	PE&SD, BHEL.R.C. Puram, Hyderabad	**Dt: 20.07.2021**
PE&SD	**Tender ref no.:** T0AUX00043, NIT_59168 in (www.bhel.com), dated 05.07.2021 **Tender id in https://eprocurebhel.co.in :** 2021_BHEL_4429_1	**Rev 00** **Page 1 of 1**

Corrigendum 02

Name of the Work: "Material Handling and site establishment" in "IOCL Paradip-Standby SRU (525TPD) Train project", Odisha.

Tender No.: T0AUX00043, NIT_59168 in (www.bhel.com), dated 05.07.2021

With reference to above tender, following corrigendum –2 is released.

Sl. No.	Document No./Title/ Reference	As Published	Should be read as/Amended to
1.	Technical Conditions of Contract, Vol. IA of NIT	TCC No: HY/PE&SD/SC-PROJECTS/2020-21/TCC/IOCL-Paradip/ Elec, C&I/00, Rev.00 (Stands null and void)	TCC No: HY/PE&SD/SC-PROJECTS/2020-21/TCC/IOCL-Paradip/ Elec, C&I/01, Rev.01 (shall be applicable)
2.	Un-price Bid Format, Vol. II of NIT	Un-price Bid Format, Vol. II published with NIT. (Stands null and void)	Un-price Bid Format, Vol. II Rev. 01 dtd. 20.07.2021 (Shall be applicable)
3.	Annexure-I PQR of NIT	Annexure-I (Pre-qualifying requirement) of *NIT dated:05.07.2021* (Stands null and void)	Annexure-I (Rev.01) (Pre-qualifying requirement) of *NIT dated:20.07.2021* (Shall be applicable)
4.	NIT- Sl.No.1(VII) EMD AMOUNT	Rs.3,72,000/- (Rupees Three Lacs Seventy Two Thousand Only)	Rs.3,92,150/- (Rupees Three Lacs Ninety Two Thousand One Hundred Fifty Only). Those bidders who have already submitted EMD of Rs. 3,72,000/- are required to submit only differential amount of Rs. 20,150/- in the manner as specified in clause no. 4.0 of NIT
5.	NIT- Sl.No.1(V) DUE DATE & TIME OF OFFER SUBMISSION	*Date : 22.07.2021 ,* *Time :16:00Hrs*	*Date : 27.07.2021 ,* *Time :16:00Hrs*
6.	NIT- Sl.No.1(VI) OPENING OF TENDER	*Date : 23.07.2021 ,* *Time :15.00Hrs*	*Date : 28.07.2021 ,* *Time :15.00Hrs*

Note:

1. All other terms & conditions of the tender will remain unchanged.

2. Bidders are requested to submit a copy of this corrigendum (as part of technical bid) duly signed by the authorized signatory & stamped with official seal as a token of Bidder's unqualified acceptance to this corrigendum.

Sd/-

Imran Javed
PE & SD, BHEL, R.C. PURAM
HYDERABAD- 502 032
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VOLUME - IA

Technical Conditions of Contract (TCC) for “Electrical, C&I” Works

FOR

IOCL Paradip-Standby SRU (525TPD) Train project

BHARAT HEAVY ELECTRICALS LIMITED

BHEL Maharatna Company	**Technical Conditions Of Contract (TCC)** **PROJECT ENGINEERING & SYSTEMS DIVISION** **HYDERABAD**	Ref No: HY/PE&SD/Projects/TCC/2020-21/Elec, C&I/01 Rev. No. 00

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TECHNICAL CONDITIONS OF CONTRACT (TCC)

FOR

"ELECTRICAL, C&I" WORKS
FOR

IOCL PARADIP-STANDBY SRU (525TPD) TRAIN PROJECT

Revisions: Refer to record of revisions	Prepared By:	Checked By:	Approved By:	Date
				20.06.2021
	Yash Pal Singh	D Nagaraju	K Ravi Kumar	

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Volume IA
Part I
Contract specific details

Chapter I- Project Information

1. **Introduction:** Indian Oil Corporation Limited (IOCL), the owner/ customer is intending to install a Standby Sulphur Recovery Unit (SRU) train of 525 TPD along with Tail Gas Incinerator at Paradip Refinery, Odisha. IOCL has appointed Technip India Limited as Project Management Consultant (PMC) for the project. The work has been awarded to BHEL on LSTK basis.

