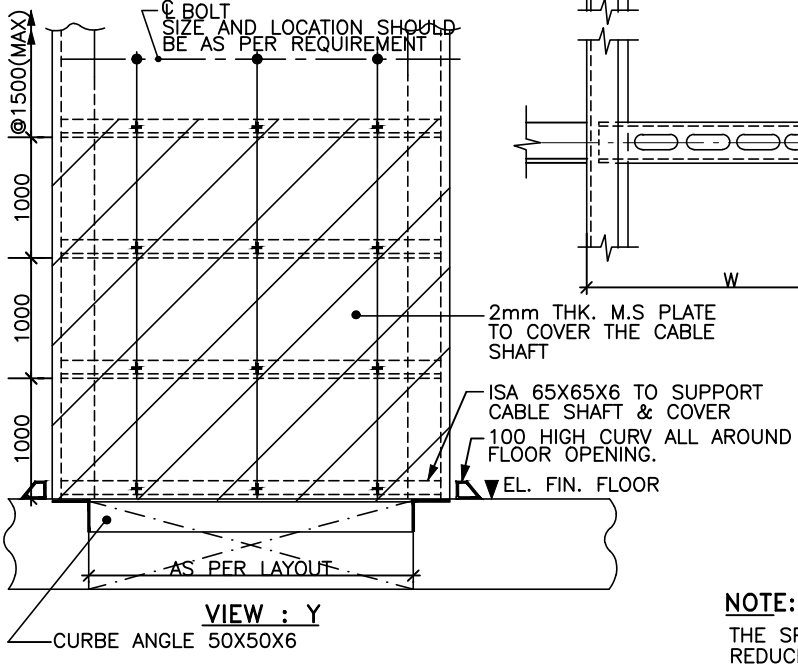
PLAN AT EL.3.5M



ENLARGED VIEW : X

TYPICAL DETAILS OF CABLE SHAFT





VIEW : Y

MOUNTING ARRANGEMENT

(CABLE SHAFT MAIN PLANT)

NOTE:-

THE SPACING MAY BE REDUCED TO 300, IF CABLE TRAY IS ACCESSIBLE FROM BOTH SIDE.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP)
(3X800MW)

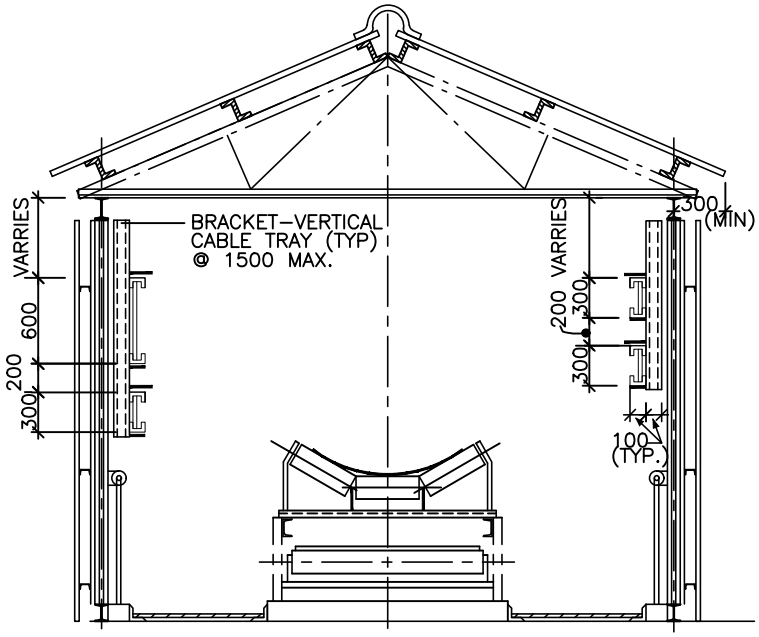
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
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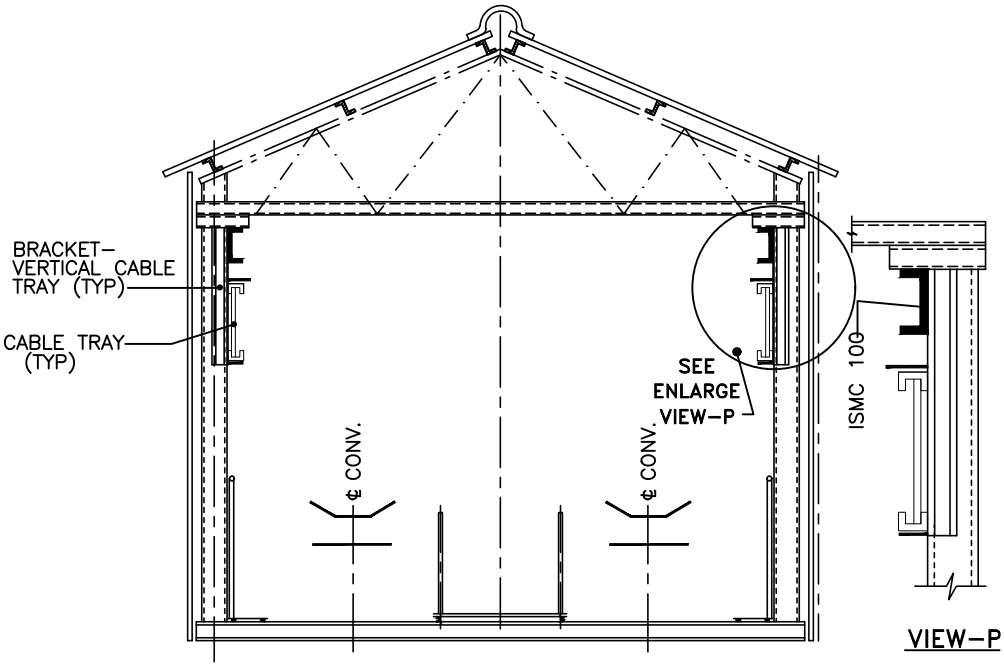
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MOUNTING ARRANGEMENT
(INSIDE CONV. GALLERY–ALT–I)

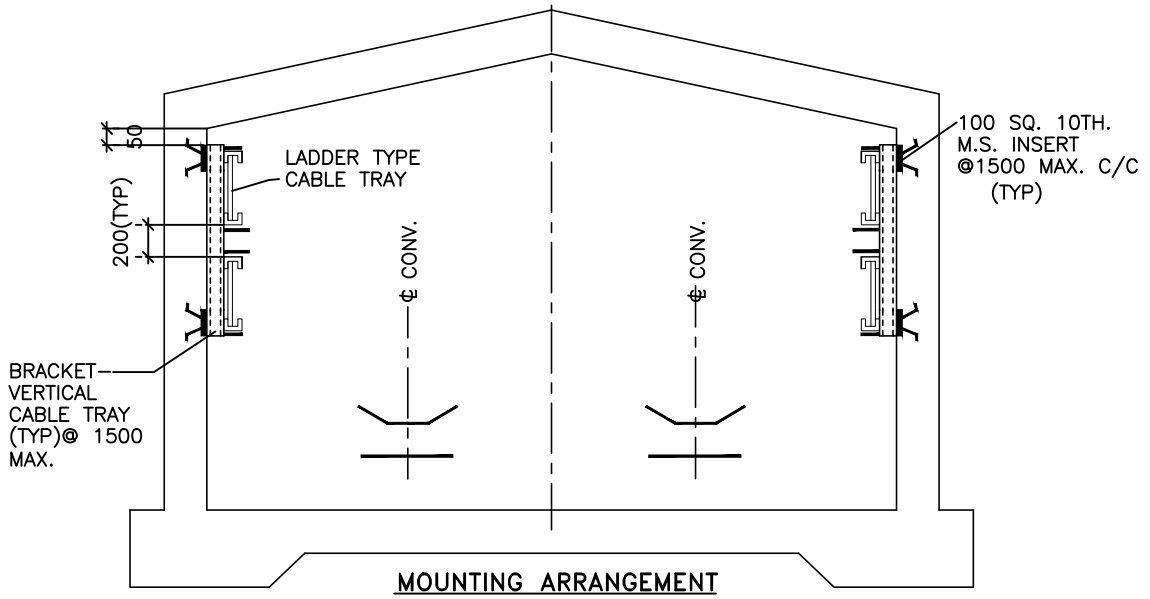


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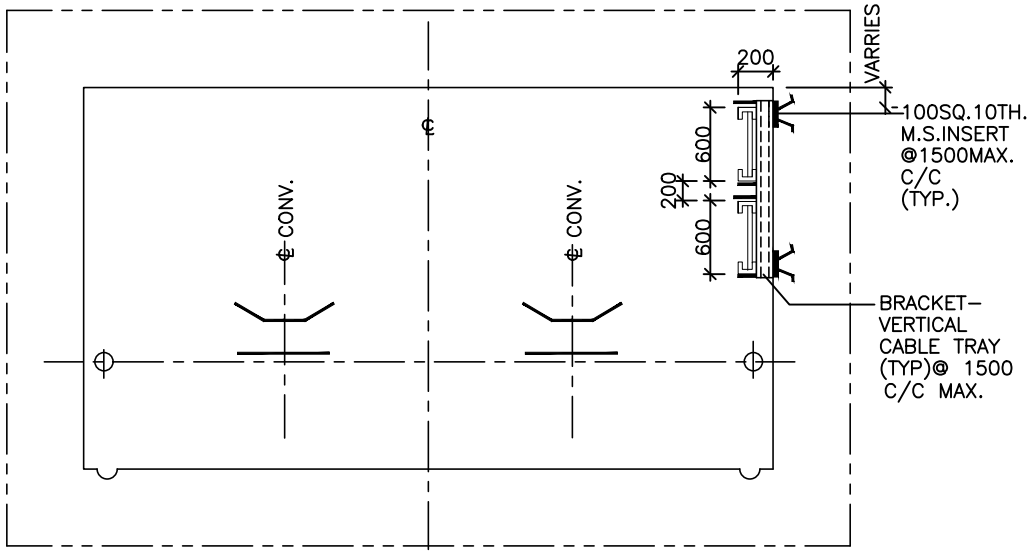
MOUNTING ARRANGEMENT
(INSIDE CONV. GALLERY–ALT–II)

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED: BG; JOB NO.: 18A03
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REV	DATE	PREPD	CHKD	APPVD	CABLING NOTES & DETAILS	APPROVED: DS; DATE: 08.10.20; REV 0
REVISION STATUS						DWG. NO.: 18A03–DWG–E–0400; SHEET 24 OF 28

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MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL–ALT–I)



MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL–ALT–II)

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

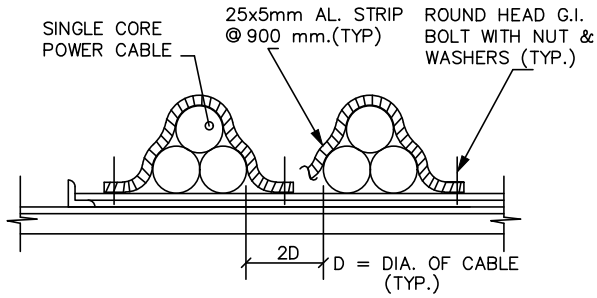
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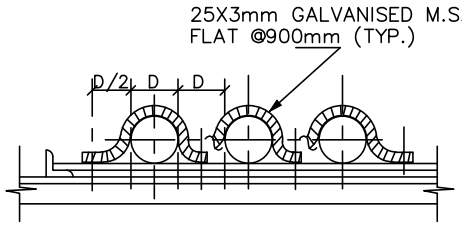
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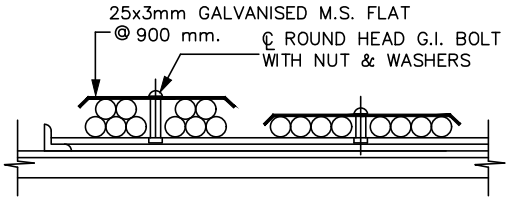
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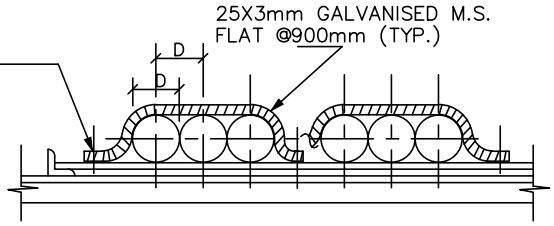
CABLE CLAMPS IN TREFOIL FORMATION FOR SINGLE CORE POWER CABLES



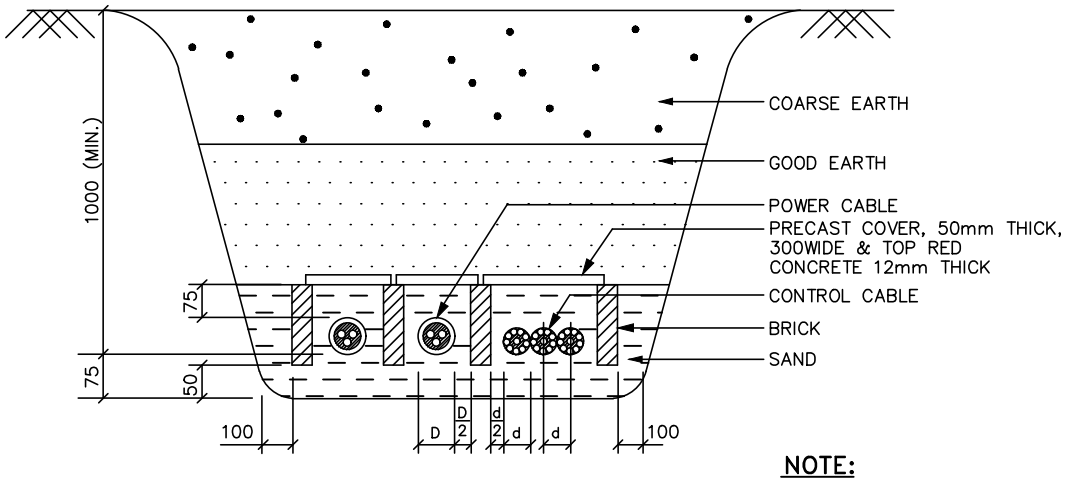
CABLE CLAMPS FOR MULTICORE POWER CABLES (NOT TOUCHING EACHOTHER)



CLAMPING ARRARNGEMENT OF CONTROL CABLES



CABLE CLAMPS FOR MULTICORE POWER CABLES (TOUCHING EACHOTHER)



BURIED CABLE LAYING DETAILS

NOTE:

ALL DIMENSIONS ARE IN 'MM'.

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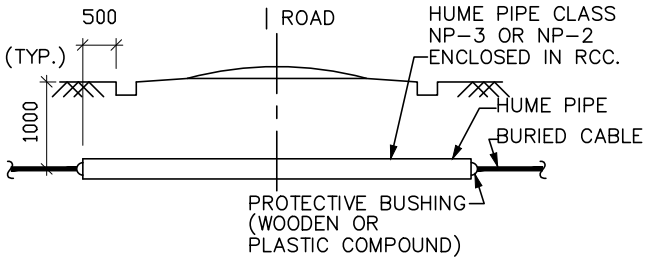
CABLING NOTES & DETAILS

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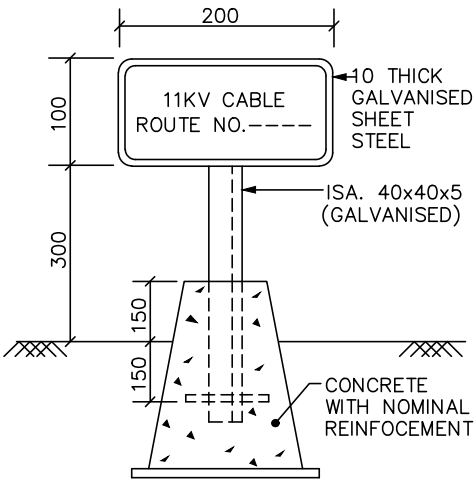
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APPROVED	DS	DATE	08.10.20
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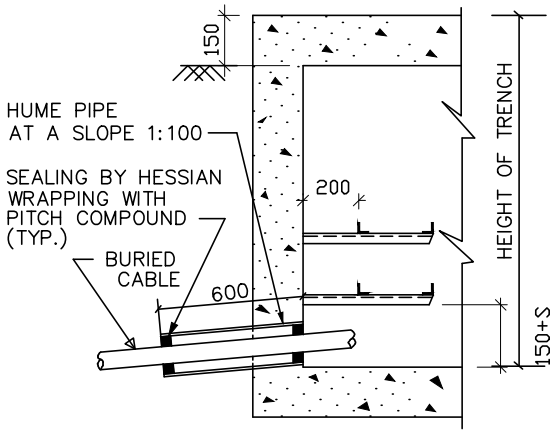
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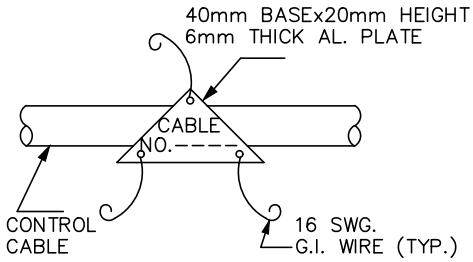
ROAD CROSSING OF BURIED CABLE



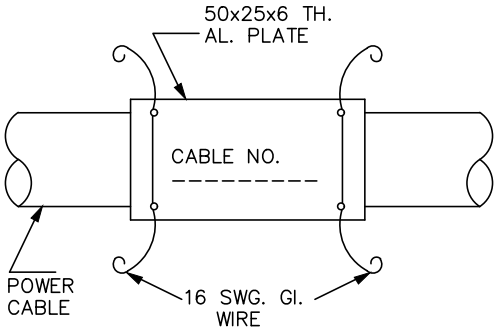
CABLE ROUTE MAKER
(VOLTAGE TO BE MARKED)



TYP. DETAILS OF BURIED CABLE ENTRY TO BLDG. OR CABLE TRENCH



CABLE TAG CONTROL CABLE



CABLE TAG POWER CABLE

NOTE:

ALL DIMENSIONS ARE IN 'MM'.

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OWNER: NLC INDIA LIMITED
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PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

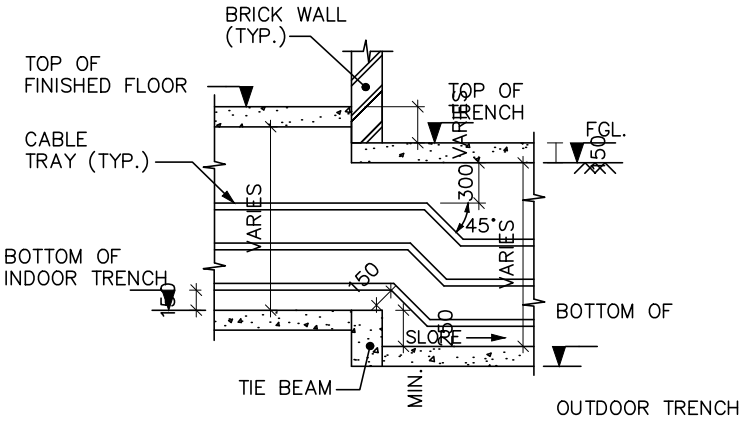
CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
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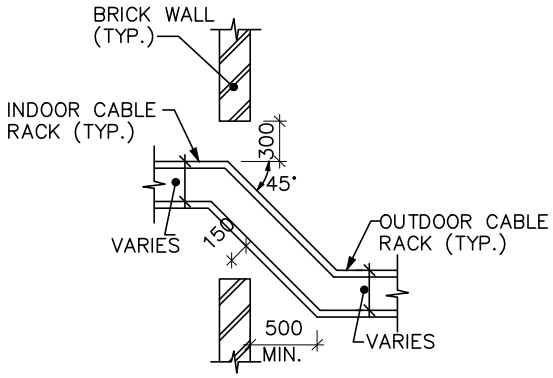
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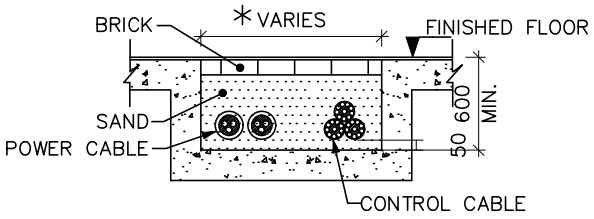
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TYPICAL DETAILS OF CABLE TRENCH ENTRY TO BUILDING



TYPICAL DETAILS OF CABLE RACK ENTRY TO BUILDINGS



CABLE LAYING IN SHALLOW TRENCH (INDOOR)

NOTE:

1. ALL DIMENSIONS ARE IN 'MM'.
2. THE PORTION OF FLOOR ABOVE THE TRENCH MARKED '*' SHALL BE FINISHED WITH WEAK MORTER.

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REVISION STATUS

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NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

CABLING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
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TECHNICAL SPECIFICATION OF CABLE GLANDS AND LUGS

1.0 Cable Glands

Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer etc. Cable glands shall match with the sizes of different H.V./L.V./Control cables.

2.0 Cable Lugs

All cable lugs shall be Cd plated copper. Cable lugs shall be suitable for termination of different cross-sections of H.V./L.V./Control/Instrumentation cables and shall be of following types:

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors. Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

VOLUME: II-F/2

SECTION-VII

ILLUMINATION SYSTEM

1.00.00 SCOPE OF WORK

Relevant sections pertaining to Illumination of IDCT package to be referred.

1.01.00 This section is intended to cover the design, engineering, manufacture, assembly, testing at manufacturer's works / laboratory, supply, delivery, properly packed for transport to site, illumination system, complete with all materials and accessories for efficient and trouble-free operation including welding system.

1.02.00 The scope of work shall also include design, engineering installation, testing, commissioning and putting into successful commercial operation of the lighting system supplies. The erection, commissioning and testing of the package illumination system shall be carried by erection contractor appointed by Contractor.

1.03.00 The major areas to be illuminated under the scope of this package are listed in Annexure-E of this section. The areas listed are however indicative only for the purpose of guidance to the seller and is subject to change during detailed engineering after finalization of plant layouts.

2.00.00 SCOPE OF SUPPLY

2.01.00 The equipment and materials within the scope of supply shall include but not limited to:

a) Lamp and LED type lighting fixtures and related LED accessories.

b) Lighting panels/boards: main lighting distribution boards, emergency AC lighting distribution boards, emergency DC lighting panels, street lighting panels.

c) Street light poles, flood lighting towers/poles/high mast.

d) Ceiling fans, receptacles, switches, switchboards, portable emergency lights, portable 24V supply module including handset as maintenance equipment, etc.

e) Cables, wires, splicing/termination/connection accessories including 4 way/3 way/2 way cable junction boxes with disconnecting devices on each way.

f) Conduit and accessories, junction and pull boxes, terminal blocks.

g) Grounding materials and connections.

h) All fittings, supports, brackets, anchors, clamps and connections.

i) Steel for field fabrication of supports and brackets.

2.02.00 Carrying out of detail engineering, including detail design calculations, preparation of lighting layouts showing location of fixtures, cable, wires conduit routing, indicating number and size of wires in each conduit and preparation of cable schedule and other related drawings as detailed in subsequent clauses consider the energy saving and energy efficient illumination system.

2.03.00 Preparation of “As built” drawings.

2.04.00 All relevant drawings, data and instruction manuals

3.00.00 CODES AND STANDARDS

3.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

3.02.00 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

4.00.00 DESIGN CRITERIA

4.01.00 Design Basis

4.01.01 The system provides lighting and electric power supply to complete Power Plant.

4.01.02 The system & equipment shall be suitable for operating in an adverse industrial environment, where Equipment will be subject to vibration, coal-dust, fly-ash, oil/water vapours as prevalent in a thermal generating plant.

4.01.03 The design shall be such as to provide average lighting levels as specified for different areas.

4.01.04 Not used.

4.01.05 The systems shall be suitable for operation on available power supply having characteristics as given in the Annexure-A.

4.01.06 Not used.

4.01.07 The illumination area shall generally be provided with

a) Main lighting system for full illumination under normal AC power supply conditions and shall operate from 415V/240V AC power supply tapped from respective MLDB/lighting panels.

b) AC Emergency lighting system for reduced illumination operated by DG supply feeders during failure of main power supply. It shall cover 20% of fixtures in the Power House Building including switchgear building, service building, Boiler & ESP, Transformer yard area ,Switchyard GIS Building, FGD area , ETP & associated area, 30% of fixtures in the Main control room & switchyard Control Room and 100% of fixtures for chimney (may be UPS feed) lighting.

c) DC emergency lighting system for reduced illumination during failure of main power supply as well as DG power supply with the help of 220V DC batteries/supply feeders.

4.01.08 Lighting panels shall be fed directly from nearest Main Lighting Distribution board. All MLDBs shall have duplicate incomers and a bus-section. These MLDBs shall be fed from respective nearest 415V PMCC / MCC through 2x100%, Dyn11, Dry type, isolating transformers to reduce fault level below 9kA. Each MLDB shall have outgoing feeders TPN MCCB with earth leakage current protection. The transformers may, preferably, be located inside the MLDB itself.

4.02.00 **System Concept**

The lighting system shall comprise following sub-systems:

4.02.01 **Normal A.C. Lighting**

a) This will be provided by A.C. lighting fixtures distributed throughout the plant area. These lights will be ON as long as the normal A.C. supply is available.

b) A.C. lighting fixtures will be fed from respective area lighting panels (LP), which in turn will be connected to nearest main lighting distribution board (MLDB). The lighting panels shall be provided with at least 20% spare outlets.

4.02.02 **Emergency A.C. Lighting**

a) On failure of normal A.C. Supply, emergency A.C. lighting will be provided in selected areas for safe movements and operation of important auxiliaries.

b) Emergency A.C. lighting fixtures will be fed from respective area emergency lighting panels (ELP) either through cable junction box or direct, which in turn will be connected to emergency AC Main Lighting Distribution Board (ACELDB). It should be fed from Emergency MCC and same like MLDB. The emergency lighting panels shall be provided with at least 20% spare outlets.

These lights will be kept "ON" from normal power supply source. But failure of normal power supply these will be fed from DG through 415V Emergency MCC. This change over of power supply will be done by automatic switching.

4.02.03 **Emergency D.C. Lighting**

a) This will be provided by D.C. lighting fixtures located strategically in critical operating areas and emergency exits. Emergency D.C. lighting fixtures will be fed from respective area DC lighting panels (DCLP) either through cable junction box or direct, which in turn will be connected to DC Emergency Lighting Distribution Board (DCELDB).

These lights will be ON all the time - normally from nearest emergency ACELDB, but on its failure from respective area D.C. supply through automatic switching.

b) The DC Emergency Lighting Distribution Boards will be fed from two power sources, namely -

- AC Emergency Lighting Distribution Board (ACELDB).
- 220V DC Distribution Boards (DCDB).

4.02.04 **Street/Area Lighting**

Time switch & Photocell arrangement with selection in between shall be used for controlling area/outdoor lights with provision for manual override.

Illumination to the roads shall be provided by providing street lighting poles.

4.02.05 **Emergency Lighting in Remote area**

This will be provided in isolated building / area / mobile equipment [where D.C. supply is not available] by light unit with self-contained battery / automatic charger. These portable emergency light units will be energized automatically on loss of normal A.C. supply. Battery packs for portable emergency lights shall be rated for minimum one hour duty.

4.02.06 **Portable 24V supply module**

24V power supply module complete shall be provided for 24V as maintenance purpose.

4.03.00 **Ratings & Requirements**

4.03.01 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.

4.03.02 MCCB, miniature circuit breakers (MCB), busbar shall be fully rated for short circuit level at the point of application.

4.03.03 All equipment and accessories shall have proper enclosure to suit the site conditions. In hazardous areas all equipment and accessories shall have flame-proof enclosure.

4.03.04 In general, wiring from lighting panels to fixtures and from lighting panels to 5/15A receptacles shall be carried out by PVC insulated wires through G.I. Conduits. Armoured cables of suitable size may be used for connection to lighting fixtures in Boiler, ESP & TG Hall area.

4.03.05 Heavy duty XLPE FRLSH power cables as per IS: 7098 will be used for connections as follows:

a) From Main Lighting Distribution Board (MLDB) to Area Lighting Panel

b) From Emergency Main Lighting Distribution Board (ACELDB) to Emergency Lighting Panels (ELP)

c) From DC Emergency Lighting Distribution Board (DCELDB) to DC Lighting Panels (DCLP).

d) From Street/Area lighting panel to Street Light Poles / Flood Light Tower

e) From welding DB to receptacles of 63A and above

Suitable number of 63A, 3-ph, 4-wire, 5-pin, 415V AC industrial receptacles shall be provided for entire plant for welding purposes, particularly near all major equipment and at an average distance of 50m. At least one 63A, 3-ph, 415V AC receptacle shall be provided in each room of each building.

Minimum Number of welding DBs to be provided:

a) Main Power House : 4 nos.
b) Transformer Yard : 2 nos.
c) Compressor House : 2 Nos
d) CPU Regeneration house: 2 Nos
e) ACW Pump houses : 2 Nos each
f) Boiler area : 2 nos. (per Unit)
g) ESP area & FGD area : 5 no. (per Unit)
h) Fuel Oil area : 2 no.

However, the Contractor has to comply with Vol. II-F1/Section-I, General Electrical Specification, Clause 4.43.00, for providing Welding receptacles for both Main plant & BOP Areas. If required additional Welding DBs to be provided to meet this specification.

4.03.06 Inside Switchboards wiring shall be carried out with 1100V PVC stranded copper wire.

4.03.07 Distinctive earth terminal shall be provided either inside or outside of each equipment included under the scope of the Contractor.

4.04.00 **Method of Calculation**

4.04.01 Standard Lumen method shall be adopted for interior & exterior lighting in order to calculate the number of lighting fixtures for obtaining the desired average level of illumination.

4.04.02 The coefficient of utilization shall be considered to take care of lumen loss due to:

a) Effect of room dimensions
b) Absorption of light in luminaires
c) Absorption of light at various room surfaces i.e ceiling wall etc.
d) Floor cavity, ceiling cavity
e) Mounting height

4.04.03 Moreover a maintenance factor shall also be considered to account for the fall of illumination due to aging, pollution like dust deposit etc. Maintenance factors to be considered for various areas shall be as follows:

Area	Maintenance factor
Control Room & A/C area	0.80
Non A/C area	0.70
Dusty Area & Outdoor area	0.60

Light Loss Factor

In interiors with fairly clean atmosphere, such as offices, air-conditioned interiors etc, a light loss factor of 0.8, in interiors which are prone to accumulate dust faster, an LLF of 0.7 and in high dirt prone interiors an LLF of 0.6 shall be adopted for calculating the no. of luminaires to be installed for a particular service illuminance.

4.04.04 To achieve the recommended luminance relationship, it is necessary to select the reflectance of all finishes of the room surfaces. The recommended reflectance values for industrial interiors and equipment are given bellow for Contractor's guide lines:

Reflectance Values

(For Station/ Other Auxiliary Area except Dusty Area)

Surface	Reflectance
Ceiling	80%
Wall	40%
Desk and Bench tops, machines And equipment	25%
Floor	20%

(For Dusty Area)

Surface	Reflectance
Ceiling	50%
Wall	30%
Floor	10%

4.04.05 Lux level to be considered for various areas are given in Annexure-B

4.04.06 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

4.04.07 Circuit loading of each lighting Panel shall be done as per relevant codes/Indian Standards in such a way that almost balanced loading in all the phases i.e. R, Y & B is achieved.

4.04.08 At least two (2) sub circuits shall be used for illumination of a particular area.

4.04.09 Sub circuit loading of each lighting panel shall be restricted to 2000 Watts or 20 fixtures whichever is lower.

4.04.10 The working plane shall be considered at 0.85m from the floor level.

4.04.11 Calculation can be done through proven software program by maintaining uniformity ratio as per relevant IS.

Uniformity in Illumination level shall be maintained as per IS 3646.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 Equipment and materials furnished shall be complete and operative in all details.

5.01.03 All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 **Lighting Fixtures**

5.02.01 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive, scratch resistant and no bright spots are produced either by direct light source or by reflection. Fixture shall conform to latest IS / IEC and its latest amendment

5.02.02 LED lamp fixtures shall be complete with all necessary wiring and accessories such as driver, ignitor, heat sink, power factor improvement capacitors (if required) etc. These shall be mounted in the fitting assembly only. The Contractor shall indicate starting time of these lamps to attain full light output. Curves for starting characteristics with varying supply voltage etc. are to be furnished by the Contractor.

5.02.03 Flood lighting shall have suitable base plate/frame for mounting on structural steel member.

5.02.04 Fixture shall be suitable for 20mm conduit entry and 16 SWG G.I. earth wire connection.

5.02.05 High bay fixtures shall have provision for vibration damper to ensure rated lamp life.

5.02.06 Fixtures shall be fully wired up to respective terminal blocks, suitable for loop in and loop out connection of PVC stranded wires of following minimum sizes:

- Lighting fixture : 2.5mm^2 copper - Two (2) numbers
- Flood light fixture : 2x2.5mm^2 copper - Two (2) numbers

5.02.07 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.

5.02.08 **Lamp holders**

Lamp holders shall be for LED lamp. Holders shall be designed and manufactured in accordance with relevant standard to give long and satisfactory service.

5.03.00 **Lamps**

5.03.01 The LED lamps to be supplied shall conform to or IS-16101, 16102, 16103,16104,16105, 16106 & 16107 and latest edition. LED lamps shall be suitable for use in any position. Restrictions, if any, shall be clearly stated. The lamps shall be capable of withstanding small vibrations without breakage of connections at lead-in wires and filament electrodes.

5.03.02 Lamps shall be suitable for use in position and capable of withstanding small vibrations. Restrictions and special features, if any shall be clearly indicated.

5.03.03 The Contractor shall furnish typical wiring diagrams for all fittings including all accessories. The diagrams shall include technical details of accessories i.e. ignitors, ballasts, capacitors etc.

5.04.00 **Lighting Panel**

5.04.01 Lighting panels shall be metal-enclosed, cabinet type, fabricated from CRCA sheet steel minimum 2mm thick, suitable for either wall/column mounting on brackets or floor mounting on channel sills.

5.04.02 Indoor Lighting Panels shall be dust and vermin-proof, IP-52; outdoor panels shall be weather-proof with canopy, IPW-55 or better. The cubicle housing transformer shall be minimum IP-42.

5.04.03 Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.

5.04.04 Lighting panels shall have provision of cable entry from top and bottom, as required, with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.

5.04.05 Two ground pads with M10 G.I. bolts and nuts shall be provided on each Lighting Panel for connection to ground conductor.

5.04.06 Each Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a circuit directory plate fixed on inside of the front cover. Circuit directory plate shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit.

The plates shall be of anodized aluminium with inscriptions indelibly etched on it.

5.04.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85ºC. Minimum size shall be 25 x 6mm.

5.04.08 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.

5.05.00 **Board / Panel Equipment**

5.05.01 Each Distribution Board shall consist of dry type transformer housed in the cubicle, voltmeter with selector switch, C.T. operated ammeter and incoming triple pole MCCB. Outgoing feeder from the Lighting Distribution Board shall have MCCBs. Proper discrimination between outgoing MCCB's and downstream MCB of Lighting Panel should be ensured.

Lighting distribution board shall have 4pole MCCB incomers & bus couplers and 4 pole MCCB outgoing feeders.

5.05.02 Each lighting panel shall have an incoming 4 pole ELCB and a number of outgoing SPN miniature circuit breakers (MCB).

5.05.03 Panel access door shall be interlocked with incoming MCCB/MCB such that the door can be opened only when the MCCB is in OFF position. Means shall be provided to defeat this interlock.

5.05.04 All MCCB shall be single throw, air break, heavy duty type having quick-make quick-break contacts. Contactors shall be air break electromagnetic type. Push buttons shall be push to actuate type.

5.05.05 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

5.05.06 Time switch & Photo cell arrangement in street & outdoor lighting panels shall be electronic 24hrs timer type with ON-OFF time setting facility, which shall ensure respective ON-OFF operation in every 24 Hours cycle.

5.06.00 **Receptacle**

5.06.01 Receptacles shall be heavy duty, complete with individual plug and switch as detailed in the annexure.

5.06.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of 3rd pin.

5.06.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.

5.06.04 63 A three phase four pin receptacle shall be provided at each major plant maintenance area as defined elsewhere in the specification.

5.07.00 **Fans & Regulators**

5.07.01 The fans shall have three well balanced metallic blades, double ball bearings and shall be reasonably free from noise. Sweep shall be 1200 / 1400mm. Pedestal fans shall also be provided as per requirement.

5.07.02 Fan motor shall be totally enclosed type with copper winding.

5.07.03 Regulator shall have minimum five steps in modular size. Electronic regulator with smooth control is to be provided.

5.08.00 **Switch & Switch Board**

5.08.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6mm thick color matching FRP/Non-Hygroscopic Synthetic cover with brass fixing screws.

5.08.02 Switch boards/boxes located in control room and office areas shall be flush mounted type on brick wall with only the switch knob projecting outside.

5.08.03 Switch boards/boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.

5.08.04 Flush type receptacles where provided shall be so located that only the plug projects outside.

5.08.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

5.09.00 **Lighting Poles & Flood Light Tower**

5.09.01 **Street Light Poles**

a) Street light poles shall be swaged and welded steel pole of height 9M and 11 M above ground, complete with fixing brackets, weather-proof junction box and all other accessories.

b) The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising of red oxide and zinc chromate in synthetic medium).

5.09.02 **Flood Light Tower**

a) Flood light tower shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.

b) Structures shall be designed for an additional load of 1500kg for maintenance crew. Deflection under maximum wind pressure shall not exceed 1 in 360. Structural design shall be as per IS-800 and subject to Owner's approval.

5.09.03 **Lighting High Masts**

Applicable standards:

The following shall be reference standards for loading of the High Mast:

a) IS-875 (Part-III) 1987 - Code and practice for design loads for Structures.

b) BSEN 10025/DIN 17100 - Grade of M.S. Plates

c) BSEN-1011 - Welding

d) BS.ISO 1461- Galvanizing

Structure:

Lighting High Mast shall be of continuously tapered polygonal cross section, at least 20-sided, hot dip galvanized and presenting a good and pleasuring appearance and shall be based on proven in-tension design confirming to the standards referred to above, to give an assured performance and reliable service. The structure shall be suitable for wind loading as per IS-875 Part-III, 1987. The masts dimensions shall be as per standards.

The Mast shall be of 20m height with lantern carriage to enable raising / lowering for ease of maintenance, including the head frame, double drum winch, continuous stainless-steel wire rope, in built power tool, luminaries, suitable lightning protection for high mast and lantern carriage of fixtures along with necessary power cables within the mast. The mast shall be delivered in three / two sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

High mast shall be complete with feeder pillar panel for power distribution to lighting fixtures and winch motor. Feeder pillar panel shall be outdoor type stand mounting with dust and vermin proof, IP55 and constructed of 14SWG sheet steel. Minimum 4 nos. high mast shall be considered for SG/TG/FGD area each and minimum 10 nos. high mast shall be considered for BOP area.

5.10.00 **Maintenance Equipment**

5.10.01 The Contractor shall supply one (1) no. of wheel mounted adjustable aluminium ladder of 12m for the maintenance of street lights.

5.10.02 For the maintenance of lighting fixtures within the building the Contractor shall supply one (1) no free standing adjustable aluminium ladder, adjustable from 5m to 10m and two (2) nos free standing adjustable aluminium ladder adjustable from 2.5m to 5.0m

5.10.03 For the maintenance of lighting fixtures within the switchyard area, the Contractor shall supply two (2) nos. free standing adjustable aluminium ladder, adjustable from 5m to 10m.

5.11.00 **Special Requirement**

5.11.01 All outdoor illumination fixtures, unless it is fed from photo cell/time switch controlled lighting panel, has to be provided with outdoor type local switches.

5.11.02 In all the air filtration units and air handling units, one marine type lamp (of 100 watt approx.) shall be provided and the wiring & fixing of the same has to be done by the Contractor.

5.12.00 **Lighting Cables & Wires**

5.12.01 Lighting Cable shall be heavy duty, 1100V grade, multicore stranded copper conductor, XLPE insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed with FRLSH conforming to IS 7098.

5.12.02 Lighting wires shall be 1100 Volt grade, PVC insulated, stranded conductor, single core wires conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLACK	for	Neutral
YELLOW	for	Y-Phase	WHITEfor	+'Ve D.C.	
BLUE	for	B-Phase	GREY	for	-'Ve D.C.

5.12.03 Minimum size of lighting wires shall be as follows:

From lighting panel to junction box	:	1/C x 6 sq. mm (Cu)
From Junction box to lighting fixture	:	1/C x2.5 Sq.mm. (Cu)
From Junction Boxes to Flood Light Fixtures	:	1C, 2x2.5 Sq. mm. (Cu)
From Lighting Panel to 230V AC, 5/15A 1-phase receptacle	:	1C, 6 Sq. mm. (Cu) (Stranded)

5.13.00 **Conduits and Accessories**

5.13.01 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3metres, threaded at both ends.

5.13.02 Thickness of conduits up to and including 25mm dia shall be of 16 SWG and conduits above 25mm shall be of 14 SWG. Minimum size of conduits shall be 20mm.

5.13.03 Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushings at both ends.

5.13.04 Flexible conduits shall be made with bright, cold rolled annealed and electro-galvanised mild steel strips and coated with PVC.

5.14.00 **Junction Box**

5.14.01 Junction boxes shall be of 16 SWG sheet steel hot-dip galvanized, dust and damp proof, generally conforming to IP-55 for indoor. For outdoor and corrosive area FRP Junction box with weatherproof IP55 enclosure shall be provided. Degree of protection shall be IP65 for dust pones area including Crusher house, Bunker, Mill area, Coal conveyor area.

5.14.02 Junction boxes shall be complete with gasketed inspection cover, conduit knock out/threaded hub and terminal blocks.

5.14.03 For hazardous location junction box shall be flame-proof type suitable for a particular zone / gas group in compliance with IS: 2148 / IS: 13346 and shall have certification from CIMFR, Dhanbad.

5.14.04 Junction boxes shall have following indelible markings:

- Circuit nos. on top
- Circuit nos. with ferrules (inside) as per drawing
- DANGER sign in case of 415V circuit

5.15.00 **Terminals**

5.15.01 Multi way terminal blocks of approved type, complete with screws, nuts, washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.15.02 Each terminal shall be suitable for connection up to 2 nos. 10sq.mm stranded aluminium conductors without any damage to the conductor or looseness of connectors.

5.16.00 **Portable Emergency Lighting Unit**

The portable emergency lighting unit shall be complete with 6volt storage battery (rechargeable), inverter, automatic charger, LED lamps Contractor shall furnish make, type and catalogue. Minimum of 20 nos. has to be supplied.

5.17.00 **24V Supply Module**

5.17.01 Each 24V A.C. supply module shall have one (1) no air cooled two winding, 500VA, 1-phase, 50HZ, 240/24V transformer with 6A (240V side) and 16A (24V side) MCB and necessary 240V and 24V terminals for incoming and outgoing connections. A group of 6A, 24V AC receptacles shall be wired up on 24V side.

5.17.02 The 24V A.C. supply modules shall be sheet steel enclosed with louvers and shall be suitable for outdoor use. The 24V A.C. supply modules shall be suitable for wall/steel structure/column mounting. Switches shall be mounted at the front on sheet steel enclosure.

5.17.03 Portable 24V AC supply modules having sheet steel enclosure with louvers as per above shall be supplied. 24V halogen automobiles lamps with reflector along with 1100 V, twin core PVC sheathed, 2.5 mm^2 stranded copper wire of 20m lengths as handset. Minimum of 20nos has to be supplied.

5.18.00 **Indication Lamp**

Lamps shall be clustered of LED type. LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow

protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamps shall be as per LED indicating lamp.

5.19.00 **Contactors**

5.19.01 Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class III category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class I - category DC2.

5.19.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10A at operating voltage. The exact requirement of contacts shall be decided by the Vendors taking into account the scheme requirements and spares.

5.19.03 Not used.

5.20.00 **Moulded Case Circuit Breaker (MCCB)**

5.20.01 MCCB shall be heavy duty, triple pole, load break-fault-make type conform to the duty as required. MCCB shall be provided with a common trip bar, so as to ensure opening of all phases even when fault occurs in only one phase.

5.20.02 MCCB shall have positive indication in ON and OFF position with indication on each Module.

5.20.03 The MCCB should be housed in a heat resistant moulded insulated housing Overload and Magnetic release of MCCB shall be suitable for setting at site. The Short Circuit release shall be of minimum of 12 x In.

5.20.04 For hazardous area, one (1) no. 63Amp MCCB shall be provided within a Flame-proof enclosure. The enclosure shall be Flame-proof as per the stipulations of relevant standard. It shall have a degree of protection of IPW-55. The enclosure front access door shall be interlocked with the MCCB. It shall have grounding facility on opposite sides complete with designation and caution notice plates fixed on the front cover. It shall meet the requirement of IS 5571 & IS – 5572. The total unit shall have a valid certification for using in the specified zone from statutory authority preferably of CMRI and/or CE Ex II 2 G EEx-D IIB T4/T5/T6; CE Ex II2 2(1) G EEx-d (ia) IIB T5/T6; CE Ex II2 (1) GD EEx-d (ia) IIB T5/T6 or similar.

5.21.00 **Nameplate**

5.21.01 Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to clearly indicate their functions.

5.21.02 All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

5.22.00 **Samples**

5.22.01 Owner reserves the right to call for samples if considered necessary and the same shall be submitted by the Contractor free and without any obligation.

6.00.00 SPECIFIC REQUIREMENTS - SERVICES

6.01.00 Responsibility of Erection

6.01.01 The Contractor shall be fully and finally responsible for proper erection, safe and satisfactory operation of plant and equipment under his scope of work to the entire satisfaction of the Engineer.

6.01.02 The work shall be executed in accordance with the directions, instructions, drawings and specifications which shall be supplied to the Contractor by the Engineer time to time.

6.01.03 If in the opinion of the Contractor any work is insufficiently specified or require modification, the Contractor shall refer the same in writing to the Engineer and obtain his instruction/ approval before proceeding with the work.

6.01.04 If the Contractor fails to refer such instances any excuse for the faulty erection, poor workmanship or delay in completion shall not be entertained.

6.01.05 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Engineer.

6.02.00 Supervision

6.02.01 The Engineer shall have the overall responsibility for co-ordination of Contractor's work and his direction shall be final.

6.02.02 Such direction and supervision however shall not relieve the Contractor of his responsibility of correctness and quality of workmanship and of other obligation under the contract.

6.03.00 Drawings

6.03.01 Drawings and schedules enclosed with this specification are for general guidance of the Contractor to assess the type and volume of the work involved.

6.03.02 These drawings and schedules will be revised to suit the actual requirement in related system. Additional drawings and schedules will also be furnished to Contractor if/when necessary. Final drawings and schedules will be furnished to the Contractor time to time as detailed designs are developed.

6.03.03 Such supervision, correction and addition to drawings and schedule shall not be considered to change the scope of work.

6.03.04 The Contractor shall mark in red on one (1) set of drawings all deviations/ alterations, not shown on drawing but carried out at field. After completion of work the Contractor shall furnish a set of marked up prints of “As built” drawings to the Owner.

6.04.00 **Methods and Workmanship**

6.04.01 All work shall be installed in a first class, neat workmanlike manner by machines/electricians skilled in the trade involved.

6.04.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.04.03 All details on installation shall be electrically and mechanically correct.

6.04.04 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

6.05.00 **Protection of work**

6.05.01 The Contractor shall effectively protect his work, equipment and materials under his custody from theft damage or tampering.

6.05.02 Finished work where required shall be suitably covered to keep it clean and free from defacement of injury.

6.05.03 For protection of his work Contractor shall provide fencing and lighting arrangement, connect up space heaters and provide heating arrangement as necessary and directed by engineer.

6.05.04 Contractor shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to contract.

6.06.00 **Safety Measure**

6.06.01 All safety codes and rules as applicable to work shall be followed without exception.

6.06.02 all safety appliance and protective devices including belt, hand gloves, aprons, helmets, shields, goggles etc. shall be provided by the Contractor for his personnel.

6.06.03 The Contractor shall provide guards and prominently display caution notices if access to any equipment/area is considered unsafe and hazardous.

6.07.00 **Co-operation**

6.07.01 The Contractor shall at all time work in close coordination with the Owner’s supervising personnel and afford them every facility to become familiar with erection and maintenance of the equipment.

6.07.02 The Contractor shall arrange his schedule of work and method of operation to minimize inconvenience to other Contractors working on the project.

6.07.03 In case of any difference between Contractors, the decision of the Engineer shall be final and binding of all parties concerned.

6.08.00 **Erection program and Progress**

6.08.01 The Contractor shall submit at such times and in such forms as maybe requested by the Engineer, schedule showing the program and the order in which the Contractor process to carry out the work with dates and estimated completion time for various parts of the work.

6.08.02 Such schedules shall be approved by the Engineer prior to starting the erection. The Contractor shall adhere to this approved program for all practical purpose. If for any reason the work is held up, the Contractor shall bring it to the attention of the Engineer in writing without any delay.

6.08.03 During the progress of work the Contractor shall submit monthly progress report and such other reports on erection work and organization as the Engineer may direct.

6.08.04 If in the of the Engineer the progress of erection work by the Contractor at any stage needs expediting so as to ensure completion of work within stipulated time, the Engineer shall have the right to instruct the Contractor to increase Contractor's manpower in appropriate categories and/or the working hours per day and/or erection tools and tackles and the Contractor shall comply with such instruction forthwith.

6.09.00 **Consumables and Hardware**

6.09.01 The Contractor shall furnish all erection materials, hardware and consumables required for the complete installation.

6.09.02 The materials shall include but shall not be limited to the following:

a) Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

b) Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.

c) Materials : Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

6.09.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Contractor.

6.10.00 **Erection Tools & Tackle**

6.10.01 The Contractor shall provide all tools, tackles, implements, scaffoldings, ladders etc which are required for handling and erection of the equipment and materials.

6.11.00 **Testing Equipment**

6.11.01 The Contractor will provide such checking and testing equipment as test lamp, buzzer, 500-volt meggar, earth meggar, lux-meter etc. with other testing equipment as required.

6.12.00 **Taking Delivery**

6.12.01 The Contractor shall take delivery of materials & brought to the erection site, stored or erected as necessary.

6.12.02 The Contractor shall submit a detailed account of materials after completion of each work.

6.13.00 **Opening of Case**

6.13.01 All packing cases and packages shall be opened in presence of engineer or his authorized representatives.

6.13.02 Packing cases shall be opened carefully to avoid damage to timber. Nails and strips shall be collected separately in boxes and not to be thrown away in random.

6.13.03 Contractor shall take back all crates, packing cases, all packing materials including steel packing material.

6.14.00 **Checking and Cleaning of Part**

6.14.01 All lighting fixtures, lamps, accessories and materials shall be carefully inspected and checked with packing list and identified with the erection drawings.

6.14.02 Any discrepancy shall be reported forthwith in writing to the Engineer and repair carried out as described herein-before.

6.14.03 all parts shall be thoroughly cleaned, all rust removed and surface polished as required.

6.14.04 Cleaned and polished parts shall be coated with anticorrosive paints where necessary and stored with care, ready for erection.

6.15.00 **Installation - General**

6.15.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions / recommendations where the same are available.

6.15.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

6.16.00 **Lighting Fixtures**

6.16.01 In case of closed ceiling industrial premises generally a continuous mounting of fittings is to be preferred.

6.16.02 In turbine hall, boiler galleries, buildings high bay fixtures shall be mounted to maintain sufficient clearance from the overhead travelling crane trolley.

Bracket for fixture mounting shall be fabricated at site from 40mm conduits with a reducing socket to suit the fixtures and clamped on to the handrails. The fixing shall be strong enough to withstand vibration and high wind velocity.

If a roof over platform is available, the fixture can be pendant mounted.

6.16.03 Floodlights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing holes shall be provided with slot to turn the fixture about 5 Deg on both sides. Bolts shall be finally tightened with spring washer.

The Contractor shall supply and install the steel base for fixing the flood light on the flood light towers.

Terminal connection to the floodlight shall be made through PVC coated flexible metallic conduits.

6.16.04 Fixtures shall be mounted on structures with suitable clamps. No cutting or drilling of structures is permitted.

6.16.05 The fixtures after erection shall be marked up indelibly with corresponding circuit number for easy identification of lamp circuit.

6.17.00 **Receptacles**

63A Receptacles shall be installed at locations not more than 50 meter or as per approved drawings.

6.18.00 **Lighting Panel**

Lighting panels shall be erected at the convenient locations with cable junction boxes as per approved drawing.

6.19.00 **Street Lighting Poles**

Erection of street light poles, flood lighting towers/poles/ high masts shall be at the convenient locations with cable lying as per approved drawing.

6.20.00 **Conduit System**

6.20.01 In case of unarmoured cable, all conduits shall originate from the respective lighting panel and terminate in lighting fixtures, receptacles etc.

6.20.02 Exposed conduits shall be run in straight lines parallel to building columns, beams and walls as far as practicable. Unnecessary bends and crossings shall be avoided to present a neat appearance.

6.20.03 Conduit supports shall be provided at an interval of 750mm for horizontal runs and 1000mm for vertical runs.

6.20.04 Conduits shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be fixed to the building steel by welding and to concrete or brick work by grouting as shown on drawings.

Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.

6.20.05 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.

6.20.06 Spacing of embedded conduits shall be such as to permit flow of concrete between them and in no case shall be less than 40 mm.

6.20.07 Where conduits are run on cable trays they shall be clamped to supporting steel at an interval of 60 mm.

6.20.08 For directly embedding in soil, the conduits shall be coated with an asphalt - base compound. Concrete pier or anchor shall be provided where necessary to support the conduit rigidly and to hold it in place.

6.20.09 Conduits shall be installed in such a way as to ensure against trouble from trapped condensation.

6.20.10 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.

6.20.11 Conduits shall be kept, wherever possible, at least 300mm away from hot pipes, heating device etc. However if such pipes & Devices are insulated, then conduit shall be routed at least 150mm from the insulated surfaces.

6.20.12 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.

6.20.13 For long run junction/pull boxes shall be provided at suitable intervals to facilitate wiring.

6.20.14 Conduits shall be securely fastened to junction box or cabinets, each with a locknut and insulated bushing inside the box and locknut outside.

6.20.15 Conduit lengths shall be joined by screwed couplers. Couplers shall be clearly cut.

6.20.16 Conduit joints and connections shall be made thoroughly water-tight and rust-proof by application of a thread compound which will not insulate the joints.

White lead is suitable for application on embedded conduit and red lead for exposed conduit.

6.20.17 The Battery Room installation shall be made with acid fume proof conduits.

6.20.18 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend.

6.20.19 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly grounded.

6.20.20 Lighting fixture shall not be suspended directly from junction box in the main conduit run.

6.20.21 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduits ends shall be plugged or capped to prevent entry of foreign material.

6.20.22 After installation the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

6.20.23 In control rooms and office areas provided with false ceiling conduit run shall be concealed type, embedded in the walls.

6.21.00 **Wiring/Cabling**

6.21.01 Wiring shall be generally carried out by PVC wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible.

Conduit fill criteria shall be as follows.

Single Wire/Cable	: 53%
Two Wires/cables	: 31%
Three or more wires/cables	: 40%

6.21.02 Wire shall not be pulled through more than two equivalent 90º bends in a single conduit run.

6.21.03 Wiring shall be spliced only at junction boxes with approved type connections or terminal strips. Maximum two wires can be connected to each way of the terminal block. Splicing of only one phase shall be done in a junction box.

6.21.04 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

6.21.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.

6.21.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from two different phase shall not run in same conduit. Circuits fed from different transformers shall be run through different conduits and Junction boxes.

6.21.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.

6.21.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.

6.22.00 **Cabling**

6.22.01 In outdoor areas, main runs from lighting panels shall be by means of XLPE cables, directly buried in ground if trenches are not available or laid in trenches for the underground portion and through conduit for the over ground portion.

6.22.02 Buried cables shall be laid and covered with sand/riddled earth, and protected from damage by bricks at sides and pre cast concrete slab at top. Buried cables shall have cable markers at 50M interval and projecting 150mm above ground. At cable bends and joints markers shall be provided.

6.22.03 When buried cables cross road/railway track, additional protection to be provided as defined in volume II G.

6.23.00 **Grounding**

6.23.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.

6.23.02 Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.

6.23.03 Lighting Panels shall be directly connected to ground grid by two nos. 35 x 6 mm G.S flats.

6.23.04 Street lighting Pole shall be grounded at two points by two nos. 25x 3 mm G.I flat risers from two (2) nos. earthing spike 20mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos. earthing terminals by 8 SWG GI wire.

6.23.05 One 16 SWG G.I wire shall be taken up to the junction box from lighting fixtures and connected to grounding point.

6.23.06 A continuous ground conductor of 16 SWG GI Wire shall run along each exposed metallic conduit run and bonded to it every 600mm by not less than two turns of the same size of wire. This conductor shall be connected to each panel ground bus.

All junction boxes, receptacles, fixtures etc. shall be connected to this 16 SWG ground conductor.

6.24.00 **Foundation & Civil Works**

6.24.01 Equipment foundations, panel foundations and all other civil work will be provided by the Contractor at the option of owner.

6.25.00 **Excavation and Back Filling**

6.25.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.

6.25.02 Excavation shall be performed up to the required depth. Such sheeting and shorting shall be done as may be necessary for protection of the work.