2. Project Details

1	Customer	:	IOCL, Paradip, Odisha
2	Project Information	:	IOCL Paradip-Standby SRU (525TPD) Train project
3	Location	:	Paradip, Odisha
4	Address Detail	:	IOCL, Paradip, Jagatsinghpur District, Odisha, India
5	Nearest Railway Station	:	Paradip Railway Station
6	Road Approach	:	118KM from Bhubaneswar via Cuttack and NH 53
7	Nearest Air Port	:	Biju Patnaik Airport, Bhubaneswar, Odisha, 125KM
11	Ambient Air Temperature (Average)	:	a) Maximum : 39^0 C b) Minimum : 16^0 C
12	Average Relative Humidity	:	71 %
13	Climatic Condition	:	Tropical Climate

Bidder is advised to visit the project site and appraise himself about the local conditions and infrastructure available in the area for fulfilling their commitments under the contract. BHEL will not admit any claims whatsoever on account of Contractor's non-familiarization of local conditions.

Chapter II- Scope of Work

The scope of the work will comprise of but not limited to the following: The scope of work under this specification covers, receipt of materials from BHEL/ Customer stores (maintaining DBR)/ storage yard, handling at stores/ storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment, achieving various milestones till handing over of the following electrical systems and associated items to BHEL's Customer:

1.0 Scope of Electrical work during plant shutdown period covered in this tender are as follows:

1.1 Modification of panels in 6.6kV Switchgear
1.2 LT Switchgear Extension
1.3 LT Switchgear Modification
1.4 LT Power Cable Work: Installation, testing, commissioning including termination, cable dressing, cable tagging, supply of all accessories (Cable glands, lugs, cable tags, markers, clamps, ties etc.) required for this work.
1.5 Installation, testing, commissioning of prefabricated cable trays, tray covers including erection hardware and painting wherever applicable.
1.6 Installation, testing, commissioning of plant earthing and plant lightning protection materials including erection hardware and painting wherever applicable.
1.7 Installation, testing, commissioning of UPS system along with UPSDB for FDA system.

2.0 Scope of Electrical work during post plant shutdown period covered in this tender are as follows:

2.1 Installation, testing, commissioning of 6.6kV HT XLPE Aluminum conductor armored cables.
2.2 LT Power Cable Work: Installation, testing, commissioning including termination, cable dressing, cable tagging, supply of all accessories (Lugs up to and including size 2.5 Sqmm, cable tags, markers, clamps, ties etc.) required for this work.
2.3 Installation, testing, commissioning of HT cable terminating kits.
2.4 Control cabling: Installation, testing, commissioning including all terminations, supply of all accessories (Lugs up to and including size 2.5 Sqmm, cable tags, markers, clamps, ties etc.) required for this work.
2.5 Installation, testing, commissioning of prefabricated cable trays, tray covers (GI & FRP) and cable ducts (GI & FRP) etc. including erection hardware and painting wherever applicable.
2.6 Installation, testing, commissioning of plant earthing and plant lightning protection materials including erection hardware and painting wherever applicable.
2.7 Installation, testing, commissioning of plant illumination package.
2.8 Installation, testing, commissioning of CCTV system.
2.9 Installation, testing, commissioning of local control station.

2.10 Installation, testing, commissioning of plant communication system (PA system & telephone).

2.11 Fabrication, erection of structural steel required for installation of equipment and systems

2.12 Installation of fire proof sealing materials, insulation mats

2.13 Supply, installation, testing and commissioning of chequered plates, erection hardware, cable accessories including glands, lugs, tags, markers etc., safety items like danger boards, Do not switch on boards, Man on work boards, display charts, first aid boxes near LT & HT panels, shock hazard charts, safety hand gloves, exit Signs, GI conduits, RCC Hume pipes, PVC conduits etc.

Chapter III- Facilities in the scope of BHEL/Contractor

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.1	**ESTABLISHMENT**			
3.1.1	**FOR CONSTRUCTION PURPOSE**:			
a	Open space for office (as per availability)	Yes		
b	Open space for storage (as per availability)		Yes	
c	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipment, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc.		Yes	
f	Firefighting equipment like buckets, extinguishers etc.		Yes	
g	Fencing of storage area, office, canteen etc. of the bidder		Yes	
3.1.2	**FOR LIVING PURPOSES OF THE BIDDER**			
a	Open space for labor colony (as per availability)		Yes	
b	Labor Colony with internal roads, sanitation, complying with statutory requirements		Yes	
3.2.0	**ELECTRICITY**			

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
3.2.1	Electricity For construction purposes		Yes	Electricity shall be provided by IOCL/ BHEL at one point on chargeable basis. Further distribution from IOCL/ BHEL feeder point shall be done by contractor. No separate payment for downstream power distribution shall be made. Contractor shall install a calibrated energy meter at feeder point for billing purpose.
3.2.2	Electricity for the office, stores, canteen etc. of the bidder		Yes	
3.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc.		Yes	
3.3.0	**WATER SUPPLY**			
3.3.1	For construction purposes		Yes	Water shall be provided by IOCL at one point on chargeable basis. Further distribution shall be done by contractor.–Further distribution from IOCL supply point shall be done by contractor. No separate payment for downstream water distribution shall be made**.**
3.3.2	Water supply for bidder's office, stores, canteen etc.		Yes	
3.3.3	Water supply for Living Purpose		Yes	
3.4.0	**LIGHTING**			
a	For construction work (supply of all the necessary materials) 1. At office/storage area 2. At the preassembly area 3. At the construction site /area		Yes	

S. No.	Description PART I	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
b	For construction work (execution of the lighting work/ arrangements) 1. At office/storage area 2. At the preassembly area At the construction site /area		Yes	
c	Providing the necessary consumables like bulbs, switches, etc. during the course of project work		Yes	
d	Lighting for the living purposes of the bidder at the colony / quarters		Yes	
3.5.0	**COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER**			
a	Téléphone, fax, internet, intranet, e-mail etc.		Yes	
3.6.0	**COMPRESSED AIR wherever required for the work**		Yes	
3.7.0	**Demobilization of all the above facilities**		Yes	
3.8.0	**TRANSPORTATION**			
a	For site personnel of the bidder		Yes	
b	For bidder's equipment and consumables (T&P, Consumables etc.)		Yes	

3.9 Construction power will be provided to the contractor at one points within plant area by BHEL on chargeable basis at the applicable rate of IOCL. Feeder Rates are as follows:

Cat No	Load Demand	Feeder Rating	Cost/ Month (Rs.)
1	Up to 32A	415V, 32A	25000
2	>32A to 63A	415V, 63A	50000
3	>63A to 125A	415V, 125A	100000
4	>125A to 250A	415V, 250A	200000

3.9.1 In the event of power requirement (and or availability of power) is for less than one month pro- rata cost will be arrived on the basis of above rates. The required digital Energy meter for measuring the consumption and MD shall be provided and installed by the contractor. Any dispute regarding consumption, the BHEL engineer's decision is final. The contractor shall make his own arrangement for further distribution (as required within plant boundary and outside plant boundary) with necessary isolator / LCB etc.