6.25.03 The Contractor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

6.25.04 All excavation shall be backfilled to the original level with good consolidation.

6.26.00 **Steel Fabrication**

6.26.01 All supports, hangers & brackets shall be fabricated by the Contractor. Necessary steel shall be supplied by the Contractor.

6.26.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.

6.26.03 Not used.

6.27.00 **Painting**

6.27.01 Street light poles shall be given two coats of aluminium paints after installation.

6.27.02 All steel fabrication shall be given two coats of red oxide primer followed by two coats of shade as specified in section-1.

6.27.03 All equipment shall be given touch-up paint as required after installation.

6.28.00 **Cleaning up of Work Site**

6.28.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No material shall be stored or placed on passage or drive ways.

6.28.02 Up on completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

6.29.00 **Inspection & Testing**

6.29.01 On completion of erection works, the Contractor shall request the Engineer for inspection and tests with minimum fourteen (14) days advance notice.

6.29.02 The Engineer shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

6.29.03 The installation shall be then tested and commissioned in presence of the Engineer and put on trial run for stipulated contract period.

6.29.04 All rectification, repair or adjustment work found necessary during inspection, testing, commissioning and trial run shall be carried out by the Contractor without any extra cost.

6.30.00 **Taking Over of Installation**

6.30.01 On successful testing, commissioning and trial run, the Contractor shall request Engineer in writing for taking over the installation.

6.30.02 The Engineer, on receipt of the request, shall arrange to take over the installation either wholly or in part as the case may be after a final inspection.

6.30.03 Till such taking over, the responsibility of the whole installation against theft or damage of any kind shall remain with the Contractor.

6.31.00 **Guarantee**

6.31.01 In the installation if any trouble arises due to the use of defective or faulty material and/or bad workmanship within a period of 12 months from the date of taking over, the Contractor shall guarantee to replace or repair the defective part(s) at site to the entire satisfaction of the Engineer free of charge.

7.00.00 TESTS

7.01.00 **Shop Tests**

7.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

7.01.02 Tests on lighting Distribution Boards/Panels shall include:

a) Wiring continuity tests

b) High voltage and insulation tests

c) Operational tests

7.02.00 **Site Tests**

7.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove that the same are free from ground and short circuit.

7.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

7.02.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

7.02.04 Illumination in different areas are as per designed lux level should be established.

7.03.00 **Test Certificates**

7.03.01 Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

7.03.02 The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

7.03.03 Valid Type test reports LM79 and LM80 including Type test certificate on any equipment, if so desired by the Owner, shall be furnished for owners review. In case of non-availability of valid test certificate, contractor shall conduct type tests as per IS / IEC without any additional commercial implication to prove the design.

8.00.00 DRAWINGS, DATA & MANUALS

8.01.00 Drawings, data and manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in the General Condition of Contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

8.02.00 **To be submitted with the Bid**

8.02.01 Make, type and catalogue number of lighting fixtures, lamps and accessories along with technical leaflets, data sheets, polar curves etc.

8.02.02 Typical outline drawings, showing constructional features, cable/ conduit entry, fixing arrangements etc of:

- Lighting Panel/receptacles/junction boxes
- Street light pole
- Flood light towers.
- High Mast

8.02.03 Technical leaflets and data sheet on each piece of equipment / device such as MCB, MCCB, receptacle etc.

8.02.04 Type test certificates on lighting fixtures and lighting panels, power cables.

8.03.00 **To be submitted after Award of Contract**

8.03.01 Detail dimensional drawing showing constructional features, cable/conduit entry, grounding, fixing arrangement etc. of:

- Lighting panels
- Receptacles & Junction boxes
- Street light poles
- Flood light tower along with design calculations
- Lighting fixture complete with lamps and accessories
- Non-integral/separate control gearbox for lighting fixtures, as applicable

8.03.02 Data sheets for lighting panels

8.03.03 Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc

8.03.04 Control schematic and wiring diagram of 415V AC/220V DC lighting panel with automatic changeover from AC to DC and back to AC normal supply on restoration, 415V normal AC Street/area lighting panel with automatic ON/OFF feature.

8.03.05 Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of cables.

8.03.06 Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.

8.03.07 Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.

8.03.08 AS-BUILT lighting layout and erection drawings, properly incorporating the changes/alterations/field modifications, if any, as carried out at field along with circuit distribution schemes of all lighting panels, conduit and cable routing and as acceptable to the Owner.

8.03.09 Any other relevant drawings, data and manuals necessary for satisfactory installation, operation and maintenance or as required by purchaser.

8.03.10 The Contractor may note that the drawings, data and manuals listed are minimum requirement only. The Contractor shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with his bid.

ANNEXURE-A

AVAILABLE POWER SUPPLY

1.0 System Voltage

Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources:

1.1 A.C. Supply : 415Volt, 3-phase, 50Hz, 3-wire (4 wire effectively grounded system after using suitable Lighting Transformer).
Fault Level 50KA r.m.s. symmetrical.

1.2 D.C. Supply : 220V, 2 wire, ungrounded system.
Fault Level 25* KA

2.0 Permissible Variation

Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:

2.1	A.C. Supply	:	Voltage ± 10% Frequency ±5%
	Combined Voltage + Frequency	:	10% (absolute sum)
	D.C. Supply	:	Voltage 198 to 242 Volt.

* Minimum only; actual value will be decided by the Contractor after substantiating the same by calculation.

ANNEXURE-B

AVERAGE LUX LEVEL FOR DIFFERENT AREAS

SL. NO	LOCATION	LUX LEVEL
1.	Central Control Room & Control Equipment Room	400
2.	Control Rooms (With false ceiling)	400
3.	Other control Rooms (Without false ceiling)	300
4.	Turbine Hall	200
5.	General Indoor area	100
6.	Transformer Yard & Switchyard	50
7.	Area near large rotating Equipment/plant	250
8.	Compressor Plant	200
9.	Air Conditioning Plant Room	200
10.	Switchgear/MCC/Electrical Equipment Rooms	250
11.	Battery Room	250
12.	UPS Room	250
13.	Battery Charger & DCDB Room	250
14.	Excitation Cubicle Room	250
15.	Air Washer Room	200
16.	AHU Room	200
17.	Elevator machine Room	200
18.	Shift Charge Engineers Room (With false ceiling)	250
19.	Central Analyzer Room (with false ceiling)	250
20.	Chemical Laboratory	300
21.	Cable spreader Area	100
22.	Oil Room and indoor hazardous areas	150

23.	Power House coal conveyor floor	150
24.	Power House Feeder floor	150
25.	PLC Room (with false ceiling)	250
26.	Surge tank platforms	100
27.	Passage, Indoor Stair, Catwalk Tunnel, Toilet etc.	70
28.	Outdoor/Semi outdoor stairs	70
29.	Office Room (Without false ceiling)	250
30.	Office Room (With false ceiling)	300
31.	AHP Compressor House	200
32.	Street & Periphery Lighting	20
33.	GIS Building	250 (*)
34.	All pump houses	250
35.	Chemical House	300
36.	Sludge Disposal P/H	100
37.	Coal Handling System Maintenance Building	200
38.	Junction Tower / Transfer House / Pent House	150
39.	Crusher House	100
40.	CW Chlorination Building / Chlorination Plant Building	100
41.	Bunker Floor	150
42.	Canteen	150
43.	Workshop	200
44.	Stores	100
45.	First aid Centre	150
46.	Fire station	150
47.	IDCT (Deck level)	100

- **(*)** Medium bay fixtures shall be used where the room height is less than 8M. Otherwise high bay fixtures are to be used.

- Lux level for main road lighting shall be 20 and for secondary road shall be 10 lux.
- One no. (1) DC emergency fixture shall be provided at entry, exit and each landing of stair cases of Electrical Buildings, Control Rooms etc.
- If Lux level of any specific area is not covered in above table, Contractor shall take specific confirmation from purchaser before finalization of Bid.

ANNEXURE-C

TYPE OF FITTINGS/FIXTURES AND OTHER AUXILIARIES

1.0 LIGHTING FIXTURES & LAMPS

Each lighting fixture shall be furnished complete with associated lamp, holder and all accessories as required.

SL. NO.	FIXTURE TYPE	DESCRIPTION	AREA OF USE
1.1	ILD-1	Commercial / decorative type, surface / pendant mounted green perform LED batten [system flux ≥ 2000lumens, 6500K colour temperature, CRI ≥ 75, system efficacy > 100lm/W] having minimum lifetime of 40,000 burning hours (at L70) with PC glossy diffuser. The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9	SWGR room / MCC room / Office / Stores
1.2	ILD-2	Decorative type, surface / pendant mounted green perform LED batten [system flux ≥ 3000lumens, 6500K colour temperature, CRI ≥ 80, system efficacy ≥ 80 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9	Office rooms / Corridor / Conference room / Engineer's room
1.3	ILD-3	Decorative type, recess mounted green perform LED Batten [system flux ≥ 3000lumens, 6500K colour temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 40,000 burning hours (at L70) with high purity anodized aluminium mirrors. The luminaire shall be made up of CRCA sheet steel (IP20) with THD < 10% and PF > 0.9	False ceiling areas (Control room / Electronic eqpt. room / Office / Conference room / Engineer's room / Corridor)
1.4	ILD-4	Indoor, industrial, corrosion resistant type, ceiling or suspension mounting, green perform LED Batten [system flux ≥ 4000lumens, 6500K colour temperature, CRI ≥ 80, system efficacy ≥ 80 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with diffuser. The luminaire shall be made up of polycarbonate with silicone gasket material (IP65) with THD < 10% and PF > 0.9	Battery room / Chemical plant / Chlorination Building / Area with corrosive atmosphere
1.5	ILD-5	Pressure die cast aluminium frame (IP65) with heat resistance toughened clear glass, medium and high bay, dust free type, green perform LED	General indoor area / Workshop /

SL. NO.	FIXTURE TYPE	DESCRIPTION	AREA OF USE
		batten/Dome Type [system flux ≥ 14000lumens, 6500K color temperature, CRI ≥ 80, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 10% and PF > 0.9 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory.	Pump House
1.7	ILD-6	Pressure die cast aluminium frame (IP65) with heat resistance toughened clear glass, medium and high bay, dust free type, green perform LED batten/Dome Type [system flux ≥ 10000 lumens, 6500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection (> 2KV) with THD < 10% and PF > 0.9 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory	General indoor area
1.8	ILD-7	Pressure die cast aluminium frame (IP65) with heat resistance toughened clear glass, medium and high bay, dust free type, green perform LED Batten/Dome Type [system flux ≥ 22000lumens, 6500K color temperature, CRI ≥ 80, System efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 10% and PF > 0.9 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory.	General indoor area
1.9	ILD-8	Integral, higher ingress protection, green perform LED batten [system flux ≥ 2700lumens, 6500K color temperature, CRI ≥ 80, system efficacy> 90lm/W] having minimum lifetime of 40,000 burning hours (at L70). The luminaire shall be made up of high pressure die cast aluminium with polycarbonate front diffuser with THD < 10% and PF > 0.9	Dust & vapor laden areas
1.10	ILD-9	LED flameproof 1x16/20W & 2x16/20 LED tube light fixture, luminaire recommended for illuminating hazardous area laden with gases or vapors of group IIA and IIB and zone 1 &2 , specially designed for light module and lamp can replace and easily serviced maintain from bottom	Area with explosive atmosphere

SL. NO.	FIXTURE TYPE	DESCRIPTION	AREA OF USE
		similar to CGL make Fiamma II	
1.11	ILD-10	LED flameproof well glass luminaire 40W, recommended for illuminating hazardous area laden with gases or vapors of group IIA & IIB & zone 1 & 2, die cast aluminium housing with toughened clear heat resistance well glass is cemented into a retaining ring which is fixed with screws to the main housing, similar to CGL make Glaze I	Area with explosive atmosphere
1.12	IA	Weatherproof LED bulkhead luminaire	AC emergency lighting / staircase / exit point
1.13	OLD-1	Pressure die cast aluminium frame (IP65), dust free type, green perform LED Batten [system flux ≥ 2100lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory	Building exterior lighting / Outdoor area lighting / Outdoor eqpt. area
1.14	OLD-2	Pressure die cast aluminium frame (IP65) with heat resistance toughened clear glass, dust free type, green perform LED batten [system flux ≥ 7200 lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory	Street lighting / boundary lighting
1.15	OLD-3	Pressure die cast aluminium frame (IP65) with heat resistance toughened clear glass, dust free type, green perform LED batten [system flux ≥ 12800lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70) with PMMA material lenses for effective light distribution. The luminaire shall have inbuilt surge protection with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory.	Street lighting / boundary lighting
1.16	ILD-11	Decorative type, surface mounted green perform	Toilet / Wash

SL. NO.	FIXTURE TYPE	DESCRIPTION	AREA OF USE
		LED batten [system flux ≥ 1100lumens, 6500K color temperature, CRI ≥ 70, system efficacy ≥ 80 lm/W] having minimum lifetime of 40,000 burning hours (at L70) down-lighter. The luminaire shall be made up of ABS material with THD < 10% and PF > 0.9	basin /Pantry Staircase
1.17	ILD-12	Recess, decorative vertical mounting down-lighter, green perform LED batten [system flux ≥ 600lumens, 6500K color temperature, CRI ≥ 70, system efficacy ≥ 80 lm/W] having minimum lifetime of 40,000 burning hours (at L70). The luminaire shall be made up of pressure die cast aluminium with a high efficiency diffuser with THD < 10% and PF > 0.9	Control room / Electronic eqpt. room / Conference room / Office / Engineer's room as UPS emergency light
1.18	ILD-13	Decorative type, surface mounted green perform LED batten [system flux ≥ 1300lumens, 6500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 40,000 burning hours (at L70) down-lighter. The luminaire shall be made up of pressure die cast aluminium with a high efficiency diffuser with THD < 10% and PF > 0.9	Control room / Electronic eqpt. room / Conference room / Office / Engineer's room as UPS emergency light
1.19	OLD-4	Pressure die cast aluminium frame (IP65), compact, sturdy, dust free type, green perform LED batten [system flux ≥ 7000lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory.	Area lighting / Yard lighting / Floodlighting purpose
1.20	OLD-5	Pressure die cast aluminium frame (IP66), compact, sturdy, dust free type, green perform LED batten [system flux ≥ 14600lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 100 lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory	Area lighting / Yard lighting / Floodlighting purpose
1.21	OLD-6	Pressure die cast aluminium frame (IP65), compact, sturdy, dust free type, green perform LED batten [system flux ≥ 7000lumens, 5500K color temperature, CRI ≥ 70, system efficacy ≥ 90	Area lighting / Yard lighting / Floodlighting purpose

SL. NO.	FIXTURE TYPE	DESCRIPTION	AREA OF USE
		lm/W] having minimum lifetime of 50,000 burning hours (at L70). The luminaire shall have inbuilt surge protection (> 2KV) with THD < 20% and PF > 0.95 LM 79 and LM80 reports need to be submitted from a NABL/UL approved laboratory.	
1.22	EX	Escape lighting luminaire with "EXIT" sign fitted with 1x20 FLT/LED lamps. Each luminaire shall be self-contained 6volt battery, battery charger unit. Normally the luminaire shall be ON continuously through 240V AC supply. When AC supply goes OFF the in built battery & inverter system automatically takes on to ignite luminaire for duration of two & half (2½) hours. The battery shall be maintenance free and shall be trickle charged when 240V AC mains supply is available	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS
1.23	FA	Die-cast aluminium housing, decorative luminaire using LED technology with symmetric and asymmetric light distribution, IP65 rated for optical assembly with high brightness LED pole mounted	Street lighting / boundary lighting
1.24	Ceiling / Column / wall mounted	Bulkhead LED luminaire, pressure die cast aluminium housing (IP66), powder coated, passive heat sink for better thermal dissipation, injection molded diffuser made of special polycarbonate material, delivering superior light output, 5600K color temperature having minimum lifetime of 50,000 burning hours (at L70), System efficacy ≥ 100 lm/W.	DC Emergency lighting in dusty area

Note: The supply also includes associated junction boxes, brackets, supports, hangers, and wires wherever applicable.

ANNEXURE – D

RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER

Type	:	Dry type, encapsulated, VPI with nomex insulation
KVA rating	:	50-75-100-150- 200 KVA
Voltage rating	:	415V/415V
Cooling	:	AN
Impedance	:	0.04 p.u $\pm$ 10%
Voltage control	:	Off load tap switch/link with change of $\pm$ 5% in step of 2.5% tapping full capacity.
Vector Group	:	Dyn11
Class of Insulation	:	F (155^0C)
Maximum Temperature rise over 50Deg C. ambient in winding by resistance	:	90^0C
Neutral	:	Solidly grounded.

The secondary neutral of the transformer shall be brought out for getting a grounded 4 wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure, which shall be an integral part of lighting distribution board.

ANNEXURE – E

BROAD LIST OF AREAS TO BE ILLUMINATED

Purpose of this list is to give general guidance on major areas to be illuminated. The list is however not exhaustive.

1. Power House Building
2. Transformer Yard for GT, ST,UT, UAT
3. Pipe and cable racks, Trenches and culverts
4. Compressor House
5. AC Plant Building
6. Condensate Storage Tank Area
7. ACW Booster P/H and Air Washer Unit Area
8. CPU Regeneration Building
9. Boiler Area for Units including SCR, Boiler galleries, platforms, stairs.
10. Aux. Boiler Area
11. ESP & FGD area
12. ESP Control-cum-Equipment Building.
13. Fuel Oil Unloading Pump House. Building including MCC & control rooms.
14. Boiler / Electrical Maintenance Building
15. Mill Maintenance Building

BOP Area

1. Coal handling system maintenance building
2. Crusher house
3. Bunker floor including intermediate floors and Bunker top
4. Junction towers
5. Conveyors, galleries, including bunker conveyors
6. CHP Control room cum switchgear room
7. FAE tower
8. DFDS / miscellaneous pump & compressor house
9. Coal stockyard including the machines e.g. Stacker & Reclaimers
10. Compressor house including switchgear room and main control room
11. Ash water pump house including sump
12. Ash slurry pump house
13. Fly ash silo
14. Silo utility building including switchgear and control room
15. Raw water transfer pump house & reservoir
16. PT Plant
17. Chemical house / Lab
18. Chlorination plant building

19. UF permeate storage tank and pump house
20. DM plant building (UF & RO plant) with switchgear room and control room
21. Neutralization pit
22. Clarified water pump house, tanks, clarifiers
23. , Intentionally deleted
24. CW pump house with switchgear room, CW forebay channel and surrounding area
25. CW treatment cum chlorination plant building
26. ETP building including pump house and control room
27. CTBD treatment plant building with effluent disposal system, sludge house
28. Sewage treatment plant building
29. Fire water pump house
30. Switchyard control building
31. 765kV,400kV & 33kV GIS building
32. Canteen
33. Fire station
34. Weigh bridge
35. Time office & security complex including gate-1
36. Watch tower
37. Workshop
38. Site office
39. Rain water harvesting pond with pump house
40. First aid centre
41. Permanent stores
42. Construction stores
43. Cycle / scooter stand at the main gate
44. H_2 & CO_2 cylinder storage shed
45. Chimney
46. Induced Draft Cooling Tower
47. Pipe & cable racks under BOP area
48. Street & periphery lighting under BOP area
49. Area lighting
50. Limestone Storage building
51. Limestone Crusher house
52. Limestone Grinding building
53. Oxygen Blower House

54. Absorber Pump House
55. Electrical & Control building
56. Gypsum De-watering House
57. Gypsum Storage building
58. Limestone Conveyor gallery
59. Gypsum Conveyor gallery
60. Junction towers for Limestone Conveyor gallery
61. Junction towers for Gypsum Conveyor gallery
62. FGD Control room cum switchgear room
63. Pipe & cable racks under FGD area
64. Street & periphery lighting under FGD area
65. Area lighting under FGD area
66. All roads under plant battery limit area (as shall be finalized during detail engineering), general area, and toilets falling within illumination zone identified to be covered under EPC package.

ANNEXURE-V

LIGHTNING PROTECTION
NOTES & DETAILS

DWG. NO. 18A03-DWG-E-1000

A4_DD (9-96) [210x297]

1.0 AIR TERMINATIONS

1.1 Vertical air terminal rods shall be installed on the top of all structured/buildings to be protected from lightning strokes.

1.2 Vertical air terminal except those for chimney shall be 20 mm dia galvanised steel rods. The projected length of the rods including mounting structure, if any, shall be as required to protect the objects, from lightning stroke. Air terminal rods provided on top of chimney/ stack for lightning protection shall be 20 mm dia lead coated solid copper rods.

1.3 Air terminal rods shall be properly fixed on top of buildings/ structures to withstand wind pressure.In case the air terminal rods are embedded in the building roof, the portion embedded in the contrete shall not touch the reinforcement bars and shall be duely insulated from them.

1.4 All vertical air terminal rods shall be electrically connected by means of horizontal conductors (galvanised MS flats) of size 50 x 6 mm.

2.0 SHIELDING MASTS

2.1 The shielding mast for lightning protection shall be installed on top of the steel column cap plates of power house main building.

2.2 The shielding masts shall be made of galvanished steel pipe and the heights of the same shall be decided considering the zones to be protected.

2.3 Each shielding mast shall be connected to grounding grid of the station by a 50 x 6 mm. galvanised MS down conductor running along the building column. In addition, all power house building column joints shall be electrically bonded.

3.0 DOWN CONDUCTORS

3.1 The down conductors shall be 50 x 6 mm galvanished MS flats. However, The down conductor of conveyor gallery may be 25 x 4 mm galvanised MS flats.

One end of these flats shall be connected to the air terminal rods/ horizontal conductors on top of roof/structure and the other end to the nearest earth terminals.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

LIGHTNING PROTECTION NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	10.10.20
DWG. NO.	18A03-DWG-E-1000		REV 0

SHEET 01 OF 12

A4_DD (9-96) [210x297]

3.2 *Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductors of the grounding system above ground*

3.3 *The connetion between each down conductor and earth terminal shall be made via test link located at approximately 1500 mm above ground level.*

3.4 *The down conductors shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleated on the outside of the building wall and or columns/structures at intervals of about 750 mm., unless indicated otherwise in the drawings.*

3.5 *Down conductors along the chimney shell shall be electrically connected with the reinforcement rods by suitable lugs welded (6 mm fillet) to both down conductor and reinforcement at the interval of 30 mm.*

3.6 *All exposed metallic parts of a building shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.*

4.0 EARTH TERMINALS.

4.1 *Where ground mat is available, the risers specifically ear-marked for lightning protection shall be considered as Earth Terminal. In such case, one electrode shall be provide close to the each Earth Terminals.*

4.2 *Where ground mat is not available sparate earth pit as per IS-3043 or approved international standard specifically for lightning protection shall be provided as Earth Terminal.*

5.0 JOINTING & CONNECTION

5.1 *Number of joints in the lightning conductors shall be kept to a minimum.*

5.2 *All the joints shall be done by arc welding process. Overlapping of conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be properly cleaned before jointing.*

5.3 *Those portions of galvanished steel flats, which have been welded at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.*

5.4 *After successful testing the bolted joints of test links shall be wrapped by bitumenons hessian tape followed by 3 mm thick coating of bitumen compound.*

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

LIGHTNING PROTECTION NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
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5.5 *Air terminal rods and shielding masts shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).*

5.6 *Steel to copper connection shall be brazed type.*

6.0 LIGHTING PROTECTION OF OUTDOOR SUBSTATION/ SWITCHYARD AND OTHER AREAS.

6.1 *Lightning protection of outdoor switchyards/substations shall be done by lightning masts on top of steel towers. shield wires may also be used wherever required. These shall be strung across the top of the steel towers and/or building/plant structure.*

6.2 *The shield wire, which shall be brought down to the bottom of the steel towers, shall be connected to the earthing conductor (50 x 6 mm galvanished MS flat), which in turn, shall be connected to the riser from the main grounding mat/grid.*

6.3 *For lightning protection of conveyor gallery, a horizontal conductor (25 x4 mm galvanised MS flat) running along the entire length of the conveyor gallery shall be provided on top of the gallery roof. This conductor be connected to a earth terminal at approximate intervals of 30M by two down conductors, each 25 x 4 mm galvanised MS flat.*

7.0 *The sizes and materials of earthing conductors used in lightning protection system are listed below :*

	DESCRIPTION	SIZE	MATERIAL
a)	Vertical Air Terminals	20 mm dia rod	Galvanished steel
	Vert Air terminal For Chimney	20 mm dia rod 1000 mm long	Lead coated copper rod
b)	Horizontal conductors	50 x 6 mm Flat	Galvanished steel
	For Conveyor gallery only	25 x 4 mm Flat	Galvanished steel
c)	Down Conductors	50 x 6 mm Flat	Galvanished steel
	For Conveyor gallery only	25 x 4 mm Flat	Galvanished steel
d)	Riser From Electrode/ Grounding Mat	40 mm dia Rod	Mild Steel
e)	Electrode for Lightning Protection	40 mm dia Rod 3000 mm long	Mild Steel

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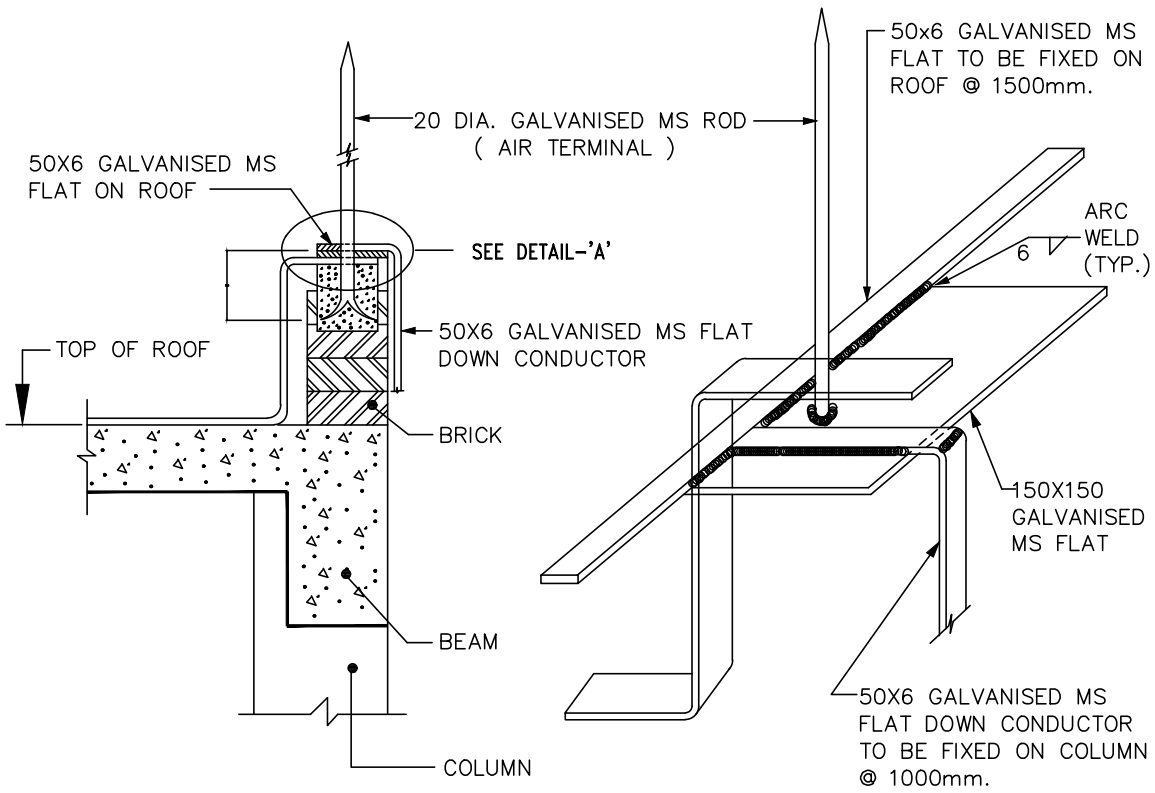
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DETAIL – 'A'

FIXING DETAILS OF AIR TERMINAL ROD ON BUILDING ROOF

(FOR LIGHTNING PROTECTION)

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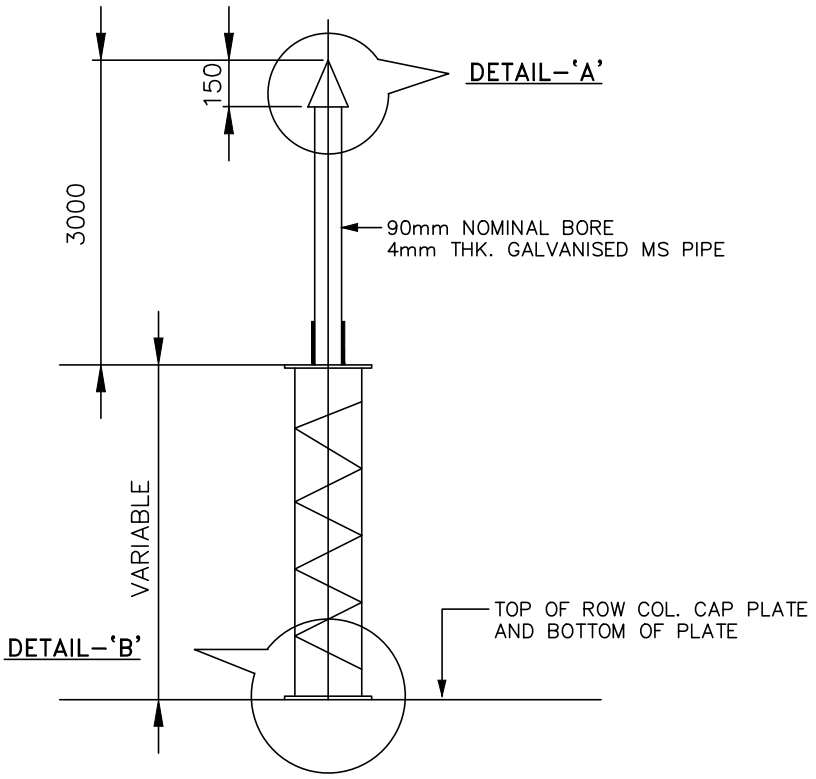
LIGHTNING PROTECTION NOTES & DETAILS

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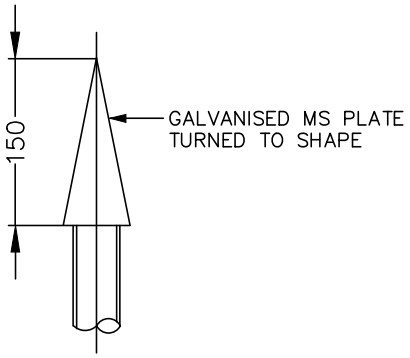
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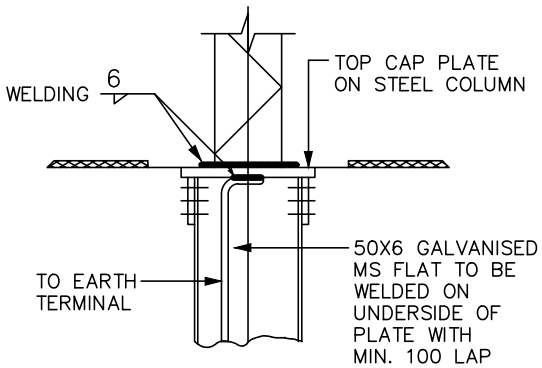
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SHIELDING MAST



DETAIL – A



DETAIL –B

FIXING DETAILS OF SHIELDING MAST ON TOP OF STEEL COLUMNS OF POWER HOUSE BUILDING (FOR LIGHTNING PROTECTION)

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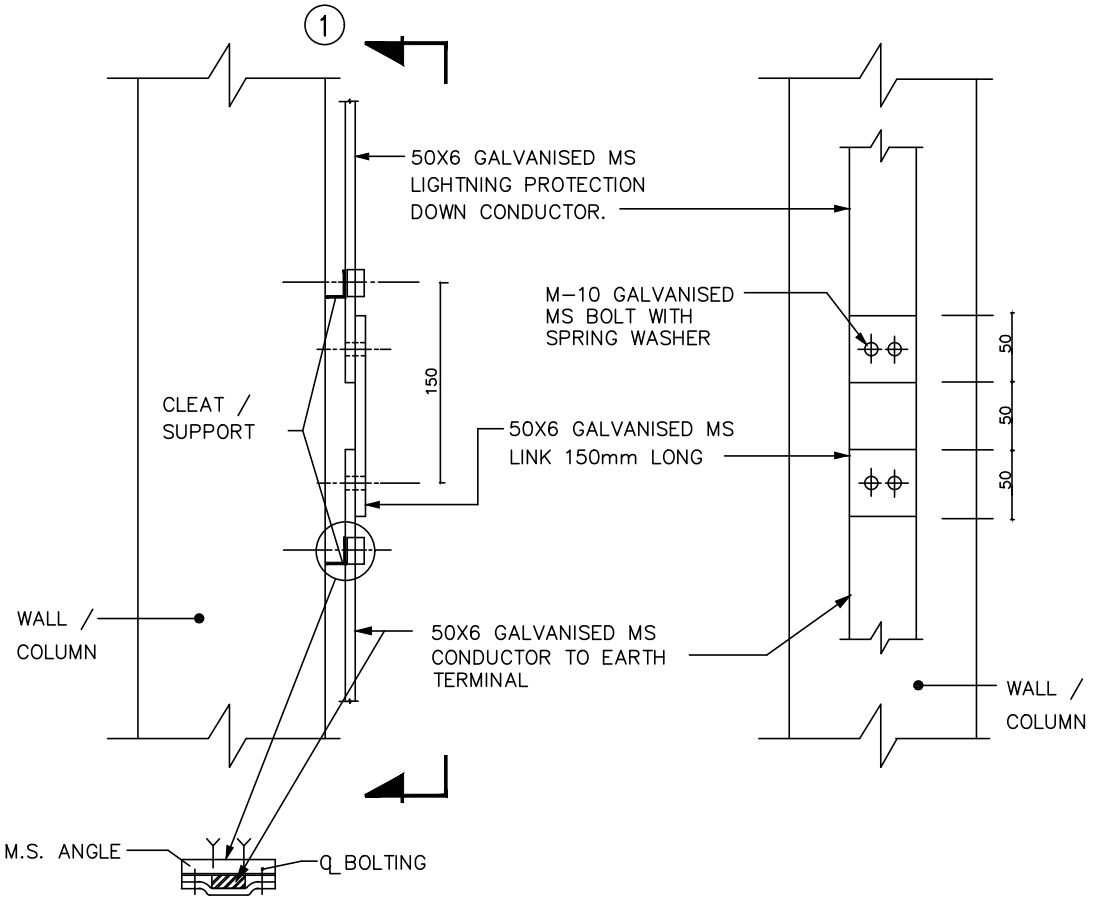
LIGHTNING PROTECTION NOTES & DETAILS

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CLEATING ARRANGEMENT

SECTION - (1)

TEST LINK POINT / CLEATING ARRANGEMENT

NOTE :-

LINK POINT TO BE MOUNTED AT A HEIGHT
OF 1.5M ABOVE GROUND LEVEL

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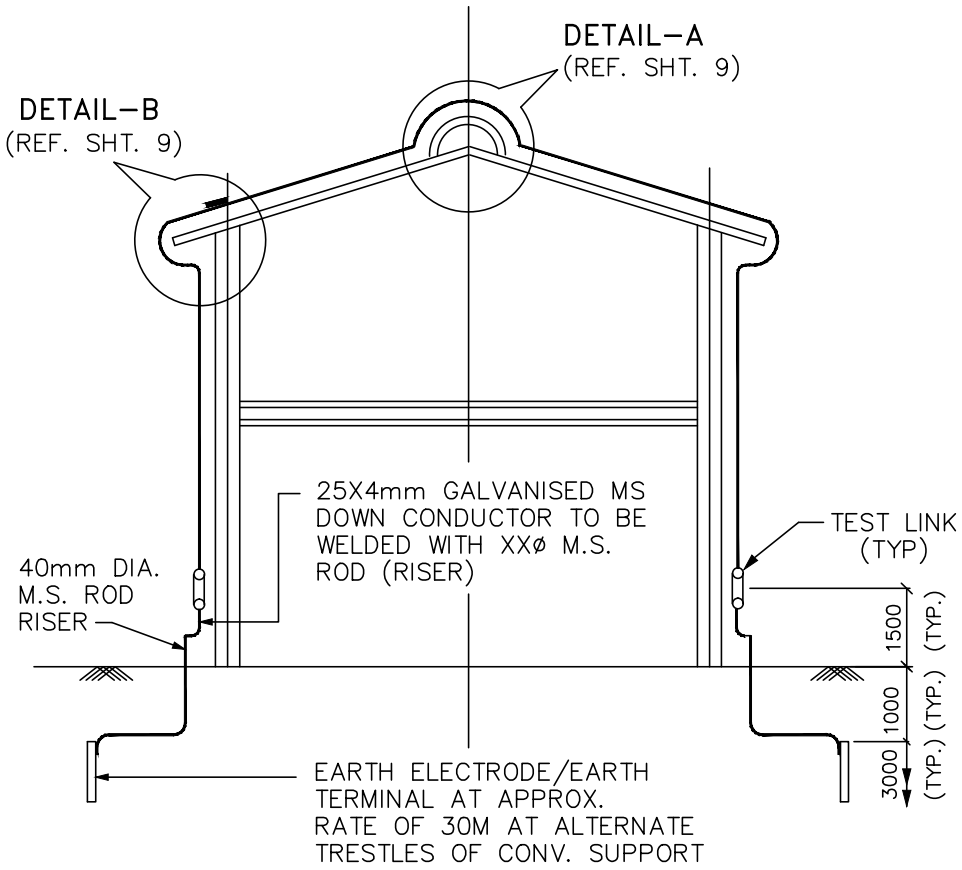
LIGHTNING PROTECTION
NOTES & DETAILS

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SECTION

(TYPICAL ARRANGEMENT OF DOWN CONDUCTOR FOR CONV. GALLERY)

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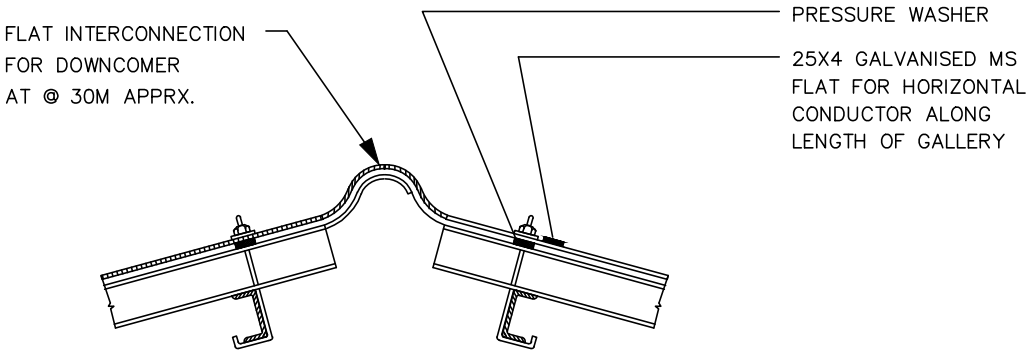
LIGHTNING PROTECTION NOTES & DETAILS

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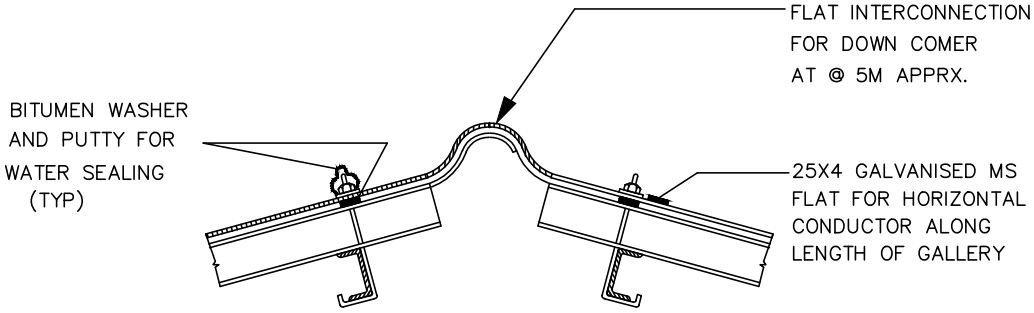
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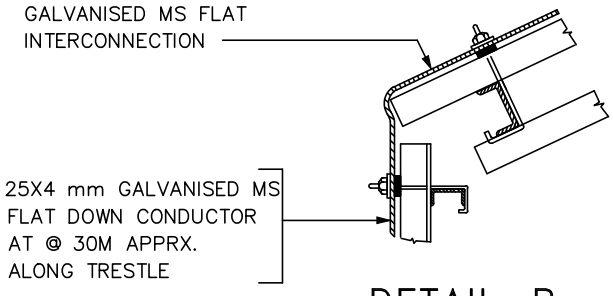
DETAIL–A

(FOR DOWNCOMER)



DETAIL–A

(WITHOUT DOWNCOMER)



DETAIL–B

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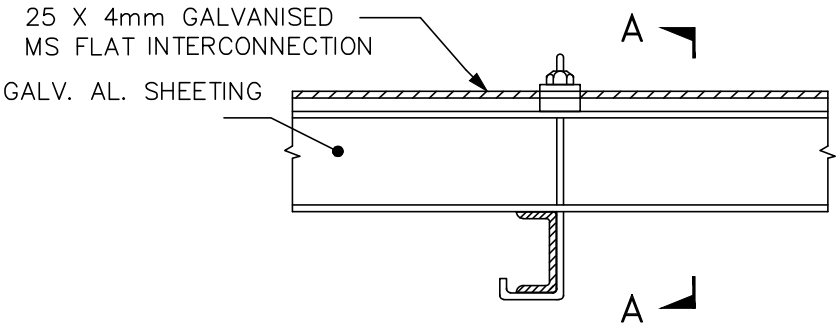
LIGHTNING PROTECTION
NOTES & DETAILS

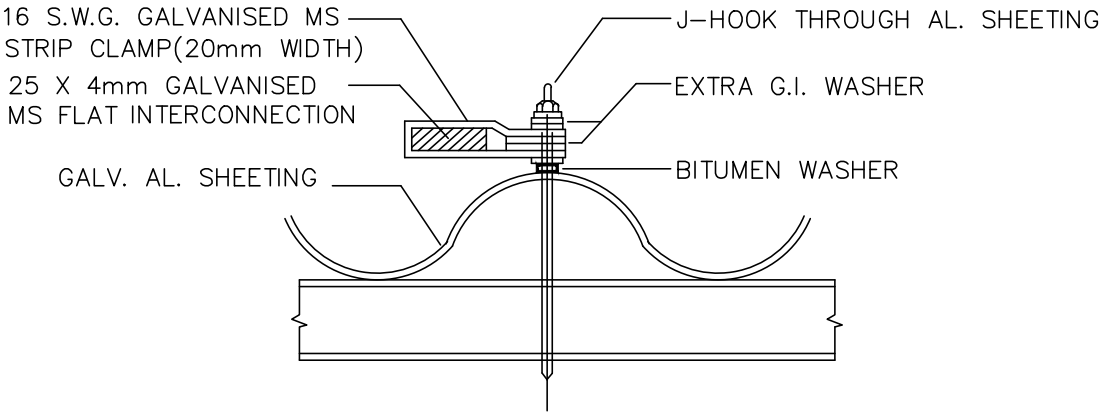
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SECTION- A-A

TYPICAL FIXING ARRANGEMENT OF GALVANISED MS INTERCONNECTION FLAT ON GALVANISED ALUMINIUM SHEETING (CONVEYOR GALLERY)

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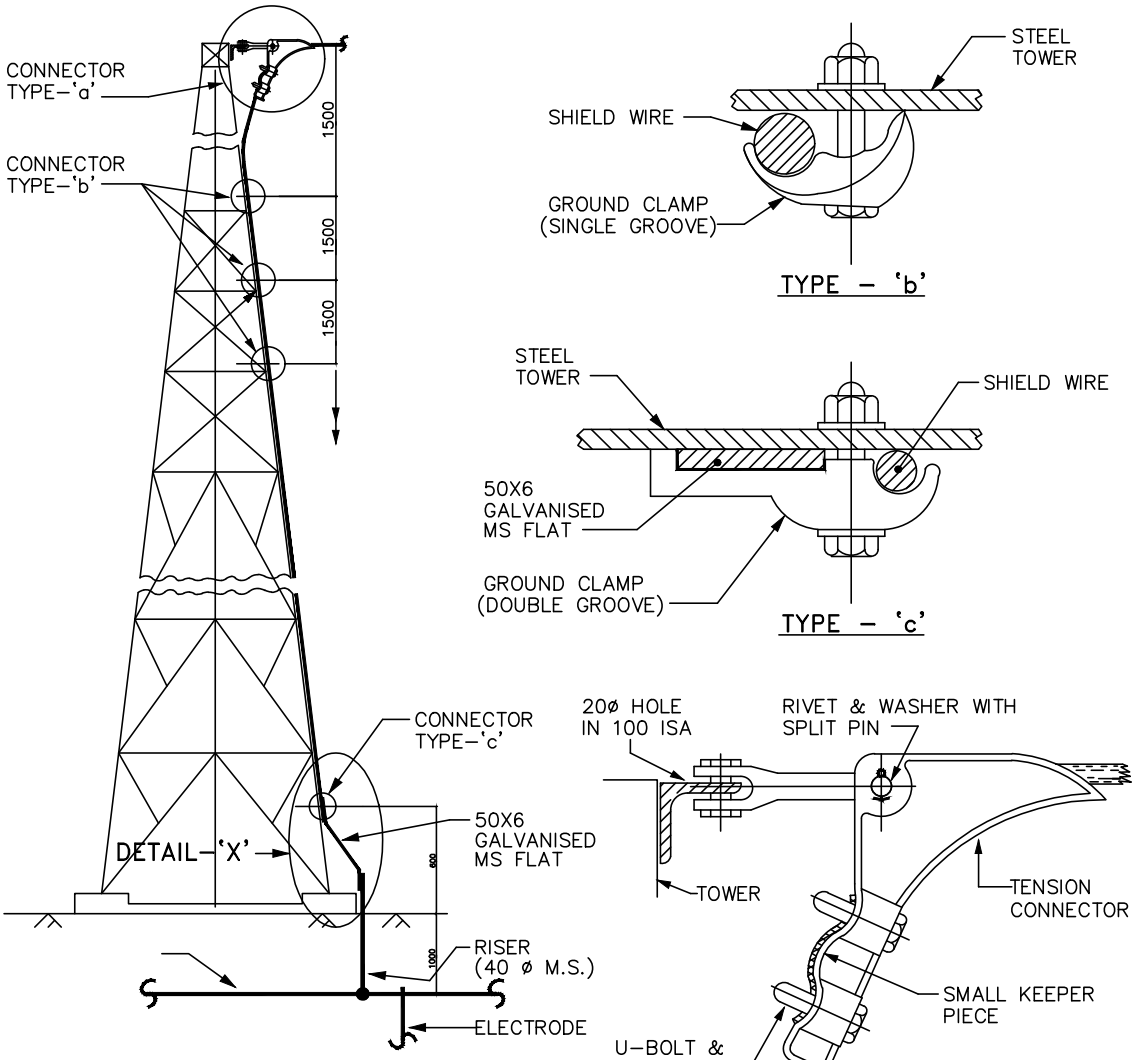
LIGHTNING PROTECTION NOTES & DETAILS

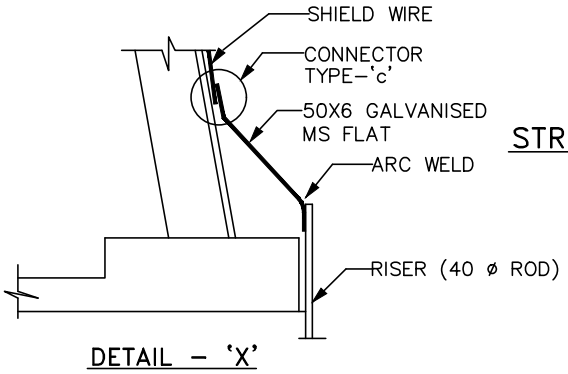
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STRINGING ARRANGEMENT & GROUNDING OF G.I. SHIELD WIRE

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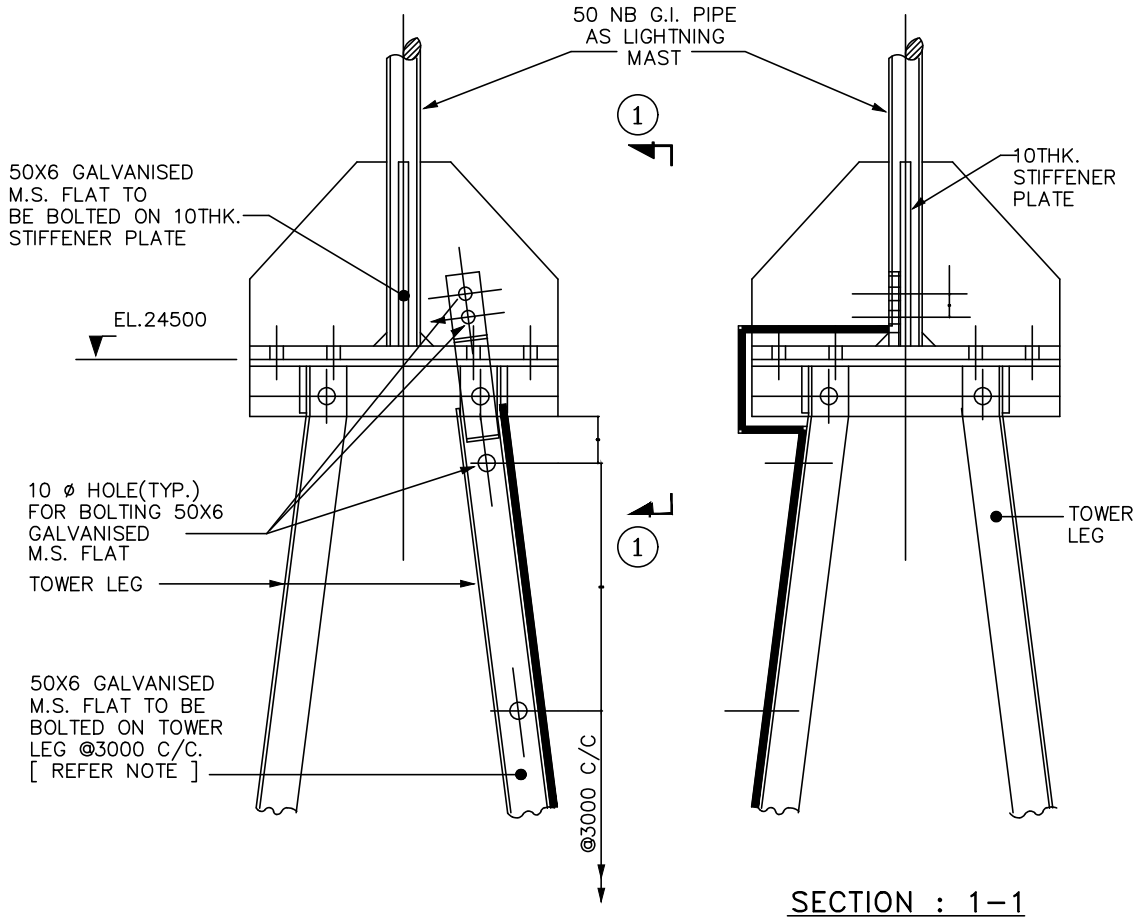
LIGHTNING PROTECTION NOTES & DETAILS

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SECTION : 1–1

GROUNDING OF LIGHTNING MAST

NOTE:

1. THESE FLATS SHALL SERVE AS GROUND CONDUCTOR DOWNCOMER AND SHALL BE CONNECTED TO BELOW GROUND EARTH GRID.

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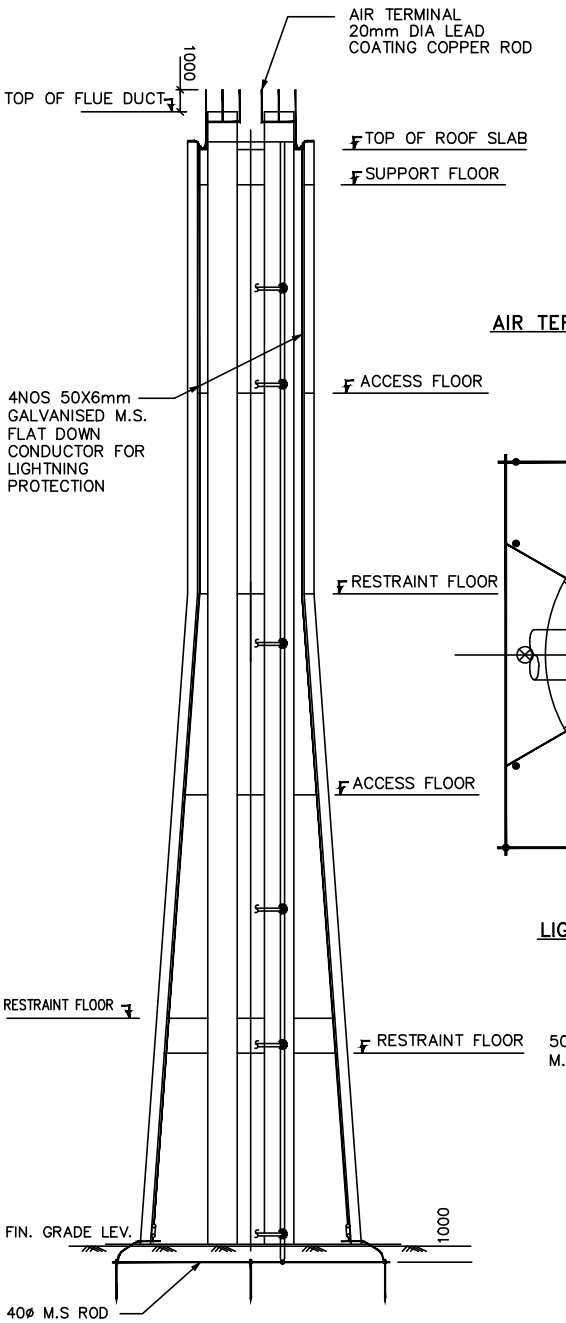
LIGHTNING PROTECTION NOTES & DETAILS

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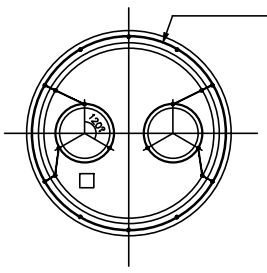
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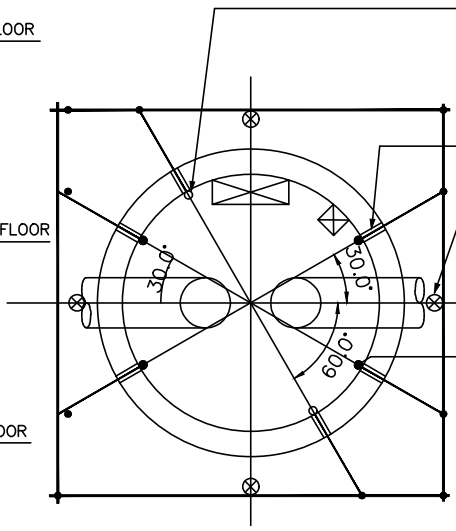
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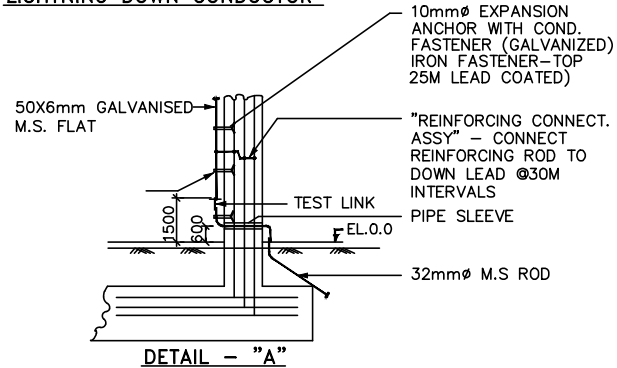
LIGHTNING PROTECTION
ARRANGEMENT OF RCC STACK



TOP OF STACK
AIR TERMINAL & DOWNCOMER LOCATION



PLAN AT EL.(±)0.0
LIGHTNING DOWN CONDUCTOR



DETAIL - "A"

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GROUNDING
NOTES & DETAILS

DWG. NO. 18A03-DWG-E-0600

A4_DD (9-96) [210x297]

GROUNDING NOTES

1.0 *These grounding notes and details shall be read and construed in conjunction with grounding drawings and specification.*

2.0 *The grounding installation work shall conform to the requirements of the Indian Electricity Rules and code of Practice for Earthing (IS:3043) as amended up-to-date in India. For the work in other country, the statutury rules and code of practice in vogue there in shall be followed.*

3.0 *The main ground grid shall be buried in earth at a minimum depth of 600 mm below grade. A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trench/foundation/underground pipe at the crossing.*

4.0 *Ground grid conductors around a building/switchyard fence shall be buried outside the boundary at a minium distance of 1200 mm.*

5.0 *A additional grid of 1500 mm x 1500 mm comprising of closely spaced (300 mmx300 mm) coductor at a depth of 300 mm from finished grade level shall be provided below the operating handle of Isolators and Circuit Breaker operating boxes located in outdoor HV/EHV substation. This grid shall be connected to the main ground grid. The ground connection to operating handle shall be made of flexible connection.*

6.0 *The ground grid conductor below grade shall be of bare 40mm Ø mild steel rod. Ground electrode shall be 40mm Ø x 3000 mm long mild steel rod, driven into the ground and connected to the ground grid conductor.*

7.0 *Riser/pigtail from the ground grid shall be 40mm Ø mild steel rod and shall project 300 mm above grade/concrete floor level unless otherwise shown.*

8.0 *All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Bending of the conductor where necessary shall be done by gas heating.*

9.0 *Above grade, 50 x 6 mm galvanised mild steel flats shall be run as main ground conductors along building steels, walls and cable trays and securely fixed to the same by welding/clamping at intervals not exceeding 750 mm.*
The ground conductors shall be interconnected between them and to the main ground grid through risers.

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GROUNDING NOTES & DETAILS

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10. *All electrical equipment and associated non-current carrying metal works, supporting structures, building/boiler columns,fence, system neutrals, lighting masts/arresters shall be connected to the plant ground system.*

11. *Two seperate and distinct ground connections shall be provided for grounding of electrical equipment frameworks.*

12. *Miscellaneous devices such as junction boxes, pull boxes, push-button stations, lockout switches, cable end boxes etc. shall be effectively grounded whether specifically shown or not.*

13. *Ground conductor connections above grade shall be generally made by electric are welding. The connection shall be coated with two (2) of cold galvanising resistant, anti-corrosive paints.*

14. *Bolted connection shall be made only for grounding of equipment/ devices and some removable structures. The contact surfaces shall be throughly cleaned before connection to ensure good electrical contact.*

15. *A continuous 50 x 6 mm galvanised M.S flat ground conductor shall be installed along the cable raceway and securely attched to each tray section, forming a solidly grounded tray system.*

16. *A 16 Swg G.I. wire shall be run along the metalic conduit and shall be securely tied with the same at an internal 300 mm.*

    Grounding connection or wire jumpers shall be installed where flexible conduit is used to connect rigid conduit to equipment.

17. *Crane rails shall be grounded at both ends. in addition all joints shall be bonded to provide electrical continuity.*

18. *Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten(10) meters. Fence gate shall be separately grounded with flexible connection to permit movement.*

19. *For shielding, the ground conductors shall be taken right upto the top along the structure/chimney and connected directly to the lightning masts.*

20. *The poles used for distribution line and / or street light shall be grounded at the bottom.*

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GROUNDING NOTES & DETAILS

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21. *Ground electrodes shall be provided at connections with generator/ transformer neutrals, lightning arresters and lightning masts.*

22. *For ground connections, the conductor sizes shall be as listed below :-*

	Equipment		Galvanised mild steel flats/rod
a.	Main ground grid conductor	:	40 dia MS rod
b.	Riser/Pigtail from Ground grid/mat	:	40 dia MS rod
c.	Electrode	:	40 dia MS rod, 3000mm long
d.	Conductor for connection of various equipment / structure		
	765kV,400 KV & 33kV equipment	:	75 x 10 mm GS flat
	11kV / 3.3kV equipment	:	50 x 6 mm GS flat
e.	Structures, busducts, control panels	:	50 x 6 mm GS flat
f.	415V Power Control Center	:	75 x 10 mm GS flat
g.	MCC, Distribution Boards	:	50 x 6 mm GS flat
h.	Local Panels, Lighting Panels	:	35 x 6 mm GS flat
i.	Motors		
	Above 90 KW	:	50 x 6 mm GS flat
	Above 30kW upto 90KW	:	35 x 6 mm GS flat
	Above 5kW upto 30 KW	:	25 x 3 mm GS flat
	Upto 5 KW	:	8 SWG GI wire
j.	Miscellaneous items like Push Button stations, Junction Box, etc.	:	No. 8 S.W.G. G.I. wire

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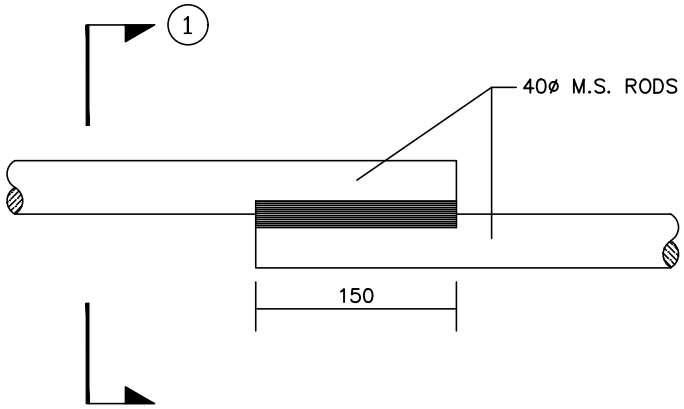
GROUNDING NOTES & DETAILS

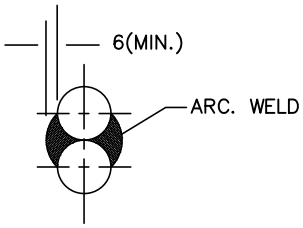
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

SHEET 03 OF 26

A4_DD (9-96) [210x297]



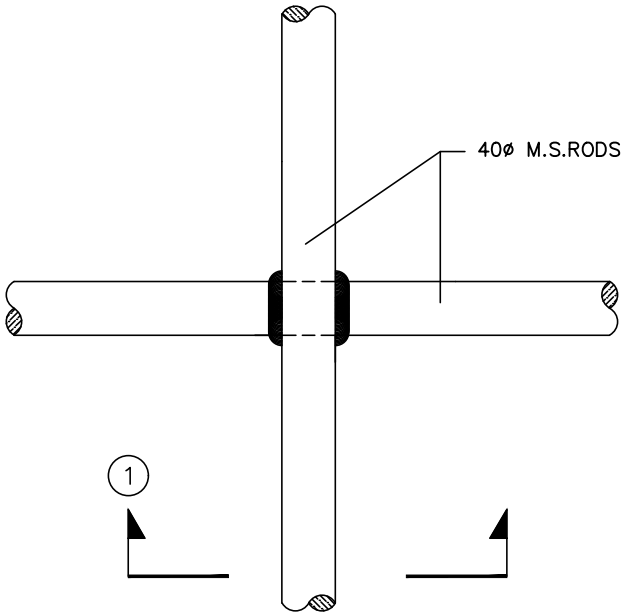


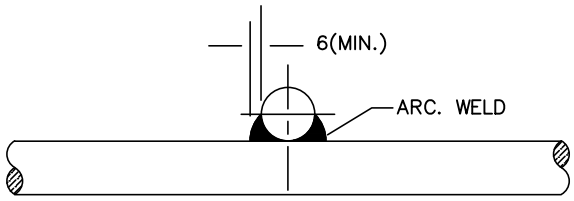
SECTION – 1

LAP JOINT
BETWEEN M.S. RODS

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED BG / JOB NO. 18A03
0	20.11.20	BG	AD	DS		CHECKED AD / SCALE NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED DS / DATE 08.10.20 / REV 0
REVISION STATUS						DWG. NO. 18A03-DWG-E-0600 / SHEET 04 OF 26

A4_DD (9-96) [210x297]



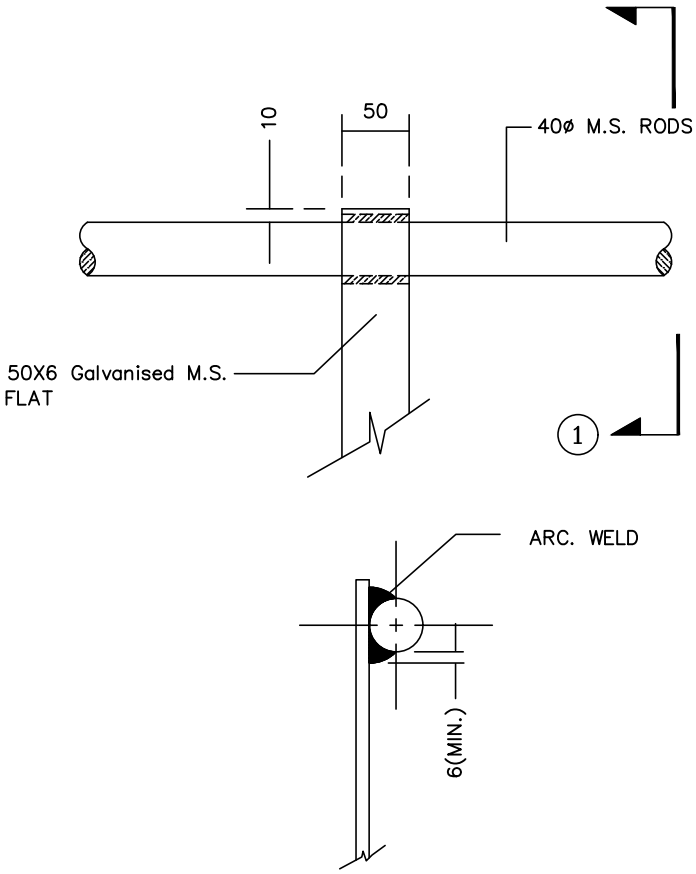


SECTION – (1)

CROSS JOINT
BETWEEN M.S. RODS

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED BG / JOB NO. 18A03
0	20.11.20	BG	AD	DS		CHECKED AD / SCALE NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED DS / DATE 08.10.20 / REV 0
REVISION STATUS						DWG. NO. 18A03-DWG-E-0600 / SHEET 05 OF 26

A4_DD (9-96) [210x297]



SECTION –(1)

CROSS JOINT
BETWEEN M.S. ROD & GALVANISED M.S. FLATS

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

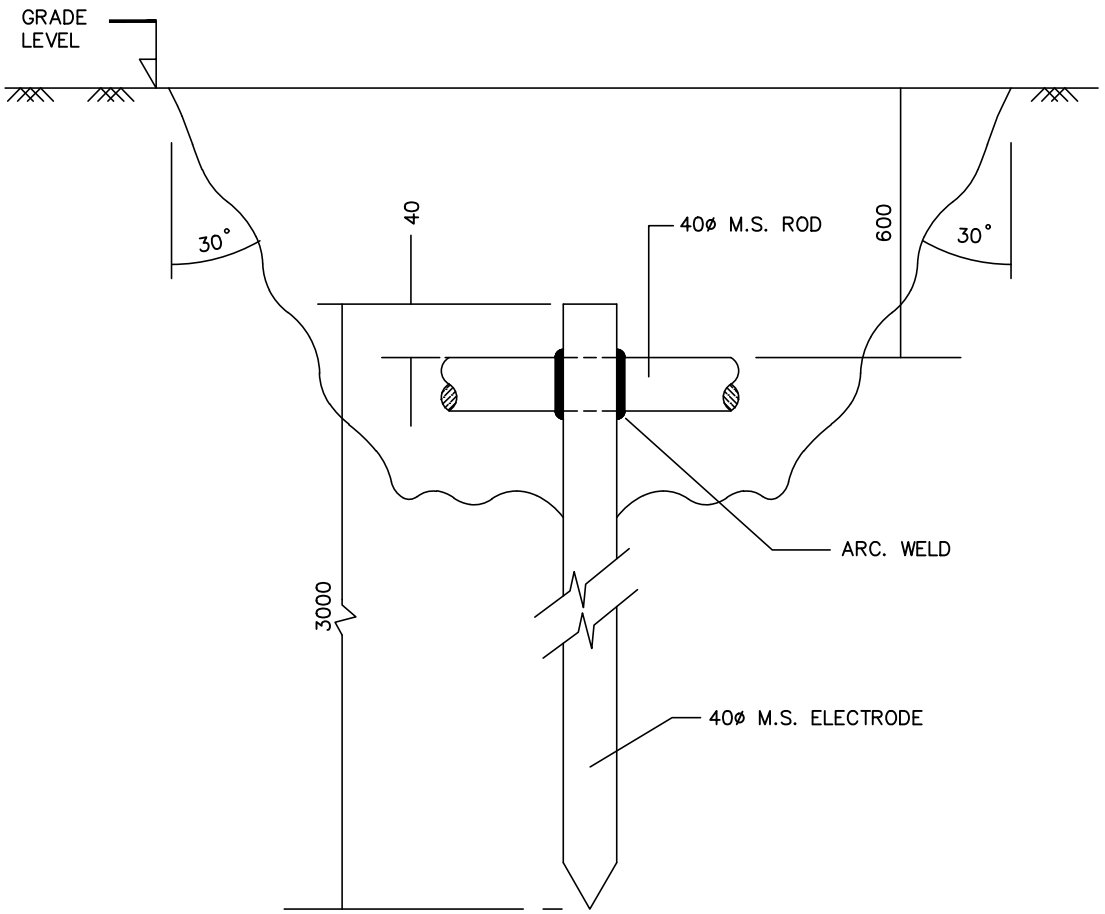
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

SHEET 06 OF 26

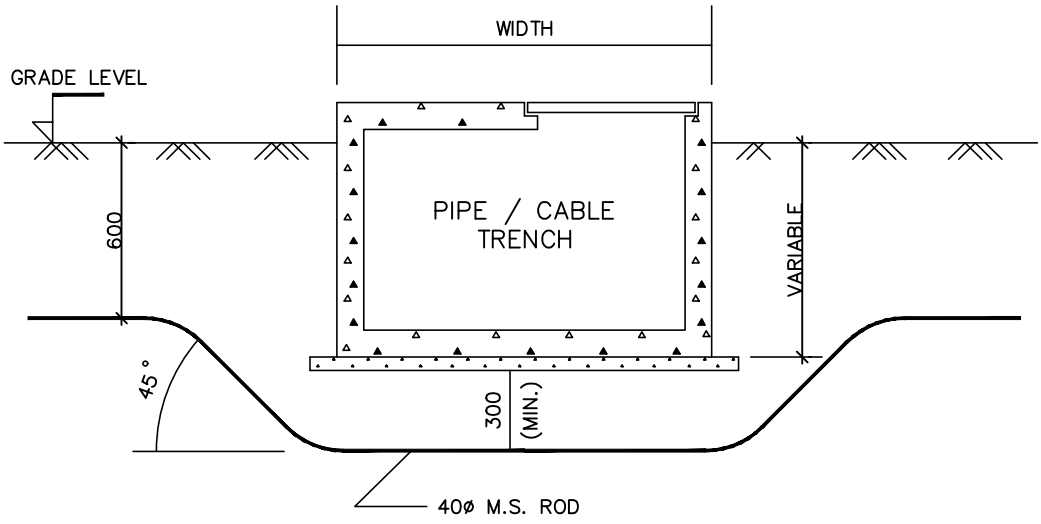
A4_DD (9-96) [210x297]



GROUND ELECTRODE

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED: BG; JOB NO.: 18A03
0	20.11.20	BG	AD	DS		CHECKED: AD; SCALE: NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED: DS; DATE: 08.10.20; REV 0
REVISION STATUS						DWG. NO. 18A03-DWG-E-0600; SHEET 07 OF 26

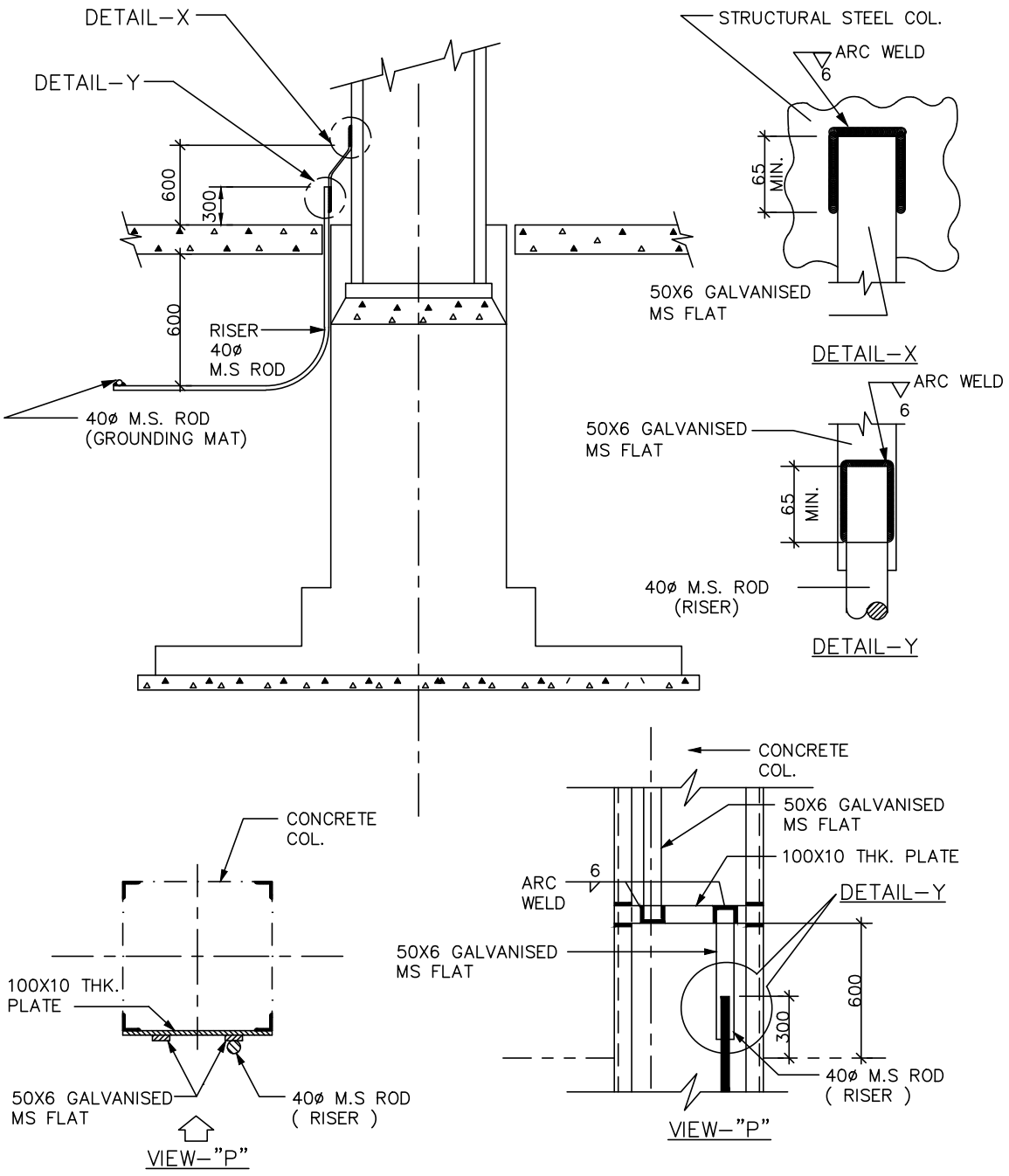
A4_DD (9-96) [210x297]



TRENCH CROSSING OF GROUNDING CONDUCTOR

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED BG / JOB NO. 18A03
0	20.11.20	BG	AD	DS		CHECKED AD / SCALE NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED DS / DATE 08.10.20 / REV 0
REVISION STATUS						DWG. NO. 18A03-DWG-E-0600 / SHEET 08 OF 26

A4_DD (9-96) [210x297]



GROUNDING OF STEEL & CONCRETE COL.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

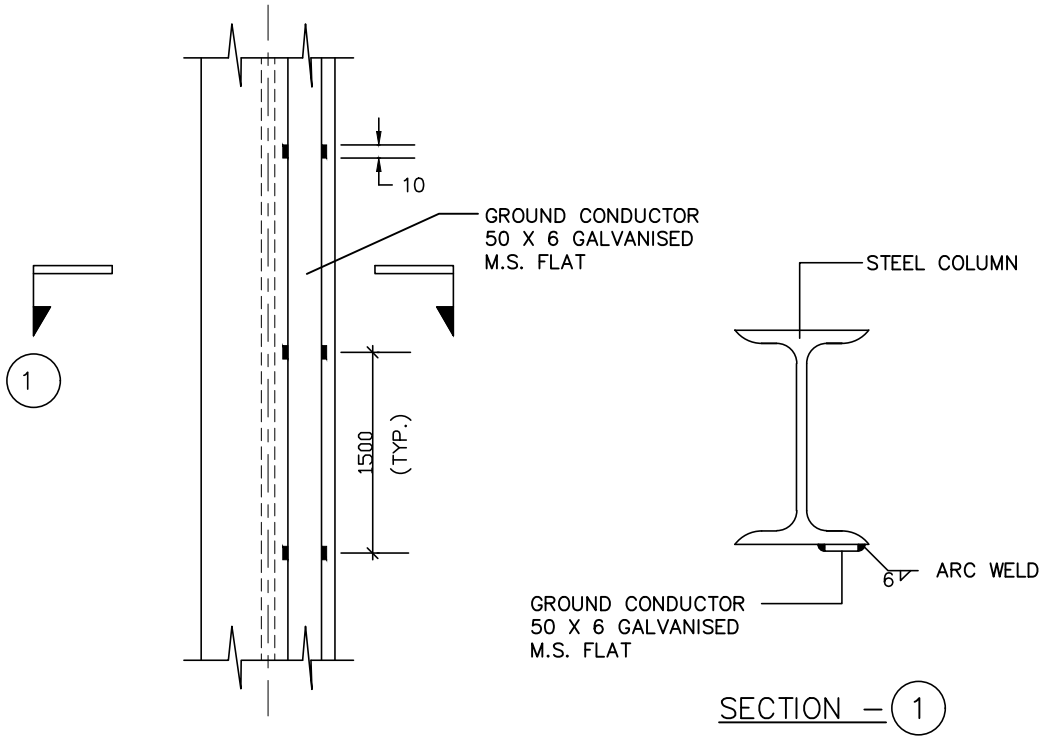
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0600		REV 0

SHEET 09 OF 26

A4_DD (9–96) [210x297]



EARTHING CONDUCTOR ALONG STEEL COLUMN

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

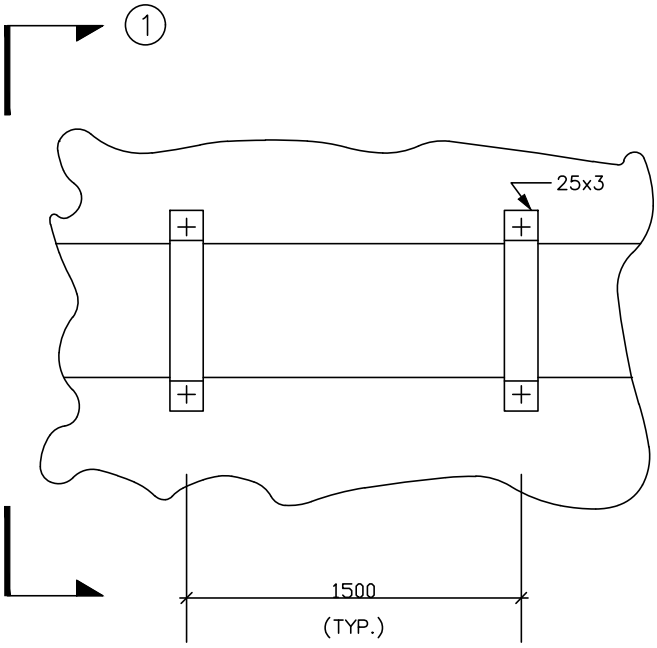
GROUNDING NOTES & DETAILS

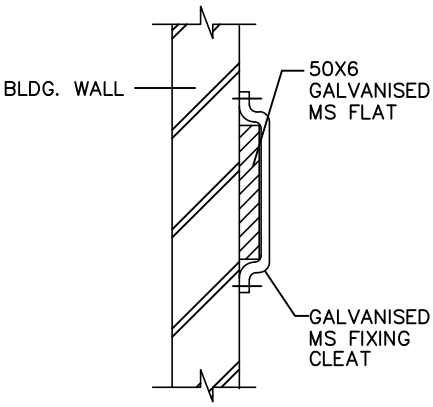
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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A4_DD (9-96) [210x297]





SECTION – (1)

EARTHING CONDUCTOR ALONG BUILDING WALL

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

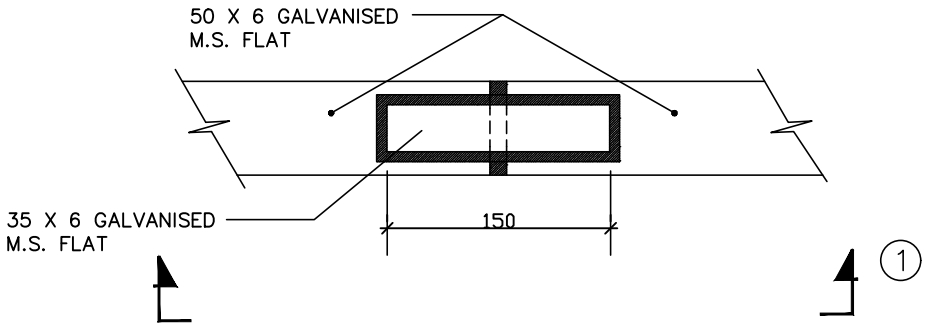
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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A4_DD (9-96) [210x297]



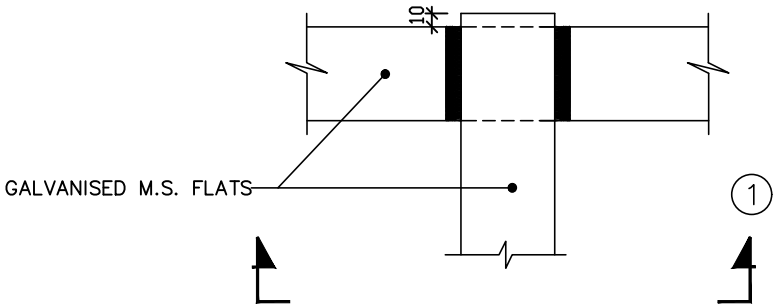


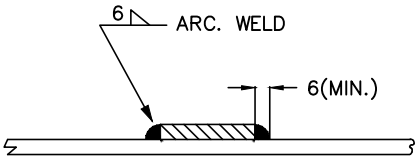
SECTION – (1)

BUTT JOINT
BETWEEN GALVANISED M.S. FLATS

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS, KOLKATA • MUMBAI • CHENNAI • NEW DELHI	
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED: BG	JOB NO.: 18A03
0	20.11.20	BG	AD	DS		CHECKED: AD	SCALE: NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED: DS	DATE: 08.10.20 REV 0
REVISION STATUS						DWG. NO.: 18A03-DWG-E-0600	SHEET 12 OF 26

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SECTION – (1)

CROSS JOINT
BETWEEN GALVANISED M.S. FLATS

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

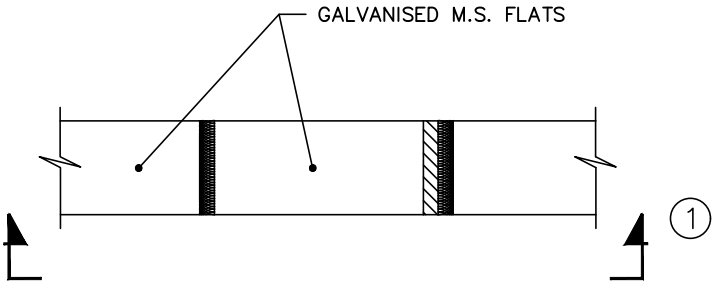
GROUNDING NOTES & DETAILS

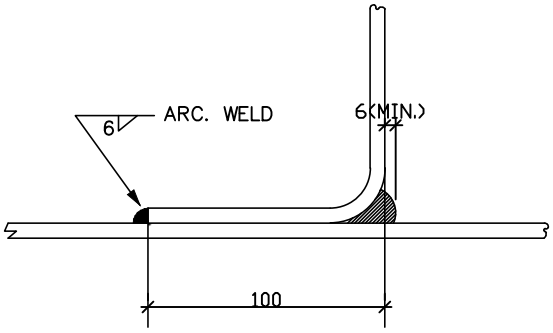
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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SECTION – (1)

ANGULAR JOINT
BETWEEN GALVANISED M.S. FLATS

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

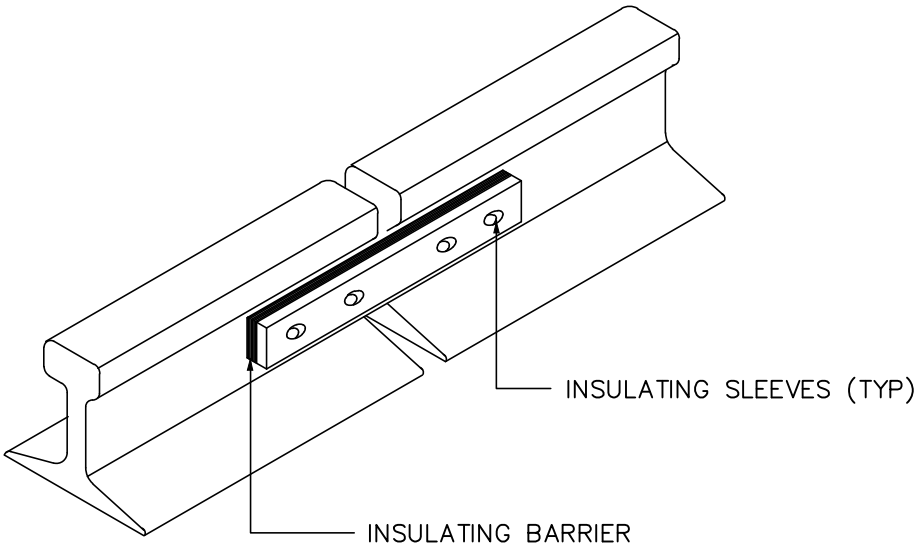
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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A4_DD (9-96) [210x297]



RAIL SECTIONS
LEAVING THE GROUND MAT

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

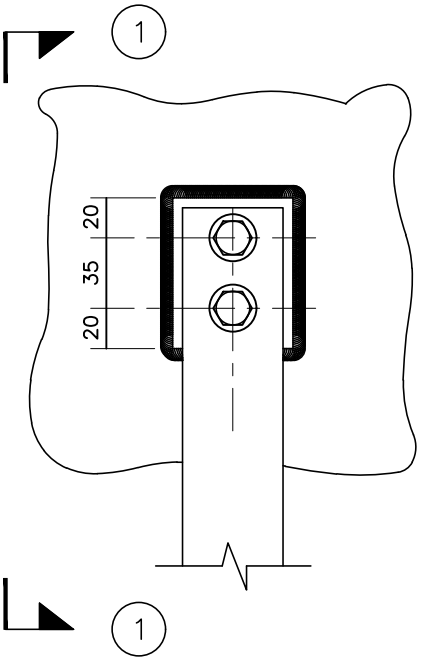
GROUNDING NOTES & DETAILS

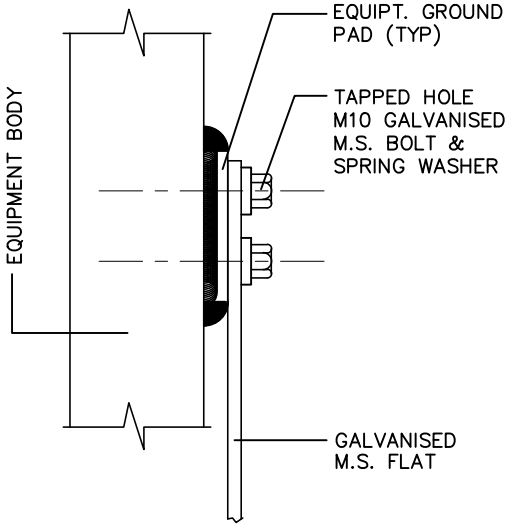
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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SECTION – (1) – (1)

EQUIPMENT GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

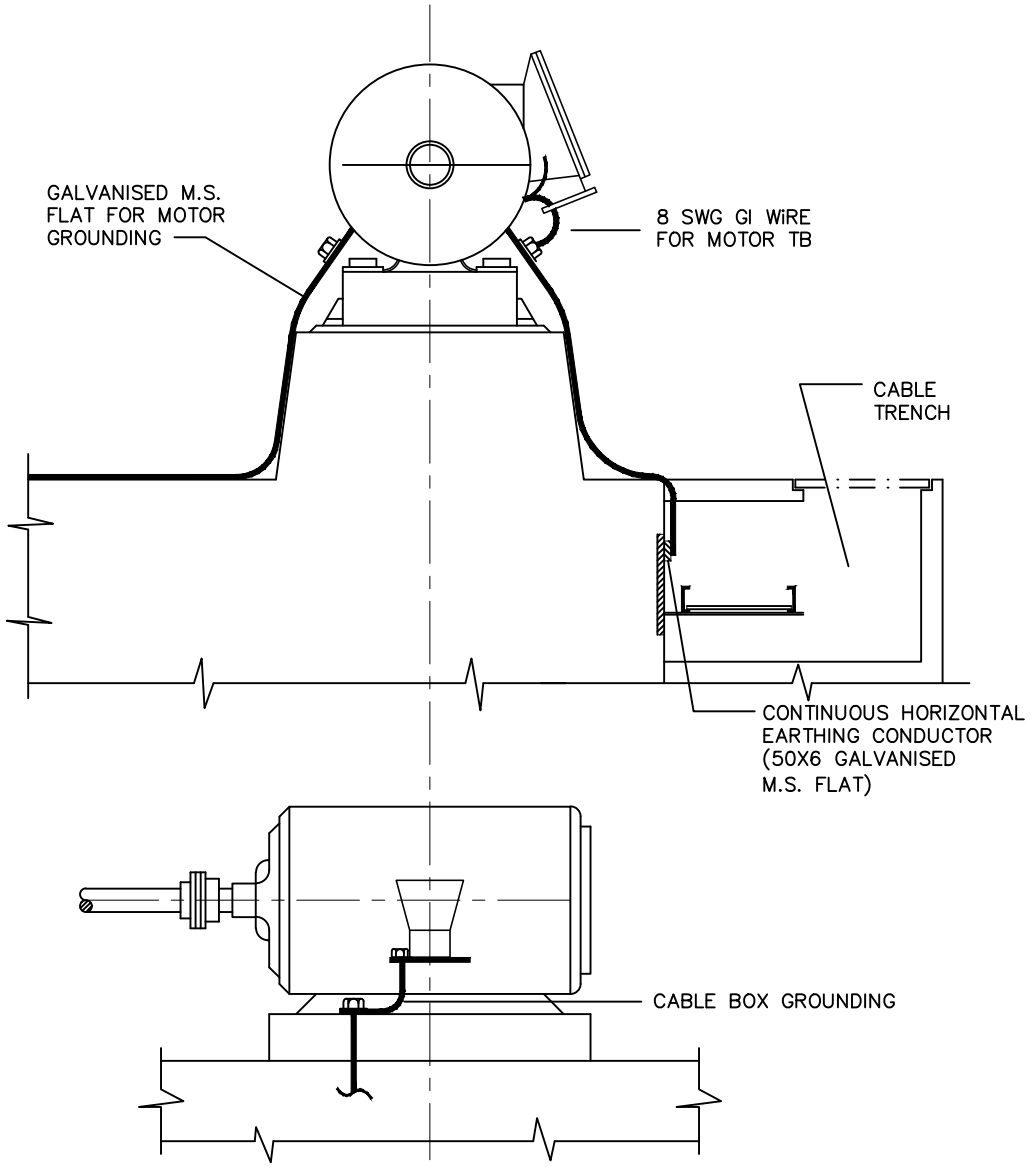
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

SHEET 16 OF 26

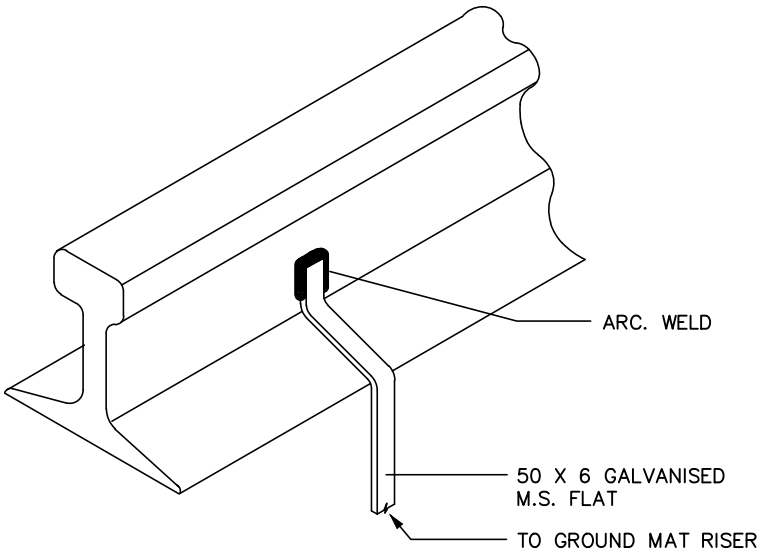
A4_DD (9-96) [210x297]



MOTOR GROUNDING

					OWNER: NLC INDIA LIMITED, NEYVELI, TAMILNADU	DEVELOPMENT CONSULTANTS PVT LTD. CONSULTING ENGINEERS, KOLKATA • MUMBAI • CHENNAI • NEW DELHI
					PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)	PREPARED: BG; JOB NO.: 18A03
0	20.11.20	BG	AD	DS		CHECKED: AD; SCALE: NTS
REV	DATE	PREPD	CHKD	APPVD	GROUNDING NOTES & DETAILS	APPROVED: DS; DATE: 08.10.20; REV 0
REVISION STATUS						DWG. NO.: 18A03-DWG-E-0600; SHEET 17 OF 26

A4_DD (9-96) [210x297]



RAIL GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

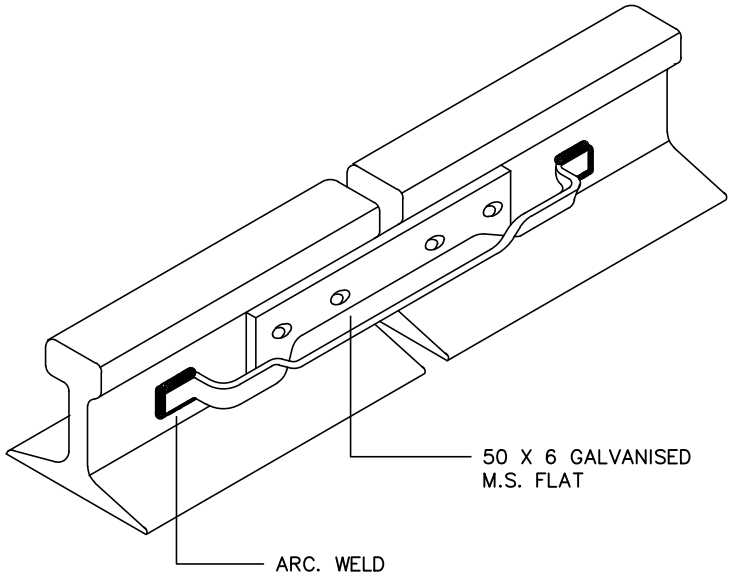
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

SHEET 18 OF 26

A4_DD (9-96) [210x297]



RAIL BONDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

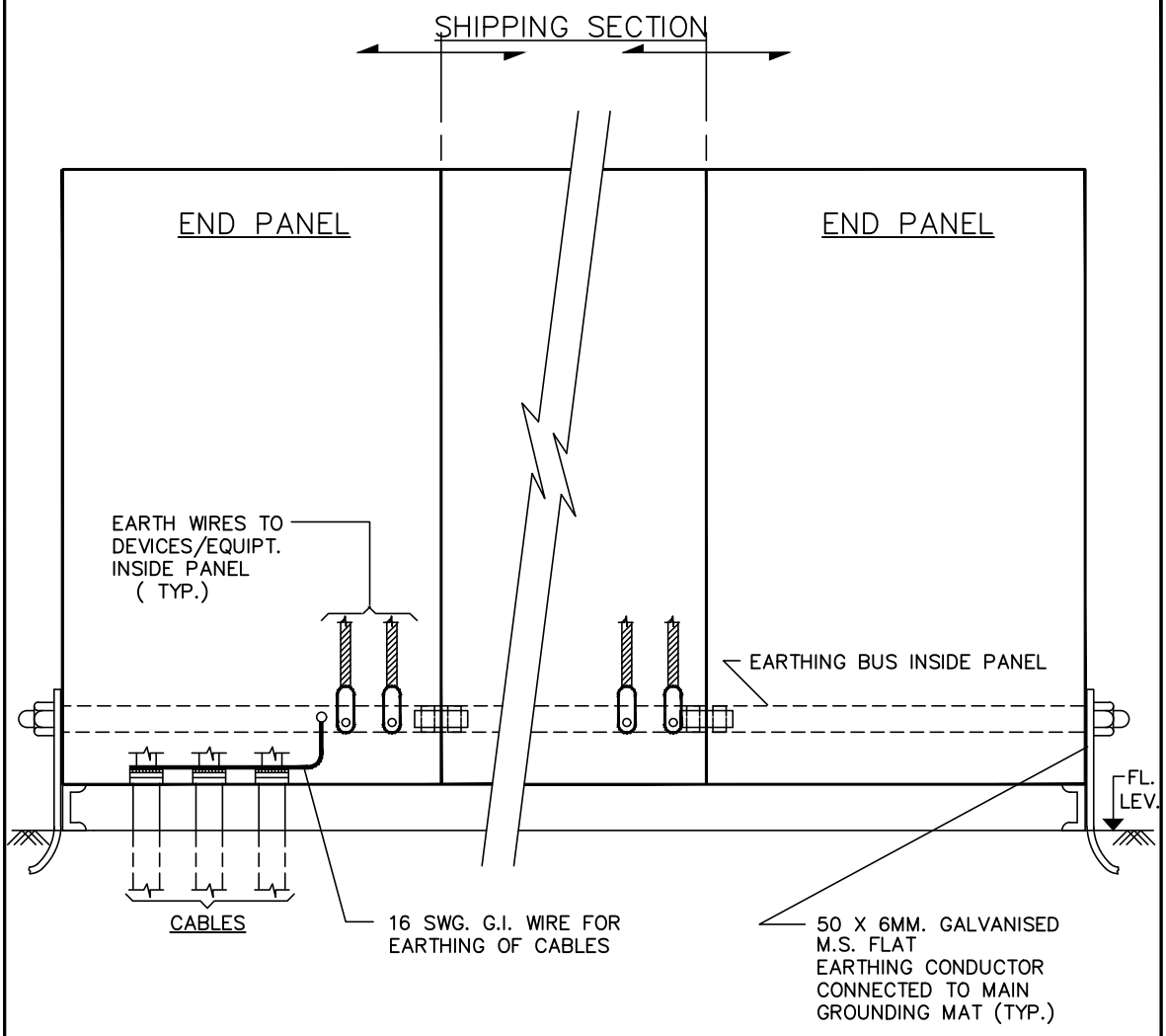
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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A4_DD (9-96) [210x297]



GROUNDING OF MCC, SWITCHGEAR

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

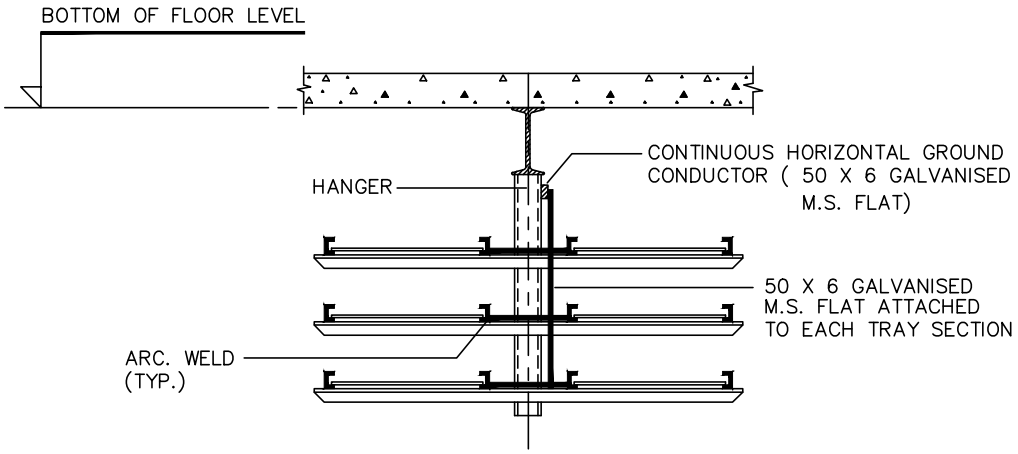
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

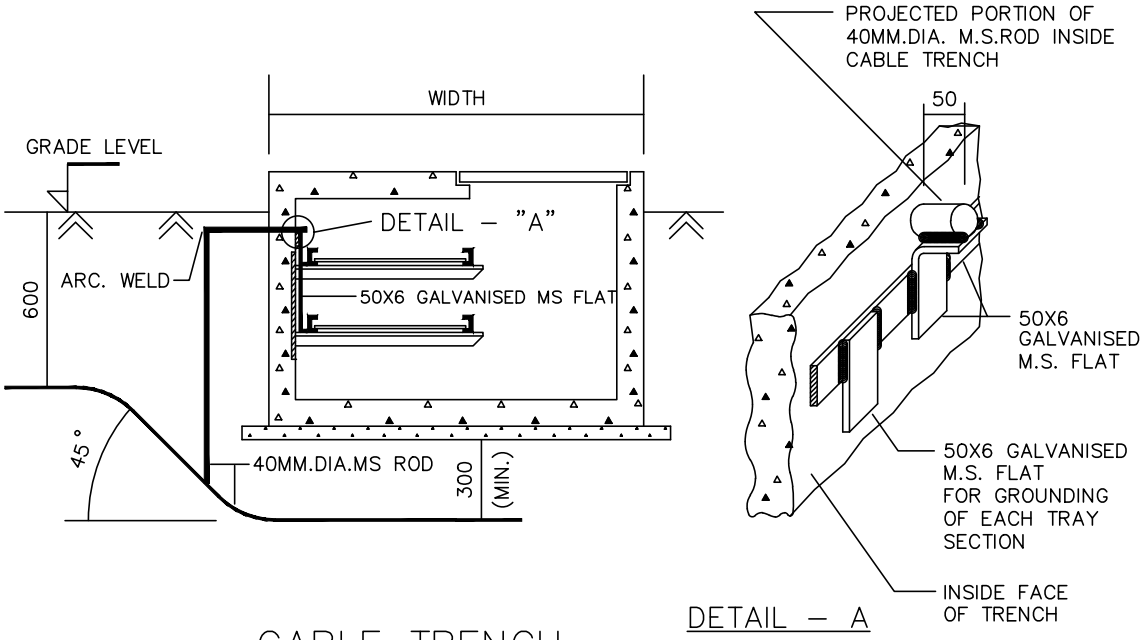
PREPARED	BG	JOB NO.	18A03
CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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A4_DD (9-96) [210x297]



OVERHEAD CABLE TRAY GROUNDING



CABLE TRENCH GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

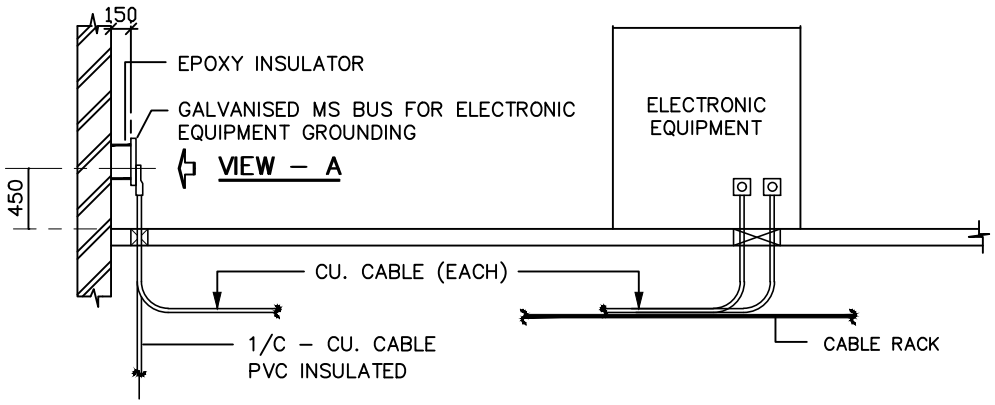
GROUNDING NOTES & DETAILS

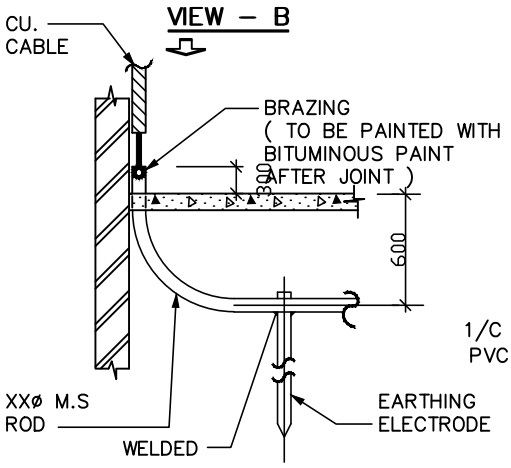
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
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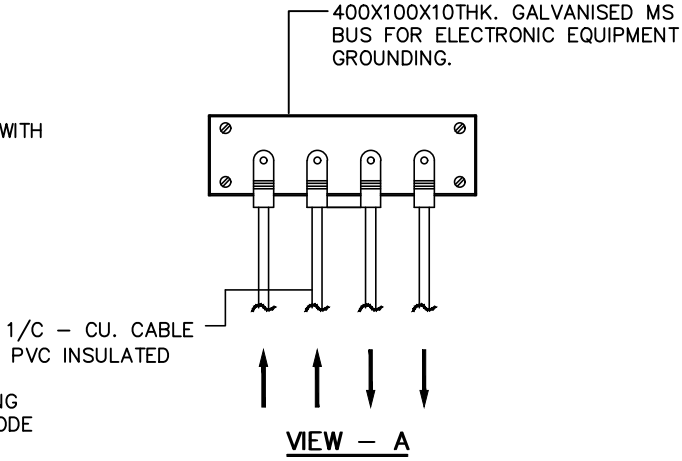
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

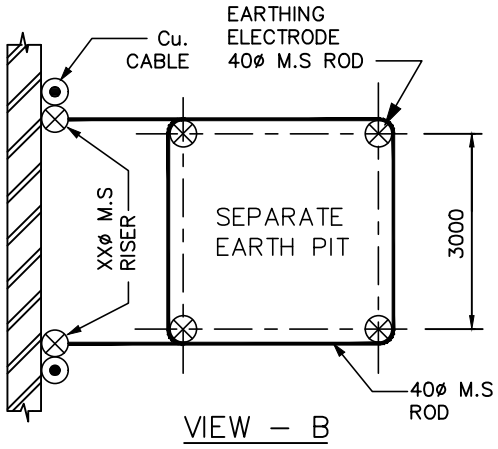
SHEET 21 OF 26

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NOTES :

1. GALVANISED MS BUS SHALL BE MOUNTED ON INSULATOR BASE AT TWO SUITABLE LOCATIONS.
2. EACH ELECTRONIC EQUIPMENT/PANEL GROUND TERMINAL SHALL BE CONNECTED TO THE BUS BY MEANS OF CU. CABLE.
3. GROUND BUS SHALL IN TURN BE CONNECTED BY MEANS OF 2–1/C PVC INSULATED CU. CABLE TO SEPARATE EARTH PIT AT SUTABLE LOCATION.
4. FOR ELECTRONIC EQUIPMENT OEM REQUIREMENT SHALL ALSO BE FOLLOWED

ELECTRONIC EQUIPMENT GROUNDING.