3.9.2 Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

3.9.3 The required energy meter for measuring power consumption shall be arranged by the contractor and taken care by the contractor. Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

3.9.4 Contractor has to make their own arrangements for electricity requirement for labour colony at their cost. Any duty, deposit involved in getting the Electricity for contractors use i.e. Office shed, labour colony etc. shall be borne by the bidder.

3.9.5 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

3.10 Construction Water: Subject to availability, Construction water shall be provided by IOCL on chargeable basis. The cost of water supply shall be recovered from CONTRACTOR'S running/ final account bill at 0.25%.

However, in case BHEL/ IOCL is not able to provide construction water due to any reason whatsoever, CONTRACTOR shall be responsible for making all arrangements for Construction water at his cost. Any statutory requirements/ documentation etc. to this effect shall be met by the CONTRACTOR.

Non-availability of water due to any reason shall not entitle the CONTRACTOR for any claim against BHEL on account of cost and time implications.

Sl. No	**Description** **PART II** **3.9.0 CONSTRUCTION FACILITIES**	**Scope / to be taken care by**		*Remarks*
		BHEL	**Bidder**	
3.9.1	**Engineering works for construction:**			
a	Providing the construction drawings for all the works covered under this scope	**Yes**		Drawing schedule shall be finalized at the time of kick off meeting
b	Drawings for construction methods			NA
c	As-built drawings – where ever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes		Yes	In consultation with BHEL
d	Shipping lists etc. for reference and planning the activities		Yes	In consultation with BHEL
e	Preparation of construction (Concreting B/W, etc.) schedules and other input requirements		Yes	In consultation with BHEL
f	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments	Yes	Yes	In consultation with BHEL
g	Weekly construction schedules based on S. No. e. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
h	Daily construction / work plan based on S. No. g. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
i	Periodic visit of senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two Weeks.		Yes	
j	Arranging the materials required for Work		Yes	
k	Coordination for inspection & checking and getting clearance from customer		Yes	

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		*Remarks*
		BHEL	**Bidder**	
1	Preparation of formats for completion of activities		Yes	
3.10	**Work Permits, gate pass etc. from customer for manpower, machinery and material**		Yes	
3.11	Ambulance Services for site staff		Yes	To be shared with contractors at monthly recoverable charges from RA bills as per GCC

Chapter IV- Tools & plants to be deployed by Contractor

LIST OF TOOLS AND PLANT:

The following tools and equipment but not limited to, are required for the efficient execution of the electrical and civil works. The contractor shall make them available for construction purposes, including all consumables likely to be used at his own cost at the time of mobilization.

S.No.	Description	Minimum Quantity	Remarks
A. For Works			
1	Hydra	1	Need based
2	JCB	1	Need based
3	Tractor	1	Need based
4	Cable unwinding Machines, rollers etc	1 No	Need based
5	MC4 connector tool kit containing (1) crimping plier MC4, (2) open end spanner set MC4, (3) stripping plier MC4, (4) socket wrench insert to tighten, (5) socket wrench insert to secure, inserts for both 4 sq-mm and 6-sqmm (of both pliers).	2 Set	Need based
6	Electrical measuring Instruments		Need based
	a) Megger-1KV	1No	
	b) HV Tester-10KV	1No	
	d) Logic probe	1No	
	e) Modbus communication check kits	1No	
	f) Digital Multi meter	5 No	
7	Tong Testers	3 No	Need based
8	Digital power meters	1 No	Need based
9	Phase sequence meter	1 No	Need based
10	OFC termination kit, Splicing kits	1 Set	Need based
11	Primary /secondary injection kit	1 No each	Need based
12	~~Transformer oil filtration unit~~	~~1 No~~	~~Need based~~
13	Earth resistance measurement kit	1 No	Need based
14	Lugs, glands as in scope of supply	1 set	Need based
15	Transmission line stringing equipment	1 No	Need based
16	DG Sets	1 No	Need based
17	Cable jointing kit and associated tools	2 Set	Need based
18	Welding equipment	1 No	Need based
19	Flood lights	5 No	Need based