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

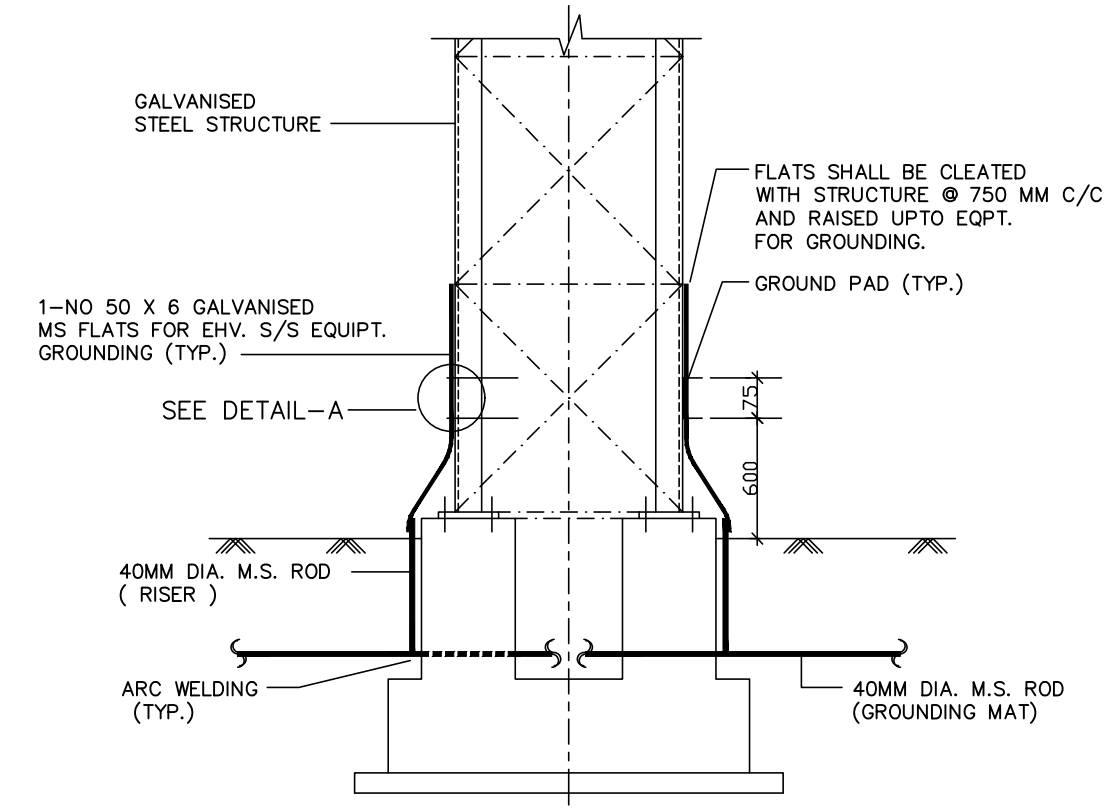
GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
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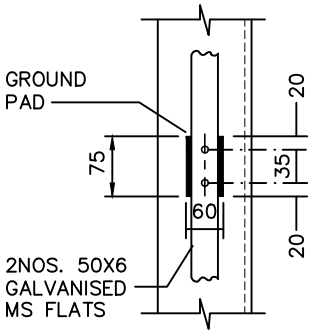
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APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0600		REV 0

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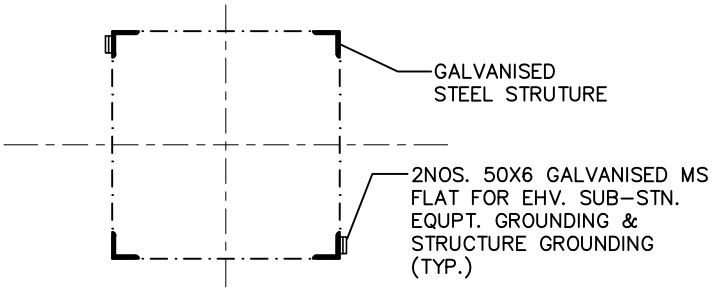
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SECTION



DETAIL – 'A'



PLAN

GALVANISED STRUCTURE AND EQUIPMENT GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

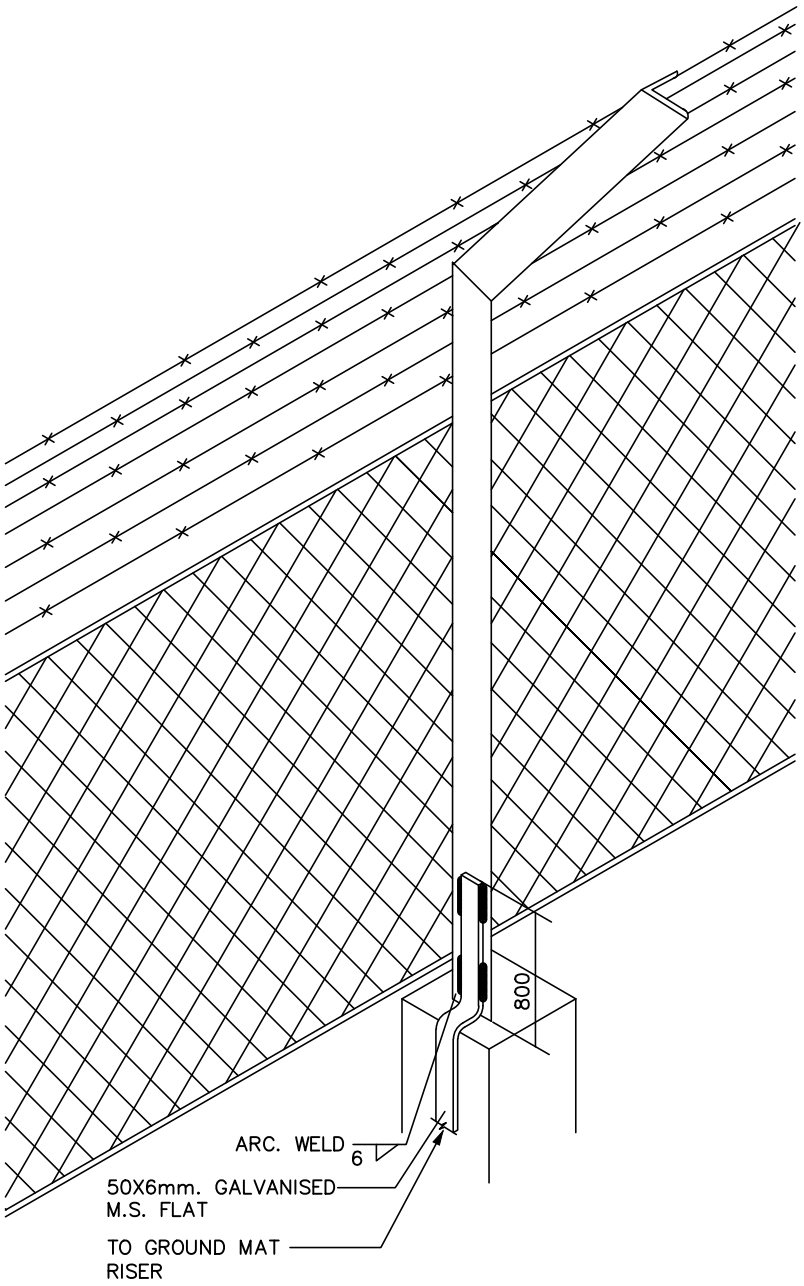
GROUNDING NOTES & DETAILS

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PREPARED	BG	JOB NO.	18A03
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APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0600		REV 0

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FENCE GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

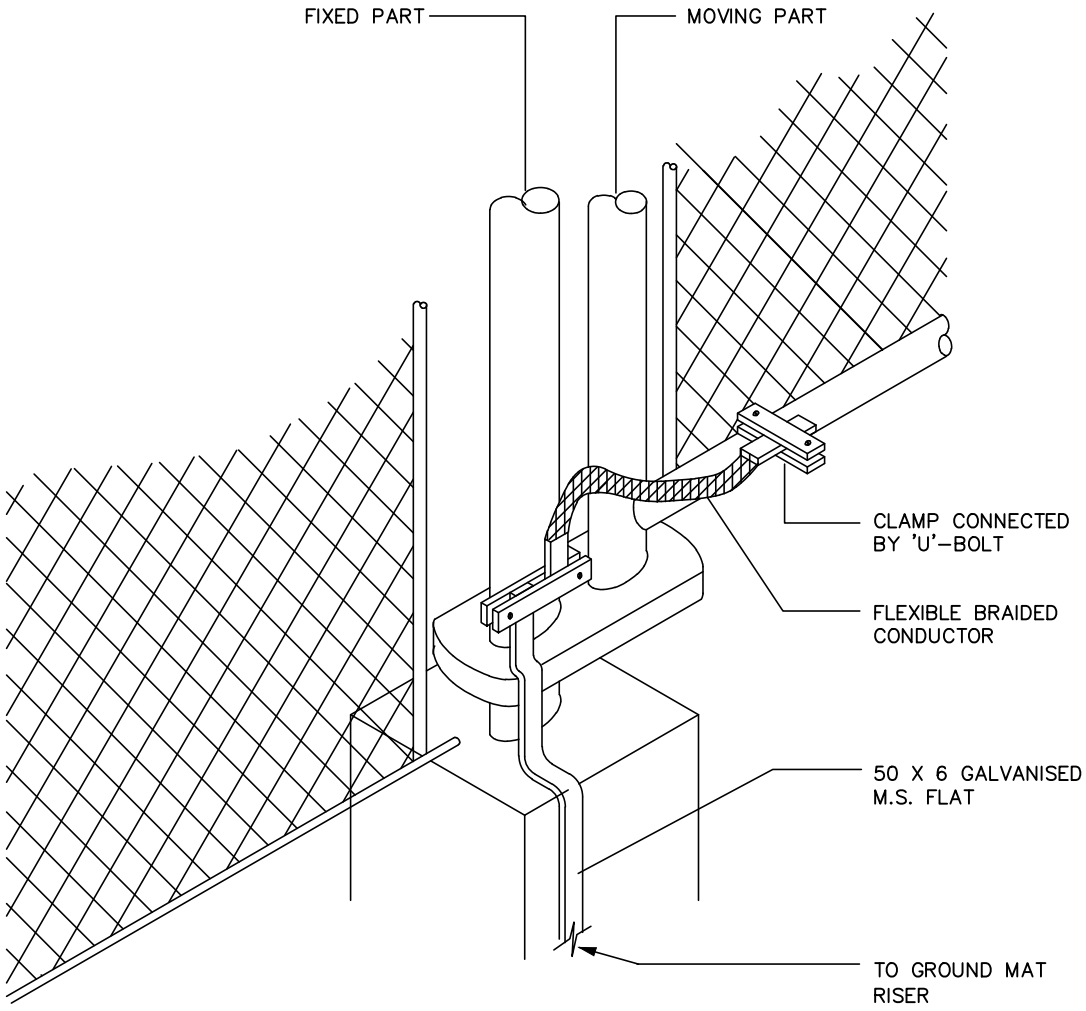
GROUNDING NOTES & DETAILS

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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03-DWG-E-0600		REV 0

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FENCE GATE GROUNDING

REV	DATE	PREPD	CHKD	APPVD
0	20.11.20	BG	AD	DS

REVISION STATUS

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

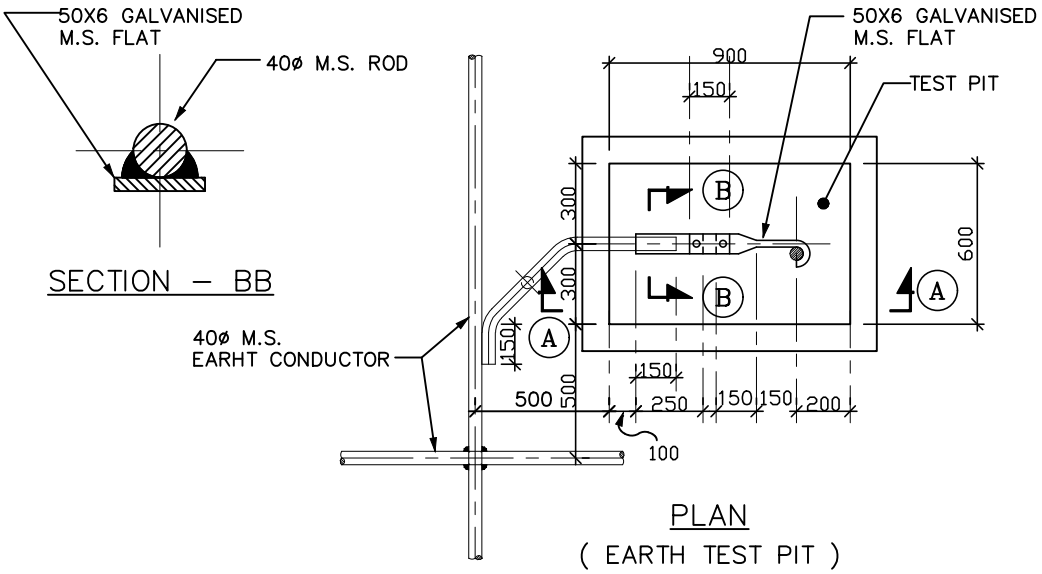
GROUNDING NOTES & DETAILS

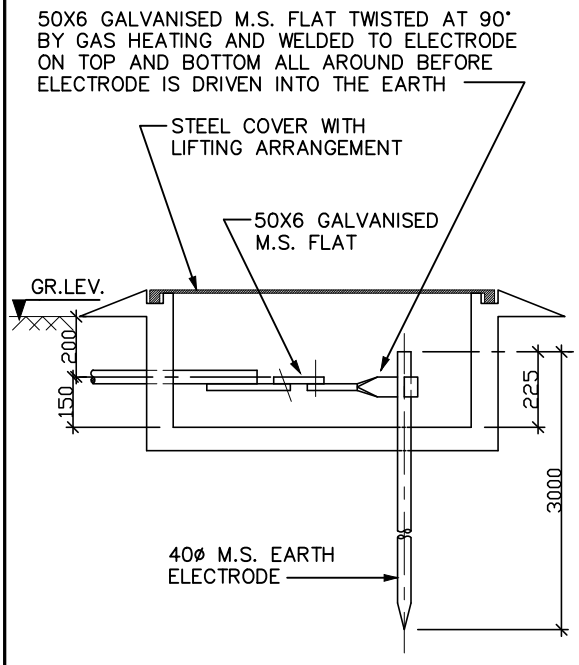
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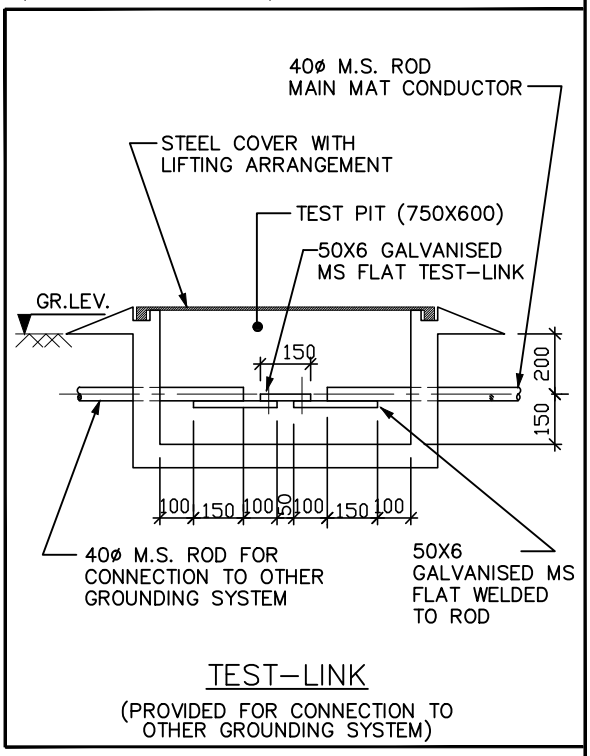
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CHECKED	AD	SCALE	NTS
APPROVED	DS	DATE	08.10.20
DWG. NO.	18A03–DWG–E–0600		REV 0

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0	20.11.20	BG	AD	DS	
REV	DATE	PREPD	CHKD	APPVD	
REVISION STATUS					

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT(NTTPP) (3X800MW)

GROUNDING NOTES & DETAILS

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	BG	JOB NO.	18A03	
CHECKED	AD	SCALE	NTS	
APPROVED	DS	DATE	08.10.20	REV 0
DWG. NO.	18A03–DWG–E–0600			SHEET 26 OF 26

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ANNEXURE-VI

BHEL	TECHNICAL SPECIFICATION IDCT NLC TALABIRA THERMAL POWER PROJECT (3X800 MW) EPC PACKAGE	PE-TS-XXX-YYY-HZZZ Issue No: 01 Rev. No. 00 Date :

TECHNICAL DATA - PART - B (SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO		UOM	DETAIL
1.0	**GENERAL**		
i)	Manufacturer & Country of origin.		
ii)	Equipment driven by motor)		
iii)	Motor type		
iv)	Country of origin		
v)	Quantity	nos.	
2.0	**DESIGN AND PERFORMANCE DATA**		
i)	Frame size		
ii)	Type of duty		
iii)	Type of enclosure and method of cooling		
vi)	Type of mounting		
vii)	Direction of rotation as viewed from DE END		
viii)	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard	(KW)	
ix)	(A) Derated rating for specified normal condition i.e. 50 deg. C ambient temperature	(KW)	
	(B) Rating as specified in load list	(KW)	
xi)	Rated speed at rated voltage and frequency	rpm	
xii)	At rated Voltage and frequency		
	a) Full load current	A	
	b) No load current	A	
xiii)	Power Factor at		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
	e) NO load		
	f) Starting.		
xiv)	Efficiency at rated voltage and frequrecy		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
xv)	Starting current*(inclusive of IS tolerance)* at		
	a. 100 % voltage	A	
	b. Minimum starting voltage	A	
xvi)	Starting time with minimum permissible voltage		
	a. Without driven equipment coupled	sec	
	b. With driven equipment coupled	sec	
xvii)	Safe stall time with 110% of rated voltage		
	a. From hot condition	sec	
	b. From cold condition	sec	

xviii)	**Torques :**		
	a. Starting torque at min. permissible voltage	(kg-mtr.)	
	b. Pull up torque at rated voltage.	(kg-mtr.)	
	c. Pull out torque	(kg-mtr.)	
	d. Min accelerating torque available	(kg-mtr.)	
	e. Rated torque	(kg-mtr.)	
xix)	Stator winding resistance per phase (at 20 Deg.C.)	Ohm	
xx)	GD^2 value of motors		
xxi)	Locked rotor KVA input (at rated voltage)		
xxii)	Locked rotor KVA/KW.		
xxiii)	**Bearings**		
	a. Type		
	b. Manufacturer		
	c. Self Lubricated or forced Lubricated		
	d. Recommended Lubricants		
	e. Guaranteed Life in Hours		
	f. Whether Dial Type thermometer provided		
	g. Oil pressure Gauge/switch		
	i. Range		
	ii. Contact Nos. & ratings		
	iii. Accuracy		
xxiv)	**Vibration**		
	a) Velocity	mm/s	
	b) Displacement	microns	
xxv)	Noise level	db	
3	**CONSTRUCTIONAL FEATURES**		
i	Stator winding insulation		
	a. Class & Type		
	b. Tropicalised (Yes/No)		
	c. Temperature rise over specified max.		
	i. Cold water temperature of 38 DEG. C.		
	ii. Ambient Air 50 DEG. C.		
	d. Method of temperature measurement		
	e. Stator winding connection		
	f. Number of terminals brought out		
ii	Type of terminal box for		
	a. stator leads		
	b. space heater		
	c. Temperature detectors		
	d. Instrument switch etc.		
iii)	For main terminal box		
	a. Location		
	b. Entry of cables		
	c. Recommended cable size		
	d. Fault level	MVA	
iv)	Temperature detector for stator winding		
	a Type		
	b. Nos. provided		
	c . Location		
	d. Make		
	e. Resistance value at 0 deg. C	ohms	
vi)	Paint shade		

vii).	Weight of(approx)		
	a. Motor stator (KG)		
	b. Motor Rotor (KG)		
	c. Total weight (KG)		
4	Relevant motor curves		

C&I

	GENERAL TECHNICAL REQUIREMENT
1	The equipment shall comply with all applicable safety codes and statutory regulations of India as well as of the locality where the equipment is to be installed.
2	In the event of any conflict between the requirements of two clauses of this specification, documents or requirements of different codes and standards specified, however more stringent requirement as per the interpretation of the owner shall apply.
3	Bidder to note that drawing/document submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.
4	The first revision drawings/ documents submitted by bidder shall be complete in all respects. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
5	**PROVEN PRODUCT** All equipment, systems and accessories furnished under this specification shall be from the latest proven product range of a reputed experienced manufacturer whose successful performance has been established by a considerable record of satisfactory operation in similar power stations. Bidder shall furnish satisfactory evidence regarding successful operation and high reliability of the proposed equipment/ systems in similar applications for meeting this requirement as specified elsewhere. The Bidder shall furnish a complete list of bought out items (i.e., items not from manufacturing range) which the Bidder has included in his proposal along with the names of proposed sub-vendors as a part of his proposal. However the make and model of all bought out items supplied by the Bidder shall be as approved by Owner / Consultant during detailed engineering stage.
6	Latest codes and standards shall be applicable as on date of bid submission.

C&I TECHNICAL REQUIREMENT

1	Control of Induced Draft Cooling Tower(IDCT) package shall be through DCS(BHEL Scope) with 24" LED based OWS located in Control Room.
2	Complete Field Intrumentation for monitoring and operation of IDCT package be provided by bidder.
3	The quantity of instruments for the system indicated in "General Technical Requirement" shall be considered as minimum requirement by the bidder. Any other instrument/item required for completeness of the system shall be in bidder's scope of supply.
4	All instrumentation, control and automation devices and accessories shall be designed with the following considerations: a) Stable in spite of temperature fluctuations. (b) Able to withstand high humidity. c) Weather proof. d) Dust proof. e) Corrosion resistant. f) Erosion resistant. g) Able to withstand high vibration. h) Easily accessible for operation & maintenance.
5	INSTRUMENT ACCURACY 1. Accuracy of linear instruments shall meet the specified accuracy over its span. 2. Level measurement shall be linear with respect to the measured level based on a specific gravity of 1.00. 3. Wherever the measured parameter like flow is influenced by process pressure & temperature, required correction against pressure and temperature shall be introduced for such measurement. 4. Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow.
6	INSTRUMENT SCALE DISPLAY a) All displays shall be in engineering units. Instrument scales displayed on screen shall have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable. b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, espectively. c) Scales and charts of all instruments shall have linear graduations.
7	INSTRUMENT RANGE The ranges of the instruments shall be selected based on the following philosophy: Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark. • For pressure and draft measurements, the maximum operating pressure shall be within 70 to 80% of the maximum scale range. • For temperature measurement, the maximum operating temperature shall be within 80 to 90% of the maximum scale range. • For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected. • For level measurement, the maximum of the range shall cover the overflow point or six inches from the top of the vessel and the minimum of the range shall be six inches above the bottom of the vessel. Also, the gauge glasses will be stacked with overlap to cover permissive, alarm and trip levels.
8	ENVIRONMENTAL CONDITIONS minimum design requirement of 55°C (Max.) and 4°C (Min.) and 95% RH.,

9	Instrumentation sensing, transmission, measuring and computing system shall be solid-state electronic type. Field process transmitters shall be smart (HART based) type.
10	Diaphragm seal shall be provided with Instruments having contact with corrosive / viscous media. For corrosive applications, all instruments applications, they shall be provided with wetted parts made of Monel/Hastelloy C. All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments.
11	The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1/2, Division 1 area & Flame proof area) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments.
12	All instruments shall be supplied with valid calibration and test certificates provided by OEM.
13	Following items are to be supplied for process as a minimum: □ Temperature Elements with temperature transmitters, thermowell and Temperature Gauges for each Gear box. Temperature sensors shall be on gear box while display (Gauge Meter & Transmitter display) shall be outside RCC Stack (near Fan Motor). □ One no. Level Switch for each of the gear box for lube oil level.
14	Following items are to be supplied as a minimum for PG Test: □ Temperature Elements with temperature transmitters and Temperature Gauges for each of the Hot Water Riser. □ Temperature Elements with temperature transmitters and Temperature Gauges with necessary stub, fitting, mounting arrangements etc. in the cold water channel for each cooling tower in canopy. □ Pressure Gauges for each of the Hot Water Riser. □ Pitot Tube along with manometers for Flow measurement with stub connections. □ Anemometer (one number) for measurement of wind velocity. □ Psychrometer (one number) - Mechanically aspirated
15	Root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold, junction boxes and all other accessories required for erection of local / remote instruments shall be provided by bidder.
16	The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes.
17	Bidder shall provide mounting pads for vibration sensors for each fan motor.
18	Bidder to provide temperature transmitter along with junction box & other erection hardware.
19	All instruments shall be terminated on junction box in the field. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling and trunk cable.
20	Number of pairs to be selected for Screen /Control cable 1. F-Type: 2P/4P/8P/12P (Size: 0.5sqmm2) 2. G-Type: 2P/4P/8P/12P (Size: 0.5sqmm2)
21	Vibration Monitoring System is envisaged for Cooling Tower Fan/Motor which is in BHEL scope. However, for mounting of vibration sensors/probe, vendor to provide vibration pad (of dimension of 80 mm*80mm*10mm each) for mounting of sensors and a notch/slot for mounting of key phasor.
22	All Temperature sensors shall be Duplex type and temperature transmitter shall be provided for all temperature measurement applications. Bidder to provide temperature transmitter along with JB/Rack & other erection hardware.
23	Bidder to furnish electrical/UPS load data required for any instruments etc. during detailed engineering
24	All instruments shall be terminated on JB/Rack/LCP in field where both instrument and JB/Rack/LCP are in bidder scope.
25	For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
26	Bidder to provide mandatory spares as per mandatory spares list.
27	All the transmitters supplied by Bidder shall be rack mounted. The transmitter racks shall be in Bidder's scope of supply. All transmitters shall be HART compatible. Only two wire transmitter shall be used. Instrument shall have the provision to be calibrated using Universal Hand held Calibrator.
28	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
29	Local Control Station (LCS) along with local/remote selector switch, indicating lamps, push buttons etc. shall be provided for each fan motor. The Fan motor shall work from local mode even if DCS is down. Protection class for LCS shall be suitable to place the same in open environment.

TECHNICAL DATA - PART - A

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	**DESIGN CODES & STANDARDS**		
1.1	Impulse pipes, tubes (material, rating)		ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70
1.2	Valves (material, pr. Class, size)		ASTM A182/ASTM A105 as per ASME 16.34
1.3	Fittings (size, rating, material)		ANSI B31.1, ANSI B31.1a, ASME B16.11
1.4	Installation schemes		BS 6739-2009, ANSI/ISA 77.70
1.5	Transducers		IEC-688, IS-12784
1.6	Instruments and apparatus for pressure measurement		ASME PTC19.2
1.7	Bourdon tube pressure and vacuum gauges		IS-3624
1.8	Instrument and apparatus for temperature measurement		ASME PTC 19.3(1974)
1.9	Temperature measurement by electrical Resistance thermometers		IS:2806
1.10	RTD Sensor		IS: 2848/ DIN-43760
1.11	Protection system		NFPA 85 & IBR latest editions
2.0	**DESIGN /SYSTEM PARAMETERS**		
2.1	**SPECIFICATIONS - PRESSURE GAUGE**		
	Type		Direct Reading
	Sensing element		Bourdon for high pressure, diaphragm/bellow for low pressure
	Sensing element material		SS316
	Movement material		SS316
	Case material		Die Cast Aluminum with stoved enamel black finish/ SS316
	Dial size	mm	150mm with toughened shatter proof glass
	End connection	inch	1/2 inch NPT (M) Bottom connection for local mounting
	Accuracy	%	±1% of span or better
	Scale		Linear, 270° arc graduated in metric units
	Over range test		150% of maximum range by internal stop. External stop at zero
	Nameplate		Tag number and Service engraved in SS tag plate
	Standard applicable		IS:3624-1966
	Housing		IP-65
	Zero/span adjustment		Micrometer screw for zero adjustment
	Accessories		a) Stainless steel Diaphragm seals (SS armoured capillary of 5 mtrs length min) for corrosive, viscous and solid-bearing or slurry type process fluids, flushing ring with plug required. b) Gauge saver, Syphon wherever required c) 3-Way stainless steel Gauge valve/ 2-valve SS-316 manifold for pressure gauges. Process connection ½" NPT d) 5-valve SS316 manifold constructed from bar-stock for differential pressure gauge. Process connection ½" NPT. e) Union, nut & tail piece and other Installation accessories as required. f) All wetted parts shall be of SS316 or better

2.2	**SPECIFICATIONS - LEVEL SWITCH**		
	Repeatability	%	+/-0.5% of full range
	No. of contacts		2 No.+2NC. SPDT snap action dry contact
	Rating of contacts	V, VA	60 V DC, 6 VA
	Elect. Connection		Plug in socket.
	Set point adjustment		Provided over full range.
	Dead band adjustment		Adjustable/ fixed as per requirement of application.
	Enclosure		IP-55
	Power Supply	V	24V DC
	Sensing Element		Float type, conductivity type, Ultrasonic type as per suitability to the application
	Material		316 SS
	End connection		Manufacturer standard
	Over range/ proof pressure	%	150% of maximum operating pr.
	Accessories		All mounting accessories
2.3	**SPECIFICATIONS - TEMPERATURE GAUGE**		
	Type		Direct reading
	Sensing element		Bimetallic type for below 450 Deg. C and inert gas actuated for above 450 Deg. C, Inert type(capillary of 5 mtrs.length)
	Material of Construction		a) Stem - SS- 304 or better b) Movement Material - SS-316 or better c) Connection- SS-316 or better d) Case Material - Die Cast Aluminum with stoved enamel black finish/ SS 304 e) Capillary - SS-316 or better f) Armor - Flexible, SS 304, optional PVC covered
	Dial		Anti parallax heavy gauge aluminum with white matte finish glare free. Black lettering on white background
	Pointer		Aluminum Black Micrometer pointer
	Dampener		Dampening pointer oscillation
	Mounting		Surface mounting with adjustable angle
	Response Time		30 seconds (max.) with Thermowell and 15 seconds bare
	Nameplate		Tag number and Service engraved in stainless steel tag plate
	Applicable Standard		EN 13190
	End connection		1/2" NPT (M)
	Accuracy	%	± 1% of span
	Dial Size	mm	150 mm with toughened shatter proof glass
	Scale		Linear, 270° arc graduated in °C
	Range selection	%	Normal process pressure 50 ~ 70% of range (approximately)
	Over range protection		150% of range or more
	Housing		IP-65 (Explosion proof for NEC Class-1, Division 1 area)
	Zero/span adjustment		Required
	Accessories		SS Thermowell, Installation accessories as required

2.4	**SPECIFICATIONS - TEMPERATURE TRANSMITTER**		
	Transmitter Type		Microprocessor based 2 wire type, HART protocol compatible
	Input		Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K types (input to be selectable at site through HART calibrator/ terminal)
	Isolation		Min. 500 V AC
	Output Signal		4~20 mA DC (Analog) along with superimposed digital signal (HART based)
	Body Material		Epoxy coated Die cast Aluminium/ SS316
	Load Impedance		600 Ohms (min.) at 24 Volts DC
	Electrical Connection		½" NPT (F)
	Operating Voltage		24V DC ±10%
	Output Indicator		LCD type digital integral indicators with scale of engineering units
	Cold Junction Compensation		Built-in (for Thermocouples)
	Burn-out Protection		In case of failure (open or burn-out) of RTD/ Thermocouple, Temperature Transmitter shall provide Low Temperature output
	EMC Compatibility		As per EN 61326
	Diagnostics		Self-indicating feature
	Operating Ambient Temperature		0-85°C (without indicator) 0-70°C (with indicator)
	Repeatibility		0.05 % of span
	Span and Zero		Adjustable in field , Non- interacting facility of elevation and suppression of zero.
	Calibration		As per N.I.S.T Monograph 125 for T/C and European Curve Alpha = 0.00385 for RTD.
	Composite Accuracy		a) For DIN-rail Mounted Type RTD ≤0.4% of 0-250° span TC-K type ≤0.4% of 0-600° span b) For Dual Input Type RTD ≤0.25% of 0-250° span TC-K type ≤0.2% of 0-600° span
	Nameplate		Tag number and Service engraved in stainless steel tag plate
	Accessories		Mounting arrangements including clamps, Cable gland, Hi-tensile carbon steel Ubolts etc.

2.5	**SPECIFICATIONS - RESISTANCE TEMPERATURE DETECTOR (RTD)**		
	Type		Four/ Three wire, Pt-100
	No. of element		Duplex
	Junction		Ungrounded
	Sheath		a) Sheath Diameter - 8 mm b) Sheath Material - SS316 c) Sheath Insulation - Compacted Magnesium Oxide High purity (99.4% minimum)
	Head Assembly		a) Head Style - Threaded Cover with SS Chain, Neoprene Gasket b) Head Type - IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area) c) Head Material - Epoxy coated Die cast aluminum or better
	Terminal Block		High quality ceramic, polarity embossed terminal block Brass - Ni Plated (Spring Loaded)
	Instrument Connection		½" NPT (M)
	Electrical Connection		½" NPT Double entry, one unused entry with blind plug
	Process Connection		a) M33x2 b) Flanged
	Extension		Threaded union (SS316) ½" NPT (F) with two nipples of SS 316 having ½" NPT (M) threads at both ends
	Extension Neck Length		Minimum 100 mm above insulation of pipe and minimum 160 mm when there is no insulation in pipe
	Calibration & Accuracy		As per DIN-43760/IEC 60751 Class-A
	Response Time		a) Bare RTD - Less than 4-6 seconds b) With Protective Sheath - Less than 10 seconds c) With Thermowell - Less than 30 seconds
	Characteristic		Linear with respect to temperature within ±0.5% of top range value
	Standard		DIN-43760/IEC 60751 for RTD and ASME PTC-19.3 (latest edition) for Thermowell
	Nameplate		Tag number and Service engraved in stainless steel tag plate with chain
	Accessories		Thermowell (as specified below) and shall be spring loaded for positive contacts with the well
	NOTES		The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540°C shall not be less than 5 mega-ohms.
			The specifications for RTDs of winding/ bearings of motor/ pump can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be PT100

2.6	**SPECIFICATIONS - THERMOWELL**		
	Design		ASME PTC-19.3 TW-Latest Edition
	Material		SS316
2.7	**SPECIFICATIONS - Anemometer WIND SPEED SENSOR**		
	Anemometer system shall be complete with wind speed sensor with integral cable, wind direction sensor with integral cable, combined dual display unit for displaying wind velocity as well as wind direction		
	Power Supply		240V AC, 50Hz (UPS)
	Output		a) Wind Velocity - Frequency Proportion to Wind Velocity b) Direction- 4 - 20mA Proportional to degrees
	Display		Graphic Display
	Range		a) Velocity : 5-245 km/hr Two (2) trip points “Alarm” and “Danger” settable over full range. Manual Reset 1NO+1NC (200 VA at 230V AC) b) Direction : 0-360 Deg. C
	Accuracy		±2% of span, ±5°
	Mounting		a) Monitor - Panel mounting b) Sensor - Pipe/ Mast mounting
	Housing		Weather proof
	Feature		Data Logging, Interface with DCS
2.8	**SPECIFICATIONS - LEVEL SWITCH**		
	Type		Capacitance type
	Probe		a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 1.5 meters. c) Reference rod for non grounded tank.
	Material of Construction		a) Probe - SS-316 and to suit fluid type b) Insulation- PTFE/PP/Kynar Part/Full as required c) Switch Housing - Epoxy coated Die-cast aluminum alloy with neoprene gasket/ SS-316
	Process Connection		1-1/2” Flanged along with companion flange with nuts, bolts and gaskets
	Mounting		Probe on Top, switch unit separate on surface
	Operating Voltage		240V AC ±10%, 50Hz / 24V DC±10%
	Switch Configuration		One DPDT/ Two SPDT. Auto reset with internal adjustable snap action micro switch
	Switch Rating		240V, 5A AC/220V, 0.5A DC
	Set Point		Provided over full range. Differential shall be adjustable
	Dead Band Adjustment		Adjustment up to 10% at set points
	Accuracy		±1% or better
	Repeatability		±0.5% of full range
	Response Time		100 msec or better
	Terminal Block		Suitable for full ring lugs for cable connection
	Electrical Connection		½” NPT conduit connection or compression gland
	Enclosure Class		IP-65 (Explosion proof for NEC Class-1, Division 1 area)
	Nameplate		Tag number, service engraved in stainless steel tag plate
	Accessories		a) Counter flange, nuts, bolts and gasket b) Prefab cable c) ½” NPT double compression type cable gland of SS 316 material
2.9	**SPECIFICATIONS - LIMIT SWITCH**		
	Sensing system		Non-contact type inductive Proximity/Namur type
	Sensing Distance		10 mm minimum
	Indicator		LED indication
	Temperature Range		-25 to 85°C
	Protection Class		IP-65
	Switch configuration		2 SPDT
	Contact rating		5A min. at 240V AC on resistive load
	Power Supply		24V DC/ 8V DC (for NAMUR)
	Integral Cable		Provided
	Hysteresis		Max. 10% of sensing distance
	Mounting		Flush mounting with check nut

2.10	**CABLE GLAND**		
	Type		Double compression
	Entry Thread		NPT
	Material		SS316
	Protection		IP 65 or better
	Accessories		Neoprene gasket, locknuts, reducers etc
2.11	**SPECIFICATIONS - JUNCTION BOX**		
	Type of Enclosure		Dust tight & weatherproof conforming to IP 65/ Flame proof/ Explosion proof as per area classification
	No. of Ways		12/24/36/48/64/72/96/128 with 20% spare terminals. Number of ways should be decided by vendor as per requirement.
	Material		4 mm min. thickness FRP (Fiberglass Reinforced Polyester) with protective coating (UV stabilized)
	Type of Cover		Hinged lockable type door, screwed at all four corners
	Door Handle		SS
	Door Lock		Identical locks for all junction boxes with common key
	Gland Plate		Undrilled / with knock-outs removable gland plate of 3 mm CRCA/ 4 mm Thick Brass for FRP JB
	Gasket		Neoprene/ polyurethane (6 mm thickness) Silicon for high temperature area (All doors, gland plate removables shall be gasketted)
	Cable Entry		Bottom/ Side
	Cable Gland		Double Compression type SS 316
	Mounting		Indoor/ Outdoor mounting on walls/ columns/ structures/ surface/ 2” pipe/ stanchion etc.
	Terminal Block		Rail mounted cage clamp type screwless terminals suitable for 0.5 mm2 to 2.5 mm2 cable. Terminal blocks shall be properly arranged inside JB with end plate & end clamp in DIN rail (MS plated) and marked-up with TB nos. from top to bottom to facilitate easy termination of the cables. Suitable cable channel with cover shall be provided on both sides of TB’s for all JB’s.
	Mounting Plate		2 mm Thickness MS powder coated DIN Rails and cable channels shall be bolted to the mounting plate/ rear body using studs
	Top Surface		With slope
	Grounding		Copper earth bus bar shall be provided in each JB Earth bus bar shall be 25 mm x 6 mm Copper
	Earthing Stud		M6 Nickel plated Brass Earthing stud with green screw head (External 2 nos., Internal 1 no.)
	Paint		RAL 7032 (Pigmented Color for FRP)
	Identification		SS Tag plate suitable for three rows engraving with tag no. Black back ground with red letters for explosion proof JBs. Identification label shall be provided for each cable and tags for cable. Instrument tag vis-à-vis service and terminal details shall be printed on Phenolic board mounted on back side of door.
	Accessories		a) Ferrules & lugs b) Canopy at top for outdoor junction boxes Canopy shall be minimum 3 mm thick extended 40 mm (approx.) from each side c) Mounting Brackets (SS 304) Wall mounting brackets shall be welded to rear side of JB d) Bolts, nuts (SS 304)
	Routine & Acceptance Test		Visual, GA, Layout, Dimension, Component Rating, IR & HV Test
	Type Test		Degree of protection Test as per IEC 60529 mentioned in IS/ IEC 60947-1:2004
	NOTES:		
	(a) Separate Terminal blocks shall be used for Analog & Digital Signals & also for signals with different voltage levels.		

	(b) The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.		
	(c) Separate shield bus shall be provided with screw connection for terminating cable shields.		
	(d) All spare cable entries shall be provided with plugs.		
2.12	**Impulse piping for water area/equipment**		
	Painting color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Sea green, ISC no. 217
2.13	**Impulse piping for Oil area**		
	Painting color scheme		Grey RAL 9002
	Identification Tag/band color scheme		Light Brown, ISC no. 410

NOTES:-

1. BIDDER SHALL PROVIDE, INSTALL AND TEST ALL REQUIRED MATERIAL FOR COMPLETENESS OF IMPULSE PIPING SYSTEM AND AIR PIPING SYSTEM AS PER THE REQUIREMENTS IN ENCLOSED DRAWINGS AND SPECIFICATION VOLUME –II E/ SECTION –VII, ON AS REQUIRED BASIS FOR THE CONNECTION OF INSTRUMENTS AND CONTROL EQUIPMENT OF ENTIRE PLANT.
2. ALL MATERIALS SHALL CONFORM TO THE LATEST EDITIONS OF AMERICAN NATIONAL STANDARD CODE FOR PRESSURE PIPING, POWER PIPING, ANSI B31.1, ANSI B16.11, ASME BOILER AND PRESSURE VESSEL CODES, IBR AND OTHER APPLICABLE ASME, ANSI AND STATE STANDARDS.
3. RATING OF PIPING / FITTINGS / VALVES ETC. IS SUBJECTED TO BE APPROVED BY OWNER AS PER THE FINAL DESIGN PRESSURE AND TEMPERATURE FINALIZED DURING THE DETAIL ENGINEERING AS PER ANSI B31.1.
4. TAP ORIENTATION SHALL BE AS FOLLOWS:–
   - –FOR LIQUID SERVICE, WITHIN 45° AT LOWER HALF OF THE PIPE HORIZONTAL PLANE.
   - –FOR GAS SERVICE, WITHIN 90° AT UPPER HALF OF THE PIPE HORIZONTAL PLANE.
   - –FOR STEAM SERVICE, WITHIN 45° AT UPPER HALF OF THE PIPE HORIZONTAL PLANE.

   AS A RULE TAP ORIENTATION OF HIGH AND LOW PRESSURE SIDE SHOULD BE PARALLEL AND SYMMETRICAL.
5. ROOT VALVES OF TWO NUMBERS FOR PRESSURE OF 40KG/CM2 OR TEMPERATURE OF 280°C AND ABOVE AND SINGLE FOR PROCESS PRESSURE LESS THEN 40KG/CM2 AND TEMPERATURE LESS THEN 280°C AS PER PIPING SPECIFICATION SHALL BE PROVIDED. FOR PROCESS PRESSURE EQUAL OR ABOVE 280°C DOUBLE BLOW DOWN VALVES SHALL BE USED BEFORE CONNECTING TO BLOW DOWN HEADER.
6. SLOPE 100MM/MTR. SHALL BE PROVIDED UNLESS OTHERWISE SPECIFIED , FOR STEAM AND LIQUID MEASUREMENTS, THE IMPULSE PIPE SLOPE SHALL BE DOWNWARDS FROM SOURCE TO INSTRUMENT. FOR VACUUM / AIR SERVICES SLOPE SHALL BE UPWARD SIDE. HIGH POINT VENTS OR LOW POINT DRAINS, OR BOTH SHALL BE PROVIDED TO ENSURE THAT ALL ENTRAPPED GAS OR LIQUID CAN BE PURGED FROM SENSING LINE.
7. SYPHONS SHALL BE PROVIDED IN THE IMPULSE PIPE OR TUBE TO PROTECT THE INSTRUMENTS WHERE FLUID TEMPERATURE IS 100°C OR MORE.
8. CONDENSING POTS SHALL BE PROVIDED FOR ALL LEVEL MEASUREMENTS IN STEAM AND WATER SERVICES ABOVE 120°C.
9. BULK HEAD FITTINGS SOCKET WELDED TYPE SHALL BE PROVIDED AT INSTRUMENT RACK / ENCLOSURE, ALL IMPULSE PIPE FITTINGS EXCEPT THE LAST FITTING CONNECTING TO THE INSTRUMENT SHALL GENERALLY BE SOCKET WELDED TYPE. PNEUMATIC PIPE FITTINGS SHALL BE THREADED. DOUBLE FERRULED COMPRESSION TYPE FITTINGS SHALL BE USED ONLY.
10. EXTENDED DIAPHRAGM WITH SS CAPILLARY SHALL BE PROVIDED WITH PRESSURE / DIFFERENTIAL PRESSURE MEASURING INSTRUMENTS IN CORROSIVE, VISCOUS, SOLID BEARING, SLURRY TYPE AND DRAIN FLUID APPLICATIONS.
11. SNUBBERS, CHEMICAL PULSATION DAMPERS AS REQUIRED BY THE PROCESS SHALL BE PROVIDED. MANIFOLDS SHALL BE NON–INTEGRAL TYPE ONLY.
12. DRAIN HEADER SHALL BE CONNECTED TO THE NEAREST DRAIN PIT AS PER SITE CONDITION.
13. IMPULSE PIPE SHALL BE CLAMPED AT SUITABLE INTERVAL NOT EXCEEDING 1.5 METER. EACH PIPE SHALL BE SUPPORTED INDIVIDUALLY USING SLOTTED ANGLE MOUNTED CLAMPS WITH NECESSARY FIXTURES, TUBING SHALL BE SUPPORTED INSIDE TRAYS BY ALUMINIUM SUPPORTS, UNION SHALL BE USED AT EVERY 6METER INTERVAL OF IMPULSE LINE OR AS REQUIRED.
14. HANGERS AND OTHER FIXTURES REQUIRED FOR SUPPORT OR PIPING AND TRAYS SHALL BE PROVIDED EITHER BY WELDING OR BOLTING ON WALLS, CEILING AND STRUCTURES.
15. INSTRUMENTS ASSOCIATED WITH TANKS LIKE LEVEL SWITCHES, GAUGES, ELECTRONIC UNITS SHALL BE SUPPORTED AS REQUIRED BY FIELD.

FOR TENDER PURPOSE ONLY

REVIEWED: PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY ✓		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED	DATE	SIGNATURE
PROCESS		
MECHANICAL		
CIVIL & STRUCTURAL		
ARCHITECTURAL		
INSTRUMENTATION		
ELECTRICAL		
OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	08.04.2019

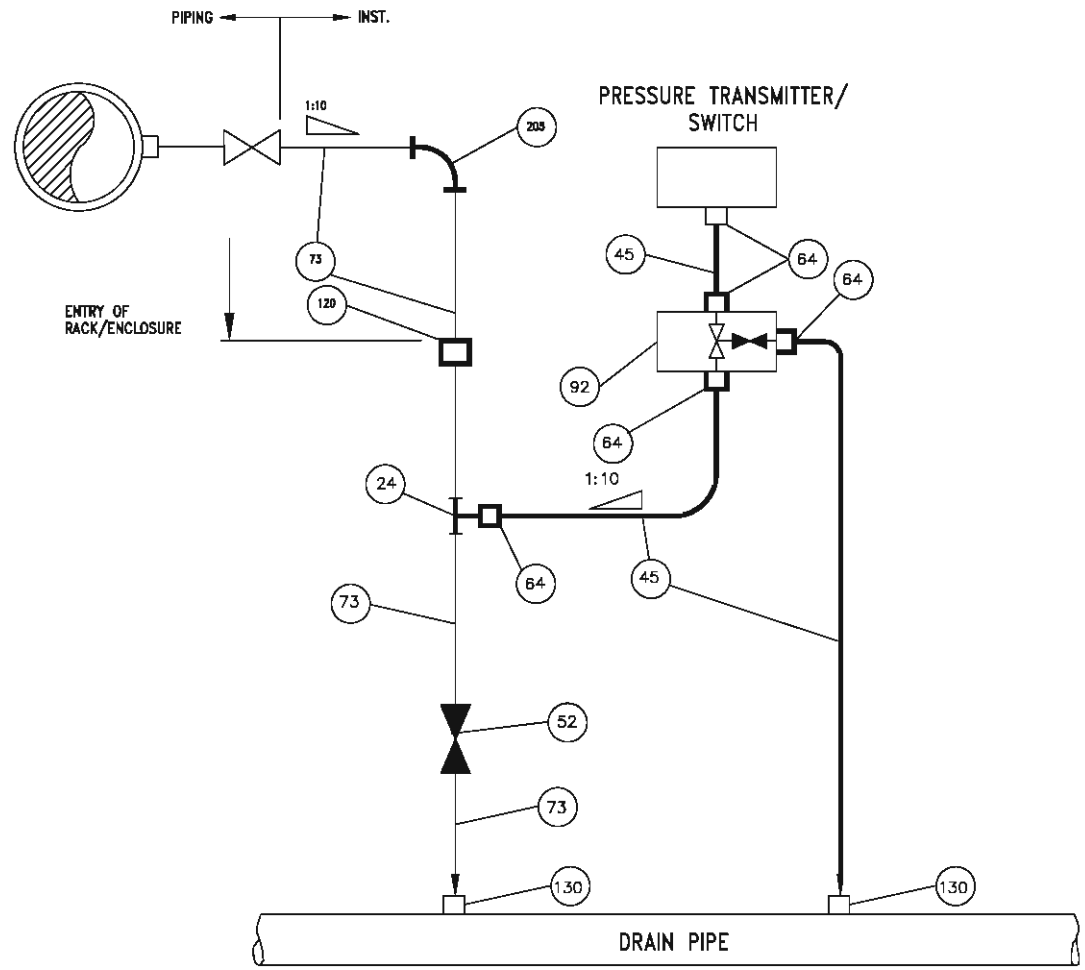
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DWG. NO. 18A03-DWG-I-0060

SHEET 3 OF 37

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0060_R0_SHT3(NOTES).dwg
PLOT DATE: 15-Nov-20 11:58 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH
WATER SERVICE [<40 Kg/cm2 & <280 Deg.C]



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, (2 X 1/2") SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	1	GLOBE VALVES, 1/2" SW
64	5	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 1/2" NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

REVIEWED

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
✓ TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		
REVIEWED: PROCESS		
MECHANICAL		
CIVIL & STRUCTURAL		
ARCHITECTURAL		
INSTRUMENTATION		
ELECTRICAL		
OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

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APPROVED	AT	DATE	08.04.2019

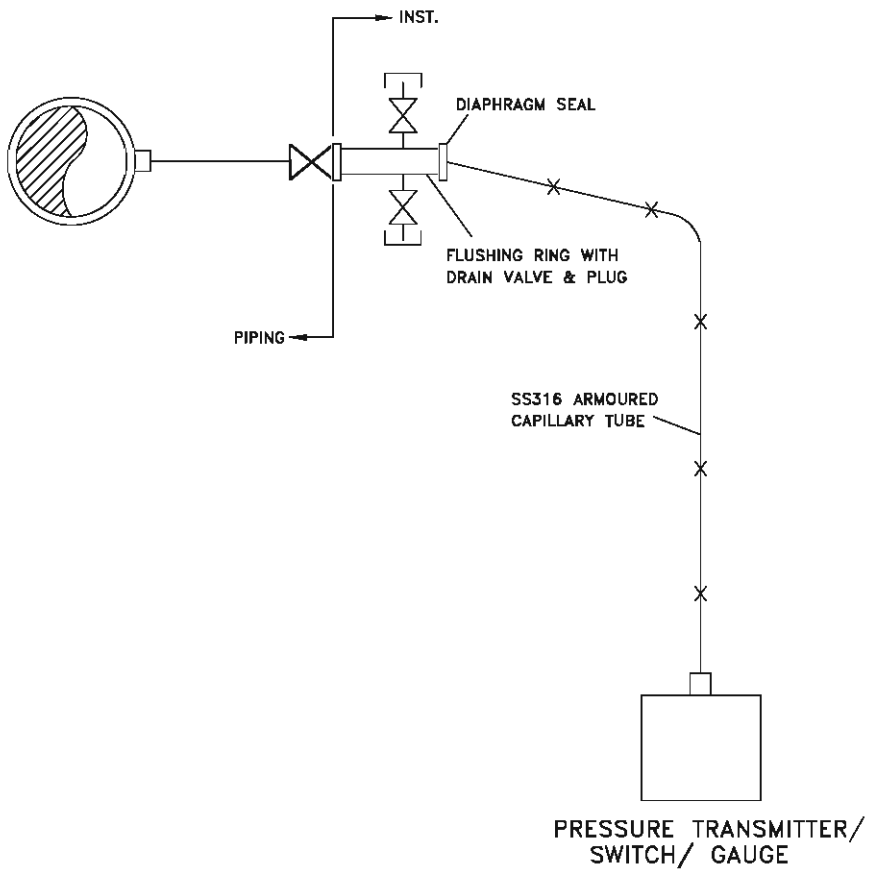
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REV 0

SHEET 4 OF 37

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PLOT DATE: 15-Nov-20 11:58 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH/PRESSURE GAUGE
LDO & OTHER SERVICES (WITH REMOTE DIAPHRAGM SEAL)



FOR TENDER PURPOSE ONLY

					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED												

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
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APPROVED	AT	DATE	08.04.2019

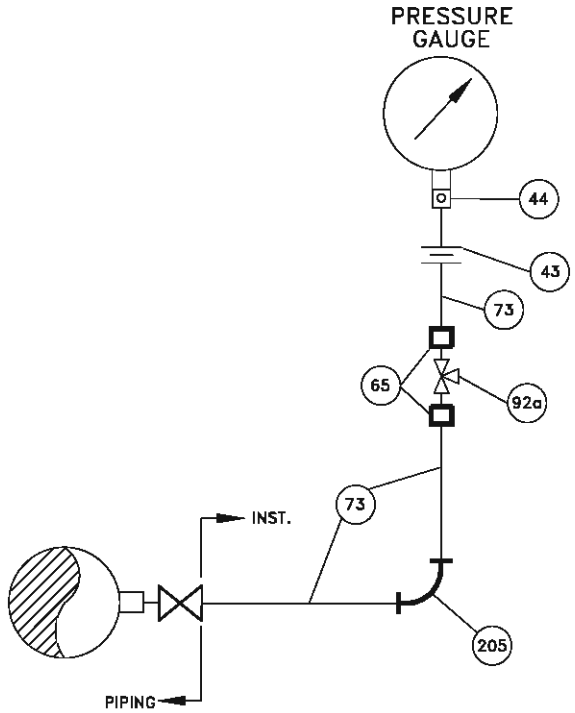
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DWG. NO. 18A03-DWG-I-0060

SHEET 10 OF 37

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PLOT DATE: 16-Nov-20 12:01 AM

PRESSURE GAUGE
WATER SERVICE [<40 Kg/cm2 & <280 Deg.C]



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
44	1	SNUBBER, 1/2" NPT (M) X 1/2" NPT (F) (AT PUMP DISCHARGE)
65	2	ADAPTOR, 1/2" SW X 1/2" NPT (M)
73	15Mtrs	IMPULSE PIPE 15 NB
92a	1	3 WAY GAUGE VALVE, 1/2" NPT (F)
205	1	90° ELBOW 1/2" SW

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED						

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

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FOR APPROVAL		
FOR CONSTRUCTION		

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CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
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OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA·MUMBAI·CHENNAI·NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	08.04.2019

DWG. NO. 18A03-DWG-I-0060

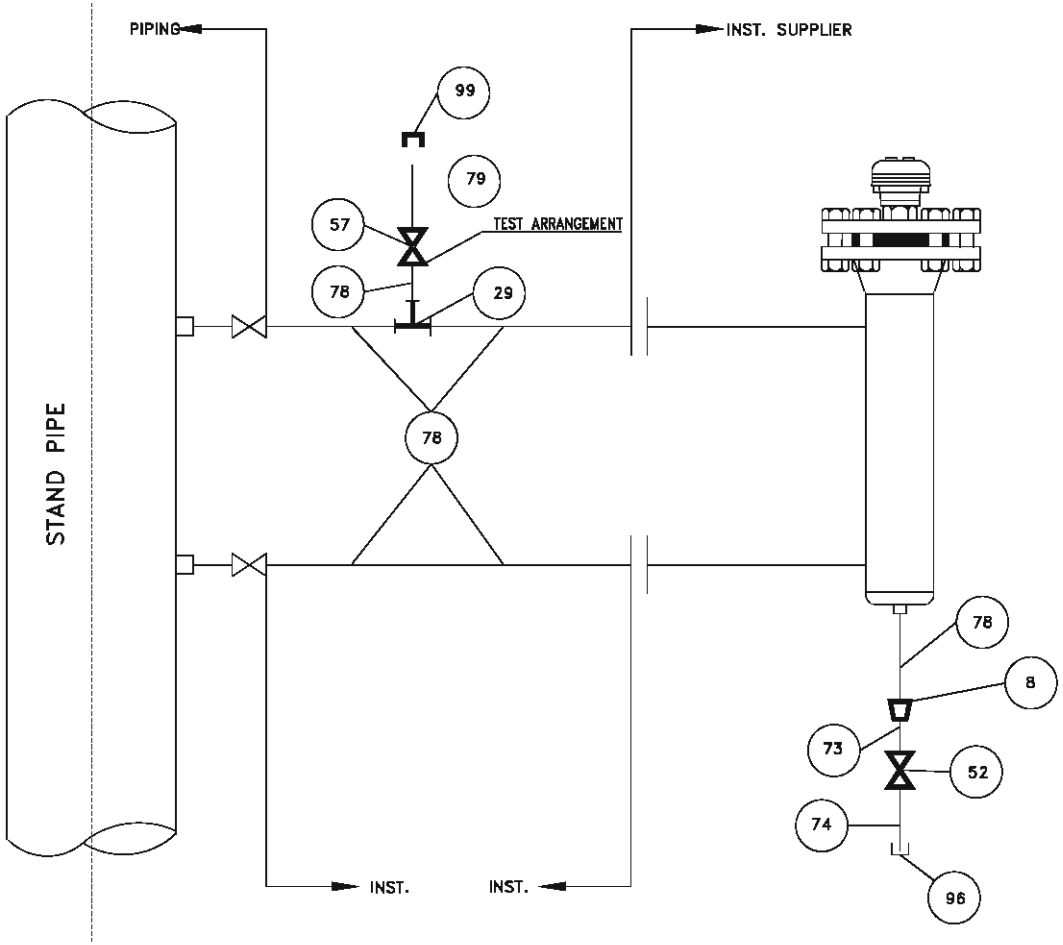
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SHEET 24 OF 37

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PLOT DATE: 16-Nov-20 12:09 AM

DWG. NO. 18A03-DWG-I-0060 REV 0

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
8	1	REDUCER, 1" SW X 1/2" SW
29	1	EQUAL TEE, 1" SW
52	1	GLOBE VALVE, 1/2" SW
57	1	GLOBE VALVE, 1" SW
73	1 M	IMPULSE PIPE, 15 NB
74	1	NIPPLE, 1/2" SW X 1/2" NPT (F)
78	3 M	IMPULSE PIPE, 1" NB
79	1	NIPPLE, 1" SW X 1" NPT (F)
96	1	DRAIN PLUG, 1/2" NPT (M)
99	1	PLUG, 1" NPT (M)

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD
REVIEWED					SB		AT

NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED	DATE	SIGNATURE
PROCESS		
MECHANICAL		
CIVIL & STRUCTURAL		
ARCHITECTURAL		
INSTRUMENTATION		
ELECTRICAL		
OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	08.04.2019

DWG. NO. 18A03-DWG-I-0060

REV 0

SHEET 32 OF 37

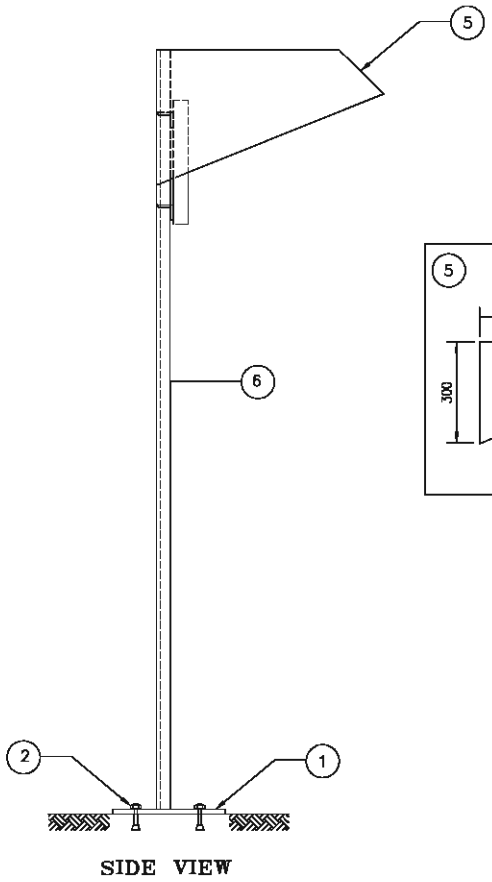
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PLOT DATE: 16-Nov-20 12:14 AM

INSTRUMENT INSTALLATION DRAWING FIELD MOUNTED ELECTRONIC UNIT

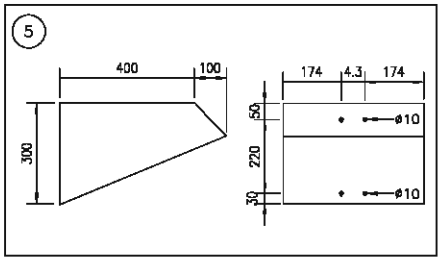
PART LIST	NAME	MATERIAL	SIZE	QTY
1	BASE PLATE	SS400(HDG)	250X250 X6T	1
2	ANCHOR BOLT/NUT	SS304	M16 X 150L	4
5	SUNSHADE	FRP	6T	1
6	CHANNEL	SS-2062	ISMC -100	1
7	ANGLE	MS	ISA 50X 50X6mm	2

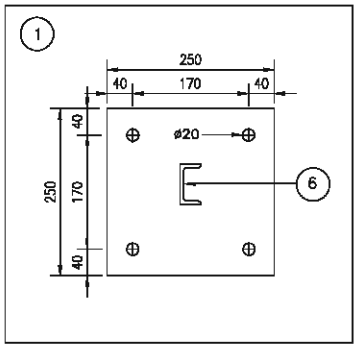
NOTE:–

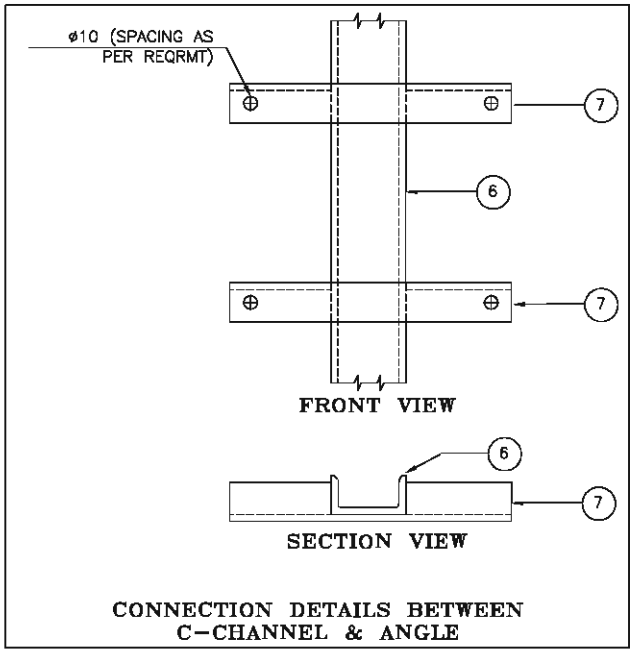
1. **CHANNEL, ANGLE, BASE PLATE DIMENSION & QUANTITY MAY VARY AS PER SITE REQUIREMENTS.**
2. **MS BOLT, NUT & WASHER AS REQUIRED TO MOUNT SUNSHADE AND TRANSMITTER/ ELECTRONIC UNIT SHALL BE PROVIDED.**



SIDE VIEW







CONNECTION DETAILS BETWEEN C–CHANNEL & ANGLE

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL INSTRUMENT INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	08.04.2019

REV 0

DWG. NO. 18A03–DWG–I–0060

SHEET 34 OF 37

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0060_R0_SHT34(ELEC).dwg
PLOT DATE: 16-Nov-20 12:15 AM

NOTES: –

1. THE MATERIAL OF THE STUB SHALL BE SIMILAR TO THAT OF THE PIPING MATERIAL OF THE SPECIFICATION.
2. LENGTH OF THE STUB (L) SHALL BE 65/45 mm DEPENDING UPON PIPE SIZE (FOR PIPE OD 88.9 mm TO 219 mm STUB HEIGHT SHALL BE=65 mm & FOR PIPE OD > 219 mm STUB HEIGHT SHALL BE=45 mm).
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3 mm & ABOVE. (REFER SHEET 2 OF 5).
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9 mm TO 159 mm. (REFER SHEET 3 OF 5).
5. FOR MAIN PIPE OD'S BELOW 88.9 mm EXPANDER OF SIZE 88.9 mm OD AND 300 mm STRAIGHT LENGTH (APPROX) SHALL BE USED.
6. THE SELECTION OF THERMOWELL MATERIAL SHALL BE GOVERNED BY THE MATERIAL GUIDE INDICATED IN VOLUME–IIE/ SECTION–VII OF THE TECHNICAL SPECIFICATION.
7. INTERNAL BORE OF THE THERMOWELL SHALL BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME PTC 19.3.
8. THERMOWELL SHALL GENERALLY BE DRILLED BAR STOCK TYPE. FABRICATED THERMOWELL AS PER MANUFACTURER'S RECOMMENDATION BASED ON LENGTH LIMITATION SHALL BE FOLLOWED.
9. PROCESS CONNECTION SHALL GENERALLY BE THREADED (M33 X 2). IF THERE IS A NEED FOR MORE FREQUENT WELL REPLACEMENT FOR HIGH CORROSIVE RATES, LARGER DIAMETER PIPE AND HIGH PRESSURE APPLICATIONS, FLANGED CONNECTION AS PER MANUFACTURER'S STANDARD PRACTICE MAY BE PROVIDED. WELDED CONNECTION MAY ALSO BE ENVISAGED WHEN PROCESS IS NOT CORROSIVE AND ROUTINE REMOVAL IS NOT REQUIRED OR THERE IS HIGH INTEGRITY REQUIREMENTS FOR HIGH TEMPERATURE AND PRESSURE APPLICATIONS.
10. THE "U" AND "L" DIMENSIONS (REFER SHEET 4 & 5 OF 5) SHALL BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAIL ENGINEERING.
11. THERMOWELLS WITH THE INSULATION LAC EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
13. ALL WELD SHALL BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
14. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THE THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESSURE AND TEMPERATURE AS PER ASME PTC– 19.3.

FOR TENDER PURPOSE ONLY

REVIEWED													
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		
REVIEWED: PROCESS		
REVIEWED: MECHANICAL		
REVIEWED: CIVIL & STRUCTURAL		
REVIEWED: ARCHITECTURAL		
REVIEWED: INSTRUMENTATION		
REVIEWED: ELECTRICAL		
REVIEWED: OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW PHASE–I)

TITLE: THERMOWELL INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	30.04.2019

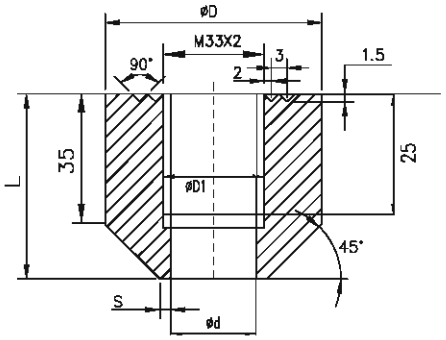
DWG. NO. 18A03–DWG–I–0061

REV 0

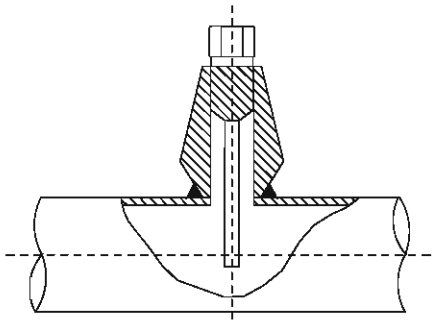
SHEET 1 OF 5

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0061_R0_SHT1.dwg
PLOT DATE: 16-Nov-20 12:25 AM
A3 [420x297]

TEMPERATURE STUB FOR STRAIGHT IMMERSION

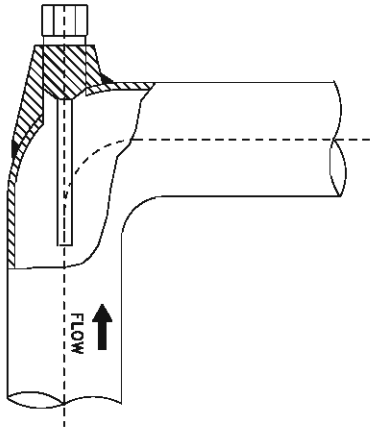


MAIN PIPE SIZES	d	D	D1	S	L
FOR PIPE OD BELOW 219 MM	29	55	33.5	1.5	65
FOR PIPE OD 219 MM & ABOVE	29	55	33.5	1.5	45



INSTALLATION TYPE–1

FOR MAIN PIPE OD 168.3 mm & ABOVE



INSTALLATION TYPE–2

FOR MAIN PIPE OD 88.9 & BELOW

FOR TENDER PURPOSE ONLY

					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED												

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		
REVIEWED: PROCESS		
REVIEWED: MECHANICAL		
REVIEWED: CIVIL & STRUCTURAL		
REVIEWED: ARCHITECTURAL		
REVIEWED: INSTRUMENTATION		
REVIEWED: ELECTRICAL		
REVIEWED: OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW PHASE-I)

TITLE: THERMOWELL INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	30.04.2019

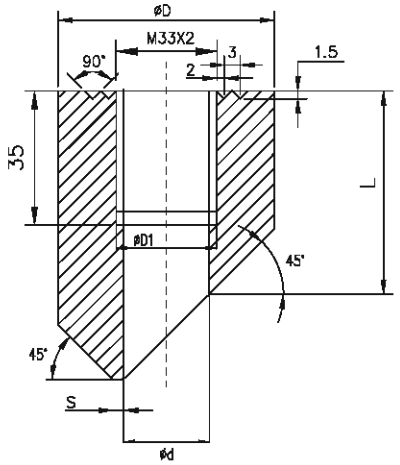
DWG. NO. 18A03-DWG-I-0061

REV 0

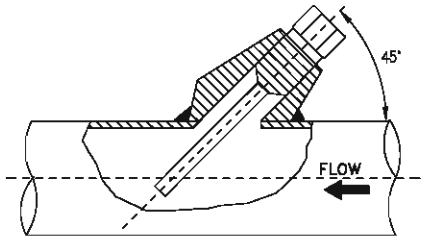
SHEET 2 OF 5

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0061_R0_SHT2.dwg
PLOT DATE: 16-Nov-20 12:25 AM

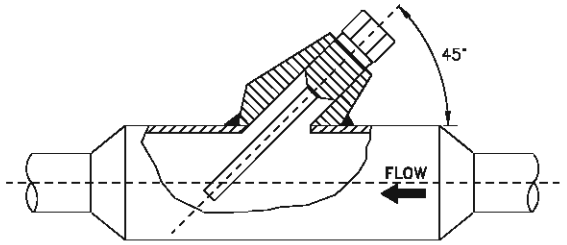
TEMPERATURE STUB FOR SLANT IMMERSION



MAIN PIPE SIZES	d	D	D1	S	L
FOR PIPE OD BELOW 219 MM	29	55	33.5	1.5	65
FOR PIPE OD 219 MM & ABOVE	29	55	33.5	1.5	45



INSTALLATION TYPE–1
FOR MAIN PIPE OD 88.9 mm TO 159 mm



INSTALLATION TYPE–2
FOR MAIN PIPE OD 88.9 mm & BELOW

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW PHASE–I)

TITLE: THERMOWELL INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	30.04.2019

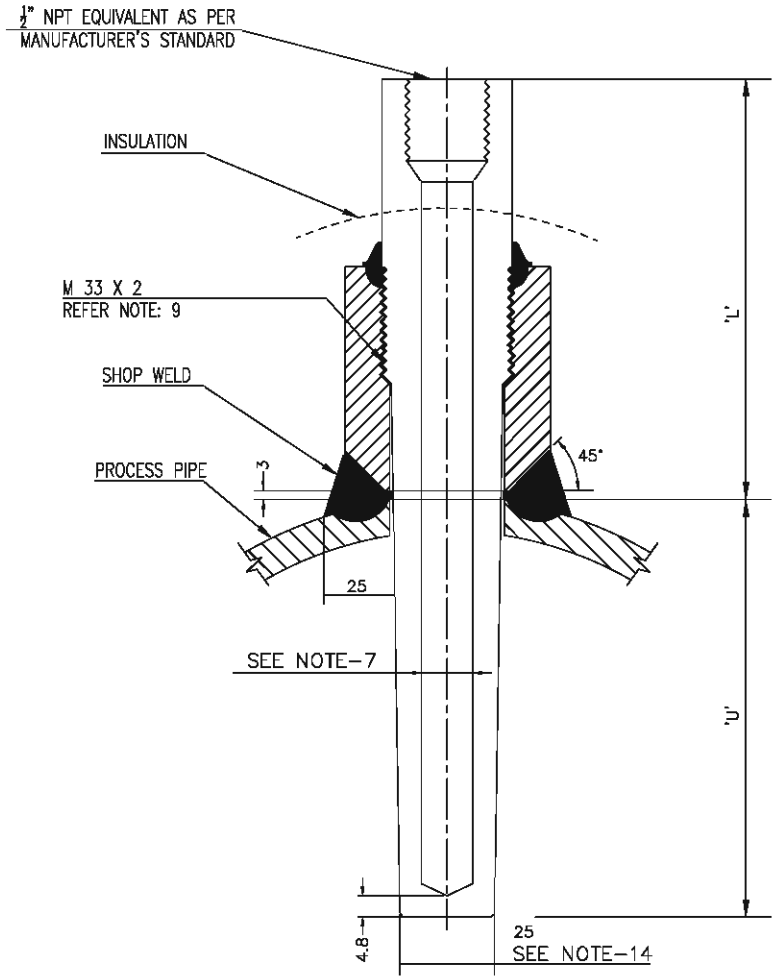
DWG. NO. 18A03–DWG–I–0061

REV 0

3 SHEET OF 5

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PLOT DATE: 16-Nov-20 12:31 AM
A3 [420x297]

TEMPERATURE CONNECTION DETAILS FOR PROCESS PRESSURE >/ = 40 Kg/ cm2



FOR TENDER PURPOSE ONLY

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW PHASE-I)

TITLE: THERMOWELL INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA·MUMBAI·CHENNAI·NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0061

REV 0

4 SHEET OF 5

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED

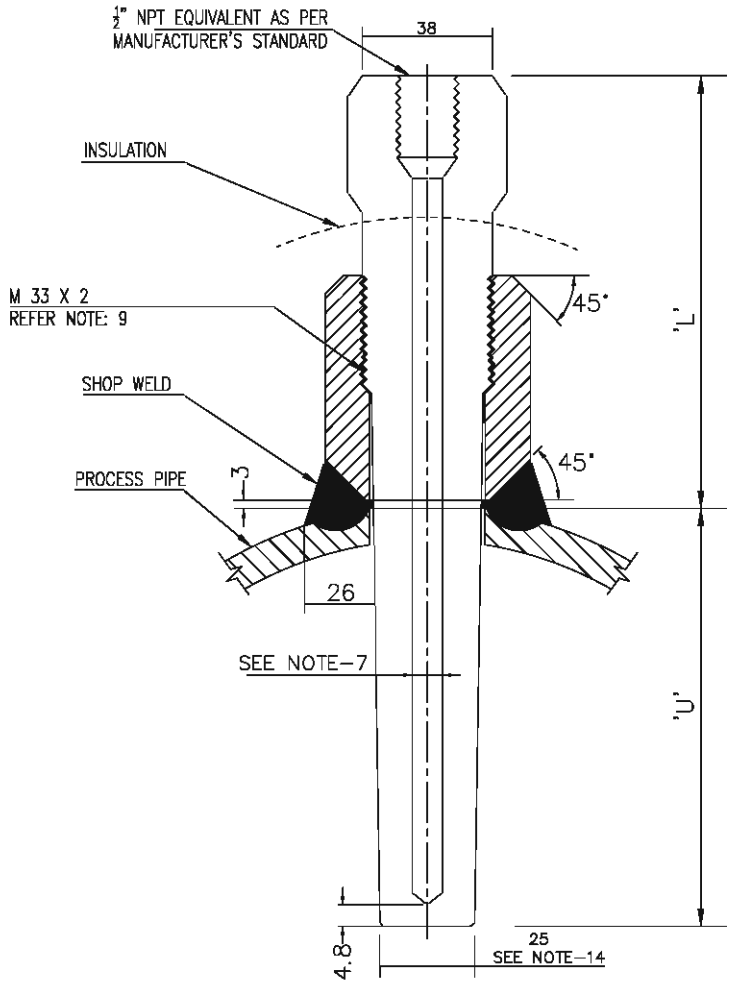
PROCESS		
MECHANICAL		
CIVIL & STRUCTURAL		
ARCHITECTURAL		
INSTRUMENTATION		
ELECTRICAL		
OTHERS		

REVIEWED							APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0061_R0_SHT4.dwg
PLOT DATE: 16-Nov-20 12:32 AM

A3 [420x297]

TEMPERATURE CONNECTION DETAILS FOR PROCESS PRESSURE < 40 Kg/ cm2



FOR TENDER PURPOSE ONLY

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED								
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION
					SB		AT	ISSUED WITH TENDER

REV	DATE	PREPD	CHKD
0	13.11.2020	SK	SB

REVIEWED	
PROCESS	
MECHANICAL	
CIVIL & STRUCTURAL	
ARCHITECTURAL	
INSTRUMENTATION	
ELECTRICAL	
OTHERS	

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW PHASE-I)

TITLE: THERMOWELL INSTALLATION DRAWING

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0061

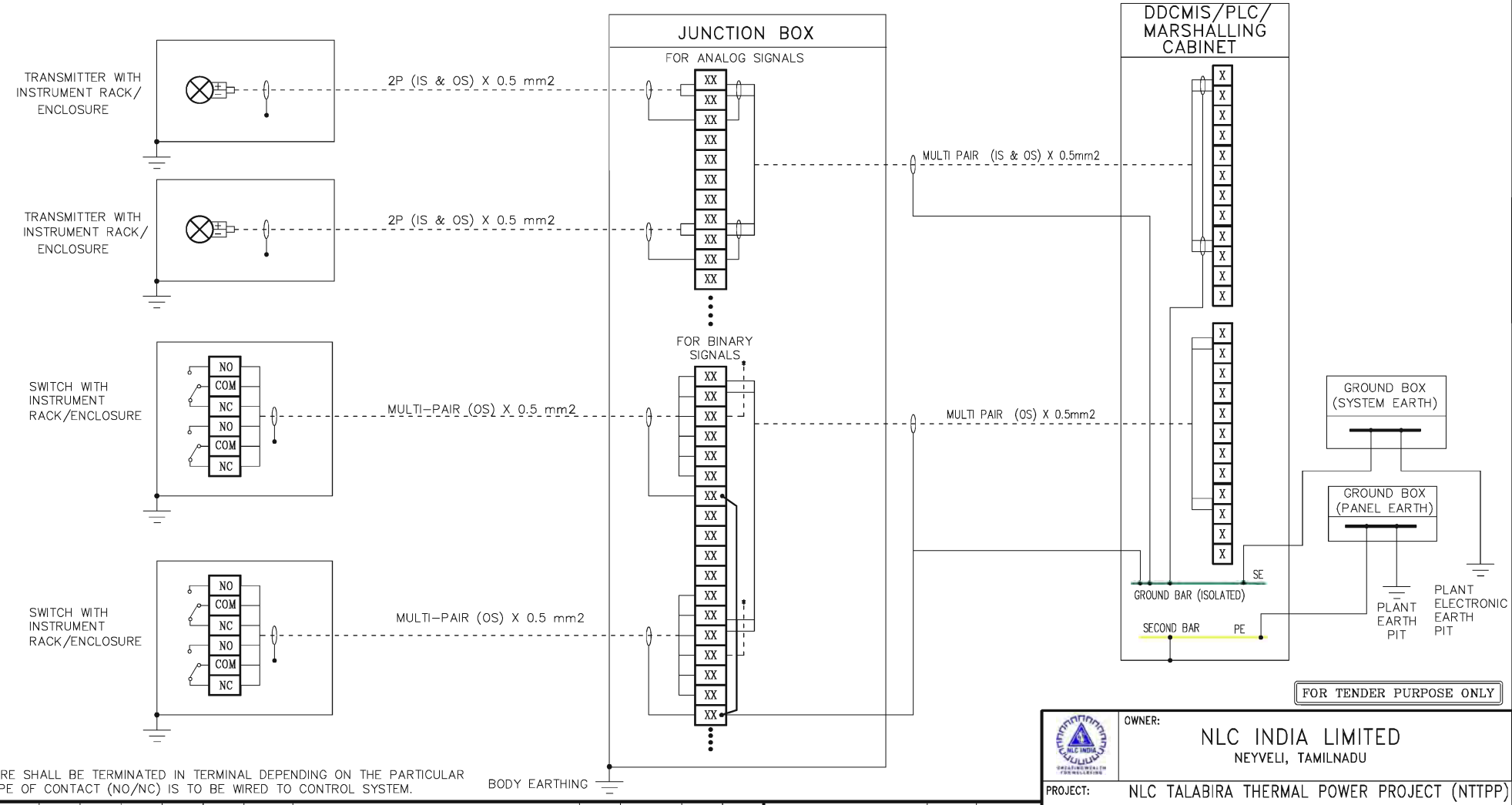
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SHEET 5 OF 5

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0061_R0_SHT5.dwg
PLOT DATE: 16-Nov-20 12:32 AM

FIELD

CENTRAL ELECTRONIC ROOM



* CORE SHALL BE TERMINATED IN TERMINAL DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO/NC) IS TO BE WIRED TO CONTROL SYSTEM.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED												
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
	PROCESS		
	MECHANICAL		
	CIVIL & STRUCTURAL		
	ARCHITECTURAL		
	INSTRUMENTATION		
	ELECTRICAL		
	OTHERS		

OWNER:
NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0090

REV 0

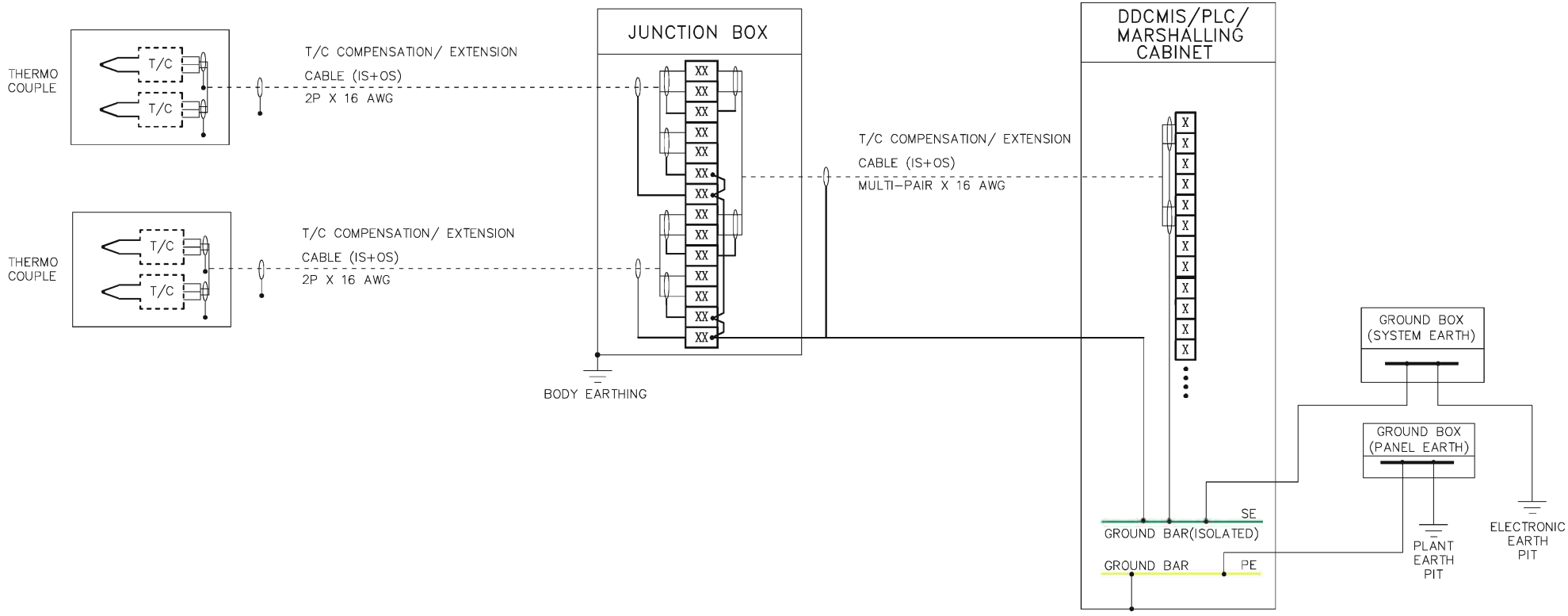
SHEET 1 OF 7

FILE LOCATION:
PLOT DATE:

A3 [420x297]

DWG. NO. 18A03-DWG-I-0090 REV 0

FIELD | CENTRAL ELECTRONIC ROOM



FOR TENDER PURPOSE ONLY

					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED												

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
	PROCESS		
	MECHANICAL		
	CIVIL & STRUCTURAL		
	ARCHITECTURAL		
	INSTRUMENTATION		
	ELECTRICAL		
	OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0090

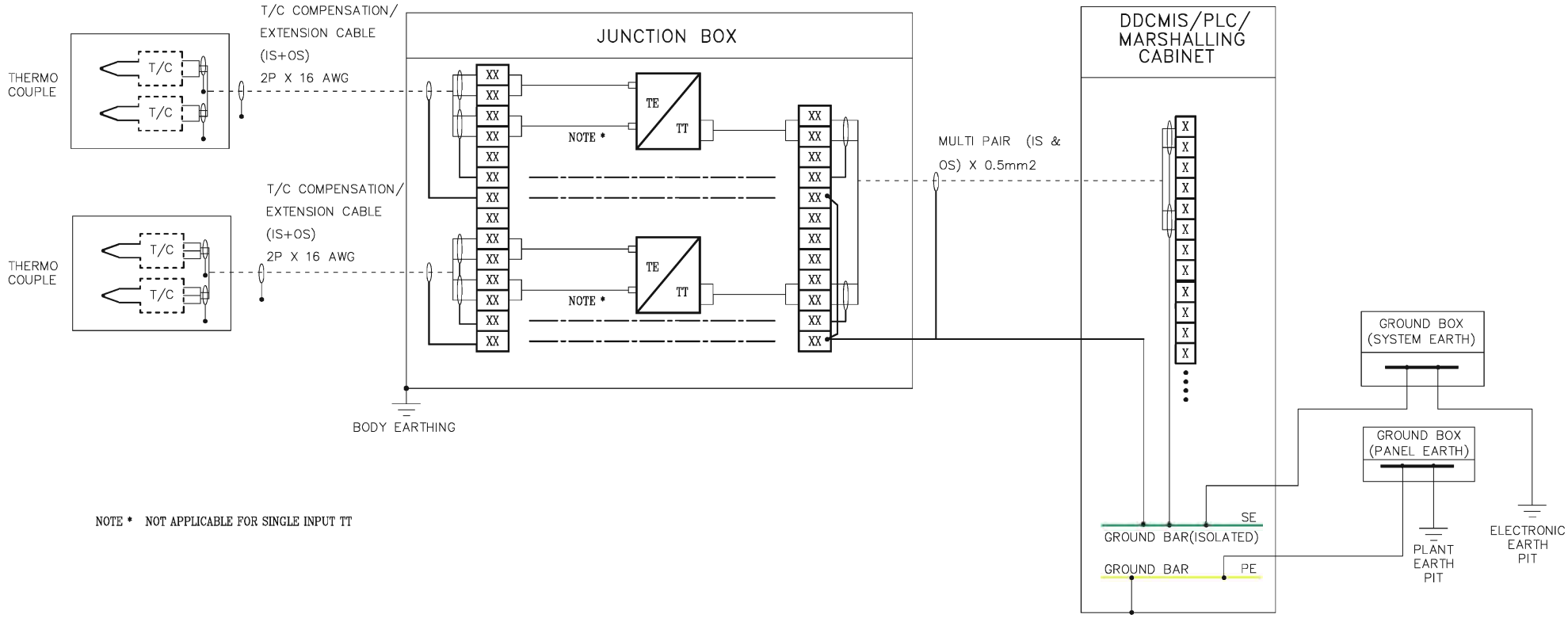
REV 0

SHEET 2 OF 7

FILE LOCATION:
PLOT DATE:

A3 [420x297]

FIELD | CENTRAL ELECTRONIC ROOM



NOTE * NOT APPLICABLE FOR SINGLE INPUT TT

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER:
NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0090

REV 0

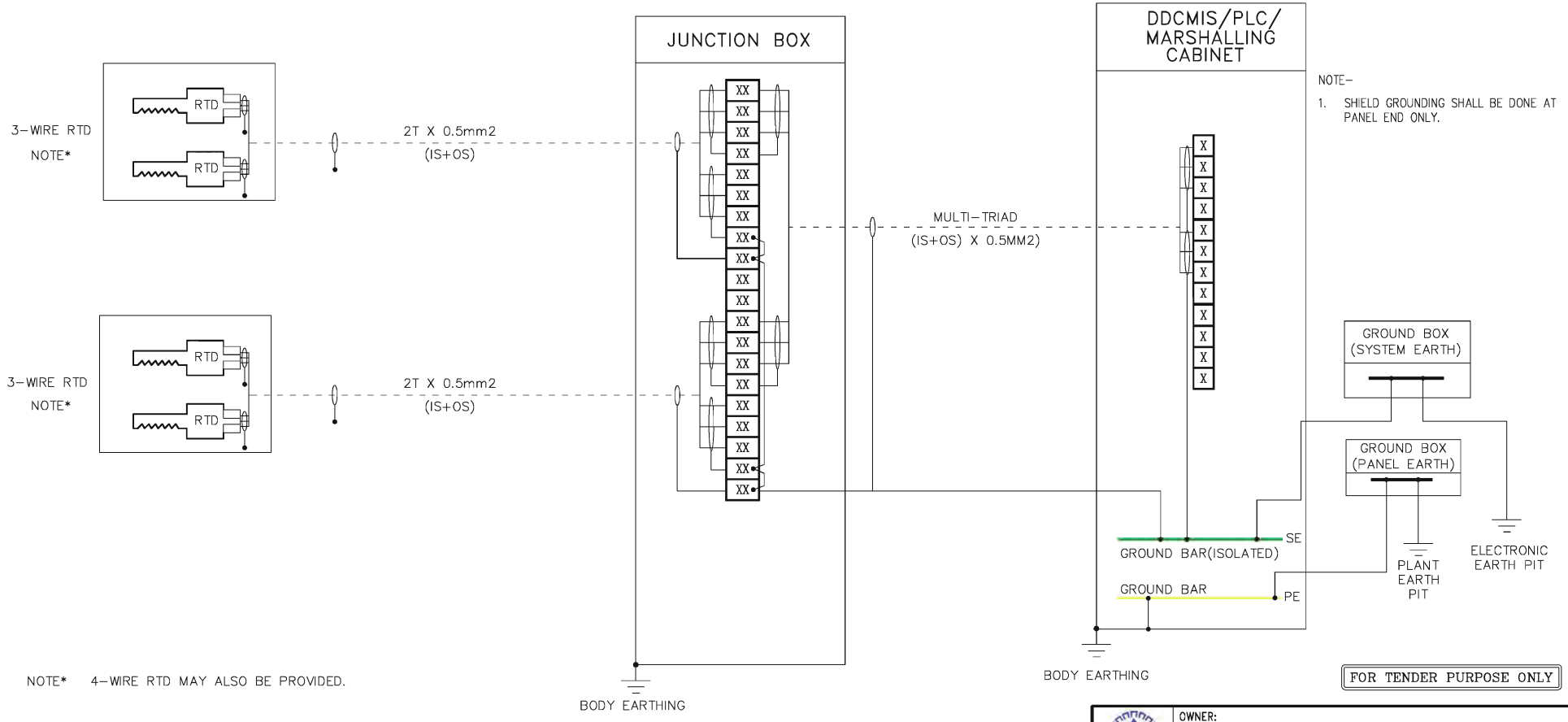
SHEET 3 OF 7

FILE LOCATION:
PLOT DATE:

A3 [420x297]

FIELD

CENTRAL ELECTRONIC ROOM



PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER:
NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2020

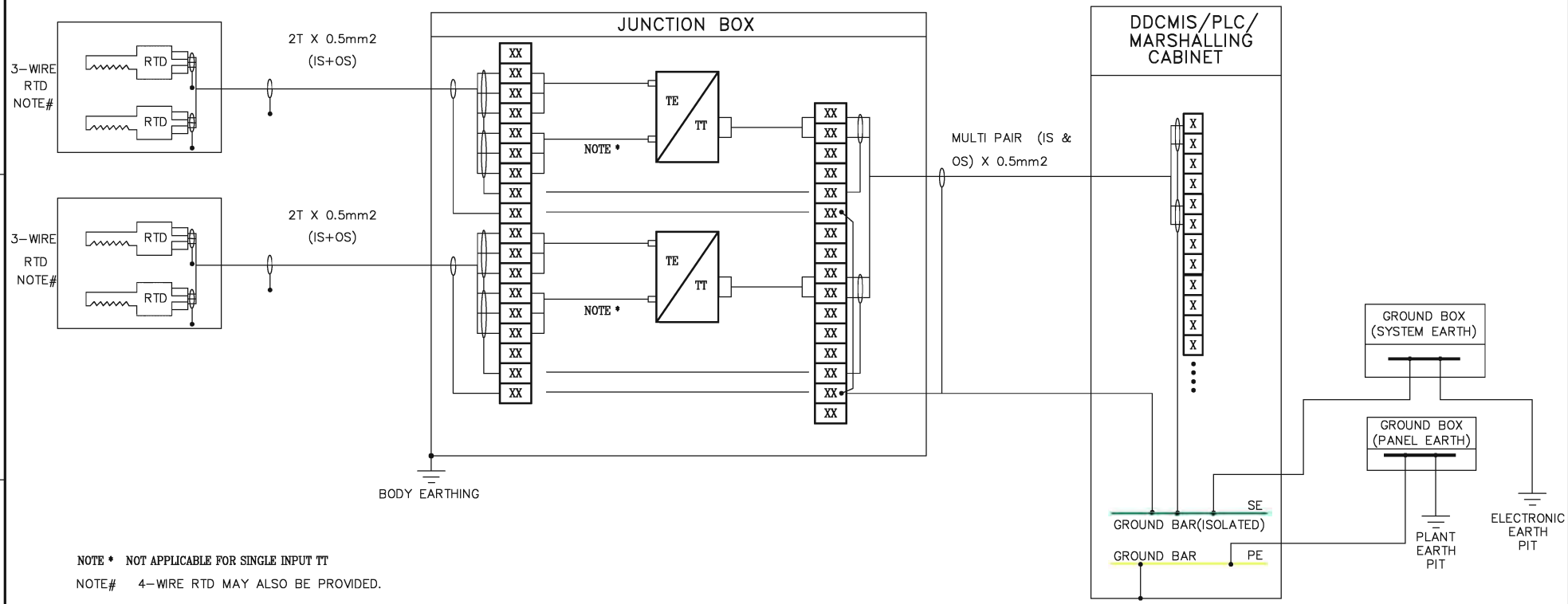
DWG. NO. 18A03-DWG-I-0090

REV 0

SHEET 4 OF 7

FILE LOCATION:
PLOT DATE:

A3 [420x297]



NOTE * NOT APPLICABLE FOR SINGLE INPUT TT

NOTE# 4-WIRE RTD MAY ALSO BE PROVIDED.

FOR TENDER PURPOSE ONLY

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2019

DWG. NO. 18A03-DWG-I-0090

REV 0

SHEET 5 OF 7

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

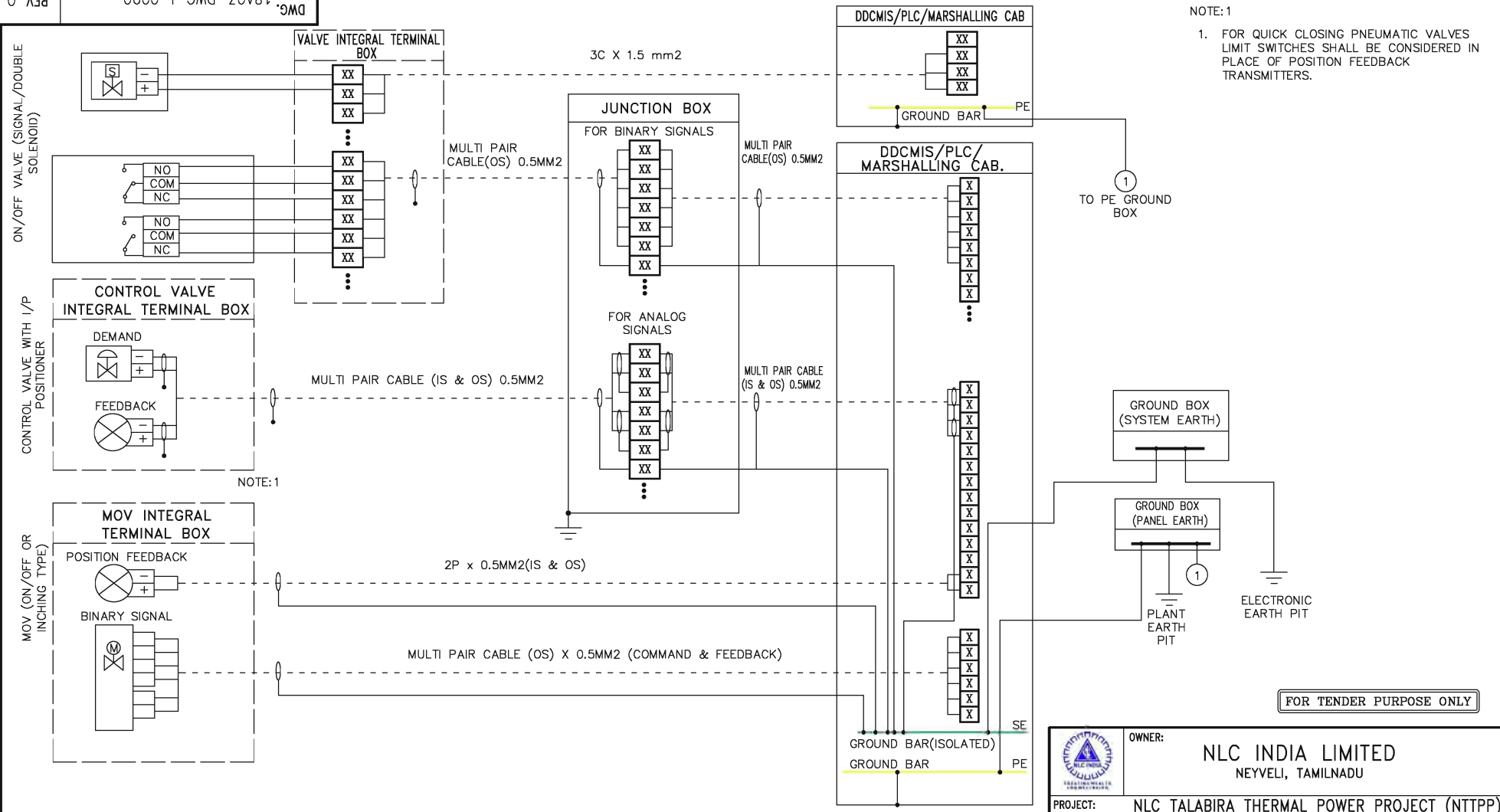
REVIEWED: PROCESS, MECHANICAL, CIVIL & STRUCTURAL, ARCHITECTURAL, INSTRUMENTATION, ELECTRICAL, OTHERS

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

REVIEWED

FILE LOCATION:
PLOT DATE:

A3 [420x297]



NOTE: 1

1. FOR QUICK CLOSING PNEUMATIC VALVES LIMIT SWITCHES SHALL BE CONSIDERED IN PLACE OF POSITION FEEDBACK TRANSMITTERS.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED	
PROCESS	
MECHANICAL	
CIVIL & STRUCTURAL	
ARCHITECTURAL	
INSTRUMENTATION	
ELECTRICAL	
OTHERS	

OWNER:
NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL SIGNAL WIRING DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	30.04.2020

DWG. NO. 18A03-DWG-I-0090

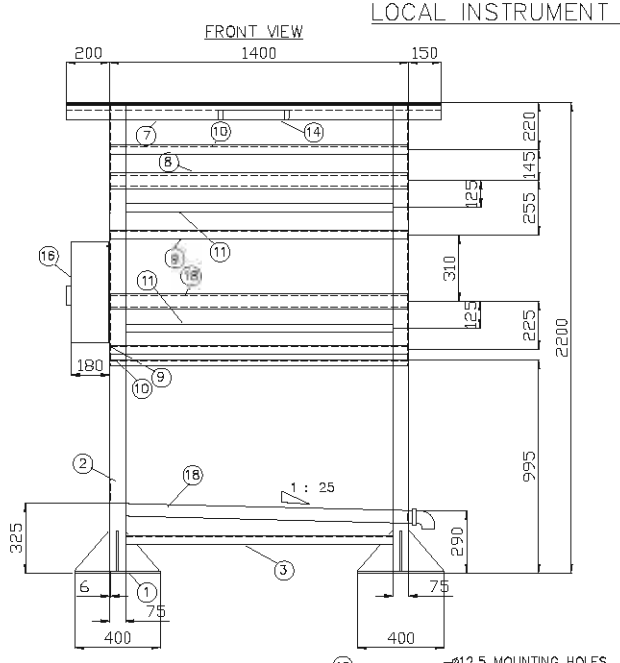
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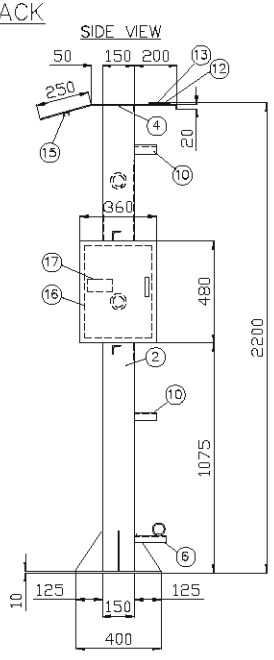
SHEET 6 OF 7

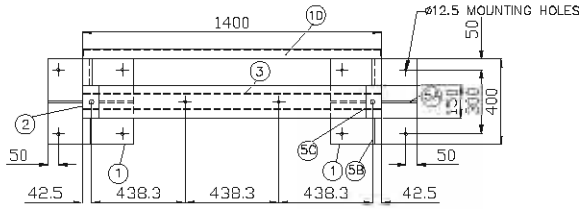
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PLOT DATE:

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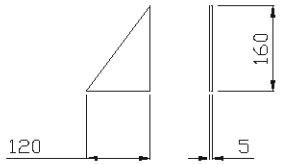
LOCAL INSTRUMENT RACK



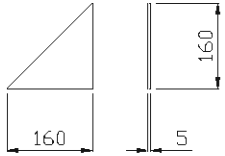




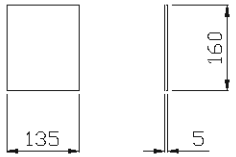
TOP VIEW (WITHOUT CANOPY)



DETAIL 5B
(SCALE-1:10)



DETAIL 5A
(SCALE-1:10)



DETAIL 5C
(SCALE-1:10)

BILL OF MATERIAL

ITEM NO.	DESCRIPTION
1	MS PLATE, 400 X 400 X 10 MM
2	ISMC 150 X 75 X 6 MM
3	ISMC 75 X 40 X 5 MM
4	CANOPY ASSEMBLY, 3 MM CRCA SHEET
5A	RIB MS PLATE 160 X 160 X 5 MM THICK
5B	RIB MS PLATE 120 X 160 X 5 MM THICK
5C	RIB MS PLATE 135 X 160 X 5 MM THICK
6	BRACKET FOR DRAIN PIPE
7	CANOPY MOUNTING PLATE 5 MM THICK
8	2" NB GALVANIZED PIPE FOR TRANSMITTER/ SWITCH MOUNTING
9	MS ANGLE, 40 X 40 X 5 MM
10	BRACKET FOR IMPULSE PIPE SUPPORT
11	PVC CABLE TRAY/FLEXIBLE CONDUIT WITH SUPPORT
12	BULK HEAD MS PLATE 5 MM THICK
13	XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY MOUNTING PLATE
14	CFL/ LED WITH FIXTURE FOR RACK ILLUMINATION
15	C CHANNEL FOR LIGHT FITTING
16	FRP JUNCTION BOX SIZE: 480 (H) X 360 (W) X 180 (D) WITH POWER SOCKETS & TBs
17	TAG PLATE
18	DRAIN PIPE (DETAIL REFER SHEET 4 OF 5)

NOTES:

1..COLOUR: RAL 7032. OVERALL THICKNESS > 100 MICRONS.
2..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
3..20% TERMINALS SHALL BE PROVIDED AS SPARE.
4..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALISED AT DETAILING.
5..PURGING TAPPING SHALL BE PROVIDED IN EACH LIE/LIR.
6..EARTH BOLT TO BE PROVIDED IN EACH LIE/LIR.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	AT APPVD
REVIEWED					SB		

REV	NATURE OF REVISION & DESCRIPTION	DATE	PREPD	CHKD
0	ISSUED WITH TENDER	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
	PROCESS		
	MECHANICAL		
	CIVIL & STRUCTURAL		
	ARCHITECTURAL		
	INSTRUMENTATION		
	ELECTRICAL		
	OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	1:25
APPROVED	AT	DATE	21.08.2020

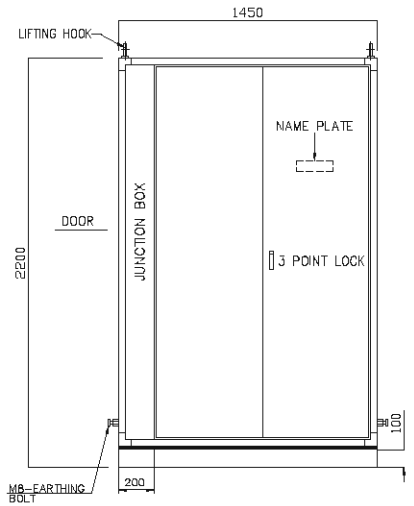
REV 0

DWG. NO. 18A03-DWG-I-0200

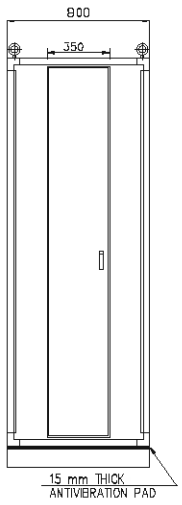
SHEET 1 OF 7

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0200_SHT1_LIR_R0.dwg
PLOT DATE: 16-Nov-20 12:54 AM

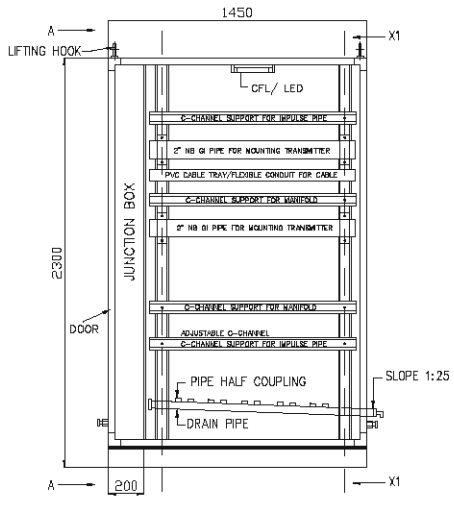
LOCAL INSTRUMENT ENCLOSURE



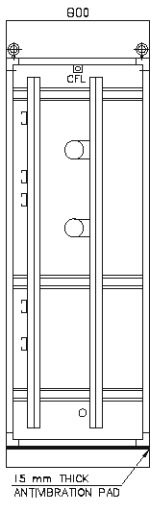
FRONT VIEW



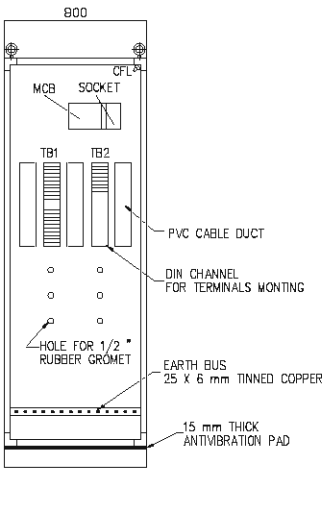
LH SIDE VIEW



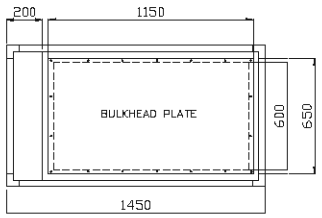
FRONT INNER VIEW



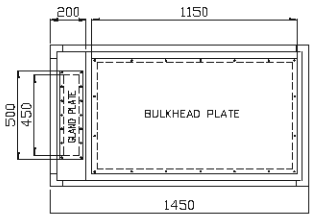
SIDE VIEW FROM X1-X1



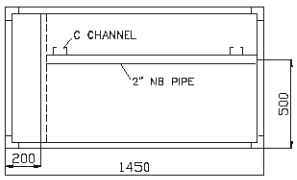
SIDE VIEW FROM A-A



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

FOR TENDER PURPOSE ONLY

					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
REVIEWED												

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		
REVIEWED: PROCESS		
REVIEWED: MECHANICAL		
REVIEWED: CIVIL & STRUCTURAL		
REVIEWED: ARCHITECTURAL		
REVIEWED: INSTRUMENTATION		
REVIEWED: ELECTRICAL		
REVIEWED: OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	1:30
APPROVED	AT	DATE	21.08.2020

REV 0

DWG. NO. 18A03-DWG-I-0200

SHEET 2 OF 7

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0200_SHT2_LIE_RO.dwg
PLOT DATE: 16-Nov-20 12:55 AM

LOCAL INSTRUMENT ENCLOSURE

NOTES:

1. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAIL ENGINEERING.
2. ALL SHEETS SHALL BE 3 mm THICK CRGA SHEET.
3. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
4. COLOUR :–
   EXTERIOR : RAL 7032 (SIEMENS GRAY)
   INTERIOR : BRILLIANT WHITE(FIRE RESISTANT)
   OVER ALL THICKNESS WILL BE > 1DO MICRONS
5. BASE FRAME WILL BE MAOE OUT OF ISMC 1DD AND COLOUR WILL BE BLACK PAINT FINISH.
6. BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 115D X 650 X 6 MM.
7. CABLE GLAND PLATE OF THICKNESS 3 mm CRCA SHEET SHALL BE PROVIDEO AT BOTTOM OF JUNCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL BE IP–65.
9. TERMINALS INSIDE JUNCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
10. DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIOE DOOR HINGES SHALL BE OF STAINLESS STEEL.
11. XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
12. EARTH BUSBAR 25 X 6 mm TINNED COPPER.
13. DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
14. COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.
15. FOUNDATION BOLTS SHALL BE PROVIDED.
16. TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
17. INSTRUMENT TAG VIS–A–VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION BOX DOOR.
18. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
19. NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.
20. PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.
21. FOR ILLUMINATION CFL/ LED LAMP IN LIE AND IN JB SHALL BE PROVIDED.
22. UNLESS DTHERWISE SPECIFIED ALL DIMENSIONS ARE IN MM.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	REV	NATURE OF REVISION & DESCRIPTION	DATE	PREPD	CHKD
AT	0	ISSUED WITH TENDER	13.11.2020	SK	SB

REVIEWED	RELEASE STATUS	DATE	SIGNATURE
	PRELIMINARY		
	TENDER PURPDSE ONLY		
	FOR APPROVAL		
	FOR CONSTRUCTION		
	PROCESS		
	MECHANICAL		
	CIVIL & STRUCTURAL		
	ARCHITECTURAL		
	INSTRUMENTATION		
	ELECTRICAL		
	OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	21.08.2020

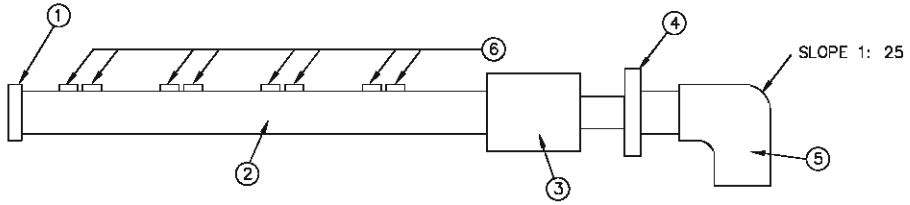
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DWG. NO. 18A03-DWG-I-0200

SHEET 3 OF 7

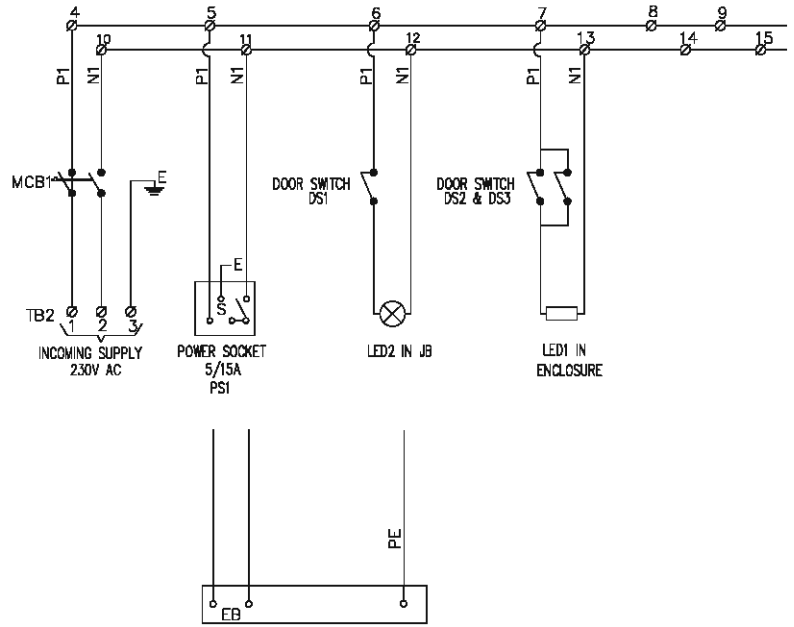
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PLOT DATE: 16-Nov-20 12:56 AM
A3 [420x297]

DRAIN HEADER DETAILS WITH LOCAL INSTRUMENT RACK / ENCLOSURE



BILL OF MATERIAL		
SL.NO.	DESCRIPTION	QTY
1	2" S.W. CAP, CS	1
2	2" NB, ASTM A-106, SCH 80/Gr. C	1
3	2" SW X 1" NPT(F) COUPLING CS	1
4	1" NPT(M) X 1" BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE:1/2" NB SW	AS REQD

POWER WIRING CIRCUIT



NOTES :

1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL– BLACK, EARTH–GREEN

2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 2.5 Sq.mm OR HIGHER AS PER LOAD.