20	Set of screw drivers	1 Set	Need based
21	Set of Allen keys (mm & inch)	1 Set	Need based
22	Small size hacksaw & fraksaw	1 Set	Need based
23	Cutting pliers	2 No	Need based
24	Nose pliers	2 No	Need based
25	Insulation stripers	2 No	Need based
26	Dry cable jointer	1 No	Need based
27	Number punches	1 No	Need based
28	Alphabet punch	1 No	Need based
29	Embossing machine with cassettes (Numbers and alphabets)	1 No	Need based
30	Portable drilling machine up to 1-1/2"	1 Set	Need based
31	Soldering gun	1 No	Need based
32	Soldering Iron	1 No	Need based
33	Continuity tester	5 No	Need based
34	Double ended spanner Set of sizes 10-11, 12-13, 14-15, 16-17, 17-18	2 Nos each	Need based
35	Screwdriver Set	1 Set	Need based
36	Crimping tool with Dye range 50-400sq-mm cable, mechanical gear power, hand operated	1 Set	Need based
37	Crimping tool up to 6 sq-mm cable	1 set	Need based
38	Drilling machine AC, hand operated, with bit size up to 20 mm	1 set	Need based
39	Measuring Tape, 5m	2 Nos	Need based
40	Measuring Tape, 50 m	2 Nos	Need based
41	Allen Key set	1 Set	Need based
42	Adjustable spanner 2-inch size	1 No	Need based
43	Hammer	2 Nos	Need based
44	Rough file kit	1 Set	Need based
45	Cutting Pliers	2 Nos	Need based
46	Nose Pliers	2 Nos	Need based
47	Vacuum cleaner, of industrial type, for control room sweeping / cleaning.	1 No	Need based
48	Blowers for cleaning the panels	2 Nos	Need based
B. For civil works			
1	Digital Concrete Mixer 2 to 4 cum with hopper/Self-loading mobile concrete mixer (Azax)with printer	2 nos.	Need based
2	Needle Vibrator (Needle type 40mm)	4 nos.	Need based
3	Needle Vibrator (Needle type 25mm)	2 nos.	Need based
4	Dewatering Pump	2 nos.	Need based

5	Earth Compactor	2 nos.	Need based
6	Theodolite with staff	2 nos.	Need based
7	Dumpy level with staff	1 no.	Need based
8	Chain pulley block for lifting of panels		As required

1. BHEL will not provide any tool, plants, facilities or any testing facility/apparatus for the work. It will be contractor's responsibility to arrange all required tools, plants and other testing apparatus, etc. at their own cost. The prices quoted & finalized are inclusive of the charges towards providing such T&P. No extra payment will be entertained because of this.
2. All the tools and tackles brought for E&C works shall have valid calibration/ fitness certificate.

Chapter V- Time Schedule

5.1 TIME SCHEDULE

5.1.1
The entire work of "Electrical, C&I Works" as detailed elsewhere in the Tender Specification shall be completed within **Eighteen (18) Months** from the date of commencement of work at site.

5.1.2
During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

5.1.3
The work shall be commenced on the mutually agreed date between the bidder and BHEL engineer. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

5.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy, the decision of BHEL engineer will be final.

5.3 MOBILISATION

5.3.1
The activities for this work shall be started as per directions of Construction manager of BHEL.
5.3.2
The contractor should mobilize man power in order to complete the work in **Eighteen (18) Months**.
5.3.3
Requisite Material, men and machinery should be arranged in order to complete the project within stipulated time.
5.3.4
The contractor has to augment his resources in such a manner that following major milestones of the project are achieved on specified schedules:

In order to meet above schedule in general, and any other intermediate targets set, to meet project, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.