3.. WIRE SHALL BE MULTI–STRANDED ANNEALED FLEXIBLE HIGH PURITY COPPER CONDUCTOR WITH HEAT RESISTANT FRLS PVC INSULATION AND SHALL PASS VERTICAL FLAME TEST PER IPCEAS–1981.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	21.08.2020

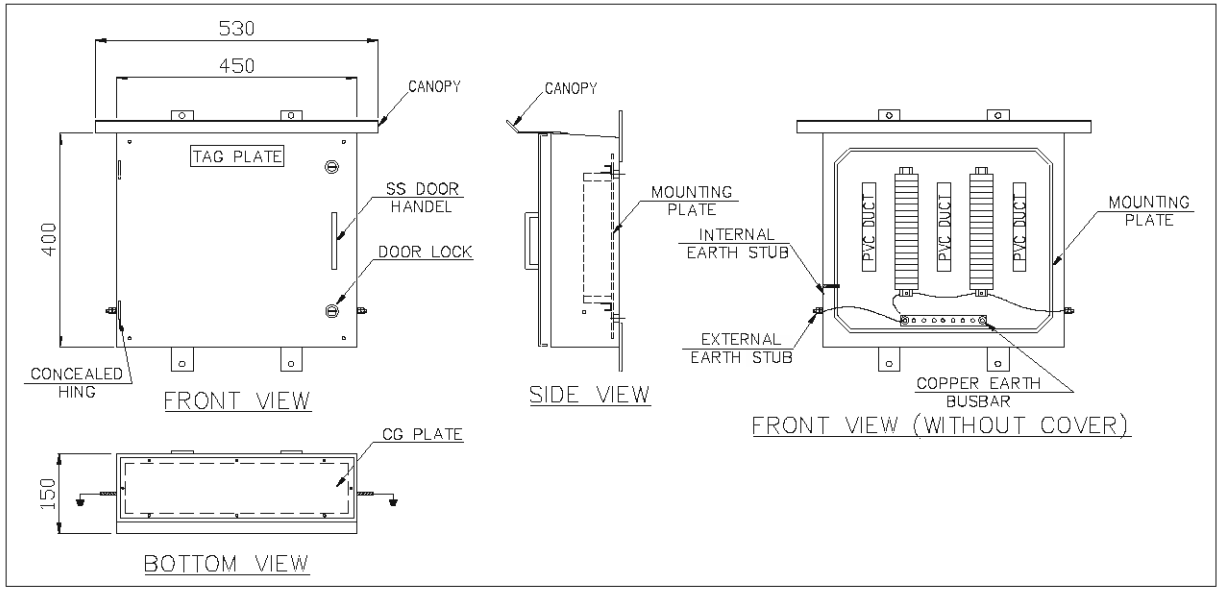
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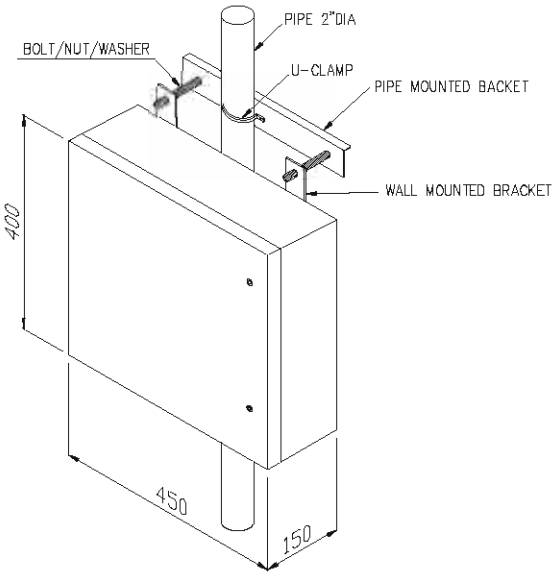
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SHEET 4 OF 7

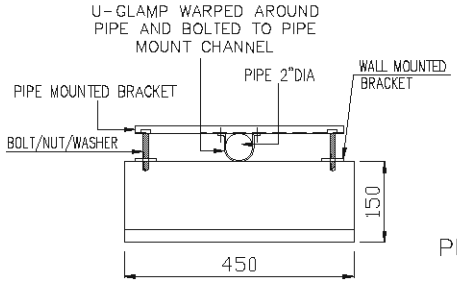
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PLOT DATE: 16-Nov-20 12:56 AM

FIELD JUNCTION BOX

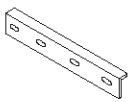




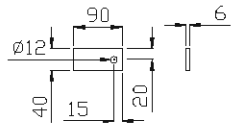
ISOMETRIC VIEW
(SCALE-1:10)



TOP VIEW
(SCALE-1:10)



PIPE/COLUMN/STRUCTURE MOUNTING BRACKET
QTY-02 NOS
(SS/316-1.5MM)
(SCALE-1:10)



WALL MOUNTED BRACKET WELDED TYPE MS-6mm
QTY-01 NOS
(SCALE-1:10)

TYPICAL PIPE MOUNTED ARRANGEMENT FOR JUNCTION BOX

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD
REVIEWED					SB		AT

NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR GONSTRUCTION		

REVIEWED		DATE	SIGNATURE
	PROCESS		
	MECHANICAL		
	CIVIL & STRUCTURAL		
	ARCHITECTURAL		
	INSTRUMENTATION		
	ELECTRICAL		
	OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP)
(3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	1:10
APPROVED	AT	DATE	21.08.2020

REV 0

DWG. NO. 18A03-DWG-I-0200

SHEET 5 OF 7

FILE LOCATION: E:\DCPL\Sanghamitra Basu\18A03_NLC TALABIRA\rev-0\18A03-DWG-I-0200_SHT5_JB_R0.dwg
PLOT DATE: 16-Nov-20 12:57 AM

FIELD JUNCTION BOX

NOTES: –

1. JUNCTION BOX SHALL BE MADE OF MINIMUM 4MM THICK FRP WITH PROTECTIVE COATING (UV STABILIZED) OR MINIMUM 3MM DIE–CAST ALUMINIUM/CRCA SHEET FOR FLAMEPROOF/ EXPLOSION PROOF AREA.
2. JUNCTION BOX SHALL BE DUST TIGHT AND WEATHERPROOF CONFORMING TO IP–65/FLAMEPROOF/EXPLOSION PROOF AS PER AREA CLASSIFICATION.
3. PAINT – RAL 7032 (PIGMENTED COLOR FOR FRP)
4. JB'S ARE WALL/COLUMN/STRUCTURAL/ PIPE MOUNTING TYPE WITH SMOOTH FINISH.
5. HINGED LOCKABLE TYPE DOOR, SCREWED AT ALL FOUR CORNERS SHALL BE PROVIDED IN GENERAL.
6. DOOR LOCK FOR ALL THE BOXES SHALL BE IDENTICAL WITH COMMON KEY.
7. UNDRILLED/ CUSTOMIZED OPENING, REMOVABLE GLAND PLATE OF 3MM CRCA/4MM THICK BRASS SHALL BE PROVIDED.
8. NEOPRENE / POLYURETHANE GASKET 6MM THICK SHALL BE PROVIDED ON DOORS AND UNDRILLED GLAND PLATE.
9. RAIL MOUNTED CAGE CLAMP TYPE SCREWLESS TERMINALS SUITABLE FOR 0.5MM^2 TO 2.5MM^2 CABLE SHALL BE PROVIDED. TERMINAL BLOCKS SHALL BE PROPERLY ARRANGED INSIDE JB WITH END PLATE AND END CLAMP IN DIN RAIL (MS PLATED) AND MARKED–UP WITH TB NOS. FROM TOP TO BOTTOM TO FACILITATE EASY TERMINATION OF THE CABLES.
10. SUITABLE CABLE (PVC) CHANNEL WITH COVER SHALL BE PROVIDED ON BOTH SIDES OF TBS FOR ALL JBS.
11. MOUNTING PLATE SHALL BE 2MM THICK MS/ALUMINIUM POWER COATED. DIN RAILS AND PVC CHANNELS SHALL BE BOLTED TO THE MOUNTING PLATE.
12. NAMEPLATE SHALL BE MADE UP OF SS AND IT SHALL BE SCREWED.
13. EARTH BUS BAR SHALL BE OF 25X6MM TINNED COPPER.
14. M6 NICKEL PLATED BRASS EARTHING STUD WITH GREEN SCREW HEAD (EXTERNAL 2NOS. INTERNAL 1NO).
15. CANOPY SHALL BE 3MM THICK EXTENDED 40MM (TENTATIVE) FROM EACH SIDE.
16. FOR AREAS WHERE ILLUMINATION IS AN ISSUE, THERE LED SHALL BE PROVIDED INSIDE THE JB FOR WORKING EASY.
17. THIS DRAWING IS INDICATIVE ONLY. DIMENSIONS SHALL BE SUITABLE WITH 12/24/48/64/72/96/128 WAY JB CONSIDERED FOR PROJECT/ SERVICE SPECIFIC APPLICATIONS. 20% SPARE TERMINALS SHALL BE PROVIDED WITH EACH JB.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS
REVIEWED					SB	

APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
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FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL ARRANGEMENT OF LIE & RACK

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NONE
APPROVED	AT	DATE	21.08.2020

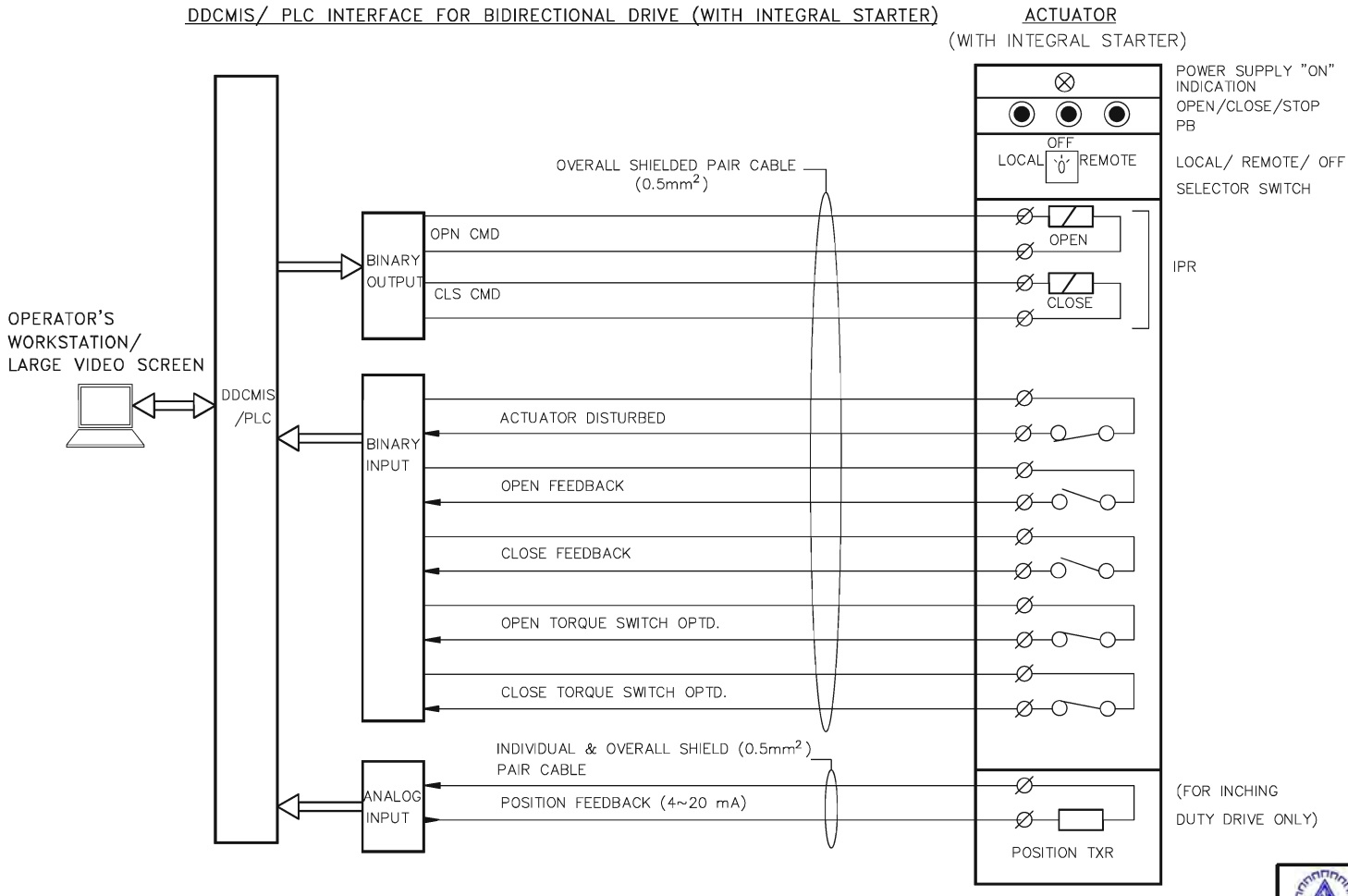
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DWG. NO. 18A03-DWG-I-0200

SHEET 6 OF 7

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PLOT DATE: 16-Nov-20 12:58 AM

DDCMIS/ PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



NOTE:

1. ACTUATOR DISTURBED CONSIST OF FOLLOWING SIGNALS:–
   a) LOSS OF POWER SUPPLY,
   b) LOSS OF CONTROL SUPPLY, MOTOR THERMOSTAT TRIP,
   c) THERMAL OVER LOAD RELAY TRIP,
   d) TORQUE OPEN/CLOSE CUT OFF,
   e) LOCAL/OFF/REMOTE SEL. SWITCH IN LOCAL OR OFF MODE.
   f) VALVE JAMMED.
   g) EMERGENCY STOP PB PRESSED.
2. DDCMIS /PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. IPR – INTERPOSING RELAY (TO BE LOCATED INSIDE THE INTEGRAL STARTER)
4. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIREMENTS (FOR EXAMPLE REDUNDANCY)

FOR TENDER PURPOSE ONLY

REVIEWED							APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS						

RELEASE STATUS	DATE	SIGNATURE
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FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL DRIVE INTERFACE PHILOSOPHY

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	13.08.2020

DWG. NO. 18A03-DWG-I-0013

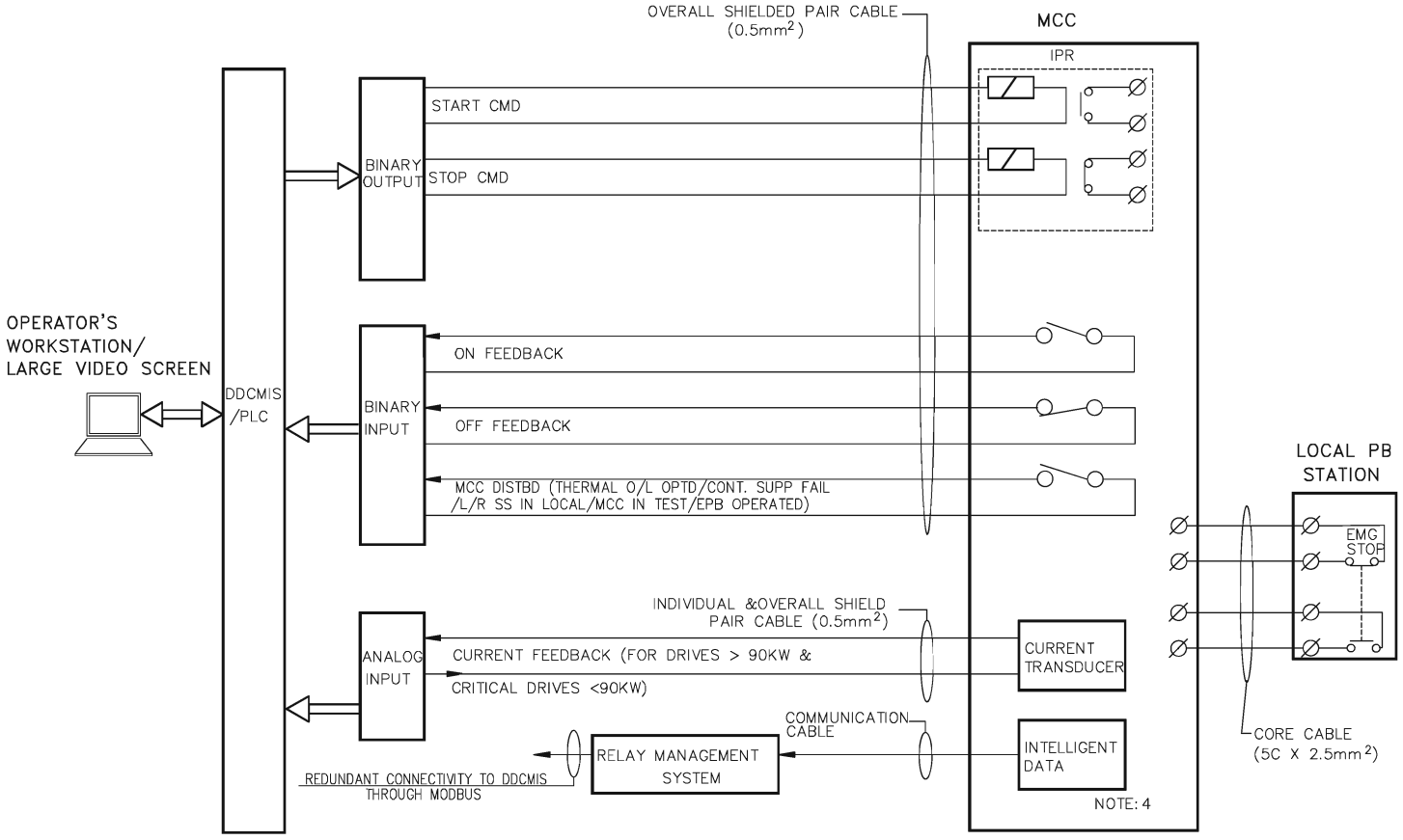
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SHEET 1 OF 5

FILE LOCATION:
PLOT DATE:

A3 [420x297]

DDCMIS / PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)



NOTE:

1. IPR – INTERPOSING RELAY
2. DDCMIS /PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).
4. REFERENCE ELECTRICAL DWG. NO. 17A08-DWG-E-4100 FOR EMS/RMS CONNECTIVITY TO DDCMIS.

FOR TENDER PURPOSE ONLY

PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB
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RELEASE STATUS	DATE	SIGNATURE
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TENDER PURPOSE ONLY		
FOR APPROVAL		
FOR CONSTRUCTION		

REVIEWED		
PROCESS		
MECHANICAL		
CIVIL & STRUCTURAL		
ARCHITECTURAL		
INSTRUMENTATION		
ELECTRICAL		
OTHERS		

OWNER: NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL DRIVE INTERFACE PHILOSOPHY

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	13.08.2020

DWG. NO. 18A03-DWG-I-0013

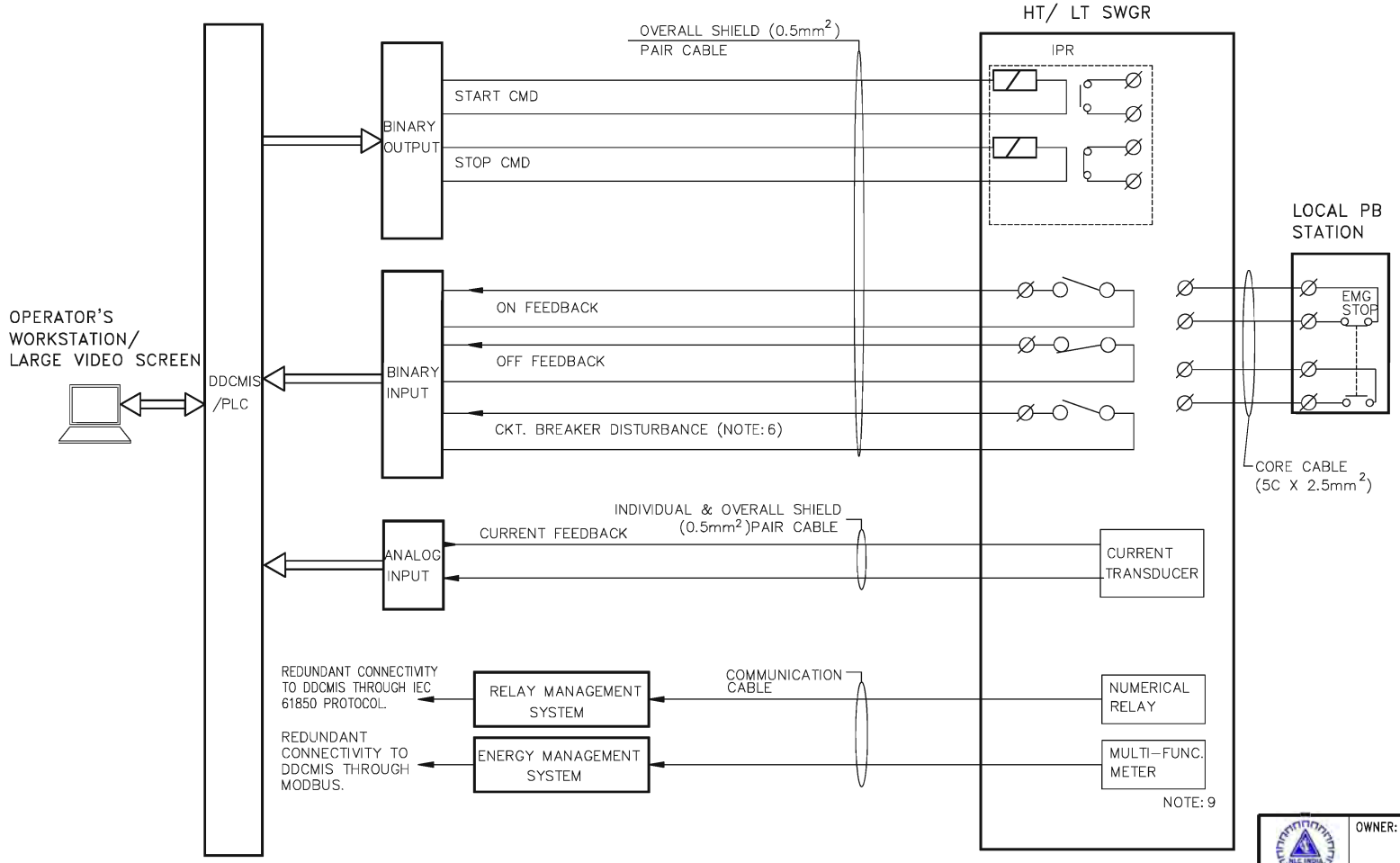
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SHEET 2 OF 5

FILE LOCATION:
PLOT DATE:

A3 [420x297]

DDCMIS/ PLC INTERFACE FOR UNIDIRECTIONAL HT/ LT DRIVE (BREAKER OPERATED)



NOTE:

1. IPR – INTERPOSING RELAYS
2. DDCMIS /PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).
4. MOTOR WDG AND BRG TEMPERATURES SHALL BE CONNECTED TO THE RESPECTIVE DDCMIS/PLC RTD I/O CARDS.
5. ALL COMMANDS AND FEEDBACKS SHALL BE REDUNDANT FOR HT DRIVES & CRITICAL LT DRIVES.
6. CKT BREAKER DISTURBANCE CONSISTS OF THE FOLLOWING:–
   - –BREAKER IN TEST POSITION
   - –TRIP COIL UNHEALTHY
   - –CONTROL SUPPLY FAIL
   - –L/R SELECTOR SWITCH IN LOCAL
   - –MASTER TRIP RELAY OPERATED
   - –EMERGENCY PUSHBUTTON OPERATED
   - –NUMERICAL RELAY FAILURE
7. EPB OPERATED AND MASTER TRIP OPERATED SHALL BE A SEPARATE DI FOR HT DRIVES.
8. CURRENT FB SHALL BE FOR ALL HT AND CRITICAL LT
9. REFERENCE ELECTRICAL DWG. NO. 17A08–DWG–E–4100 FOR EMS/RMS CONNECTIVITY TO DDCMIS.
9. EDMS (INCOMERS, BUS COUPLERS, BUS PT, LINE PT ETC.) TYPICAL SIGNALS SHALL BE DECIDED DURING DETAIL ENGINEERING STAGE.

FOR TENDER PURPOSE ONLY

REVIEWED													
PROCESS	MECH	C&S	ARCH	ELEC	INST	OTHERS	APPVD	NATURE OF REVISION & DESCRIPTION	REV	DATE	PREPD	CHKD
					SB		AT	ISSUED WITH TENDER	0	13.11.2020	SK	SB

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
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FOR CONSTRUCTION		

REVIEWED			
PROCESS			
MECHANICAL			
CIVIL & STRUCTURAL			
ARCHITECTURAL			
INSTRUMENTATION			
ELECTRICAL			
OTHERS			

OWNER:
NLC INDIA LIMITED
NEYVELI, TAMILNADU

PROJECT: NLC TALABIRA THERMAL POWER PROJECT (NTTPP) (3x800 MW)

TITLE: TYPICAL DRIVE INTERFACE PHILOSOPHY

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA•MUMBAI•CHENNAI•NEW DELHI

PREPARED	SK	JOB NO.	18A03
CHECKED	SB	SCALE	NIL
APPROVED	AT	DATE	13.08.2020

DWG. NO. 18A03–DWG–I–0013

REV 0

SHEET 3 OF 5

FILE LOCATION:
PLOT DATE:

A3 [420x297]

9.00.00 TYPE TEST

9.01.00 GENERAL REQUIREMENTS

a) The Bidder shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. List of major tests are furnished below for solid state equipment. For the balance systems & instruments, which are not indicated here, type tests may be conducted as per manufactures standard or if required by relevant standard.

b) The Bidder/ sub-vendor / manufacturer is required to conduct certain type tests specifically for this project as specified in respective sections and to be witnessed by Owner /Consultant or their authorized representative, even if the same had been conducted earlier. Incase Owner /Consultant decides to waive any of the Type tests for any item based on tests conducted by Bidder in the last five years, Test certificates for same shall be provided for review/ acceptance and the final decision rests with Owner /Consultant.

c) Submission of type test results and certificate shall be acceptable provided:

i) The same has been carried out by the Bidder / sub-vendor on exactly the same model / rating of equipment.

ii) There has been no change in the components of offered equipment from tested equipment.

iii) The test has been carried out as per the latest standards along with amendments.

d) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder within the quoted price and no extra cost shall be payable by the Owner on this account.

e) The schedule of conduction of type tests / submission of reports indicating the test standard shall be submitted and finalized during pre-award discussion for Owner /Consultant's review & approval.

f) For the type tests to be conducted, Bidder shall submit detailed test procedure for approval by Owner /Consultant. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

g) As mentioned against certain items, the test certificated for some of the items shall be reviewed and approved by the Main Bidder or his authorized representative and the balance have to be approved by the Owner.

h) The Bidder shall indicate in the relevant Break-up Price Schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective type test in presence of authorized representative of Owner. If a test is waived off, then the cost shall not be payable.

9.02.00 SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPMENTS& SYSTEMS

The type tests reports, as a minimum, over and above the requirements of above clause which are to be submitted for each of the major C&I system shall be as indicated below:

9.02.01 ELECTROMAGNETIC IMMUNITY AS PER EN 61000-6-22

a) Equipment furnished by Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electromagnetic interferences especially encountered in power plant environment. Equipment, which is vulnerable to such interference, shall be suitably immunized to eliminate possible problems.

b) Required shielding, input balancing, ripple amplitude and grounding for field signals and for the control systems to achieve an installation with minimum noise coupling from all sources.

c) Any additional equipment, deliverables required for effectively eliminating the noise problems shall be identified and included.

d) Electromagnetic emission as per EN 61000-6-43.

9.02.02 **SURGE-PROTECTION FOR SOLID STATE EQUIPMENT**

All solid state systems / equipment shall be immuned and able to withstand the electrical noise and surges as encountered in actual service conditions inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a-1989. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90a. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, IEC / EN 61000-4-4 & IEC / EN 61000-4-5 for Electrical fast transient / burst and Surge immunity may also be adopted for SWC test.

9.02.03 **DRY HEAT TEST** as per IEC-60068-2-2 or equivalent to determine the ability of the equipment / devices to operate under the environmental temperature condition.

9.02.04 **DAMP HEAT TEST** as per IEC-60068-2-3 or equivalent to determine the ability of the device to operate under environmental humidity condition.

9.02.05 **VIBRATION TEST** as per IEC 609454 to determine the ability of components, equipment and other articles to withstand specified severities of sinusoidal **VIBRATION SHOCKS** as per IEC 60721-3-3M15.

9.02.06 **ELECTROSTATIC DISCHARGE TESTS** as per EN 61000-4-2 or equivalent.

9.02.07 **CONDUCTED RADIO FREQUENCY IMMUNITY TEST** as per EN 61000-4-6 or equivalent.

9.02.08 Chemical conditions as per IEC 60721-3-3C1.

9.02.09 **TYPE TEST REQUIREMENT FOR C&I SYSTEMS (APPLICABLE ITEMS SHALL BE MENTIONED FOR COMPLETE EPC PACKAGE)**

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	Transducers	As per Standard	IEC-688, IS-12784	NO	YES	
02.	Thermocouples	Degree of Protection Test	IS-2147	NO	NO	
03.	RTD	As per Standard	IEC-751	NO	NO	
04.	Electronic Transmitter	As per Standard	BS-6447 / IEC-770	NO	YES	
05.	E/P Converter	As per Standard	Mfr. Standard	NO	YES	
06.	Dust Emission Monitor	Degree of Protection Test	IS-2147	NO	YES	
07.	Instrumentation Cables Twisted & Shielded			YES	YES	
	a) Conductor	• Resistance Test	VDE-0815			
		• Diameter Test	IS-10810			
		• Tin Coating Test (drain wire)				
	b) Insulation	• Loss of mass	VDE-0472			
		• Aging in air ovens	0472 **			** As per VDE 0207 for Teflon insulated

SL. NO.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• HV Test • Drain Wire Continuity	VDE 0472			
08.	Pressure Gauge	• Degree of Protection Test • Temperature Interference Test	IS-2147 IS-3624	NO NO	NO NO	
09.	Temperature Gauge	Degree of Protection Test	IS-2147	NO	NO	
10.	Pressure & Differential Pressure Switch	• Degree of Protection Test • As per Standard	IS-2147 BS 6134	NO NO	NO NO	
11.	Level Switch	Degree of Protection Test	IS-2147	NO	NO	
12.	Conductivity Level Switch	Degree of Protection Test	IS-2147	NO	YES	
13.	Control Valves	CV Test	ISA 75.02	YES	NO	
14.	Flow Nozzles & Orifice Plate	Calibration	ASME PTC, BS-1042	YES	NO	
15.	PLCs	All tests as per IEC-1131	IEC-1131			

10.01.07 **CABLE GLAND**

1.	Type	:	Double compression
2.	Entry Thread	:	NPT
3.	Material	:	SS316
4.	Protection	:	IP 65 or better
5.	Accessories	:	Neoprene gasket, locknuts, reducers etc

10.02.00 **PROCESS HOOK UP ACCESSORIES &SPECIFICATION**

10.02.01 The Bidder shall provide, install and test all required material for completeness of impulse piping system and air piping system as per the requirements of this section, enclosed installation drawings and source connection drawings on as required basis for the connection of instruments and control equipment (provided by the Bidder) to the process of entire plant.

10.02.02 Instruments installation philosophy is shown in the reference Drawing No. 18A03-DWG-I-0060. Bidder shall furnish the drawing and documents showing the installation detail of instruments along with Bill of materials at detailing stage for Owner / Consultant's approval.

10.02.03 Instrument piping installation shall be as per standard "Fossil Fuel Power Plant Instrument Piping Installation, ANSI/ISA–77.70–1994 (R2010)".

10.02.04 All material supplied under this section and the installation there of shall conform to the latest editions of American National Standard Code for pressure piping, power piping ANSI B 31.1, ANSI B16.11, ASME Boiler & Pressure Vessel codes, IBR and other applicable ASME, ANSI and state standards.

10.02.05 **IMPULSE PIPING SYSTEM**

a) **PROCESS TAP CONNECTION**

i) The process connection shall be a minimum of ½ inch (12.7 mm) nominal pipe size for service conditions when pressures are 900 psig (6.21 MPa) or less, and temperatures are 800°F (426.67˚C) or less. The minimum size shall be ¾ inch (19.05 mm) for conditions that exceed either of those limits.

ii) Shutoff valves shall be designed for maximum design pressure and temperature of the piping system and shall be located as close as possible to the process tap connections. If the process line is smaller than the appropriate takeoff connection size, the connection shall be the same size as the source.

iii) Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.

Impulse pipe including taps for furnace, flue gas and Coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

iv) Process connection for instruments on line and vessel shall be in accordance to standards such as ASME and other recognized international standards. Table below indicates the type of connection generally to be used for the various types of instruments. Bidder shall furnish detail of tapping points with drawing during detailed engineering for Owner /Consultant approval.

INSTRUMENTS	**EQUIPMENT/ PIPE SIDE**	**INSTRUMENT SIDE**
LEVEL INSTRUMENTS		
Internal Displacer	4" – Flanged	4" - Flanged
External Displacer	2" – Flanged	2" - Flanged
Level gauge	¾" –Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded

INSTRUMENTS	EQUIPMENT/ PIPE SIDE	INSTRUMENT SIDE
FLOW INSTRUMENTS		
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
PRESSURE INSTRUMENTS		
Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application	½" - NPT
Diaphragm type- LDO/Slurry application	3"- Flanged	3"- Flanged
TEMPERATURE INSTRUMENTS		
Thermowell	Generally - M 33 X 2 (M) 1½" Flanged- For air/FG path application	½" NPT
ANALYZER		
Liquid analyzer	½"- 1" – welded	½"

Rotameter shall generally be flanged type except if less than ½", in such case connection shall be screwed type.

v) Each instrument shall have its own independent connection to the process except for instruments located on standpipe. In this case only the connections to the vessel are common. Each instrument shall be connected independently to the standpipe through isolation valve. Standpipe shall have isolation / block valves for connection with the process.

vi) Separate stubs and take-off points with thermos-well / root valves shall be provided for performance guarantee test and shall not be shared with online measuring instruments.

vii) Drain shall be provided for all water / steam and non-inflammable / non-corrosive fluids only.

Funnel with drain header shall be provided in the racks for blowing / draining out the process fluid in the impulse tubing. The size of drain header will be 1".

When instruments are mounted local to the tapping point and are not mounted in rack, or panel or enclosure. The drains will be connected to the nearest floor level or plant drain.

For air / flue gas measurement a drain pot with plug will be provided in place of drain valves.

A ½" vent line with a ½" isolation valve will be provided in the instrument rack for air and compressible fluids or other wise if the installation call for e.g. for liquid service where the transmitter is located at a higher elevation than the tapping point.

b) **MATERIAL/ DESIGN PRESSURE & TEMPERATURE**

i) Alll impulse pipes shall be of seamless type conforming to ANSI B 36.10 for schedule numbers, sizes and dimensions etc. The material of impulse pipe shall be same as that of main process pipe. For various applications, specification of impulse pipe materials and associated fittings and valves shall be as given in the following Table (Clause no. 10.02.07).

ii) Length of the impulse pipe shall not be more than 15 meter for non compressible fluids and 12 meter for compressible fluid.

iii) The lines between the shutoff valves (root valve) and the instruments shall have design pressures as follows:

For sub-critical steam services, the lines shall be designed for process design pressure at saturated temperature; for all other services, the line shall be designed for process piping design

pressure and temperature. To prevent plugging and obtain sufficient mechanical strength, the inside diameter of the tube or pipe shall not be less than 0.360 inch (9.14 mm) and shall have a minimum wall thickness of 0.049 inch (1.25 mm). ANSI B31.1, Section 104, shall be followed for calculating minimum wall thickness required for a given pressure and temperature.

iv) Blowdown valves shall be the gradual opening type. For steam service, these valves shall be suitable for the maximum design pressure of the process line and its corresponding saturated steam temperature. For all other services, the blow down valve shall be designed for the process piping design pressure and temperature.

v) Root valves of two numbers for process pressure of 40 Kg/cm^2 or temperature of 280°C and above and single for process pressure less than 40 Kg/cm^2 and temperature less than 280°C as per piping specification shall be provided. For process pressure equal or above 40 Kg/cm^2 or temperature equal or above 280°C double blow down valves shall be used before connecting to blow down header.

vi) Manifold valve shall be installed close to / at the instrument. The valves shall be of the gradual opening type and shall be capable of operation during maximum design pressure and temperature. Materials for pressure-retaining parts such as the body, bonnet, disc, pipe plugs, fittings, tube stubs, or bolting shall be as required by ANSI B31.1. Packing materials shall be rated for the pressure and temperature service intended. Asbestos shall not be used.

vii) SS tube shall be provided inside enclosures/ racks from the tee connection to valve manifold and then to instrument. For high pressure/ temperature applications, the material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard. The minimum bending radius shall be 2¼ times the tubing outside diameter (O.D.) for tubing less than ½ inch (12.70 mm) O.D. and 3 times the tubing O.D. for tubing ½ inch (12.70 mm) and larger. Fittings shall be at least three tubing diameters away from a bend.

viii) All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. tee, elbow etc.) shall be ASTM A182 Gr. 316H for high pressure/ temperature applications and ASTM A182 Gr. 316L for other applications. The material for bar stock fittings (straight applications) shall be SS 316. Metal Thickness in the fittings shall be adequate to provide actual bursting strength equal to greater than those of the impulse pipe or SS tube, with which they are to be used.

ix) The following guidelines shall also be considered for size, material and rating for impulse line/tube fittings and accessories:

- Nipple shall be provided for root valve size more than ½" and the nipple size shall be same as the root valve size. Reducer / adapter shall be provided to suit instrument connection, where nipple, root valve size is more than ½".
- Bulk head fitting socket welded type shall be provided at instrument rack / enclosure.
- All pipe fittings except the last fitting connecting to the instrument shall generally be socket welded. The size of the fittings shall be same as the impulse line size.
- The fitting connecting to the instrument shall have a size and thread to suit the instrument connection.
- Threads of piping component shall be of tapered construction.
- Double ferruled compression type fittings shall be used only, wherever required. Tube fitting installation shall be in accordance with both ANSI B31.1 and the manufacturer's recommendations.

x) The source shut-off (primary process root valve) and blow down shall be ½" size globe valve type for all in general (except for air and flue gas service). For various applications the valve body material, stem material and pressure class shall be as given in the table below. The end connections shall be of socket welded type unless otherwise specified. The disc and seat ring material of carbon steel and alloy steel valves be ASTM A105 and ASTM A182 Gr.F22, hard faced with stellite (minimum hardness 350 BHN). The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be reconditioned and stem and disc may be replaced without removing the valve body from the line.

xi) Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.

xii) Pressure instruments for steam or hot fluids service shall have a loop (pigtail) or other suitable isolator between the gauge and the source of pressure when mounted on the process piping. This isolation protects the instrument from excessive temperature. Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100˚C or more. Syphons shall not be used on differential pressure instruments.

xiii) Condensate pots are used in the measurement of steam or other vapors for condensing the vapor to a liquid state to minimize errors due to gas trapped in the instrument piping.

Condensing pots shall be provided and installed wherever required. In any case condensing pots shall be provided for all level measurements in steam and water services and all flow measurements in steam and water services above 120°C. For drum level measurement required balancing chamber shall be provided and installed.

Condensate pots, also referred to as reservoirs, shall be designed in accordance with ANSI B31.1.

c) **INSTALLATION AND ROUTING**

i) All local instruments viz. pressure and temperature gauges, pressure and temperature switches, transmitters as equipment supply shall be mounted on gauge boards & instrument racks located at convenient place near to the equipment.

ii) Other pipe and duct mounted pressure and temperature gauges shall be installed at tapping point located at a readable distance.

iii) Transmitters & switches installed at outdoor location shall be mounted in closed type Local Instrument Enclosure (LIE). For indoor areas, open type Local Instrument Rack (LIR) with canopy shall be used for installation of transmitters and process switches. Drain from LIE / LIR shall be connected to nearby plant drainage system.

iv) Tap orientation shall be as follows :

- For liquid service, within 45 ° at lower half of the pipe horizontal plane.
- For gas service, within 90 ° at upper half of the pipe horizontal plane.
- For steam service, within 45 ° at upper half of the pipe horizontal plane.

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

v) Routing of sensing lines shall ensure that the function of these lines is not affected by the entrapment of gas (fluid-sensing line) or liquid (gas-sensing line).

- Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping

shall be sloped to avoid formation of air pocket.

- Pressure & Differential pressure instruments in gas service shall be located above the taps and the piping shall be sloped to avoid formation of any liquid.

One of the following methods shall be used to ensure that the sensing line is not affected:

- For liquid measurement it is preferred that the downward slope from the tap to the instrument of the sensing line be 1" or more per foot (80 mm or more per meter of run); for gas measurement it is preferred that the upward slope from the tap to the instrument of the sensing line be 1" or more per foot (80 mm or more per meter of run). Where the preferred minimum slope cannot be obtained in the two cases above, the lines shall be installed to the maximum slope available, and in no case shall the slope be less than ¼ " per foot (20 mm per meter).

- High point vents or low point drains, or both, shall be provided to ensure that all entrapped gas or liquid can be purged from the sensing line.

- A combination of above two.

vi) For level measurement by DP cell low level taps on the vessel shall be made horizontal to avoid plugging.

vii) All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Instrument piping tubing shall not be routed across equipment removal areas, above or below monorails, cranes, removable gratings, cable trays. All impulse piping shall be installed to permit free movement due to thermal expansion, where-in required expansion loops shall be provided.

viii) Color coding of all impulse pipes shall be done by the Bidder in line with the color coding being followed for the parent pipes.

ix) Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe. Each pipe shall be supported individually using slotted angle mounted clamps with necessary fixtures. Tubing shall run in proper perforated trays with proper cover. Tubing shall be supported inside the trays by aluminium supports.

x) Hangers and other fixtures required for support of piping and trays shall be provided, either by welding or by bolting on walls,

ceilings and structures. Hanger clamps and other fastening hardware shall be of corrosion resistant metals and hot dip galvanized.

xi) Instrument primary piping connecting to high temperature systems, which might become hot enough to injure personnel during blow down of the instrument line, will be insulated where such hazard exists. Insulation materials, exterior finish, and metal lagging shall conform to the standards adopted for the process piping.

10.02.06 **SPECIFICATION FOR PROCESS HOOK UP MATERIALS**

SR. NO	SYSTEM	PIPING CLASS	IMPULSE PIPE MATERIAL	SCHEDULE (SIZE)	MATERIALS FOR VALVE BODY/ FITTINGS	VALVE STEM MATERIAL	RATING OF FITTING	PRESSURE CLASS OF VALVE
1.	Main Steam, upstream of HP Bypass and Auxiliary Steam pressure reducing valve, separator level	A	ASTM-A335 Gr. P-91/22 (Note-2)	XXS (½ inch)	Note-3	Note-3	9000 lb	3000 SPL
2	BFP discharge / super-heater attemperator / spray to PRDS, Phosphate dosing P/P discharge, BCW pumps	B	ASTM-A106 Gr. C	160 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	6000 lb	2500 SPL
3.	Re-heater attemperator	C	ASTM-A106 Gr. C	160 (½ inch)	ASTM-A 105	ASTM-A182 Gr. F-6a	6000 lb	1500 SPL

SR. NO	SYSTEM	PIPING CLASS	IMPULSE PIPE MATERIAL	SCHEDULE (SIZE)	MATERIALS FOR VALVE BODY/ FITTINGS	VALVE STEM MATERIAL	RATING OF FITTING	PRESSURE CLASS OF VALVE
	air mixture		Gr. C			Gr. F-6a		
9.	Air / Flue Gas Inside Furnace	N	ASTM-A335 Gr. P-22	80 (¾ inch)	ASTM-A 182 Gr. F-22	ASTM-A182 Gr. F-6a	3000 lb	800
10.	Purge Air	O	ASTM-A106 Gr. C	80 (¾ inch)	ASTM-A 105	SS316	3000 lb	800
11.	DM Cooling Water	P	ASTM A312 TP 316	80/40 (½ inch)	ASTM A182 F316	SS or better	3000 lb	800
12.	CW & ACW	Q	ASTM-A106 Gr. C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

1) Above requirements are minimum to be complied by Bidder. Rating of piping/ fittings / valves etc. is subjected to be approved by Owner as per the final design pressure & temperature finalized during the detail engineering as per ANSI B31.1.

2) In case temperature is more than 540°C, the material shall be P-91 only.

3) Material shall be compatible with that of the impulse pipe material and design parameter.

4) For DM Plant or DM water services, complete erection hardware material shall be SS316 only.

5) Separator related impulse piping material shall be as per main process pipe/ tank material.

10.02.07 **SPECIFICATION FOR PNEUMATIC HOOK UP MATERIALS**

a) All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This shall include as a minimum air supply to pneumatically operated control

valves, actuators, instruments, continuous and intermittent purging requirements etc.

b) For individual supply line and control signal line to control valve, ¼" size light drawn tempered SS tubing shall be used. It shall be at least 0.065 inch.

The fittings to be used with SS tubes shall be of cast SS, screwed type.

c) All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends.

Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.

d) The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header with isolation valve from the instrument air and service air terminal points. In the boiler/turbine area the 2" head shall be provided up to most elevation of boiler/turbine floor and from this 2" header, 1"sub header shall be branched off at each floor with isolation valve. From this 1" sub-header, branch line of ½", with isolation valve shall be provided up to various devices.

Similar system is to be followed for service air required for intermittent purging in the local instrument enclosures (LIEs).

e) The continuous purging with instrument air shall be done, for all air and flue gas measurements, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all instruments enclosures and instrument racks for Air and flue gas applications.

For intermittent purging with service air, necessary arrangements inside all the air and flue gas enclosures shall be provided. The SS316 four ways valve provided in the SS316 tubing shall be used for isolating the transmitter and connecting the service air quick disconnect line.

Purging arrangement is not required for instrument air and service air measurement applications. Purge air lines shall be of mild steel hot dipped galvanized inside and outside as per IS1239, heavy duty with threaded ends.

f) Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply.

The filter regulators shall be suitable for 10 kg/cm2 max. inlet pressure. The filter size shall be 5 microns and of material sintered

bronze. The air set shall have 2" size pressure gauge and built in filter housing blow down valve. The end connection shall be ¼" /½" /¾" NPT as per the requirement to be finalized during detailed engineering.

g) All the isolation valves in the air supply line shall be gate/ ball valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½" to 2".

h) Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports to be provided and fabricated by the Bidder. Air supply piping shall be installed with a slope of over 1/100 to prevent accumulation of condensed water within the pipe. Signal/control air tubing shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy link up and checking of proper connections. Single and multi-tubes shall run with the minimum number of changes in direction. Suitable identification tags shall be provided for easy checkups and for connections.

10.02.08 **TECHNICAL PARTICULARS**

a) **SEAMLESS PIPE**

i) **ALLOY STEEL PIPE**

1.	Reference	:	ASTM-A 335 gr. P-91/22/ 11
2.	Material	:	Cold drawn seamless A.S
3.	Type	:	Seamless / Plain ends
4.	Size	:	½"
5.	Schedule	:	80/160/XXS
6.	Standard Length	:	5 M

ii) **STAINLESS STEEL PIPE**

1.	Reference	:	ASTM A-312 TP 316
2.	Material Grade	:	TP 316
3.	Type	:	Seamless /Plain end
4.	Size	:	½"
5.	Schedule	:	40/60/80
6.	Standard Length	:	5 M

iii) **CARBON STEEL PIPE**

1.	Reference	:	ASTM-A 106 Gr. C
2.	Material	:	Cold drawn seamless black C.S
3.	Type	:	Seamless/ Plain ends/ threaded ends as per ASA B2.1/ Hot dip Galvanized from Inside & outside as per IS-1239
4.	Size	:	½" to 2"
5.	Schedule	:	80/160/XXS
6.	Standard Length	:	5 M

b) **PIPE FITTINGS**

i) **A.S. PIPE FITTINGS**

1.	Reference	:	ASTM-A 182 F22/ ANSI B 16.11

2.	End Connection	:	Socket weld
3.	Type	:	Forged
4.	Size	:	½"
5.	Rating	:	3000/6000/9000 lb
6.	Type of Fittings	:	Reducing coupling, Male-Female reducer, Straight coupling, Equal Tee, Three Piece Union, Elbow, Cap etc.

ii) **STAINLESS STEEL PIPE FITTINGS**

1.	Reference	:	ASTM A-182 F 316
2.	End Connection	:	Generally socket weld
3.	Type	:	Forged conforming to ANSI B16.11
4.	Size	:	½"
5.	Rating	:	3000/6000/9000 lb
6.	Type of Fittings	:	Reducing coupling, Male-Female reducer, Straight coupling, Equal Tee, Three Piece Union, Elbow, Cap etc.

iii) **CARBON STEEL PIPE FITTINGS**

1.	Reference	:	ASTM-A 105 / ANSI B16.11

2.	End Connection	:	Generally socket weld/ Threaded as per ASA B2.1
3.	Type	:	Forged/ hot dip galvanized from inside & outside
4.	Size	:	½"
5.	Rating	:	3000/6000/9000 lb
6.	Type of Fittings	:	Reducing coupling, Male-Female reducer, Straight coupling, Equal Tee, Three Piece Union, Elbow, Cap etc.

c) **TUBE & TUBE FITTINGS**

i) **SEAMLESS STAINLESS STEEL TUBE**

1.	Reference	:	ASTM A-213 TP 316
2.	Material Grade	:	TP 316
3.	Size	:	½" OD X 2.1 mm thick
4.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube
5.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80

6.	Test Pressure	:	400 Kg/cm^2 (minimum)
7.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
8.	Standard Length	:	5 M
9.	Test	:	Flare, Hardness, Ball and Bubble Test

ii) **STAINLESS STEEL TUBE FITTINGS**

1.	Reference	:	ASTM A-182
2.	Material Grade	:	SS 316 forged
3.	Type	:	Double ferrule double compression
4.	Ferrule	:	SS316
5.	Size	:	To suit SS tubing and NPT end connection
6.	Type of Fittings	:	Male / female connector, elbow, cross / equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation

iii) **SEAMLESS STAINLESS STEEL TUBE**

1.	Reference	:	ASTM A-269 TP 316
2.	Material	:	TP 316

3.	Size	:	¼" OD x 0.049" wall thickness
4.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube
5.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80
6.	Test Pressure	:	400 Kg/Sq. cm
7.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
8.	Standard Length	:	5 M
9.	Test	:	Flare, Hardness, Ball and Bubble Test

d) **GLOBE VALVE**

i) **ALLOY STEEL GLOBE VALVE**

1.	Reference	:	ANSI B31.1
2.	Type	:	Globe
3.	Construction	:	Forged Body

4.	End Connection	:	Generally Socket Weld
5.	Size	:	½"
6.	Pressure Class	:	800/ 2500/ 3000
7.	Material	:	
	a) Body	:	ASTM A-182 Gr. F22
	b) Stem	:	ASTM A182 Gr. F6a/ SS 316
	c) Plug	:	SS 316
	d) Seat	:	Stainless steel stellited
	e) Packing	:	Grafoil as required
	f) Yoke	:	ASTM A-182 Gr. F22
8.	Hand-wheel	:	Carbon Steel

ii) **STAINLESS STEEL GLOBE VALVE**

1.	Reference	:	ASTM-A 182 F316/ ANSI B 16.34
2.	Type	:	Globe
3.	Construction	:	Forged Body
4.	End Connection	:	Generally Socket Weld
5.	Size	:	½"

6.	Pressure Class	:	800
7.	Material	:	
	a) Body	:	ASTM-A 182 F316
	b) Stem	:	SS 316
	c) Plug	:	SS 316
	d) Seat	:	Stainless steel stellited
	e) Packing	:	Teflon as required
	f) Yoke	:	ASTM A182 F316
8.	Hand-wheel	:	Carbon Steel

iii) **CARBON STEEL GLOBE VALVE**

1.	Reference	:	ASTM- A105 / ANSI B 16.34
2.	Type	:	Globe
3.	Construction	:	Forged Body Cadmium Plated
4.	End Connection	:	Generally Socket Weld/ Screwed Female ends as per ASA B2.1
5.	Size	:	½" to 2" as required
6.	Pressure Class	:	800/ 1500/ 2500
7.	Material	:	

	a) Body	:	ASTM- A105
	b) Stem	:	ASTM A182 Gr. F6a/ SS 316
	c) Plug	:	SS 316
	d) Seat	:	Stainless steel stellited
	e) Packing	:	Teflon / Grafoil as required
	f) Yoke	:	ASTM- A105
8.	Hand-wheel	:	Carbon Steel

e) **INSTRUMENT VALVE MANIFOLD**

1.	Reference	:	ASTM A-182 Gr. F22/ ANSI B 16.34
2.	Type	:	2 valve/ 3 valve/ 5 valve manifold
3.	Mounting	:	Remote 2” pipe mounting
4.	Construction	:	Single block (bar stock)
5.	Material	:	
	a) Body/ Bonnet	:	AISI 316 SS
	b) Seat & Stem	:	AISI 316 SS
	c) Plug	:	AISI 316 SS free to turn on stem / 17-4 PH

	d) Handle Bar	:	AISI 316 SS
	e) Packing	:	PTFE Wafer
6.	Ports	:	1/2 " NPT (F)
7.	Rating	:	420 Kg/ cm^2 at ambient
8.	Connection	:	Straight
9.	Operating Temperature	:	(-) 30°C to (+)170°C
10.	Accessories	:	Plugs for all ports Mounting Bracket, bolts, nuts

f) **CONDENSATE POT**

1.	Reference	:	ANSI B31.1
2.	Material	:	ASTM A-182 Gr. F22/ ASTM A105 based on application
3.	Construction	:	Drilled from bar-stock
4.	End connection	:	3 nos. ½" socket weld end
5.	Accessories	:	Vent valves

g) **AIR HEADER**

			FOR PANEL	**FOR FIELD**

			FOR PANEL	FOR FIELD
1.	Material of Construction	:	SS 316	SS 316
2.	Inlet Connection	:	2" NPT (M)	1" NPT (M)
3.	Header Take-off	:	SS 316	SS 316
4.	Take-off Connection	:	½" NPT (M)	½" NPT (M)
5.	Take-off Valves	:	½" Ball Valve SS 316	½" Ball Valve SS 316
6.	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
7.	Drain	:	½" Ball Valve SS 316 at lowest point	½" Ball Valve SS 316 at lowest point

10.02.09 **SHOP & SITE TESTS**

The equipment and work performed as per this chapter shall be subject to shop and site test as per requirements of Quality Assurance & Inspection (V.IIE/ Section-XIV), other applicable clauses of this section and Owner approved Quality Assurance Plan.

a) All material used in construction of piping and components shall be certified by the manufacturer with a certificate of compliance to the ASTM/ASME specifications. The manufacturer should have a quality assurance program for material control and verification. All certificates of compliance applicable to material used in a component should be furnished by the manufacturer with the material at the time of shipment.

b) Each completed installation shall be visually inspected prior to testing. This inspection shall ensure compliance with design drawings and specifications.

c) Pressure tests should be conducted to ensure the pressure integrity of

sensing and control lines. Tests shall be in accordance with the latest edition and addenda of ANSI B31.1, which provides additional guides to this testing.

(i) Hydrostatic Testing

All instrument piping/ tubing shall be hydrostatically tested upon completion of erection. The test pressure shall be 1.5 times the maximum process pressure. The test shall be performed either with the testing of associated process piping or without the associated process piping (by closing the root valve). In both the cases, the instrument shall be isolated by closing the shut-off valve.

(ii) Pneumatic Testing

All air headers & branch pipes shall be air tested by pressure decay method as per ANSI B 31.1. Flexible hoses and short signal tubing shall be tested at normal pressure for leakage. Long signal tubing shall be tested by charging each tube with air at 2 Kg/cm2 through a bubbler sight glass. The boiler draft and vacuum piping shall be air tested by the same method as long signal tubing.

11.00.00 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT

11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

11.02.00 The special tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

11.03.00 Bidder shall furnish list of special tools & tackle and test equipment proposed to be supplied along with the bid, if applicable. Minimum two (2) nos. antistatic wrist band in each control panels are mandatory and shall be included in the bid.

at least 60 days before the schedule date if the test is to be conducted abroad.

6.02.03 **SITE TEST**

a) Site tests shall include but not be limited to calibration, pre-commissioning trials, start-up trials, trial operation and performance guarantee test.

b) Bidder shall provide all required test equipment and simulation devices of reputed make, of required accuracy class and recently calibrated by some appropriate authority.

6.03.00 **TEST & INSPECTION FOR INSTRUMENTS**

After Manufacturing, all instruments shall be tested and calibrated at Shop/ Factory. Bidder shall be responsible in obtaining test certificates related to calibration of all the Instruments and submit for Owner/Consultants approval. Bidder shall allow dispatch of these instruments only after passing applicable Factory Acceptance test and approved by Owner/consultant. The details of the tests to be carried out for the different instruments / field equipments/ Systems shall be as indicated in the following table and any other tests as required by the Standards and Codes.

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
1	Pressure indicators	• Calibration Test • Accuracy Test • Hydro Test (1.5 times max. Pr.)
2	Pressure switches	• Calibration test • Hydro test • Contact rating test • Accuracy test • Repeatability Test • Hysteresis test • Differential test

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
3	Pressure Transmitters	• Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test.
4	Differential Pressure Indicators	• Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test.
5	Differential Pressure Switches	• Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test
6	Differential Pressure Transmitters	• Calibration test • Hydro test • Leak test

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		• Over range test • Accuracy test • Repeatability test.
7	Thermometers	• Calibration test • Material test • Accuracy test • Bore concentricity (±5% of wall thickness) • Hydrostatic test for TW (1.5 times max. pr.).
8	Temperature switch	• Calibration test • Material test • Accuracy test • Bore concentricity (1.5% of wall thickness) • Hydrostatic test for TW (1.5 times max.pr.) • Contact rating test
9	Resistance temperature detector assembly	• Calibration • Material test • Accuracy test • Bore concentricity test (±5% of wall thickness) • Insulation test (<500 M ohms at 500 V DC) as per

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		ISA • Hydro test for TW. • Accuracy test
10	Thermocouple assembly	• Calibration • Material test • Insulation test (<500 ohms at 500 V, DC) as per ISA • Hydro static test (1.5 times max. pr.) • Bore concentricity (±5% of wall thickness) • Accuracy test
11	Temperature transmitters	• Calibration test • Accuracy test • Ambient temperature error test
12	Thermowells	• Material test • Bore concentricity : ±5% of wall thick • Hydrostatic test for TW (1.5 times max.pr)
13	Interposing relay	• Functional test • Temperature rise test • High voltage test

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		• Limits of operation test • Insulation test • Contact rating test
14	Level gauges	• Hydrostatic test • Material test • Seat leakage test • Ball check test
15	Level switches	• Material test • Contact rating test • Hydro test • Calibration test
16	Level Switch (Probe)	• Material test • Contact rating test • Hydro test • Calibration test
17	Flow switch	• Material test • Hydro test (1.5 time max. pr) • Functional test
18	Flow glasses	• Material test • Hydro test (1.5 time max. pr) • Functional test

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		• Calibration • Hysteresis test • Actuator Leakage Test • Also refer V.IIE/ Section-IV for further details
22	Position Transmitters	• Calibration • Hysteresis • Accuracy test
23	I/P Converters	• Calibration test • Accuracy Test
24	Solenoid Valves	• Hydro test • Seat leakage test • Coil insulation test
25	Air Filter Regulators	• Calibration test • Accuracy test
26	Junction Boxes	• Test for degree of protection • Material test
27	Transmitter Racks/ Enclosures	• Hydro test • Air leak test for tubing, Piping & fittings • Verification of degree of protection

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		• IBR certification as required for tubing/ piping and fittings
28	Terminal Blocks	• Test for moulding for flame resistant, non-hygroscopic and de-carbonized • Insulation test between terminals • Insulation between terminal block and frame
29	Thermocouple extension cable, Instrumentation Cables and Fiber Optic Cables	• Thermo-emf characteristic • Continuity test • Measurement on capacitance, inductance and loop resistance • Insulation resistance • High voltage test as per latest IS • Tensile & elongation test • Oxygen index test • Any other test as applicable (Also refer V.IIE/Section-IV for further details)
30	Mass Flowmeter	• Performance Test • Calibration Test • Hydrostatic test
31	Boiler Level Gauge	• Hydrostatic test

S.N	INSTRUMENTS/EQUIPMENT	TEST TO BE CONDUCTED
		per relevant IS
38	Wiring Termination & accessories	• Routine Test • Conductor resistance test • High voltage test • Impulse dielectric test • Insulation test • Humidity test • Temperature rise test on power circuits • Short time current test on power circuit • Type Test • Annealing test • Test for insulation and sheath • Flame retardance test • Oxygen index • Flammability • Test for acid gas generation • Test for water absorption • Wet dielectric test

NOTES:

a) Test certificates in addition to inspection at Manufacturer's works shall be furnished for all the instruments for Owner/ consultant's review.

b) Above test to be witnessed shall be finalized by Owner.

TECHNICAL DATA - PART - B (MECHANICAL)
(SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO	DESCRIPTION	UOM	DETAIL
1.0	Type Model No. (Single air inlet, Double air inlet)		
2.0	Quantity	Nos/ Unit	
3.0	Rated Capacity	M^3/Hr	
4.0	No. of Cells	Nos./ CT	
4.1	Working		
4.2	Standby		
5.0	Ambient Design Wet Bulb Temperature	°C	
6.0	Recirculation Allowance	°C	
7.0	Design Inlet Wet Bulb Temp (including recirculation allowance)	°C	
8.0	Cold Water Temperature	°C	
9.0	Cooling Tower Approach	°C	
10.0	Cooling Tower Range	°C	
11.0	Cooling Tower Loss		
11.1	Evaporation Loss		
11.2	Drift Loss		
11.3	Blow Down Loss (Concentration Factor to be indicated)		
12.0	Basin Storage capacity	M3/hr	
13.0	Cell size (Length x Width x Height)	M x M x M	
14.0	Overall Size of Cooling Tower (Length x Width x Height)	M x M x M	
15.0	Required Pumping Head including all losses	M	
16.0	Dia of fan stack	M	
17.0	Cooling Tower Levels		
17.1	Graded Level	M	
17.2	Maximum Water Level	M	
17.3	Basin Curb Level	M	
17.4	Minimum Water Level	M	
17.5	Basin Bottom Level	M	
18.0	Overall Tower Height from Basin Floor	M	
19.0	Basin Dimensions		
19.1	Length	M	
19.2	Width	M	
19.3	Depth (from basin curb)	M	
20.0	Free Board (Above Max. Water Level)	mm	
21.0	Heat Transfer Data		
21.1	Heat Transfer Coefficient (K)		
21.2	Tower Coefficient © Ka V/L	M	
21.3	Average Fill Height	M	
21.4	Total Fill Volume	Cub M	
21.5	Total Water wetted surface	Sq M	
21.6	Total Tower Wetted Surface	Sq M	
22.0	Hot Water Distribution Piping		

22.1	Size (OD X Thk)	mm x mm	
22.2	Elevation of Center Line of Hot Water distribution Header	M	
22.3	Design pressure for Hot Water Distribution System	Kg/cm2 (g)	
23.0	Isolation Valves in Hot Water Risers		
23.1	Size	mm	
23.2	Quantity	Nos./ cell	
23.3	Type/Code & Standard		
23.4	Make		
23.5	Pressure drop across the valve in fully open position	MWC	
23.6	Materials of Construction		
23.6.1	Body		
23.6.2	Disc		
23.6.3	Drive Shaft/Stub Shaft		
23.6.4	Bearings		
23.7	Test Pressure / duration	Kg/cm2 (g) / Minutes	
24.0	Flow Control Valves (If Applicable)		
24.1	Make		
24.2	Size	mm	
24.3	No. of Cell	Nos	
24.4	Materials of Construction		
24.4.1	Body		
24.4.2	Spindle		
24.4.3	Trim		
25.0	**Isolating Valve in Sludge Pit**		
25.1	Size	mm	
25.2	Quantity	Nos / CT	
25.3	Type		
25.4	Make		
25.5	Conform to which code in respect of design/testing		
25.6	Materials of Construction		
25.6.1	Body		
25.6.2	Stem		
25.6.3	Trim		
26.0	**Stationary Screen**		
26.1	Quantity	Nos / CT	
26.2	Size & Material of Bar		
26.3	Clear Space between the bar		
26.4	Lifting Arrangement		
27.0	**Fill & Fill Supports**		
27.1	Type of fill		
27.2	Material		
27.3	Type of treatment (in case of timber fill)		
27.4	Expected Life	Years	
27.5	Arrangement of Fill/splash bars (horizontal etc.)		

27.6	Method to prevent dislocation of Fills		
27.7	Type/Material/Size of fixing arrangement to supporting grid		
27.8	Fill Support Grids		
27.8.1	Type		
27.8.2	Material (give full specification)		
27.8.3	Size		
27.8.4	Colour of Fill		
27.9	Grid Supporting Frames		
27.9.1	Type		
27.9.2	Material (give full specification)		
27.9.3	Size		
27.10	Fasteners		
27.10.1	Type		
27.10.2	Fill		
27.10.3	Fill Support Grids		
27.10.4	Frames for Supporting the Grids		
28.0	Drift Eliminators		
28.1	Number of Passes		
28.2	Gross Face Area per pass	Sq M	
28.3	Type		
28.4	Eliminator Blades		
28.4.1	Material		
28.4.2	Maximum Length of blade	mm	
28.4.3	Size and shape of blades		
28.4.4	Type and material of drain boards		
28.5	Blade Support Spacers		
28.5.1	Type		
28.5.2	Material		
29.0	**FANS**		
29.1	Manufacturer		
29.2	Type		
29.3	Model Number		
29.4	Number furnished	Nos./CT	
29.5	Diameter	M	
29.6	Number of Blades/fan		
29.7	Fan speed	RPM	
29.8	Tip speed	M/Sec	
29.9	Blade tip clearance	mm	
29.10	BHP per fan		
29.11	Air delivery per fan	Cubm/hr	
29.12	Fan static efficiency	%	
29.13	Blade material		
29.14	Hub material		
29.15	Fasteners & Hardware material		
29.16	Entire fan assembly statically balanced		
29.17	Total differential pressure drop (considering receovery)		
29.17.1	Drop through louvers	MWC	

29.17.2	Drop through fills	MWC	
29.17.3	Drop though eliminators	MWC	
29.17.4	Velocity pressure	MWC	
29.18	Drop through plenum	MWC	
29.19	Noise level of fan at rated pitch and speed	dB	
29.20	Total guaranteed power consumption at motor inlet (to be supported by calculations)	KW/Fan	
29.21	Fan motor rating	KW	
30.0	**GEAR REDUCER**		
30.1	Manufacturer		
30.2	Model Number		
30.3	Reduction Ratio		
30.4	Service factor at rated HP of drive		
30.5	Bearing and material		
30.6	Material of gear tooth and hardness.		
31.0	**DRIVE SHAFT**		
31.1	Manufacturer		
31.2	Number		
31.3	Rated HP		
31.4	Drive and shaft material		
31.5	Coupling material		
31.6	Number of couplings furnished per driving unit		
31.7	Type of couplings and whether coupling guard provided.		
31.8	Drive shaft statically dynamically balanced.		
32.0	**Gate in Cold Water Outlet Channel**		
32.1	Number per cold water outlet channel		
32.2	Gate Type		
32.3	Name of Manufacturer		
32.4	Gate Size		
32.5	Weight of each gate	Kg	
32.6	Are elements of gate dismantling type?		
32.7	Weight of each Element	Kg	
32.8	Frame Type		
32.9	Fixing arrangement of frame with RCC channel		
33.0	**Lifting Arrangement of Gate**		
33.1	Type of treatment for the wood (in case of wooden gates)		
33.2	Expected Life	Years	
34.0	**VERTICAL SLUDGE PUMP & MOTOR (Optional Item)**		
	Vertical sludge pumps complete with electric motors, valves, piping and fittings at their discharge offered.	Yes / No	
34.1	Make & Model No.		
34.2	Rated capacity	M3/Hr	
34.3	TDH	MWC	
34.4	Pump speed	RPM	
34.5	Pump efficiency	%	

34.6	Power consumption at rated flow	KW	
34.7	Motor HP provided	HP / KW	
34.8	Material of Construction		
34.8.1	Impeller		
34.8.2	Casing		
34.8.3	Pump & Line Shaft		
34.8.4	Bearings		
34.8.5	Impeller/Casing Wearing Rings		
35.0	Oil Level Indication in Gear Box provided	Yes/No	
35.1	Type & Model No.		
35.2	Manufacturer		
35.3	Contact rating		
36.0	Cooling Tower Materials of Construction		
36.1	Casing		
36.2	Louvers		
36.3	Cell Partition Walls		
36.4	Basin Partition Walls		
36.5	Stack		
36.6	Stair Case		
36.7	Hot Water piping		
36.8	Hot Water distribution basin		
36.9	Internal Walkways		
36.10	Supporting Structure		
36.11	Hand Rails		
36.12	Structure Connector		
36.13	Bolts, nuts, washers and other hardware		
36.14	Nails		
36.15	Anchor Bolts		
36.16	Hot Water Distribution Nozzle		
36.17	Hot Water distribution Plates		
36.18	Spacers		
36.19	Mechanical Equipment Support		
37.0	Weight of Equipments		
37.1	Weight of Heaviest part to be handled	Kg	
37.2	Size of largest part to be handled		
37.3	Weight of gear box	Kg	
37.4	Weight of fan drive motor	Kg	
38.0	Inspection & Testing		
38.1	Hydro Test Pressure for Hot water piping		
38.1.1	Test Pressure	Kg/cm2 (g)	
38.1.2	Duration	Minutes	
38.2	Balancing test for the fan and the drive shafts shall be conducted.	Yes / No	
38.3	Field performance test for the tower shall be conducted.	Yes / No	
39.0	Flow per cell at design condition	M^3/Hr	
40.0	Maximum Water Handling capacity (per cell)	M^3/Hr	
41.0	Cooling Water Flow Rate (L)	$Kg/m^2/Hr$	

42.0	Dry Air Flow Rate (G)	$Kg/m^2/Hr$	
43.0	Ratio of Water to Air	(L/G)	
44.0	Dry Air Flow	Kg/Hr	
45.0	Temperature of air leaving the Stack	°C	
46.0	Inlet air Enthalpy	KCal/Kg	
47.0	Exit air Enthalpy	KCal/Kg	
48.0	Total Heat Exchange/Kg of Inlet Dry air	KCal/Kg	
49.0	Losses in hot water piping	MWC	
50.0	Type of air inlet	MWC	
51.0	Pressure recovery from fan stack	mm	
52.0	Air inlet are per cell	Max.	
53.0	Splash surface of fill per cell	M^2	
54.0	Whether fan blades are adjustable degree of pitch adjustment	°C	
55.0	Max. possible discharge through fan (indicate angle of pitch)	M^3/Hr	
56.0	Design value of discharge through fan (indicate angle pitch)	M^3/Hr	
57.0	Weight of complete fan assembly	kg	

TECHNICAL DATA - PART - B (ELECTRICAL)
(SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO		UOM	DETAIL
1.0	**GENERAL**		
i)	Manufacturer & Country of origin.		
ii)	Equipment driven by motor)		
iii)	Motor type		
iv)	Country of origin		
v)	Quantity	nos.	
2.0	**DESIGN AND PERFORMANCE DATA**		
i)	Frame size		
ii)	Type of duty		
iii)	Type of enclosure and method of cooling		
vi)	Type of mounting		
vii)	Direction of rotation as viewed from DE END		
viii)	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard	(KW)	
ix)	(A) Derated rating for specified normal condition i.e. 50 deg. C ambient temperature	(KW)	
	(B) Rating as specified in load list	(KW)	
xi)	Rated speed at rated voltage and frequency	rpm	
xii)	At rated Voltage and frequency		
	a) Full load current	A	
	b) No load current	A	
xiii)	Power Factor at		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
	e) NO load		
	f) Starting.		
xiv)	Efficiency at rated voltage and frequrecy		
	a) 100% load		
	b) At duty point		
	c) 75% load		
	d) 50% load		
xv)	Starting current*(inclusive of IS tolerance)* at		
	a. 100 % voltage	A	
	b. Minimum starting voltage	A	
xvi)	Starting time with minimum permissible voltage		
	a. Without driven equipment coupled	sec	
	b. With driven equipment coupled	sec	

xvii)	Safe stall time with 110% of rated voltage		
	a. From hot condition	sec	
	b. From cold condition	sec	
xviii)	**Torques :**		
	a. Starting torque at min. permissible voltage	(kg-mtr.)	
	b. Pull up torque at rated voltage.	(kg-mtr.)	
	c. Pull out torque	(kg-mtr.)	
	d. Min accelerating torque available	(kg-mtr.)	
	e. Rated torque	(kg-mtr.)	
xix)	Stator winding resistance per phase (at 20 Deg.C.)	Ohm	
xx)	GD^2 value of motors		
xxi)	Locked rotor KVA input (at rated voltage)		
xxii)	Locked rotor KVA/KW.		
xxiii)	**Bearings**		
	a. Type		
	b. Manufacturer		
	c. Self Lubricated or forced Lubricated		
	d. Recommended Lubricants		
	e. Guaranteed Life in Hours		
	f. Whether Dial Type thermometer provided		
	g. Oil pressure Gauge/switch		
	i. Range		
	ii. Contact Nos. & ratings		
	iii. Accuracy		
xxiv)	**Vibration**		
	a) Velocity	mm/s	
	b) Displacement	microns	
xxv)	Noise level	db	
3	**CONSTRUCTIONAL FEATURES**		
i	Stator winding insulation		
	a. Class & Type		
	b. Tropicalised (Yes/No)		
	c. Temperature rise over specified max.		
	i. Cold water temperature of 38 DEG. C.		
	ii. Ambient Air 50 DEG. C.		
	d. Method of temperature measurement		
	e. Stator winding connection		
	f. Number of terminals brought out		
ii	Type of terminal box for		
	a. stator leads		
	b. space heater		
	c. Temperature detectors		
	d. Instrument switch etc.		
iii)	For main terminal box		

	a. Location		
	b. Entry of cables		
	c. Recommended cable size		
	d. Fault level	MVA	
iv)	Temperature detector for stator winding		
	a Type		
	b. Nos. provided		
	c . Location		
	d. Make		
	e. Resistance value at 0 deg. C	ohms	
vi)	Paint shade		
vii).	Weight of(approx)		
	a. Motor stator (KG)		
	b. Motor Rotor (KG)		
	c. Total weight (KG)		
4	Relevant motor curves		

TECHNICAL DATA - PART - B (C&I)
(SUPPLIER DATA TO BE FURNISHED AFTER AWARD OF CONTRACT)

SL.NO	DESCRIPTION	UOM	DETAIL
	FOLLOWING DATA SHALL BE FILLED UP BY VENDOR FOR EACH		
1.0	MAKE		
1.1	MODEL		
1.2	TAG NO. / KKS NO.		
1.3	SERVICE		
1.4	QUANTITY		
1.5	OPERATING PRESSURE		
1.6	OPERATING TEMPERATURE		
1.7	DESIGN PRESSURE		
1.8	DESIGN TEMPERATURE		
1.9	RANGE		

COMPLIANCE DRAWING

A) WATER ANALYSIS (ANNEXURE-I)
B) DETAILS OF CT OUTLET (ANNEXURE-II)
C) COORDINATES AND BATTERY LIMIT OF IDCT (ANNEXURE-III)

TABLE- IV

DESIGN RAW WATER ANALYSIS

Sl.	Parameter	Unit	Values(*)
1	**Physical Characteristics**		
	pH at 25°C	----	6.34 – 7.39
	Turbidity	NTU	7.55 – 14.9
	Conductivity at 25°C	µS/cms	384 - 428
	Total Dissolved Solids	ppm	246 - 274
2	**Cations**		
	Calcium Hardness	ppm as $CaCO_3$	51 - 121
	Magnesium Hardness	ppm as $CaCO_3$	44 - 112
	Sodium + Potassium	ppm as $CaCO_3$	45.5 - 79
	Iron	ppm as $CaCO_3$	0.24 – 0.97
3	**Anions**		
	M-Alkalinity	ppm as $CaCO_3$	58 - 118
	Chlorides	ppm as $CaCO_3$	34 - 90
	Sulphates	ppm as $CaCO_3$	7 - 32
	Nitrates	ppm as $CaCO_3$	13.6 – 25.3
4	Total Hardness	ppm as $CaCO_3$	95 - 233
5	Reactive Silica	ppm as SiO_2	10.27 – 24.1
	Colloidal Silica		-
6	COD	ppm	36
7	BOD	ppm	5

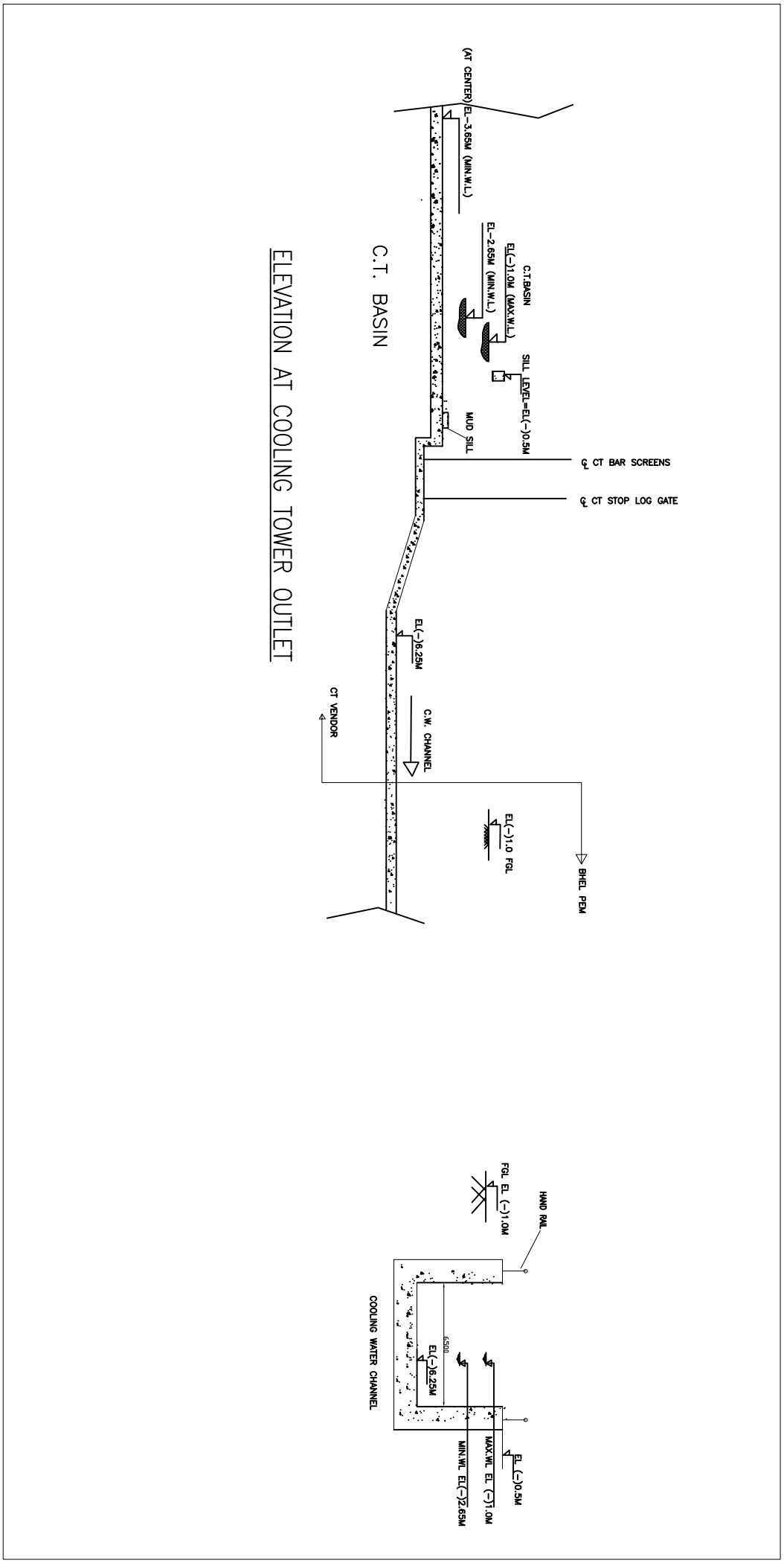
* Updated values if any, will be provided at later date

TABLE-V

QUALITY OF CLARIFIED WATER

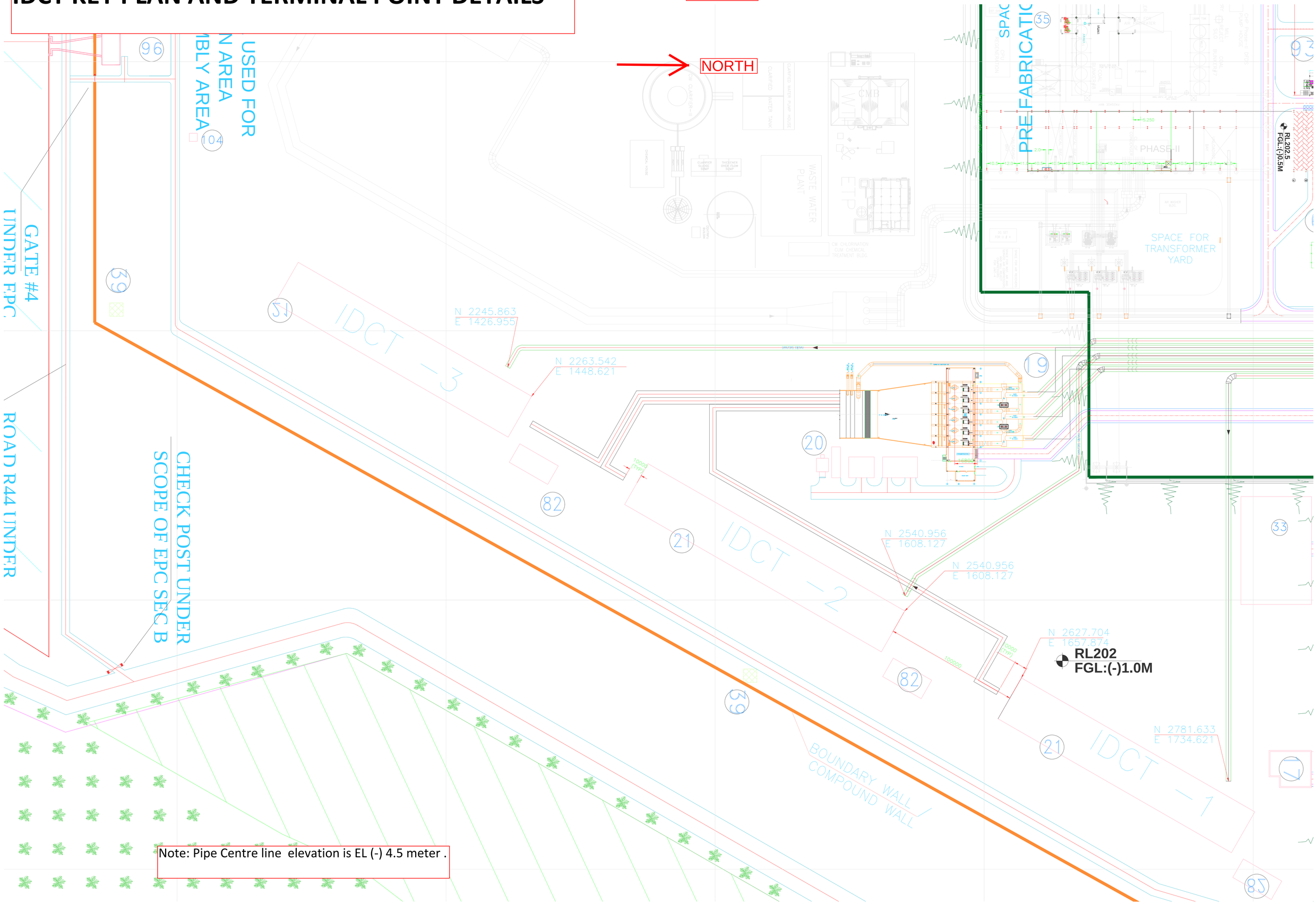
1.	Turbidity of treated water	Shall not exceed 10 NTU at rated flow and 15 NTU AT 20% overloading condition.

ANNEXURE-2


ELEVATION AT COOLING TOWER OUTLET
C.T. BASIN
(AT CENTER) EL-3.65M (MIN.W.L.)
EL-2.65M (MIN.W.L)
C.T.BASIN
EL(-)1.0M (MAX.W.L.)
SILL LEVEL=EL(-)0.5M
MUD SILL
℄ CT BAR SCREENS
℄ CT STOP LOG GATE
EL(-)6.25M
C.W. CHANNEL
CT VENDOR
EL(-)1.0 FGL
BHEL PEM
FGL EL (-)1.0M
HAND RAIL
COOLING WATER CHANNEL
6500
EL(-)6.25M
MIN.WL EL(-)2.65M
MAX.WL EL (-)1.0M
EL (-)0.5M

IDCT KEY PLAN AND TERMINAL POINT DETAILS

ANNEXURE-3



Note: Pipe Centre line elevation is EL (-) 4.5 meter .

PERFORMANCE GUARANTEES TO BE DEMOSTRATED AT SITE

1	**PERFORMANCE GUARANTEES:**
1.1	Each equipment shall be guaranteed to meet the performance requirement as specified.
1.2	The cold-water temperature shall be guaranteed for the design conditions of CW flow, range, ambient WBT and RH as per the performance test procedure of cooling tower attached herewith.
1.3	All costs associated with the tests including cost associated with the supply, calibration shall be included in the bid price.
1.4	Instruments required for conducting the PG Test shall be as per 'CT PG Test Procedure' attached in the specification.
1.5	The Performance / Acceptance test shall be carried out as per the standard procedure included in the specification.
1.6	The performance test of one of the Cooling Tower shall be carried out by the Successful Contractor through CTI approved/listed testing agency in presence of Owner. The testing agency proposed by the Successful Contractor shall be approved by the Owner. The tower to be tested through CTI testing agency shall be decided / chosen by Owner. For the balance cooling tower the performance test shall be conducted by the Successful Contractor for demonstration purpose only.
1.7	Apart from above performance guarantees, bidder shall guarantee the total Power consumption per Cooling Tower, for the cooling tower fans.
2	**Fan Power Consumption (KW) and CW Pumping Head:**
2.1	The total fan Power Consumption (KW) and the CW Pumping head (MWC) within bidder's terminal points shall not exceed the respective maximum limits specified in Technical Data Part-A.
2.2	Bidder shall submit the total fan Power Consumption (KW) and CW pumping head calculation along with his technical offer for reference.
2.3	The CW pumping head specified limit is inclusive of static head plus frictional losses including 10% margin on frictional losses.
2.4	Bids with total fan power consumption (KW) and the CW pump head (MWC) more than the specified maximum limits shall not be accepted.
2.5	The elevation of the top of the hot water distribution pipe header of each cell shall not be less than as indicated in technical data sheet part-A.
2.6	No advantage shall be given to any bidder for total fan power consumption (KW) and CW pumping head (MWC) offered less than specified maximum limits.
2.7	The bidder's Cooling Tower thermal design shall take care of above aspects including maximum permissible plan dimensions indicated in Technical Data Part-A.
2.8	The bidder shall substantiate the CW pumping head with calculations in the event of order and same shall be subjected to approval. CW pumping shall be calculated as follows:

2.9	Frictional losses for pipes shall be as per William & Hazen formula with C = 100. Frictional losses for various valves & fittings e.g. Miter bends, valves, tees, reducers etc. shall be as per crane handbook. Ft Value for fitting friction drop calculation to be considered as 0.01 for all sizes greater than 600NB.The frictional losses shall be computed considering 10% margin on same. William & Hazen formula: V = 0.85 X C X (i)^0.54 X (d/4)^0.63.	
3	**AMOUNT OF LIQUIDATED DAMAGES FOR SHORTFALL IN GAURANTEED PARAMETERS:**	
3.1	If the performance guarantee(s) are not met by the Contractor during PG Test, it will be concluded that, the equipment has failed to meet the guarantee(s) and action shall be taken as per the Contract Requirement.	
3.2	If the performance guarantee(s) specified above are not met by the Contractor even after the modifications and/or replacements mentioned, BHEL / NLC will accept the equipment / system only after levying liquidated damages against the Contractor and such liquidated damages shall be deducted from the Contract Price.	
3.3	The liquidated damages, for shortfall in performance and aux power consmption indicated are on per unit basis and shall be levied separately for each unit. The liquidated damages shall be prorated for the fractional parts of the deficiencies.	
	Guarantee	**Rate of liquidated damages (LD)**
	Per Cooling Tower - For every 0.1 deg. C rise (upto 0.5°C) in Cold Water Temperature from the guaranteed value **Limiting Value**: Increase of cold water temperature more than 0.5 deg C (i.e more than 33.5 deg C) from the guaranteed value of 33 deg C, IDCT shall be rejected.	INR 2,46,87,735/- (Rupees Two Crore Forty Six Lac Eighty Seven Thousand Seven Hundred and Thirty Five Only) For every 0.1 deg C increase of the cold water temperature at design condition from the guaranteed value.
	Per Cooling Tower - For every KW of aux power consumption	INR 1,48,045/- (Rupees One Lac Forty Eight Thousand and Forty Five Only) For every 1 KW increase in auxiliary power consumption of all operating power consuming auxiliaries at 100% TMCR load from the guaranteed value.
4	The purchaser is, however, not bound to accept the equipment and reserves the right to reject it if the actual values exceed beyond the plant design limits.	

SUB VENDOR LIST

2.00.00 ACCEPTANCE CRITERIA FOR SUB VENDORS

2.01.00 **For all Mechanical, Electrical, Control and Instrumentation**

2.01.01 **For Class I Items:**

a) Acceptance criteria:

Contractor to furnish documentary evidence to show that similar type of Equipment/
Component/ System (as the case may be), that has been supplied by the Contractor/Sub-vendor or their associate/collaborator for 500 MW or higher size unit and the same has been operating satisfactorily for two years as on date of request from main Contractor but not later than one year after the date of award of EPC package unless otherwise specified in the respective clause. The documentary evidence shall be in the form of Performance certificates furnished by the end user with relevant supporting documents. .

b) Acceptance criteria:

Contractor to furnish documentary evidence to show that similar or higher capacity of respective Equipment/component/ system (as the case may be) has been supplied by the Contractor/Sub-vendor or their associate/collaborator and the same has been operating satisfactorily for two years as on date of request from main Contractor but not later than one year after date of award of EPC package unless otherwise specified in the respective clause. The documentary

evidence shall be in the form of Performance certificates furnished by the end user with relevant supporting documents.

2.01.02 **For Class II Items:**

a) Acceptance Criteria:

Contractor to furnish documentary evidence to show that similar type Equipment/Component/ System (as the case may be) has been supplied by the vendor for 500MW or higher size unit. The documentary evidence shall be in the form of Material Receipt Certificate or Site Inspection Report or any other documentary evidence from the end user for having received the material by the end user.

b) Acceptance criteria :

Contractor to furnish documentary evidence to show that similar or higher capacity of respective Equipment/Component/ System (as the case may be) has been supplied by the vendor. The documentary evidence shall be in the form of Material Receipt Certificate or Site Inspection Report or any other documentary evidence from the end user for having received the material by the end user.

The component/equipment / system covered under Class I and Class II are furnished below for Mechanical, Electrical, Control and Instrumentation.

MECHANICAL ITEMS
i) Class I items: Items for which Performance certificates shall be furnished for approval of Category-II sub vendors during detail engineeringas stipulated above in Cl. No. 2.01.01.

H	**Cooling Tower**	
1	Nozzle for distribution system	2.01.01 (a/b)
2.	CT Fans	2.01.01 (a/b)
3.	Gearbox	2.01.01 (a/b)

MECHANICAL ITEMS
Class II items: The documentary evidence for approval of Category II sub vendors shall be in the form of Material Receipt Certificate or Site Inspection Report etc. from the End user for having received the material by the end user as stipulated above in Cl. No. 2.01.02.

G	**Cooling Tower**	
1	Tower Fill	2.01.02 (a/b)
2	Drift eliminator	2.01.02 (a/b)
3	Sluice gate valve	2.01.02 (a/b)

COOLING TOWER - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)			
SL. NO	**EQUIPMENTS / SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
H.	**COOLING TOWER**		
1.	NOZZLE FOR DISTRIBUTION SYSTEM	1. COOLDECK INDUSTRIES PVT. LTD., 2. HAMMON, INDIA. 3. M M AQUA TECHNOLOGIES LTD., 4. PAHARPUR,	1. CALCO, INDIA 2. HAMONSHRIRAM COTTRELL PVT. LTD., 3. KAUSHIKMOULDING, INDIA. 4. NEEL KAMAL LTD., 5. NILKAMAL LTD.
2.	CT FANS	1. PAHARPUR,	1. AEROTECH, 2. AMALGAMATED, INDIA 3. COFIMCO, INDIA 4. HAMONSHRIRAM COTTRELL PVT. LTD., 5. HOWDEN 6. MAYA, INDIA 7. PARAQ, INDIA 8. SPANCRETE,
3.	GEARBOX	1. BONFIGLIOLI, INDIA 2. ELECON, INDIA 3. GREAVES 4. PREMIUM TRANSMISSION LTD, INDIA 5. SHANTI GEARS, INDIA	1. BREVINI, INIDA 2. ESENPRO, INIDA 3. MAGTORQ BANGALORE, INIDA 4. MOVENTAS, MULTINATIONAL 5. NEW ALLENBERRY WORKS, 6. PAHARPUR, 7. ROSSI GEARMOTORS (INDIA) PVT. LTD, INIDA 8. SIEMENS (FLUNDER) GERMANY, INIDA 9. SIEMENS FLENDER, INIDA/GERMANY 10. SEW EURODRIVEGMBH& CO. , INDIA

COOLING TOWER - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)

SL. NO	EQUIPMENTS / SYSTEM	ACCEPTABLE SUB VENDORS (CATEGORY – I)	BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)
H.	**COOLING TOWER**		
1	TOWER FILL	1. COOLDECK, INDIA 2. ENEXIO INDIA, INDIA 3. MM AQUA, INDIA 4. PAHARPURCOOLING TOWERS LTD., INDIA	1. HEWITECH GMBH & CO. KG, INDIA 2. NEEL KAMAL LTD., 3. NILKAMAL LTD., 4. BRENTWOOD,
2	DRIFT ELIMINATOR	1. HAMON COOLING SYSTEM PVT. LTD. 2. M M AQUA TECHNOLOGIES LTD., 3. PAHARPUR COOLING TOWERS LTD, INDIA 4. SUPERPLAST COMPANY, 5. COOLDECK INDUSTRIES PVT. LTD., 6. ENEXIO	1. BRENTWOOD, 2. HEWITECH GMBH & CO. KG, INDIA
3	SLUICE GATE VALVE	1. FOURESS ENGINEERING, 2. H.SARKAR, INDIA 3. HAWA ENGINEERS, 4. JASHENGG, INDIA. 5. KBL, INDIA 6. LEADER VALVES	1. A.V. VALVES LTD., 2. ATAM VALVES, 3. CANLE VALVES, 4. DURGA, 5. EQUAL, 6. FLOW LINK, INDIA 7. FLUIDLINE VALVES, 8. INTERVALVEPOONAWALLA, 9. MACMET, INDIA 10. MECGALE, INDIA. 11. MICON VALVES (INDIA), 12. NITON VALVES INDUSTRIES, 13. NSSL PRIVATE LTD., 14. ORBINOX, INDIA 15. OSWAL INDUSTRIES, 16. R&D MULTIPLES, INDIA 17. SAP INDUSTRIES, 18. SK INDUSTRIES (SHREE KRISHNA), INDIA 19. STEEL STRONG VALVES, 20. TRILLIUM FLOW TECHNOLOGIES, 21. V.K. VALVES 22. VALTECH INDUSTRIES

CIRCULATING WATER SYSTEM - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)			
SL. NO	**EQUIPMENTS / SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
F.	**CIRCULATING WATER SYSTEM**		
1.	CONCRETE VOLUTE PUMP	1. FLOW SERVE, INDIA 2. FLOW SERVE, SPAIN 3. JYOTI PUMP, INDIA 4. KBL, INDIA 5. WPIL, INDIA	1. ANDRITZ PUMP, AUSTRIA 2. ANDRITZ PUMP, CHINA 3. ANDRITZ PUMP, INDIA 4. BHEL 5. CHANGSHA PUMP, CHINA 6. LEO GROUP PUMP (HUNAN) CO.LTD, CHINA 7. MITSUBISHI HEAVY INDUSTRIES, JAPAN
2.	VERTICAL TURBINE PUMP	1. FLOW SERVE, INDIA 2. FLOW SERVE, SPAIN 3. JYOTI PUMP, INDIA 4. KBL, INDIA 5. WPIL, INDIA	1. ANDRITZ PUMP, AUSTRIA 2. ANDRITZ PUMP, CHINA 3. ANDRITZ PUMP, INDIA 4. BHEL 5. CHANGSHA PUMP, CHINA 6. LEO GROUP PUMP (HUNAN) CO.LTD, CHINA 7. MITSUBISHI HEAVY INDUSTRIES, JAPAN
3.	RUBBER EXPANSION JOINT (2000 NB & ABOVE)	1. CORI ENGINEERS PVT LTD, INDIA 2. D.WREN INDUSTRIES LTD. INDIA 3. SRMEXOFLEXPVT LTD, INDIA	1. APHRODITE POLYPRENEPVT LTD, INDIA 2. BHEL 3. PRECISE ENGINEERS LTD. INDIA
4.	CW SUPPLY AND RETURN PIPING	1. RATNAMANI METALS & TUBES LTD.,, AHEMEDABAD 2. WELSPUN CORP LIMITED,, MUMBAI	1. ALTEC FABRICATORS, TRICHIRAPALLI 2. ARCELORMITTAL NIPPON STEEL, HAZIR 3. CAPACITE STRUCTURES LTD., MUMBAI 4. EXCEL INDUSTRIES., HYDERABAD 5. JINDAL SAW LTD.,, NEW DELHI 6. MEGHA ENGINEERING, HYDERABAD 7. SG HEAVY ENGINEERING PVT LTD, PALGHAR

CIRCULATING WATER SYSTEM - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)			
SL. NO	**EQUIPMENTS / SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
5.	ELECTRO HYDRAULIC ACTUATOR (POWER PACK) FOR BUTTERFLY VALVES	1. ROTORK INDIA	1. AIRA INDIA 2. BOSCH REXROTH (INDIA) LIMITED, AHMEDABAD 3. HENGEHUN CHINA 4. HYDAC (INDIA) PVT. LTD, MUMBAI 5. PARKER HAANNIFIN (INDIA) PVT. LTD., MUMBAI 6. ROTEXINDIA 7. SEHUCK INDIA 8. YUKEN INDIA LTD., DELHI
6.	BUTTERFLY VALVES (2000NB & ABOVE)	1. AUDCO, INDIA 2. ADVANCE VALVE, INDIA 3. BDK, INDIA 4. BANKIM COMPANY, INDIA 5. BHEL 6. DEL VALVE, INDIA 7. FOURESS, INDIA 8. HAWA ENGINEERS, INDIA 9. H SARKAR& COMPANY, INDIA 10. INTERVALVE, INDIA 11. KEYSTONE, INDIA 12. KIRLOSKAR BROS. LTD, INDIA 13. LARSEN & TOUBRO LIMITED, INDIA 14. R&D MULTIPLES INDIA PVT. LTD, INDIA 15. SAUNDERS (CRANE), INDIA 16. TYCO, INDIA	1. ADAMS, INDIA, 2. AMPO POYAM VALVES, INDIA 3. BRAY CONTROL, INDIA 4. CRANE, INDIA 5. INSTRUMENTATION LIMITED, INDIA 6. TYCO/ PENTAIR, INDIA
7.	STOP LOG GATE	1. GMWENGG. PVT LTD. 2. JASHENGG. WORKS 3. MACMET 4. TRIVENI ENGINEERING & INDUSTRIES LTD 5. SHREE TRIMURTHI	1. BANGALORE HYDRO ENGINEERS & CONSULTANTS PRIVATE LIMITED 2. HINDUSTAN ENGINEERING WORKS 3. HINDUSTAN ENGINEERS LTD

CIRCULATING WATER SYSTEM - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)			
SL. NO	**EQUIPMENTS / SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		TECHNOLOGIST PVT LTD.	4. INDO ASIATIC 5. MECGALE PNEUMATICS PVT LTD 6. SREESARAVANA ENGINEERING BHAVANI (P) LIMITED 7. PRADEEP STRUCTURES 8. REDFAB 9. BSBK ENGG 10. PARCHURE ENGINEERS PVT LTD.
8.	COARSE SCREEN	1. GMWENGG. PVT LTD. 2. JASHENGG. WORKS 3. MACMET 4. MECGALE PNEUMATICS PVT LTD 5. TRIVENI ENGINEERING & INDUSTRIES LTD 6. SHREE TRIMURTHI TECHNOLOGIST PVT LTD.	1. BANGALORE HYDRO ENGINEERS & CONSULTANTS PRIVATE LIMITED 2. HINDUSTAN ENGINEERING WORKS 3. HINDUSTAN ENGINEERS LTD 4. INDO ASIATIC 5. SREESARAVANA ENGINEERING BHAVANI (P) LIMITED 6. PRADEEP STRUCTURES 7. REDFAB 8. BSBK ENGG 9. PARCHURE ENGINEERS PVT LTD.

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS I)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		8. VARAT PUMP & MACHINERY PVT LTD, KOLKATA 9. FLOWCON ENGINEER INDIA PRIVATE LIMITED,COIMBATORE 10. WPIL LTD. INDIA 11. JYOTI PUMPS LTD. INDIA 12. FLOW MORE INDIA 13. MATHER & PLATT INDIA 14. SULZER INDIA INDIA 15. WEIR MINERALS (INDIA) PVT LTD., BANGALORE 16. XYLEM INDIA 17. MAXFLOW PUMPS INDIA PVT LTD, MANESAR	
ii)	Positive displacement pumps		1.ALEKTON ENGG.INDUSTRIES P.L 2. ALLWEILER INDIA PVT.LTD. 3. U.T.PUMPS & SYSTEMS PVT. LTD.
iii)	Submersible pumps	1. SU MOTORS PVT. LTD., MUMBAI INDIA 2. DARLING PUMPS PVT. LTD, INDOR INDIA 3. FLOWMORE LTD., GHAZIABAD INDIA 4. VARAT PUMP AND MACHINERY PVT. LTD., HOWRAH INDIA 5. WPIL LIMITED, THANE INDIA 6. KIRLOSKAR BROTHERS LTD. INDIA 7. JYOTI PUMPS LTD. INDIA 8. MATHER & PLATT INDIA 9. KISHOR PUMP INDIA 10.SULZER INDIA INDIA 11.SAM TURBO INDIA 12.XYLEM INDIA AHMEDABAD INDIA	1. MODY PUMPS (INDIA) PRIVATE LIMITED, THANE INDIA 2. AQUA MACHINERIES (P) LTD., AHMEDABAD INDIA 3. JASCO PUMP PVT. LTD.,
iv)	Sump pumps a. Centrifugal type b. Screw type	1. SAM TURBO, COIMBATORE 2. KISHORE PUMPS, PUNE 3. SU MOTORS, MUMBAI 4. FLOWMORE PUMP, GAZIABAD 5. DARLING PUMP, INDORE 6. KIRLOSKAR BROTHERS LTD. (KBL) 7. KSB	1. MCNALLY SAYAJI, BANGALORE 2. AQUA MACHINERY, AHMEDABAD 3. VARTAK PUMPS 4. MAXFLOW 5. DOWELL ENGINEERS,/NEYVELI 6. XYLEM INDIA

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS I)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		8. VARAT PUMP & MACHINERY PVT LTD/KOLKATA. 9. WPIL LTD. INDIA 10. JYOTI PUMPS LTD. INDIA 11. MATHER & PLATT INDIA 12. SULZER INDIA INDIA 13. MODY PUMPS (INDIA) PRIVATE LIMITED, THANE INDIA	
13	FANS		
i)	Centrifugal Fan	1. PATEL AIR TEMP, AHMEDABAD 2. FLAKT, KOLKATA 3. CB DOCTOR 4. KRUGER INDIA 5. CITIZEN INDIA	1. MARATHAN ELECTRIC, KOLKATA 2. S.K. SYSTEMS, DELHI 3. DUSTVEN, BANGALORE 4. EBMNADI INDIA 5. NICOTRA INDIA
14	HEAT EXCHANGER: i) Plate Type Heat Exchanger for DMCW (SG & TG)	1. KELVION INDIA PVT. LTD., PUNE INDIA 2. ALFA LAVAL, INDIA / SWEDEN/KOREA 3. IDMC LIMITED, ANAND, INDIA 4. SONDEX HEAT EXCHANGERS INDIA PVT. LTD., VADODARA, INDIA 5. TRANTER INDIA PRIVATE LIMITED, PUNE,INDIA	1. DKT CO. LTD, INDIA 2. HISAKA, KOREA 3. ABACAS, INDIA 4. MYTEC, KOREA 5. FUNKE, INDIA 6. L&T
15	BUTTERFLY VALVE LARGE DIA (450NB AND BELOW 2000NB)	1. ADVANCE VALVE, INDIA 2. AUDCO,INDIA 3. BHEL, INDIA 4. CRANE , INDIA 5. FOURESS, INDIA 6. HAWA ENGINEERS, INDIA 7. IL, INDIA 8. INTERVALVE, INDIA 9. LARSEN & TOUBRO LIMITED, INDIA 10. SAUNDERS (CRANE) , INDIA 11. R&D MULTIPLES PVT. LTD INDIA 12. KRILOSKAR BROS. LTD,INDIA	1. ADAMS, INDIA 2. BRAY CONTROLS , INDIA 3. PENTAIR , INDIA 4. TRILLUM FLOW (WEIR BDK)

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS I)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
16	MS PIPE (OTHER THAN CW SUPPLY AND RETURN PIPING) 450 NB AND ABOVE	1. JINDAL SAW LTD.,, NEW DELHI 2. RATNAMANI METALS & TUBES LTD.,, AHEMEDABAD 3. WELSPUN CORP LIMITED,, MUMBAI 4. ARCELORMITTAL NIPPON STEEL, HAZIRA 5. SURYA ROSHNI LTD, BAHADUR GARH 6. JCO GAS PIPE LTD., CHHINDWARA	1. ASIAN MILLS PVT LTD, AHMEDABAD 2. CAPACITE STRUCTURES LTD., MUMBAI 3. LALIT PIPES AND PIPES LIMITED, NAVI MUMBAI 4. MEGHA ENGINEERING, HYDERABAD 5. MUKAT TANKS AND VESSELS PVT LTD, MUMBAI 6. SG HEAVY ENGINEERING PVT LTD, PALGHAR 7. TOPWORTH PIPES & TUBES PVT.LTD.,, NAVI MUMBAI
17	MAIN PLANT IA/SA COMPRESSOR	1. ATLAS COPCO (INDIA) LTD. 2. CHICAGO PNEUMATIC SALES 3. ELGI EQUIPMENTS LTD 4. ELGI SAMSUNG (CENTRIFUGAL TYPE) 5. INGERSOLL RAND (INDIA) LIMITED 6. KIRLOSKAR PNEUMATIC COMPANY 7. KOBELCO COMPRESSORS INDIA PVT LTD	1. AERZENER MACHINEN FABRIK GmbH 2. CICB CHEMICON P LTD 3. FS COMPRESSORS INDIA PVT. LTD. 4. FS ELLIOTT 5. HITACHI

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS II)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
7	Manual Hoist	1. REVA INDUSTRIES INDIA PRIVATE LIMITED, FARIDABAD 2. TRACTEL TIRFOR INDIA PVT.LTD., NEW DELHI 3. EDDY CRANES PRIVATE LIMITED, MUMBAI 4. TUOBRO FURGUSON [INDIA]PVT.LTD., KOLKATA 5. TECHNO INDUSTRIES,/AHMEDABAD 6. UNIVERSAL HOIST-O FABRIK,/MUMBAI 7. HERCULES HOISTS LTD. 8. BRADY & MORRIS ENGINEERING CO. LTD. 9. TUOBRO FURGUSON (INDIA) P 10. TRACTEL TIRFOR INDIA PVT. 11. TECHNO INDUSTRIES 12. UNIVERSAL HOIST-O-FABRIK 13. TECHNO INDUSTRIES INDIA 14. ANUPAM INDUSTRIES LTD INDIA 15. ELECTROMECH INDIA 16. WMI INDIA 17. FAFECO INDIA 18. ACME INDIA 19. DEMAG INDIA 20. KONE INDIA INDIA 21. WH BRADY INDIA 22. UNICON INDIA 23. ALFA CRANES INDIA 24. AVON CRANES INDIA 25. GLOBAL TECHNOLOGIES INDIA 26. TISCO GROWTH INDIA 27. ROCKWELL HOISTO INDIA 28. TUOBROFURGUSON (INDIA) PVT. LTD. INDIA	1. MELTECH CRANES PVT LTD.,MUMBAI 2. MANGLA HOISTS PRIVATE LIMITED, NEW DELHI 3. BAKELITE ELECTRICAL MFG. CO PVT LTD 4. UNIQUE INDUSTRIAL HANDLERS INDIA 5. JAPS PROJECTS INDIA 6. ENDEAVOUR INDIA 7. CENTURY INDIA 8. CRANETECH EQUIPMENT INDIA 9. ELEQUIP INDIA 10. SUNITCONCRANES INDIA 11. SMACO / YCUBE INDIA 12. CRANEX LTD INDIA 13. RMS ENGINEERS INDIA 14. TRANSPADEENGNRS. PVT. LTD INDIA 15. MILLARS INDIA 16. DYNAMECH CRANES AVON CRANE INDIA 17. LEAP LIFTING MACHINES PVT LTD INDIA 18. NAMSUNG MACHINARY INDIA 19. POWER BUILD P LTD INDIA

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS II)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		29. BRADDY& MORRIS INDIA 30. SAFEX INDIA 31. LIFTING EQUIPMETS AND ACCESSORIES INDIA 32. GRIP ENGINEERS PVT. LTD, HYDERABAD 33. INDEF INDIA 34. ARMSEL MHE PVT LTD., BANGALORE 35. HERCULES HOISTS LTD., MUMBAI 36. CENTURY CRANE ENGINEERS PVT LTD, FARIDABAD 37. CONSOLIDATED HOISTS PVT LTD.,PUNE 38. LIFTING EQUIPMENT INDIA	
8	Thermal Insulation	1. LLOYDS INSULATION, INDIA 2. MINWOOL ROCKFIBRE, BHILAI 3. THERMOCARE, RAJNANDGAON 4. MURUGAPPA MORGAN, CHENNAI 5. MINSULATE MANUFACTURING COMPANY, JAMSHEDPUR 6. GOENKA ROCKWOOL (INDIA) PVT LTD.,/RAIPUR (C.G) 7. HEINRICH TAPP GMBH - GERMANY 8. EUGEN ARNOLD GMBH - GERMANY 9. POLYBOND INSULATION PVT.LTD.,/BHILAI 10. SHREERAM EQUITECH PVT. LTD., DURG 11. ROCKWOOL INDIA PVT. LTD.	1. DHANBAD ROCKWOOL INSULATION PVT LTD 2. IIG INDUSTRIEISOLIERUNGEN GMBG GREMANY 3. ADVANCE THERMAL CORP USA 4. IZOLACE BERAN S.R.O. CZECH REPUBLIC 5. ADVANCE THERMAL SOLUTIONS FLORIDA USA 6. ADARSH INSULATION 7. HI-TEC ROCKFIBRE PVT LTD //RAJNANDGAON. 8. JAMSHEDPUR MINERAL WOOL MFG.CO./JAMSHEDPUR 9. LION INSULATION PRIVATE LIMITED/KOLAR ROAD, BHOPAL 10. PUNJSTAR INSULATION FIBRE/BHILAI 11. INDO BELL INSULATIONS LTD. KOLKATA 12. SHREE ENGINEERS INDORE 13. ALLIED INSULATIONS (INDIA) 14. ENERGY SAVING AND ALLIED PRODUCTS 15. SUDHIR TRADING COMPANY 16. SHREE CERAMIC FIBRES PVT. LTD.