5.4 CONTRACT PERIOD

For the purpose of contract, the period shall be taken as **Eighteen (18) Months**. Completion of the work shall be as per BHEL Bar Charts revised from time to time. In order to expedite the work, the contractor has to deploy manpower as per site requirement without any extra cost to BHEL.

5.5 GUARANTEE PERIOD

The guarantee period of twelve months shall commence from the date of completion of all works as certified by the BHEL site engineer.

5.6 PROTECTION OF WORK

The contractor shall have total responsibility for protecting his works until it is taken over by the Employer. No claim will be entertained by the Employer or the representative of the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because of other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned.

If disagreement, conflict, or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be rectified. The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

5.7 Establishment of Construction power supply arrangement shall be completed within 30 Days from the date of commencement of work.

5.7 Tentative Schedule

Sl No	Description	Start	End
1	Commencement of work at site	Zero Date (D)	
2	Shutdown Works	D + 30 Days	D + 60 Days
3	Post Shutdown Works	D +300 Days	D + 540 Days

Schedule given above is tentative and subjected to customer permissions and front availability.

5.8 Schedule for Shutdown period Works: Customer (IOCL) is planning to give shutdown for one (1) month in November 2021. Contractor shall mobilize approximately 30 Days before the shutdown starts for preparatory works and complete the shutdown period scope of work within 1 Month.

In case, contractor is not able to complete the shutdown period scope of work within the shutdown period, contractor shall have to complete it during running plant condition by taking all precautionary and necessary required measures in line with IOCL approvals.

Customer (IOCL) shall give plant shutdown for one (1) month only, in the month of November. Contractor shall have to carry out all the work in that period only. In order to achieve that, contractor shall deploy multiple gangs at parallel fronts simultaneously and work shall be done 24Hrs x 7Days (Round the clock). Contractor shall mobilize minimum 1 Months (30Days) before the shutdown start (Or as per instructions of BHEL Construction manager) to carry out the pre shut down activities.

Post shutdown work may be started after seven to eight month tentatively after completion of above shutdown, subjected to availability of site readiness and material availability at site or as per instruction of BHEL site in-charge.

Approvals to be taken during Pre-shutdown period: This is a brown field refinery project; therefore, this work contains various approvals to be taken from customer, which will take time. Customer's approval according authorities shall be occupied one week before shut down starts. Therefore, It is essential for Contractor to obtain following (But not limited to) approvals during pre-shutdown period:

i) Labor License

ii) Gate passes of staff, labor, machines, materials etc.

iii) Safety Training of contractor's staff

iv) Work Permits

v) Other required approvals in consultation with BHEL/ IOCL

Chapter VI- Statutory Regulation

6.1 BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998 and

INTER-STATE MIGRANT WORKMEN ACT, 1979 (IN CASE BIDDER ENGAGE MANPOWER FROM OTHER STATE)

In case any portion of work involves execution through building or construction workers and/or inter-state migrant workers, then compliance to the above titled Acts as applicable shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the circumstances, it may be ensured as under:-

It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a license to the Competent Authority under the BOCW Act and/or ISMW Act as applicable and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of license / permission to BHEL within a period of one month from the date of award of contract.

It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these acts and rules including that of payment / deposit of cess as per the applicability under above referred Acts within a period of one month from the receipt of payment.

It shall be the responsibility of the sub-contractor to furnish the receipts / challans towards deposit of the cess together with the number, name and other details of beneficiaries (building/Inter-state Migrant workmen) engaged by the sub-contractor during the preceding month.

It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.

Chapter VII: HSE (Health, Safety, Environment) and PPE (personal Protective Equipment) Guidelines

1. Contractor shall follow all the HSE guidelines as mentioned chapter IX off SCC and IOCL (Annexure-III).
2. Contractor shall deploy one (1) number of qualified and experienced safety officer for the entire period of contract.
3. Contractor shall submit the biodata of safety officer to BHEL/Customer (IOCL), for approval.
4. In case of any dispute/ contradiction, IOCL HSE rules and guidelines shall prevail.