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS II)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		COIMBATORE 6. TEMSONN VESSELEX, NOIDA & MANESAR 7. GEM, COIMBATORE 8. UNITED ENGINEERING WORKS, NASHIK 9. UNITED ENGINEERS INDIA 10. INTEGRATED ENGINEERS INDIA 11. ABACUS HEAT TRANSFER INDIA 12. ECO CONTROL SYSTEM INDIA 13. MACABER BEEKEY INDIA 14. INDURE INDIA 15. UTTAM FABRICATORS INDIA 16. BANSHIWALA ENGINEERING SERVICES INDIA 17. PRANJAL PROJECTS INDIA 18. TEMASMEVESELEX INDIA	
17	SHEAVE PULLEY	-	-
18	SLUICE GATES	1. JASH ENGG. WORKS,INDIA 2. MACMET,INDIA 3. GMW,INDIA	1. MECGALE,INDIA
19	STOP LOG GATE	1. GMW,INDIA 2. JASH ENGG. WORKS,INDIA 3. MACMET,INDIA 4. TRIVENI ENGINEERING & INDUSTRIES LTD	1. MECGALE,INDIA 2. MECGALE PNEUMATICS PRIVATE LIMITED 3. HINDUSTAN ENGINEERING WORKS 4. HINDUSTAN ENGINEERS LTD 5. BANGALORE HYDRO ENGINEERS & CONSULTANTS PRIVATE LIMITED 6. SREE SARAVANA ENGINEERING BHAVANI (P) LIMITED

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS II)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
20	COARSE SCREEN/TRASH RACK	1. GMW,INDIA 2. JASH ENGG. WORKS,INDIA 3. MACMET,INDIA 4. TRIVENI ENGINEERING & INDUSTRIES LTD	1. MECGALE,INDIA 2. MECGALE PNEUMATICS PRIVATE LIMITED 3. HINDUSTAN ENGINEERING WORKS 4. HINDUSTAN ENGINEERS LTD 5. BANGALORE HYDRO ENGINEERS & CONSULTANTS PRIVATE LIMITED 6. SREE SARAVANA ENGINEERING BHAVANI (P) LIMITED
21	DIAPHRAGM VALVE		1. DRESSER 2. FLOW TECH 3. KITAMURA VALVE 4. NEWCON VALVE 5. NIPPON DAIYO 6. PROCESS CONTROL 7. RICHER 8. SAUNDERS VALVES
22	CPVC VALVES		1. ASTRAL 2. BHAVANA POLYMERS 3. CEPEX 4. FINEFLOW DURO 5. FIP 6. GORGE FISHER 7. KATARIA 8. KISAN IRRIGATION 9. ORI PLAST 10. PRINCE 11. PURE WATER 12. SIGNET 13. SPAN CORPORATION. 14. SUDHAKAR PIPE INDIA
23	HDPE PIPES		1. INDIA FLEX 2. KATARIA INDUSTRIES PVT. LTD. 3. MANDHANA POLYMERS 4. MANJEERA 5. NARMADA PIPES

COMMON TO ALL ABOVE PACKAGES - CONSOLIDATED SUB-VENDOR LIST (CLASS II)			
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			6. PACIFIC INDUSTRIES 7. PARIXIT INDUSTRIES 8. REASELACK PIPES 9. SUDHAKAR 10. VARUNA 11. WIIK & HOEGLUND
24	UPVC PIPES		1. PRINCE 2. SUPREME 3. APOLLO PIPES 4. CENTURION 5. KISSAN 6. PREMIER 7. TRUBORE
25	CPVC PIPES		1. ASTRAL 2. BHAVANA POLYMERS 3. CEPEX 4. FINEFLOW DURO 5. FIP 6. GORGE FISHER 7. KATARIA 8. KISAN IRRIGATION 9. ORI PLAST 10. PRINCE 11. PURE WATER 12. SIGNET 13. SPAN CORPORATION. 14. SUDHAKAR PIPE INDIA
26	H2 AND CO2 CYLINDER		1. BPCL,INDIA 2. EVEREST IKANTO CYLINDERS,INDIA 3. MKC,INDIA 4. RAMA,INDIA
27	EXTERNAL COATING & WRAPPING MATERIAL FOR BURIED STEEL PIPING.	1. IWL INDIA LIMITED,INDIA	1. AR LAMINATORS,INDIA 2. MP TAR PRODUCTS,INDIA
28	INTERNAL COATING MATERIAL FOR MS PIPE	1. ASIAN PAINTS,INDIA 2. SHALIMAR PAINTS,INDIA	1. JOTUN PAINTS,INDIA 2. MP TAR PRODUCTS,INDIA
29	AXIAL FANS (OTHER THAN ID, PA & FD FAN)	1. ALMONAROD (P) LIMITED,INDIA	1. AIR CONTROL & CHEMICAL ENGINEERING COMPANY

ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)

H	**HT AND LT MOTOR AND ACTUATORS**		
1.	HT MOTORS	1. ABB 2. BHEL 3. CROMPTON GREAVES 4. CG POWER INDUSTRIAL SOLUTIONS 5. JYOTI 6. KEC 7. KIRLOSKAR ELECTRICL CO. LTD 8. SIEMENS 9. WEG 10. MARATHON 11. TMEIC	1. ABB, FINLAND 2. ASIR ROBICON, ITALY 3. BBL 4. BHARAT BIJLEE 5. CONVERTEAM , FRANCE 6. GE 7. HHI 8. HYOSUNG, KOREA 9. HYUNDAI HEAVY INDUSTRIES (HHI), KOREA 10. HYUNDAI, KOREA 11. IJLIN ELECTRIC, KOREA 12. JEUMONT ELECTRIC 13. NANYANG ELECTRIC MACHINE LTD.CO, CHINA 14. NANYANG, CHINA 15. SEC ELECTRIC MACHINERY , CHINA 16. SHANGHAI ELECTRIC, CHINA 17. SHANGHAI SHANGDIAN ELECTRIC MACHINE LTD.CO, CHINA 18. SIEMENS LTD,GERMANY 19. TD POWER 20. TECO ELECTRIC & MACHINERY, TAI-WAN 21. TECO, TAIWAN 22. TMEIC, JAPAN 23. TOSHIBA-MITSUBISHI 24. WEG, BRAJIL 25. XEMC, CHINA 26. XIAN ELECTRICAL MOTOR, CHINA

ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)

SL. NO	EQUIPMENTS/SYSTEM	ACCEPTABLE SUB VENDORS (CATEGORY – I)	BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)
2.	LT MOTORS (AC & DC)	1. ABB 2. ALSTOM 3. BHEL 4. BHARAT BIJLEE 5. CROMPTON GREAVES 6. CG POWER & INDUSTRIAL SOLUTION LTD 7. JYOTI 8. KEC 9. KIRLOSKAR ELECTRIC CO. LTD 10. LAXMI HYDRAULICS MARATHON 11. SIEMENS 12. TMEIC 13. WEG	1. ABB, SWEDEN 2. BALDOR, USA 3. BENN ELECTRICALS PVT LTD 4. CEMP, ITALY 5. DALIAN, CHINA 6. DAZHONG, CHINA 7. FUJI ELECTRIC, INDIA/BRAZIL 8. HAVELLS 9. HEM INDUSTRIES 10. HINDUSTAN 11. HYOSUNG, KOREA 12. HYUNDAI HEAVY INDUSTRIES (HHI), KOREA 13. HYUNDAI, KOREA 14. INTEGRATED ELECTRIC CO . KAWA-MATA, JAPAN 15. LDW, GERMANY 16. LEROY SOMER, CHINA 17. LEROY SOMER, FRANCE 18. NGEF 19. NORD 20. POWER HOUSE 21. PRECISION ENGINEERING WORKS 22. TECO, TAIWAN 23. TIPM, JAPAN 24. TOSHIBA-MITSUBISHI 25. TMEIC,JAPAN 26. TRIDENT POWERCRAFT 27. WEG, BRAZIL 28. WINKLEMAN, GERMANY 29. XEMC, CHINA
3.	LT MOTORS (FLAMEPROOF)	1. ABB 2. BHARAT BIJLEE 3. BHEL 4. CROMPTON GREAVES 5. CG POWER & INDUSTRIAL SOLUTION LTD 6. JYOTI 7. KEC 8. LAXMI HYDRAULICS 9. MARATHON 10. SIEMENS	1. ABB, SWEDEN 2. ALSTOM 3. CEMP, ITALY 4. FUJI ELECTRIC, INDIA/ JAPAN 5. HAVELLS 6. HEM INDUSTRIES 7. HYOSUNG, KOREA 8. HYUNDAI HEAVY INDUSTRIES (HHI), KOREA 9. INTEGRATED ELECTRIC CO 10. KAWAMATA, JAPAN

ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)

SL. NO	EQUIPMENTS/SYSTEM	ACCEPTABLE SUB VENDORS (CATEGORY – I)	BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)
		11. WEG	11. KIRLOSKAR ELECTRIC CO LTD 12. LDW, GERMANY 13. LHP 14. NGEF 15. NORD 16. PRECISION ENGINEERING WORKS 17. TECO, TAIWAN 18. TIPM, JAPAN 19. TMEIC, INDIA/ JAPAN 20. WEG,BRAZIL
4.	ELECTRICAL ACTUATORS	1. ABB 2. ANTRIEB TECHNIK 3. AUMA 4. LIMITORQUE INDIA LTD 5. NIPPON 6. ROTORK CONTROL (INDIA) LTD 7. SIEMENS	1. ABB, GERMANY 2. AUMA (I) PVT. LTD, GERMANY 3. AUMA RIESTER GmbH &Co., Germany 4. CONTROLS & SWITCHGEARS (C&S) 5. DREHMO, GERMANY 6. EMERSON, INDIA/ USA 7. ENERTORK, VIETNAM 8. FESTO 9. FLOWSERVE 10. FORBES MARSHALL (ARCA) 11. HAROLD BECK, USA 12. HENGCHUN 13. IL 14. LIMITORQUE (I) LTD, USA 15. LIND CO, USA 16. NIPPON GEAR, JAPAN 17. QUALITY PRECISION 18. ROTEX 19. ROTORK CONTROLS, UK 20. SIEMENS, GERMANY 21. SIPOS AKTRORIK GMBH, GERMANY 22. SUDHIR SWITCHGEARS PVT LTD 23. WEIR BDK VALVES- A UNIT OF WEIR, FRANCE
5.	VARIABLE FREQUENCY DRIVE (VFD) / VVFD	1. ABB 2. BHEL 3. GE 4. HITACHI HI-REL 5. POWER ELECTRONICS 6. ROCKWELL AUTOMATION 7. SCHNEIDER ELECTRIC	1. ALLEN BRADLEY 2. AMTECH 3. AMTECH ELECTRONICS INDIA LIMITED 4. ANSALDO (NIDEC), ITALY 5. ANSALDO, ITALY 6. BRUSH ELECTRIC

ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-I)

SL. NO	EQUIPMENTS/SYSTEM	ACCEPTABLE SUB VENDORS (CATEGORY – I)	BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)
		8. SIEMENS	7. BUSH ELECTRIC 8. CARRIER MIDEA INDIA PVT LTD 9. CGL 10. CONTROL INFOTECH LIMITED 11. CONTROL TECHNIQUE, UK 12. CONTROL TECHNIQUES INDIA PVT.LTD. 13. CONVERTEAM (GE), FRANCE 14. CONVERTEAM (GE), INDIA 15. DANFOSS 16. DANFOSS INDUSTRIES PVT LTD 17. DELTA 18. DYNASPEDE INTEGRATED 19. EMERSON 20. EUROTHERM (SCHNEIDER ELECTRIC), INDIA/ UK 21. EUROTHERM, INDIA 22. FUJI ELECTRIC INDIA PVT LTD 23. FUJI ELECTRIC SYSTEMS CO. LTD., 24. FUJI ELECTRIC SYSTEMS, JAPAN 25. FUJI ELECTRIC, JAPAN 26. GEMCO CONTROLS LTD 27. HI-REL ELECTRONICS LTD. 28. HITACHI 29. HITECHI 30. INGETEAM TECHNOLOGIES, SPAIN 31. KIRLOSKA 32. LARSEN & TOUBRO (L&T) 33. LENZE AC TECH 34. MEGATECH CONTROLS LTD 35. MOTORS AND DRIVES, LLC 36. NELCO 37. NEXTGEN AUTOMATION PVT. LTD./ C.D. AUTOMATION PVT. LTD. (SIEMENS MAKE) 38. NIDEC 39. PARKER HANNIFIN INDIA PVT LTD 40. POWERTECH 41. SERVO TECH 42. STOCK 43. TELAWNE 44. TMEIC

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
J	**LIGHTING FIXTURES**		
1.	LIGHTING FIXTURES (LED)	1. BAJAJ 2. CROMPTON GREAVES 3. GE 4. HAVELLS 5. HPL ELECTRIC & POWER PVT. LTD 6. INSTA POWER 7. SURYA ROSHNI LIM-ITED 8. SYSKA 9. PYROTECH ELECTRON-ICS PVT. LTD. 10. NESSA ILLUMINATION TECHNOLOGIES PVT. LTD 11. PHILIPS 12. WIPRO	1. APEX LUMINAIRES (P) LIMITED 2. AVAIDSTECHNOVATORSPVT. LTD. 3. BALIGA 4. C&S ELECTRIC LTD 5. CANARA LIGHTING INDUSTRIES LTD 6. CONTROL DEVICES 7. ELEXPRO ELECTRICALS PVT. LTD. 8. ENSAVE DEVICES PRIVATE LIMITED 9. EVERGREEN ENGG. CO. 10. GLOSTAR ELECTRICALS 11. GOLDWYN 12. HALONIX 13. JASPER ENGINEERS PRIVATE LIMITED 14. K.C.FIXTURES 15. FORUS ELECTRIC PVT LTD 16. HALONIX TECHNOLOGIES PVT LIMITED 17. TRANSRAIL LIGHTING LTD 18. MIKA ENGINEERS 19. NEEV LUMINARIES 20. PHIAMANG LIGHTING 21. R.K.LIGHTING 22. SHAKTI ENTERPRISES 23. VINTUS SYSYTEM

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
2.	LIGHTING FIXTURES (FLAME PROOF)	1. BAJAJ 2. CROMPTON GREAVES 3. GE 4. HAVELLS 5. PHILIPS 6. WIPRO	1. AJMERA 2. BALIGA ELECTRICALS 3. C&S 4. CGL 5. FCG 6. FLEXPRO 7. GELTRONIX 8. HALONIX 9. J B INDUSTRIES 10. KHERAJ 11. PYROTECH 12. SPECTRUM 13. SUDHIR SWITCHGEAR 14. SURYA ROSHNI

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
E.	**CABLE TRAYS AND ITS ACCESSORIES**		
1.	CABLE TRAYS	1. INDIA ELECTRICALS SYNDICATE 2. INDIANA 3. INDUSTRIAL PERFO-RATION (INDIA) PVT. LTD. 4. JAMNA METAL COM-PANY 5. PATNY SYSTEMS (P) LTD 6. TECHNO FAB MANU-FACTURING LTD, 7. RATAN	1. ADVANCE POWER PRODUCTS 2. AM - TECH ENGINEERING SERVICES 3. AMTECH 4. ANAND UDYOG 5. APT ENGINEERING 6. ASPG INFRASTRUCTURES PVT. LTD.,MEERUT 7. ASSOCIATED POWER STRUCTURES PVT LTD 8. A-SUNG 9. AV ENGG, 10. CHEMIN CONTROLS AND INSTRUMENTATION, 11. DEBASISH INDUSTRIES 12. DONGSUNG 13. ELCON 14. ERCON COMPOSITES

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			15. EROS METAL WORKS (P) LTD. 16. FEEDERS LLOYD CORPORATION LIMITED 17. GEE DEE PACKAGES PVT LTD, MYSORE 18. GLOBE INDUSTRIES 19. GRAM ENGG 20. HIND RUNWAYS 21. INAR PROFILE PVT LTD 22. INDEANA ENGINEERING 23. INDIA ELECTRIC SYNDICATE 24. INDIANA CABLE TRAYS 25. INDIANA GRATINGS 26. INDIANA GROUP 27. INDMARK FORMTECH PVT LTD 28. INNOSPACER ENGNEERING TECHNOLOGIES 29. K P BUILDCON 30. KANADE ANAND UDYOG 31. M.J.ENGINEERING 32. MAHAVEER ENGINEERING 33. MAHESHWARI ELECTRICAL 34. MAHESHWARI ELECTRICAL MFRS. PVT. LTD., 35. MJ ENGINEERING WORKS (P) LIMITED,DELHI 36. NAMDHARI INDUSTRIAL TRADERS PVT LTD 37. NEHA POWERTECH 38. OMKARESHWAR 39. PARMAR METAL PVT. LTD. 40. PASSIVE INFRA 41. PASSIVE INFRA PROJECTS PRIVATE LIMITED 42. PENTAX FERRO INCORPORATE 43. PRAMMEN INDUSTRIES 44. PREMIER POWER PRODUCTS PVT LTD 45. R.K. ENGINEERING WORKS 46. RABI ENGG 47. RATAN ENGINEERING 48. RATAN PROJECTS & ENGINEERING, 49. RUKMANI

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			50. RUKMANI ELECTRICAL & COMPONENTS PVTLTD 51. SARAL INDUSTRIES 52. SHIVA ENGINEERING WORKS,KOLKATA 53. SHRUTI INDUSTRIES 54. SILVERLINE POWER INFRA 55. STEELITE 56. STEELITE ENGG. 57. SUMIP COMPOSITES PVT. LTD., 58. SUMIT COMPOSITE (FRP) 59. SUN ENGINEERING,PUDDUKOTTAI 60. T.R.G 61. TECH - UP ENGINEERING PVT LTD.,,TIRCHY 62. TECHNO 63. TECHNO ENGG COMPANY 64. TECHNO FAB 65. TRG ENGINEERING INDUSTRIES,CHENNAI 66. UNITECH FABRICATORS and ENGINEERS PVT LTD 67. VATCO 68. VATCO ELEC-POWER PVT. LTD.
2.	CABLE SUPPORT STRUCTURES	1. AMTECH 2. ENCORP 3. HIND RUNWAYS 4. INAR PROFILES LTD. 5. INDIANA GRATINGS 6. INDUSTRIAL PERFORATION 7. JAMNA METAL 8. MAHAVEER ENGINEERING 9. MAHESHWARI ELECTRICAL 10. NEHA POWERTECH 11. PATNY SYSTEMS (P) LTD. 12. PREMIER POWER PRODUCTS 13. RABI ENGINEERING	1. AM - TECH ENGINEERING SERVICES,PUNE 2. EROS INFRASTRUCTURES PVT. LTD. 3. INDMARK FORMTECH PVT. LTD. 4. JAGANNATHAN ENGINEERING WORKS 5. NAMDHARI INDUSTRIAL TRADERS PVT. LTD 6. NEHA POWERTECH 7. PARMAR METALS PVT.LTD. 8. PENTAX FERRO INCORPORATE 9. RATAN PROJECTS & ENGINEERING CO. PVT.LTD. 10. RUKMANI ELECTRICAL & COMPONENTS PVT LTD 11. SARAL INDUSTRIES 12. TJSV STEEL FABRICATION & GALVANIZING (INDIA) LIMITED 13. VINFAB ENGINEERS INDIA PVT. LTD. 14. VSP ENTERPRISES PVT. LTD.

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		WORKS 14. RATAN POWER PRO-JECTS 15. SHRUTI INDUSTRIES 16. STEELITE ENGG. 17. UNITECH FABRICA-TORS & ENGINEERS PVT.LTD. 18. VATCO	
F.	**ILLUMINATION SYSTEM**		
1.	HIGH MAST WITH LED FITTINGS	1. BAJAJ ELECTRICALS LIMITED 2. CROMPTON GREAVES 3. CONSUMER ELECTRI-CALS LIMITED, 4. M I K A E N G I N E E R S , 5. TRANSRAIL LIGHTING LIMITED 6. WIPRO ENTERPRISES PVT LTD	1. AVAIDS 2. AVAIDSTECHNOVATORSPVT. LTD. 3. BP PROJECTS 4. C&S ELECTRIC LTD 5. CGL 6. CONTROL DEVICES 7. FORUS ELECTRIC PVT LTD 8. GE 9. HALONIX TECHNOLOGIES PVT LIMITED 10. HAVELLS 11. INSTAPOWER LIMITED 12. JASPER ENGINEERS PRIVATE LIMITED 13. PHIAMANG LIGHTING, CHINA 14. PHILIPS 15. PYROTECH 16. SKIPPER 17. SURYA ROSHNI 18. SYSKA 19. TRANSRAIL 20. TRANSRAIL LIGHTING LTD 21. UTKARSH INDIA LIMITED
G.	**MISC. ITEMS**		

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
1.	POWER JUNCTION BOX	1. AJMERA 2. BALIGA 3. BCH ELECTRIC LTD 4. BHARTIA INDUSTRIES 5. C&S ELECTRIC 6. CONCORD CONTROLS 7. ELECTRONIC AUTO-MATION 8. FCG 9. GE 10. GEC 11. HAGER 12. HAVELLS 13. HENSEL ELECTRIC IN-DIA PVT LTD 14. HONEYWELL 15. INDO-ASIAN 16. JYOTI 17. L&T 18. PYROTECH 19. RAAS CONTROLS 20. RISHABH 21. SCHNEIDER ELECTRIC 22. SIEMENS 23. SIMCO 24. SPACEAGE 25. SUB KLEW 26. TECNIK 27. TELEMECHANIQUE 28. VAISHNO ELECTRICALS	1. BHARTIA INDUSTRIES 2. CONCORD CONTROLS 3. CONTROL DEVICES 4. CUBIC CONTROL SYSTEMS 5. CYCLO ELECTRIC DEVICES & SERVICES CO 6. DYNASPEDE INTEGRATED SYSTEMS PVT LTD., 7. ELECON PERIPHERALS LIMITED 8. ELECTRONIC AUTOMATION 9. ELKTRISCHEN POWER GEARS 10. FCG 11. GEMCO CONTROLS LTD 12. HI POWER CONTROLS, 13. HI-TECH SERVICES, 14. JASPER ENGINEERS PVT LTD 15. JOLLY ENGINEERING INSUSTRIES 16. NITYA ELECTRO CONTROLS 17. ORVEEM INDUSTRIES, 18. PATNY SYSTEMS PRIVATE LTD 19. POSITRONICS PRIVATE LIMITED 20. POWER & PROTECTION 21. POWERTECH SWITCHGEARS (I) PVT LTD 22. PRAMMEN INDUSTRIES 23. PRIMA AUTOMATION (INDIA) PVT LTD 24. PRIYADARSHINI ENTERPRISES 25. RAAS CONTROLS 26. RISHABH 27. RYB SWITCHGEAR 28. S.B. POWER SYSTEMS, 29. SAMCON INDUSTRIAL CONTROLS PVT LTD 30. SARAVANA SWITCHGEARS 31. SHRENIK & COMPANY 32. SUB KLEW 33. SWITCHING CIRCUITS 34. TECHNOFINE 35. TECNIK 36. TTS SYSTEMATIX PVT LTD, 37. UNILEC ENGINEERS LIMITED

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			38. VEE VEE CONTROLS PRIVATE LIMITED 39. VRL AUTOMATION ENGINEERING
2.	PUSH BUTTON	1. AJMERA 2. BALIGA 3. BCH ELECTRIC LTD 4. BHARTIA INDUSTRIES 5. C&S 6. CONCORD CONTROLS 7. ELECTRONIC AUTO-MATION 8. FCG 9. GE 10. GEC 11. HAGER 12. HAVELLS 13. HENSEL ELECTRIC IN-DIA PVT LTD., 14. HONEYWELL 15. INDO-ASIAN 16. JOLLY ENGG. 17. JYOTI 18. L&T 19. PYROTECH 20. RAAS CONTROLS 21. RISHABH 22. SCHNEIDER ELECTRIC 23. SIEMENS 24. SIMCO 25. SPACEAGE 26. SUB KLEW 27. TECHNOFINE 28. TECNIK 29. TELEMECHANIQUE 30. VAISHNO ELECTRICALS	1. BHARTIA INDUSTRIES 2. C & S ELECTRIC LTD,NOIDA 3. CONTROL DEVICES 4. CUBIC CONTROL SYSTEMS 5. CYCLO ELECTRIC DEVICES & SERVICES CO. 6. DYNASPEDE INTEGRATED SYSTEMS PVT LTD 7. ELECON PERIPHERALS LIMITED 8. ELECTRONIC AUTOMATION 9. ELKTRISCHEN POWER GEARS 10. FCG 11. GEMCO CONTROLS LTD., 12. HI POWER CONTROLS 13. HI-TECH SERVICES, 14. INDO-ASIAN 15. JASPER ENGINEERS PVT LTD,NOIDA 16. NITYA ELECTRO CONTROLS 17. ORVEEM INDUSTRIES 18. PATNY SYSTEMS PRIVATE LTD. 19. POSITRONICS PRIVATE LIMITED 20. POWER & PROTECTION 21. POWERTECH SWITCHGEARS (I) PVT LTD 22. PRAMMEN INDUSTRIES 23. PRIMA AUTOMATION (INDIA) PVT LTD, 24. PRIYADARSHINI ENTERPRISES 25. RYB SWITCHGEAR 26. S.B. POWER SYSTEMS 27. SAMCON INDUSTRIAL CONTROLS PVT LTD SARAVANA SWITCHGEARS 28. SHRENIK & COMPANY 29. SWITCHING CIRCUITS 30. TECNIK 31. TTS SYSTEMATIX PVT LTD 32. UNILEC ENGINEERS LIMITED

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			33. VEE VEE CONTROLS PRIVATE LIMITED 34. VRL AUTOMATION ENGINEERING
3.	LOCAL CONTROL PAN-ELS	1. C&S ELECTRIC 2. HAVELL 3. CONTROL & SCHE-MATIC 4. GE 5. PYROTECH 6. RITTAL 7. SCHNEIDER 8. SIEMENS	1. ADLEC POWER 2. ANAND POWER 3. CONTROL & SWITCHGEAR 4. CONTROL DEVICES 5. ELECON PERIPHERALS LIMITED 6. ELKTRISCHEN POWER GEARS 7. EMCONS 8. HINDUSTAN CONTROL &EQUIPMENT 9. HI-TECH SERVICES 10. HPL 11. JAKSON 12. JASPER 13. JOLLY ENGG. 14. KHOKHAR ELECTRICALS PVT. LTD.,NOIDA 15. L&T 16. MAKTEL 17. MEDITRON 18. POSITRONICS 19. POSITRONICS PRIVATE LIMITED 20. POWER CONTROL EQUIPMENTS 21. RSI 22. STELMEC LIMITED 23. SWITCHING CIRCUIT 24. SYSTEM INFOTECH 25. TENCO SYSTEMS AND SWITCHGEAR PVT LTD 26. TRICOLITE 27. UNILEC 28. VIDYUT CONTROL 29. VOLTECH MANUFACTURING CO LTD

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
4.	MS ROD	1. JINDAL STEEL 2. RINL 3. SAIL 4. TATA STEEL	1. AXIS ELECTRICALS 2. ELECTRO MAC INDUSTRIES 3. INDIAN PERFORATION 4. INDIANA 5. JAMNA METALS 6. K P BUILDCON 7. KANADE ANAND UDYOG PVT. LTD 8. MAHAVIR STEEL INDUSTRIES LIMITED 9. OMKAR GRATINGS 10. PRIMERE 11. R SQUARE 12. RATAN PROJECTS & ENGINEERING CO. PVT. LTD. 13. SUN VIJAY 14. TAMRA 15. TECHNO FAB MFG. LTD 16. VATCO
5.	GS FLAT	1. AXIS ELECTRICALS 2. ELECTRO MAC INDUS-TRIES 3. INDIAN PERFORATION 4. INDIANA 5. JAMNA METALS 6. K P BUILDCON 7. KANADE ANAND UDYOG PVT. LTD 8. OMKAR GRATINGS 9. PREMIER POWER PRODUCTS (CAL) PVT. LTD. 10. R SQUARE 11. RATAN PROJECTS & ENGINEERING CO. PVT. LTD. 12. RUKMANI ELECTRICAL & COMPONENTS PVT. LTD. 13. TAMRA 14. TECHNO FAB MFG. LTD 15. VATCO	1. AARPEE & ASSOCIATES 2. AXIS ELECTRICALS 3. DEBASISH INDUSTRIES 4. ELECTRO MAC INDUSTRIES 5. INAR PROFILES, 6. INDIA ELECTRICALS SYNDICATE 7. INDUSTRIAL PERFORATION (INDIA) PVT. LTD 8. MAHAVEER ENGINEERING 9. PATNY SYSTEMS PRIVATE LTD 10. POWERTRAC INDUSTRIES LIMITED, 11. PREMIER POWER PRODUCTS (CAL) PVT. LTD. 12. RABI ENGINEERING WORKS PVT LTDRATAN PROJECTS & ENGINEERING CO. PVT. LTD. 13. SARAL INDUSTRIES, 14. SHIVA ENGINEERING WORKS, 15. SILVERLINE POWER INFRASTRUCTURE PVT LTD, 16. UNITECH FABRICATORS & ENGINEERS PVT LTD 17. VATCO ELEC-POWER PVT LTD.,

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		16. VIJAY TRANSMISSION PVT LTD	
6.	GS STRIP	1. AXIS ELECTRICALS 2. ELECTRO MAC INDUS-TRIES 3. INDIAN PERFORATION 4. INDIANA 5. JAMNA METALS 6. K P BUILDCON 7. KANADE ANAND UDYOG PVT. LTD 8. OMKAR GRATINGS 9. PREMIER POWER PRODUCTS (CAL) PVT. LTD. 10. R SQUARE 11. RATAN PROJECTS & ENGINEERING CO. PVT. LTD. 12. RUKMANI ELECTRICAL & COMPONENTS PVT. LTD. 13. TAMRA 14. TECHNO FAB MFG. LTD 15. VATCO 16. VIJAY TRANSMISSION PVT LTD	1. AARPEE & ASSOCIATES 2. DEBASISH INDUSTRIES 3. INAR PROFILES 4. INDIA ELECTRICALS SYNDICATE 5. INDUSTRIAL PERFORATION (INDIA) PVT. LTD 6. MAHAVEER ENGINEERING, 7. PATNY SYSTEMS PRIVATE LTD 8. POWERTRAC INDUSTRIES LIMITED, 9. RABI ENGINEERING WORKS PVT LTD, 10. RUKMANI ELECTRICAL & COMPO-NENTS PVTLTD 11. SARAL INDUSTRIES 12. SHIVA ENGINEERING WORKS 13. SILVERLINE POWER INFRASTRUCTURE PVT LTD 14. UNITECH FABRICATORS & ENGINEERS PVT LTD 15. VATCO ELEC-POWER PVT LTD
7.	LOCAL PUSH BUTTON STATION	1. ABB 2. C & S ELECTRIC LTD 3. JASPER ENGINEERS PVT.LTD. 4. JOLLY ENGG. 5. L&T 6. PYROTECH 7. SCHNEIDER 8. SIEMENS	1. AJMERA 2. BALIGA 3. BCH EELCTRIC LTD 4. BENTEX 5. BHARTIA INDUSTRIES 6. CONCORD CONTROLS 7. CONTROL DEVICE 8. CUBIC CONTROL SYSTEMS,BANGALORE 9. CYCLO ELECTRIC DEVICES & SERVICES CO.,BANGALORE

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			10. DYNASPEDE INTEGRATED SYSTEMS PVT LTD.,,HOSUR 11. ELECMECH 12. ELECON PERIPHERALS LIMITED,ANAND 13. ELECTRONIC AUTOMATION 14. ELKTRISCHEN POWER GEARS,BANGALORE 15. FCG 16. GE 17. GEC 18. GEMCO CONTROLS LTD.,,FARIDABAD 19. HAGER 20. HAVELLS 21. HENSEL 22. HENSEL ELECTRIC INDIA PVT LTD.,,BANGALORE 23. HI POWER CONTROLS,BANGALORE 24. HI-TECH SERVICES,BARODA 25. HONEYWELL 26. HULASI 27. INDO-ASIAN 28. INDUSTRIAL CONTROL APPLIANCE 29. JACKSON 30. JYOTI 31. NITYA ELECTRO CONTROLS 32. ORVEEM INDUSTRIES, 33. PATNY SYSTEMS PRIVATE LTD 34. POSITRONICS 35. POSITRONICS PRIVATE LIMITED 36. POWER & PROTECTION 37. POWERTECH SWITCHGEARS (I) PVT LTD 38. PRAMMEN INDUSTRIES 39. PRIMA AUTOMATION (INDIA) PVT LTD, 40. PRIYADARSHINI ENTERPRISES 41. RAAS CONTROLS 42. RISHABH 43. RYB SWITCHGEAR 44. S.B. POWER SYSTEMS 45. SAMCON INDUSTRIAL CONTROLS PVT LTD

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			46. SARAVANA SWITCHGEARS 47. SCHNEIDER ELECTRIC 48. SHRENIK & CO 49. SHRI TULSI SWITCHGEAR 50. SIMCO 51. SPACEAGE 52. SUB KLEW 53. SWITCHING CIRCUIT 54. TECHNIC 55. TECHNOFINE 56. TECNIK 57. TELEMECHANIQUE 58. TTS SYSTEMATIX PVT LTD, 59. UNILEC ENGINEERS LIMITED 60. VAISHNO ELECTRICALS 61. VEE VEE CONTROLS PRIVATE LIMITED 62. VIDHUT CONTROLS 63. VRL AUTOMATION ENGINEERING
8.	TTB	1. CONTROL DYNAMICS 2. DAV 3. JVS 4. L&T 5. NELSTER	--
9.	EXHAUST FANS	1. BAJAJ 2. CROMPTON 3. FLAKT 4. USHA	1. ADVANCE_VENTILATION 2. ALMONAROD 3. C DOCTOR 4. CB_DOCTO 5. CGL 6. DUVENT 7. GEC 8. GEC ALSTOM 9. HAVELLS 10. HYDERABAD_POLUTION_CONTROL 11. INDUSTRIAL FAN 12. ICEBERG 13. KHAITAN 14. KIRLOSKAR AAF 15. KRUGER 16. MARATHON 17. NADI AIR TECHNICS 18. NICOTRA

	ELECTRICAL - CONSOLIDATED SUB-VENDOR LIST (CLASS-II)		
SL. NO	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			19. ORIENT 20. PATEL AIR TEMP 21. PATEL_AIR 22. POLAR 23. PYROTECH 24. SARLA(SITAL) 25. SK_SYSTEM 26. SUVIDHA 27. WOLLAQUE 28. WOLTER
10.	CEILING FANS	1. BAJAJ 2. CROMPTON GREAVES 3. USHA	1. ANCHOR 2. GEC 3. GREAT WHITE 4. HAVELLS 5. KHAITAN 6. LUMINOUS 7. ORIENT 8. ORPAT 9. POLAR 10. PYROTECH
11.	WELDING RECEPTACLES	1. AJMERA 2. ANCHOR 3. BCH ELELCTRIC LTD 4. CGL 5. C & S ELECTRIC LTD 6. EX-PROTECTA 7. PYROTECH 8. SAKTHI & CROWN 9. SCHNEIDER 10. SHRENIK & COMPANY 11. SUDHIR SWITCHGEAR	1. BEST & CROMPTON ENGG. LIMITED, 2. CONTROL DEVICES 3. CYCLO ELECTRIC DEVICES & SERVICES CO 4. ELECON PERIPHERALS LIMITED 5. HENSEL ELECTRIC INDIA PVT LTD 6. MEDITRON 7. NEPTUNE INDIA LTD 8. SAKTHI ELECTRICALS

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
33	Hydrazine Analyzer	1. ABB 2. EMERSON 3. FORBES MARSHALL 4. HACH 5. ORION 6. YOKOGAWA	1. DKK 2. DR. THIEDIG 3. E&H 4. HONEYWELL 5. METTLER-TOLEDO 6. SWAN 7. TELEDYNE 8. THERMO ORION 9. WTW
34	TDS and Turbidity Analyzer	1. ABB 2. EMERSON 3. FORBES MARSHALL 4. HACH 5. ORION 6. YOKOGAWA	1. DKK 2. DR. THIEDIG 3. E & H 4. HONEYWELL 5. METTLER-TOLEDO 6. SWAN 7. TELEDYNE 8. THERMO ORION 9. WTW
35	Chlorine Leak Detector	1. HUSAINI ENGINEERS 2. IEC FABCHEM	1. PERFECT CHLORO 2. PERFECT ENGINEERING 3. W&T
36	Hydrogen purity Analyzer & leak detector	1. ABB 2. EMERSON 3. YOKOGAWA	1. ADAGE AUTOMATION 2. SIEMENS 3. E-ON
37	Smart Positioners	1. ABB 2. SIEMENS 3. EMERSON (FISHER ROSEMOUNT) 4. SMAR 5. YAMATAKE 6. YOKOGAWA	1. AUMA 2. DRESSER MASONEILAN 3. FLOW SERVE 4. FORBES MARSHALL 5. FOX BORO 6. KOSO 7. KSB MILL CONTROLS 8. LESLIE 9. LIMITORQUE 10. MASOLENIEN 11. MASONEILAN 12. MESTO 13. MOORE 14. PRUSS 15. TYCO SAMPELL 16. YOUNT TECH
38	Smart Transmitter (P, L, F, DP)	1. ABB 2. EMERSON	1. AUTROL 2. BALDOTA CONTROL &

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		(ROSEMOUNT) 3. HONEYWELL 4. SIEMENS 5. YOKOGAWA	EQUIPMENTS 3. CHEMTROLS 4. CHINO CORPORATION 5. DRESSER MASONEILAN 6. ENDRESS + HAUSER 7. FOXBORO 8. FUJI ELECTRIC 9. KHRONE 10. LAXSONS AUTOMATION 11. LEVCON 12. MAGNETROL 13. NIVELCO 14. PUNE TECHTROL 15. SBEM 16. SMAR 17. TOSHNIWAL INDUSTRIES 18. VEGA 19. YAMARI 20. YAMATAKE
39	Temperature Transmitter	1. ABB 2. EMERSON (ROSEMOUNT) 3. ENDRESS+HAUSER 4. HONEYWELL 5. SIEMENS 6. YOKOGAWA	1. AUTROL 2. BALDOTA 3. CAMILLE –BAUR 4. FORBES MARSHALL 5. FOXBORO 6. FUJI ELECTRIC 7. INOR 8. KHRONE MARSHAL 9. MOORE INDUSTRIES 10. M-SYSTEM 11. OMEGA 12. P & F 13. PYROTECH 14. SMAR 15. TEMFLO SYSTEMS 16. TEMPSENS INSTRUMENTS 17. TOKYO KEISO 18. TOSHNIWAL INDUSTRIES 19. WIKA 20. YAMARI 21. YAMATAKE
40	Thermocouples/ Metal Temperature Thermocouples /RTDs	1. ABB 2. BAUMER TECHNOLOGIES 3. DETRIV INSTRUMENTATION	1. ALTOP INDUSTRIES 2. ELEIND ENGINEERING 3. EPHY MESS 4. EXOTHERM INSTRUMENTS 5. GAUGES BOURDON

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		4. EMERSON (ROSEMOUNT) 5. GENERAL INSTRUMENTS CONSORTIUM 6. GOA INSTRUMENTS INDUSTRIES 7. HERAUS SENSOR 8. MINCO 9. OKAZAKI 10. PYRO ELECTRIC INSTRUMENTS 11. SIEMENS 12. TECHNO INSTRUMENTS 13. TEMPSENS INSTRUMENTS 14. TOSHNIWAL INDUSTRIES 15. WIKA INSTRUMENTS 16. YAMARI	6. INDUSTRIAL INSTRUMENTATION 7. ITALCOPPIE SENSORI 8. JINDAL ELECTRONICS 9. NESSTECH INSTRUMENTS 10. PRECISION MASS PRODUCTS 11. RUBY ENTERPRIESES 12. THERMAL INSTRUMENT 13. THERMO ELECTRIC INSTRUMENTATION 14. THERMO ENGINEERING 15. THERMO SENSOR 16. TM TECHNOMATIC 17. WISE CONTROL
41	Level Transmitters (Acoustic type – 3 D)	1. EIP ENVIRO 2. APM 3. APM (EIP ENVIRO)	1. ABB 2. ACOUSTIC MONITORING INTERNATIONAL 3. BHEL 4. E & H 5. EIP TECHNOLOGIES 6. EMERSON 7. HONEYWELL 8. INSTROTECH (PTY) 9. MAGNETROL 10. PROCON ENGINEERING 11. RECTUSON
42	Level Transmitters (Displacer Type)	1. CHEMTROL SAMIL 2. CHEMTROLS 3. D.K.INSTRUMENT 4. DRESSER MASONEILAN 5. DRESSER 6. FISHER 7. LEVCON 8. MAGNETROL 9. PUNE TECHTROL 10. SBEM 11. V AUTOMAT	1. ABB 2. BAUMER 3. BLISS ANAND 4. ECKARDT AG 5. EMERSON 6. ENDRESS + HAUSER 7. EVCON INSTRUMENTS 8. FUJI ELECTRIC 9. GAUGES BOURDON 10. HONEYWELL 11. LEVELSTATE 12. MIL CONTROLS 13. NAKATIYA 14. OMEGA

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			6. HONEYWELL 7. OVAL 8. RHEONIK MESSTECHNIK 9. TOSHNIWAL
46	Magnetic Flowmeter	1. ABB 2. EMERSON 3. ENDRESS + HAUSER 4. KROHNE MARSHALL 5. SIEMENS 6. YOKOGAWA	1. ADEPT FLUIDYNE 2. E&H FLOWTECH 3. ELECTRONET EQUIPMENTS 4. HONEYWELL 5. OMEGA 6. VEGA
47	Parshall Flume type Flow Transmitter		1. BM TECHNOLOGIES 2. HAWK
48	Ultrasonic Flow Transmitter	1. ABB 2. EMERSON 3. ENDRESS & HAUSER 4. FUJI ELECTRIC 5. GE 6. SIEMENS 7. YOKOGAWA	1. ADEPT FLUIDYNE 2. CHEMTROLS 3. CHEMTROLS ENGG 4. DURAG 5. ELECTRONET EQUIPMENTS 6. FLASH FORGE 7. FLEXIM FLEXIBLE INDUSTRIEMESSTECHNIK 8. FORBES MARSHALL 9. GMBH 10. HONEYWELL 11. KROHNE 12. MICROMOTION 13. NIVO CONTROL 14. NIVUS 15. OMEGA 16. ROCKWIN FLOWMETER 17. SBEM 18. SICK 19. TELEDYNE 20. TOSHNIWAL INDUSTRIES
49	Instrumentation Cables (including Triad cable)	1. ADVANCE CABLE 2. CCI 3. CMI 4. CORDS CABLE 5. DELTON CABLES 6. ELKAY TELELINKS 7. HABIA CABLES 8. INCAB 9. KEC 10. KEI INDUSTRIES	1. APAR INDUSTRIES 2. ASSOCIATED FLEXIBLES & WIRES 3. BELDEN 4. BHANSALI CABLES & CONDUCTORS 5. BROOKS CABLES 6. CHANDRESH CABLES 7. FINOLEX 8. GEMSCAB

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		11. LAPP 12. NICCO 13. PARAMOUNT 14. POLYCAB 15. SPECIAL CABLES 16. T C COMMUNICATION 17. THERMO CABLES 18. TORRENT 19. UNIVERSAL CABLE	9. GENERAL INSTRUMENTS 10. GLOSTER CABLES 11. GOVIND CABLE 12. GOYOLENE FIBRES 13. GOYOLETIONAL 14. GUPTA POWER INFRASTRUCTURE 15. IMT CABLES 16. INCOM 17. INDUSTRIAL INSTRUMENTATION 18. KERPEN CABLES 19. LEONI CABLE 20. MANOJ CABLES 21. MANSFIELD CABLE 22. NANGALWALA INDUSTRIES 23. NE FIBRES 24. PAGODA CABLES 25. POWER CABLE INDUSTRIES 26. R.J.INDUSTRIAL CORPORATION 27. RASHI CABLES 28. RAVIN CABLES 29. RELIANCE 30. RR CABLE 31. RR KABEL 32. SBEE CABLES 33. SERVEL INDIA 34. SHIVA PRIYA CABLES 35. SIECHEM 36. SRIRAM CABLES 37. SUYOG 38. TCL 39. TEMPSENS 40. TEW & C 41. THERMO ELECRTA 42. TOSHNIWAL 43. UDEY PYRO CABLES 44. ULTRACAB 45. UNIFLEX CABLES (APAR INDUSTRIES) 46. URJA 47. VIKAS
50	Thermocouple cables	1. ADVANCE CABLE TECHNOLOGIES 2. CORDS CABLE	1. BELDEN 2. CCI 3. CMI

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – I)			
SL NO.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		3. DELTON CABLES 4. GEMS CAB 5. GOYOLENE FIBRES 6. KEI INDUSTRIES 7. KERPEN CABLES 8. LAPP 9. NICCO 10. PARAMOUNT COMMUNICATIONS 11. POLYCAB 12. T C COMMUNICATION 13. THERMO CABLES 14. TOSHNIWAL INDUSTRIES 15. UDEY PYRO CABLES 16. UNIVERSAL CABLE	4. ELKAY TELELINKS 5. FINOLEX 6. GENERAL INSTRUMENTS 7. GUPTA POWER INFRASTRUCTURE 8. HABIA CABLES 9. INCAB 10. INCOM 11. INDUSTRIAL INSTRUMENTATION 12. KEC (RPG) 13. LEONI CABLE 14. MANSFIELD CABLES COMPANY 15. POWER CABLE INDUSTRIES 16. R.J.INDUSTRIAL CORPORATION 17. SIECHEM 18. SPECIAL CABLES 19. SUYOG ELECTRICALS 20. TCL 21. TEMPSENS 22. TEW & C 23. THERMO ELECRTA 24. TORRENT 25. UNIFLEX CABLES (APAR INDUSTRIES)
51	Fibre optic cables	1. AKSH FIBRE 2. BELDEN 3. BIRLA ERICSSON 4. DIGILINK 5. D-LINK 6. FINOLEX 7. HFCL 8. KEC INTERNATIONAL 9. LAPP CABLES 10. POLYCAB 11. RPG CABLES	1. AKSH OPTIFIBER 2. APAR INDUSTRIES 3. CORNING 4. GUPTA POWER 5. IIJIN CABLE 6. JIANGSU TONGGUANG 7. LENOX-HITECH 8. LEONI CABLES 9. MOLEX 10. POWER CABLE INDUSTRIES 11. PRESTON 12. R&M 13. RAYCHEM 14. SCHNEIDER 15. SCHNEIDER-DIGILINK 16. SPECIAL CABLES 17. TERRACOM 18. TYCO/AMP 19. UNIFLEX CABLES

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			8. PALOALTO 9. SOPHOS
11	Flow Switch	1. CHEMTROLS 2. D K INSTRUMENT 3. E & H 4. KROHNE MARSHAL 5. LEVCON 6. MAGNETROL 7. SWITZER 8. V AUTOMAT	1. ABB 2. ASHCROFT 3. ASHCROFT (NAGANO) 4. AUXITROL 5. DANFOSS 6. DELTA CONTROLS 7. DWYER INST 8. EMERSON 9. GAUGES BOURDON 10. HONEYWELL 11. MERICOID 12. MERIUM 13. SUNAG CORPORATION 14. UNIVERSAL FLOW METER 15. WIKA 16. YOKOGAWA
12	Flow Meters (Other than Class I items)	1. ABB 2. BOPP & REUTHER 3. BROOKS 4. E & H 5. EMERSON 6. EUREKA 7. FUJI 8. GE 9. HONEYWELL 10. KROHNE MARSHALL 11. YOKOGAWA	1. B.K.EQUIPMENTS 2. BLISS ANAND 3. BOPP & ROUTHER 4. CHEMTROLS 5. DURAG 6. FLUIDYNE 7. GIC 8. GREENBANK ENGERY 9. INSTRUMENT ENGINEERS 10. INSTRUMENTATION ENGINEERS 11. MANAS MICROSYSTEMS 12. MICRO PRECISION 13. OVAL 14. RHEONIK MESSTECHNIK 15. ROCKWIN FLOWMETER 16. SCIENTIFIC DEVICES 17. SICK 18. SIEMENS 19. SIGMA INSTRUMENTS 20. TELEDYNE 21. TOSHNIWAL CORPORATION 22. TOSHNIWAL HYVAC 23. V. AUTOMAT
13	Junction Boxes	1. BALIGA 2. BCH ELETRIC	1. ARHAM HI-TECH 2. C & S ELECTRIC

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		3. CHEMIN 4. CONTROL DEVICES 5. DEVI POLYMERS 6. ELECTRO MECHANICAL 7. HENSEL ELECTRIC 8. JASPER 9. K.S. INSTRUMENTS 10. PHOENIX 11. PYROTECH 12. RITTAL 13. SAJAS ELECTRICALS 14. SHRENIK & COMPANY 15. SUCHITRA INDUSTRIES	3. COTMAC 4. CUBIC CONTROL SYSTEMS 5. CYCLO ELECTRIC DEVICES & SERVICES 6. DYNASPEDE INTEGRATED SYSTEMS 7. ELECON PERIPHERALS 8. ELKTRISCHEN POWER GEARS 9. ELMEX 10. EMECON CONTROLS 11. EXCEITEC 12. EXPROTECTA 13. FICOM ENGINEERING 14. FLEXPRO ELECTRICALS 15. FORBES MARSHALL 16. GEE DEE PACKAGES 17. GEMCO CONTROLS 18. HENSLE 19. HI POWER CONTROLS 20. HI-TECH SERVICES 21. HULASI METALS 22. JINDAL ELECTRONICS 23. JOLLY ENGINEERING 24. KEY ELECTRICALS 25. KHODAY CONTROL 26. MANISHA COMPOSITEK 27. NITYA ELECTRO CONTROLS 28. ORVEEM INDUSTRIES 29. PATNY SYSTEMS 30. POLYTECH ENTERPRISES 31. POSITRONICS 32. POWER & PROTECTION 33. POWERTECH SWITCHGEARS 34. PRAMMEN INDUSTRIES 35. PRIMA AUTOMATION 36. PRIYADARSHINI ENTERPRISES 37. RMG ELECTROMECH 38. RUBY ENTERPRISES 39. RYB SWITCHGEAR 40. S.B. POWER SYSTEMS 41. SAMCON INDUSTRIAL CONTROLS 42. SARAVANA SWITCHGEARS 43. SCG EX D TECH 44. SUDHIR SWITCHGEAR 45. SWITCHING CIRCUITS 46. TECHNO GRIP

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			47. TRIJAL ELECTRIKALS 48. TTS SYSTEMATIX 49. UNILEC ENGINEERS 50. VEE VEE CONTROLS 51. VENKAT ELECTRONICS 52. VICTORY STANDARD 53. VRL AUTOMATION ENGINEERING 54. WAGO 55. WEIDMULLER
14	Erection Hardware including pipe, fittings, manifold etc.,	1. ASTEC 2. AURA INC 3. BALDOTA 4. BHARAT HEAVY ELECTRICALS 5. EXCEL HYDRO-PNEUMATICS 6. FLOWTECH 7. HP VALVES & FITTINGS 8. HYDAIR 9. INDIAN SEAMLESS METAL TUBES 10. ISMT 11. JINDAL SAW 12. MAHARASHTRA SEAMLESS 13. METPRESS ENGINEERING 14. MICRO PRECISION PRODUCTS 15. PARKER 16. PRECISION ENGG 17. PRIME ENGINEERS 18. RATNAMANI METALS & TUBES 19. SANDVIK 20. SUMITOMO 21. SWAGELOK	1. ADITYA ENGINEERING 2. ARCELLOR CONTROLS 3. ARYA CRAFTS & ENGINEERING 4. AURO 5. BALIGA 6. DK TECH 7. DYNA FLUID VALVES AND FLOW CONTROL 8. FLUID CONTROLS 9. GENERAL INSTRUMENTS 10. HAMLET 11. HEAVY METAL AND TUBES 12. HYLOK 13. INSTRUMENTATION LIMITED 14. MAXIM TUBES COMPANY 15. MBM TUBES 16. MET LOK HYDRO PENUMATICS 17. NAV DURGA FORGING AND FITTINGS 18. PANAM ENGINEERS 19. PAUL INDUSTRIES 20. PMT ENGINEERS 21. SALZGITTER MANNESMANN 22. SANDEEP INDUSTRIES 23. SHUBHLAXMI METALS AND TUBES 24. SUPER TECHNICAL (PARKER MAKE) 25. SURAJ STAINLESS 26. TPS TECHNITUBE ROHREN WERKE 27. TROUVAY AND CAUVIN 28. TUBACES 29. TUBACEX PRAKASH

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			30. V.K. INDUSTRIES 31. VELURIC & MANESSMANN 32. VIKAS INDUSTRIAL PRODUCTS 33. VIPAL ENTERPRISES
15	Laptop	1. DELL 2. HP 3. LENOVO	1. COMPAQ 2. FUJITSU 3. IBM 4. SIEMENS
16	Laser Printers	1. CANON 2. EPSON 3. HP	1. BROTHERS 2. DELL 3. GENICOM 4. IBM 5. KYOCERA 6. LEXMARK 7. LIPI 8. PITNEY BOWES 9. SAMSUNG 10. SEIKO 11. TVSE 12. WIPRO 13. XEROX
17	Level Switches (Float , Displacer Type, Capacitance) & Level Gauges (All Types)	1. ABB 2. CHEMTROLS 3. CHEMTROLS SAMIL 4. D.K.INSTRUMENTS 5. EIP 6. EMERSON 7. ENDRESS +HAUSER 8. GAUGES BOURDON (GIC) 9. KHRONE 10. LEVCON 11. LEVEL STATE 12. MAGNETROL 13. NIVO CONTROLS 14. PUNE TECHTROL 15. ROSEMOUNT 16. SBEM 17. SIEMENS 18. SIGMA INSTRUMENTS 19. SOLATRON 20. V.AUTOMAT 21. YARWAY	1. ASHCROFT 2. ASIAN INDUSTRIAL VALVES 3. BAUMER 4. BELL CONTROLS 5. BK EQUIPMENT 6. BLISS ANAND 7. BUNKABOEKI KOGYO 8. DEMPA KOGYO 9. DEMPER KOGYO 10. FLOW STAR ENGINEERING 11. HITROL 12. IGEMA 13. INDFOSS 14. KEYSTONE 15. KUBLER 16. KUEBLER (WIKA) 17. MASONELIN 18. NAKATIYA 19. NIHON KLINGAGE 20. NISAN SCIENTIFIC 21. PLACKA 22. PRATOLINA INSTRUMENTS 23. PROTO CONTROLS

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			24. PYROELECTRIC 25. SAMIL INDUSTRY 26. TECNOMATIC 27. TOKOIO KEISO 28. TOSHNIWAL INDUSTRIES 29. TRANDUCER & CONTROL 30. UNI KLINGER 31. WAREE 32. WIKA
18	Level Switches (RF type)	1. ASHCROFT (NAGANO) 2. E&H 3. EIP ENVIRO 4. LEVCON 5. MAGNETROL 6. NIVO CONTROL 7. SBEM 8. V.AUTOMAT 9. VEGA	1. D.K.INSTRUMENTS 2. DELTA CONTROL 3. FLOW STAR ENGINEERING 4. HITROL 5. HYDRASTEP (DELTA MOBREY) 6. IGEMA 7. JAY 8. NAGANO 9. PUNE TECHTROL 10. SEOJIN INSTECH 11. SHREE ELECTRON 12. SOR
19	Level Switches (Conductivity type)	1. E & H 2. EIP ENVIRO LEVEL CONTROLS 3. EMERSON 4. HITECH 5. IGEMA 6. LEVELSTATE SYSTEMS 7. PUNE TECHTROL 8. RAMAN INSTRUMENTS 9. SBEM 10. SOLATRON MORBREY 11. YARWAY	1. ASHCROFT (NAGANO) 2. BHEL 3. D K INSTRUMENT 4. DELTA CONTROL 5. FLOWSTAR ENGINEERING 6. GIC 7. HITROL 8. HYDRASTEP (DELTA MOBREY) 9. MAGNETROL 10. NAGANO 11. SEOJIN INSTECH 12. SOR 13. TOKYO KEISO 14. V- AUTOMAT
20	LIE / LIR	1. CHEMIN 2. FORBES MARSHALL 3. INSTRUMENTATION LTD 4. PRAMMEN 5. PYROTECH ELECTRONICS 6. RITTAL	1. AJMERA 2. ASTEC AUTOMATION 3. ASTECH 4. AVOUSIC CONTROLS (ACOUSTIC CONTROL) 5. BCH 6. C&S

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		7. SAJAS ELECTRICALS	7. ERCON COMPOSITES 8. INDUSTRIAL CONTROL APPLIANCES 9. KEMROCK 10. MANISHA 11. MIRAJ INSTRUMENTATION 12. NASAN 13. PANAM ENGINEERS 14. POSITRONICS 15. POSITRONIX 16. PROCON INSTRUMENTATION 17. SHYAM MACHINE TOOLS 18. SUJAL 19. SUMIP COMPOSITES 20. SYSPRO 21. TRINITY TOUCH
21	LIU/Optical Link	1. D-LINK	1. AMP 2. CORNING 3. DELTAFULL 4. DIGI-LINK 5. DIGISOL 6. MOLEX 7. PANDUIT 8. TYCO
22	Media Converters	1. MOXA	1. AVEONET 2. BLACK BOX 3. CTC UNION 4. PERLE
23	Panels/ cabinets (DCS,PLC,CEMS,SWAS)	1. EMERSON 2. LARSEN & TOUBRO (L&T) 3. PYROTECH 4. RITTAL 5. SCHNEIDER 6. FORBES MARSHALL 7. SIEMENS	1. ABB 2. ADAGE AUTOMATION 3. ANALYSER INSTRUMENTATION 4. ANALYSER INSTRUMENTS 5. BALIGA-STALH 6. CHEMIN CONTROLS 7. CHEMTROLS INDUSTRIES 8. CONTROL PANELS 9. COTMAC 10. CREATIVE INSTRUMENTS 11. ELEMECH 12. ENDRESS + HAUSER 13. EX-PROTECTA 14. FLOWLINE INSTRUMENTATION 15. HOFMANN

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
			16. MITSUBISHI/ MELCO 17. POSITRONICS 18. POSITRONIX 19. RSI SWITCHGEAR 20. SICK 21. STEAM EQUIPMENTS 22. YOKOGAWA
24	Pressure Gauges/DP Gauge	1. A.N.INSTRUMENTS 2. ASHCROFT 3. BAUMER 4. BUDENBERG 5. GAUGES BOURDON 6. GENERAL INSTRUMENTS CONSORTIUM (GAUGES BOURDON) 7. GOA THERMOSTATIC INSTRUMENTS 8. H.GURU 9. MANOMETER 10. PRECISION MASS 11. PYRO ELECTRIC 12. SWITZER 13. WIKA	1. ASHCROFT (NAGANO) 2. ASHCROFT (MASS) 3. BUDENBERG (WIKA) 4. CHEMTROLS 5. GOA INSTRUMENT INDUSTRIES 6. KONICS 7. FORBES MARSHALL 8. MINCO INDIA FLOW ELEMENTS (GIC) 9. NAGANO KEIKI 10. NESSTECH INSTRUMENTS 11. NEW SCIENTIFIC REPAIRS & TRADING 12. PRECISEMEASURE CONTROLS 13. PRESSURE & TEMP.CONTROL 14. PROTECH CONTROL 15. SBEM 16. TEMPSENS 17. THERMAL INSTRUMENT 18. US GAUGE 19. WALCHANDNAGAR INDUSTRIES 20. WAREE INSTRUMENT (BAUMER) 21. WINTERS 22. WISE
25	Pressure & Differential Pressure Switches, Temperature Switches	1. ASHCROFT 2. BARKSDALE 3. CELLA 4. GAUGES BOURDON (GIC) 5. GENERAL INSTRUMENTS 6. GORGEION 7. HERION 8. INDFOS (SWITZER) 9. SOR	1. ASHCROFT (NAGANO) 2. BAUMER 3. BOLL & KIRCH FILTERBAU 4. CELLA (WIKA) 5. DELTA CONTROL 6. DRESSER (ASHCROFT) 7. HYDAC 8. IMI NORGREN HERION 9. ITI BARTON 10. ITT BARTON 11. KAUSTUBHA UDYOG

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		10. SWITZER 11. TRAFAG CONTROLS 12. UNITED ELECTRIC 13. WIKA	12. KONICS 13. NAGANO KEIKI 14. NEODYNE 15. NESSTECH 16. PRECISION MASS 17. SIEMENS 18. SMC 19. VASU TECH 20. WAAREE INSTRUMENTS 21. WISE CONTROL
26	Proximity sensor/switch	1. FORBES MARSHALL /SHINKAWA 2. GE BENTLEY NEVADA 3. MEGGITT / VIBROMETER 4. PEPPERL+FUCHS 5. ROCKWELL	1. AG SYSTEMS 2. BRUEL AND KJAER 3. EMERSON 4. IFM 5. JAYASHREE ELECTRON 6. PROVIBTECH 7. SKF 8. TIFENBACH
27	Rotameter	1. EUREKA 2. FLOW STAR 3. IEPL 4. PLACKA INSTRUMENTS 5. SAMIL 6. SCIENTIFIC DEVICES 7. INSTRUMENTATION ENGINEERS	1. BROOKS 2. EUREKA INDLEQUIPMENT 3. FLUIDYNE INSTRUMENTS 4. GAUGES BOURDON 5. TANSA EQUIPMENTS 6. TIPL 7. TOKOYO KEISO 8. TRAC 9. TRANSDUCER & CONTROL 10. V-AUTOMAT
28	Server Station/ Engineering/Operator Work Stations	1. DELL 2. HP	1. COMPAQ 2. FUJITSU 3. IBM-LENOVO 4. SIEMENS
29	Solenoid Valves	1. ASCO 2. AVCON 3. HERIONNORGREN 4. ROTEX	1. BUSCHJOST 2. IMI NORGREN HERION 3. MULLER CO-AX AG 4. SCHOVILL DUNCAN 5. SCHRADER
30	Temperature Gauges	1. A.N.INSTRUMENTS 2. ASHCROFT 3. BAUMER 4. BUDENBERG 5. DRESSER (ASHCROFT) 6. GAUGES BOURDON	1. ALTOP INDUSTRIES 2. BUDENBERG (WIKA) 3. FORBES MARSHALL 4. GOA INSTRUMENT INDUSTRIES 5. JINDAL ELECTRONICS

CONTROL & INSTRUMENTATION - CONSOLIDATED SUB-VENDOR LIST (CLASS – II)			
S.No.	**EQUIPMENTS/SYSTEM**	**ACCEPTABLE SUB VENDORS (CATEGORY – I)**	**BIDDER TO FURNISH CREDENTIALS (CATEGORY – II)**
		7. GENERAL INSTRUMENTS CONSORTIUM 8. GOA THERMOSTATIC INSTRUMENTS 9. H.GURU 10. PRECISION MASS 11. PYRO ELECTRIC 12. WAREE INSTRUMENT 13. WIKA	6. KONICS 7. MINCO INDIA FLOW ELEMENTS (GIC) 8. NAGANO KEIKI 9. NESSTECH INSTRUMENTS 10. NUOVA FIMA 11. PRESSURE & TEMPERATURE CONTROL 12. TEMPSENS INSTRUMENTS 13. THERMAL INSTRUMENT 14. US GAUGE 15. WALCHANDNAGAR INDUSTRIES 16. WINTERS 17. WISE CONTROL
31	GIU	1. ROCKWELL 2. SCHNEIDER	1. ADVANCE TECH CONTROLS 2. DIGITAL INSTRUMENTS & CONTROL 3. REDLION 4. SSM INFOTECH SOLUTIONS
32	Bottom Ash Hopper Camera	1. HONEYWELL	1. ADTECH 2. CEPL 3. COEN BHARAT 4. DIAMOND POWER 5. DURAG 6. EUTECH SCIENTIFIC ENGINEERING 7. FIRE EYE 8. FLIR 9. FORNEY CORPORATION 10. HI-TECH SYSTEMS & SERVICES 11. IMAGE SENSING TECHNOLOGY 12. LENOX INSTRUMENT 13. LTTS 14. LUCENT (DELTA KAMERASYSTEME) 15. MIRION 16. NETWARE 17. PIPER GMBH 18. SAMHOI 19. SERTEL ELECTRONICS 20. SOBOTTA 21. TECHFAB SYSTEMS 22. TEMPSENS