Chapter VIII- Field quality control plan

1. Work shall be executed as per approved field quality control plan (FQCP). Indicative quality control plan of IOCL is attached as Annexure-IV. Contractor shall prepare, submit the field quality control plan in line with IOCL QCP.

Submitted FQCP shall be reviewed and approved by BHEL/IOCL/ TECHNIP.

Chapter IX- L-1 Schedule for Shutdown Activities

Sl No	Activity Description	Duration (Days)
A	**Electrical Works**	**20**
1	Modification of 6.6kV Switchgear (2 Nos)	7
2	LT Switchgear Extension and Modification (13 Nos)	20
3	Cabling	10
4	Earthing	15
C	**C&I Works**	**23**
1	Installation of DCS & PLC panels (34 Nos)	7
2	Addition/ Modification of existing Controllers/ cards/ Switches/ modules in both SRU and TGTU packages	7
3	Installation of Workstations and Hardwired consoles.	3
4	Installation of New/Common UPS PDB for DCS and ESD system	3
5	Installation of Existing PDB for non-UPS for DCS & PLC and Dedicated mini UPS for FDAS	3
6	Inter-panel cabling.	15
7	Earthing	10
8	Network/ firmware, database, Software integration with the existing system (DCS, SCADA, ESD, BMS, FDAS, GDS etc)	12
9	Integration of new points in the existing systems software such as – IAMS, AMS, SOE, History node, History server, Back up server, OPC server, Large Video screens, Domain controller, RTD BMS, ESD HMI's and DCS HMI etc.	10

Volume IA
Part II
Technical Specification: Electrical Works

1.0 GENERAL:

CONTRACTOR SHALL ABIDE BY THE SAFETY/ SECURITY RULES AND REGULATIONS AS PER THE REQUIREMENT OF IOCL/BHEL. CONTRACTOR SHALL OBTAIN INFORMATION ABOUT ALL SAFETY/ SECURITY NORMS OF IOCL WELL IN ADVANCE. BHEL WILL NOT ADMIT ANY CLAIMS WHATSOEVER ON ACCOUNT OF CONTRACTOR'S NON-FAMILIARIZATION OF SITE SAFETY/ SECURITY REGULATIONS.

1.1 The intent of this specification is to procure services according to the most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for proper and efficient execution of this work shall not relieve the contractor of the responsibility of providing such facilities to complete the work without any extra compensation.

1.2 The scope of work under this specification broadly covers the receipt of materials from BHEL/Customer stores/storage yard, handling at stores/storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment as defined in scope of work Chapter-2, Part-I of TCC document, Bill of Quantities , achieving various milestones till handing over of the electrical system and associated items to BHEL's Customer.

Unloading of materials and storage is by other contractor. The scope of work also covers temporary storing (if required) of contractor's own construction material, using the same in the work, survey, excavation, backfilling.

1.3 All works such as cleaning, leveling, aligning, trial assembly, dismantling of certain equipments/ components for checking and cleaning, surface preparation, fabrication as per general engineering practice and as per BHEL engineer's instructions at site, cutting, gouging, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting up etc., as may be applicable in such erection works and which are treated incidental to the erection works and necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work within the quoted rates.

1.4 The work covered under this specification is of highly sophisticated nature, requiring the best quality of workmanship for engineering and construction management. The Contractor should ensure proper planning and successful and timely completion of the work to meet the overall project schedule. The Contractor must deploy adequate quantity of tools and plants, modern/ latest

construction aids, equipments etc. He must also deploy adequate trained, qualified and experienced supervisory staff and skilled personnel.

1.5 The work shall be executed under the usual conditions not affecting refinery unit construction and in conjunction with numerous other operations at site. The Contractor and his personnel shall cooperate with personnel of BHEL, BHEL's Customer, Customer's Consultant and other Contractors, coordinating his work with others and proceed in a manner that shall not delay or hinder the progress of work of the project as a whole.

1.6 Contractor shall carry out all work as per the sequence, instructions and methodology prescribed by BHEL depending upon the technical requirements. The sequence of activities, methodology will be decided by BHEL engineers depending upon the availability of material, drawings, work fronts etc. BHEL engineer's decision regarding correctness of the work and method of working shall be final and binding on the contractor. No claims for extra payment from the Contractor will be entertained on the grounds of deviation from the methods and sequence of construction advised by BHEL engineer or for any reasons whatsoever.

1.7 The contractor shall take delivery of the equipments from the BHEL stores/ storage area after getting the approval of BHEL engineer on standard indent forms of BHEL. Complete and detailed account of the materials and equipment's after usage shall be submitted to the BHEL and reconciled periodically.

Contractor shall plan and transport equipments, components from storage to erection site and erect them in such a manner and sequence that material accumulation at site does not lead to congestion at site of work. The contractor should also note that the transport of equipments to erection site, assembly yards etc. should be done by the prescribed route without disturbing the other works and contractors and in the most professional manner. Materials shall be stacked neatly, preserved and stored in the contractor's shed and at work areas in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work areas/ site to enable other agencies to carry out their work or for any other reason, contractor shall do it most expeditiously. No claim for extra payment for such work will be entertained.

Special equipments such as measuring and control equipments, panels, electronic items etc. shall be stored when taken over by the contractor in appropriate manner as per BHEL's instructions.

1.8 The Erection Contractor shall at his cost perform any services, tests etc. although not specified but nevertheless required for completion of the work.

1.9 All necessary certificates and licenses required to carry out this work are to be arranged by the Contractor expeditiously at his cost in time to ensure smooth progress of work.

1.10 The work shall conform to dimensions and tolerances specified in various drawings, documents etc. that will be provided during the course of construction. If any portion of the work is found to be defective in workmanship or not conforming to drawings or other stipulations due to Contractor's fault, the Contractor shall dismantle and re-do the work duly replacing the defective materials at his cost, failing which the work will be got done by BHEL at the cost and risk of the contractor.

BHEL reserves right to recover from the contractor any loss, which arises out of undue delay/ discrepancy/ shortage/ damage or any other causes due to contractor's lapse during any stage of work. Any loss to BHEL due to contractor's lapse shall have to be made good by the contractor.

1.11 The terminal points as decided by BHEL shall be final and binding on the Contractor for deciding the scope of work and affecting payment for the work done.

1.12 During the course of execution of this work, certain rework/ modification/ rectification/ repairs/ fabrication/ dismantling etc. will be necessary on account of feedback from Customer or BHEL/ revision in drawing on account of design discrepancies and manufacturing defects and site operation/ maintenance requirements. Contractor shall carryout such rework/ modification/ rectification/ fabrication/ repairs etc. promptly and expeditiously. Daily log sheets signed by BHEL engineer and indicating the details of work carried out, man-hours etc. shall be maintained by the Contractor for such reworks. Claims of contractor, if any, for such works will be dealt as per relevant clauses of General Conditions of Contract.

1.13 Daily log sheets indicating the details of work carried out, man-hours, consumables used etc., shall be maintained by the Contractor and got signed by BHEL engineer every day.

1.14 All transport equipment, handling equipment, tools, tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables etc. except otherwise specified as in BHEL scope of free issue, required for the scope of this work shall be provided by the Contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clauses. The Erection Contractor's quoted rates should be inclusive of all such contingencies.

1.15 The Contractor shall make all fixtures, temporary supports, steel structures required for jigs and fixtures, anchors for load and guide pulleys required for the work (excepting those specifically included in BHEL scope). However, necessary steel will be provided from the scrap/ surplus materials available at site.

Plant materials should not be used for any temporary supports/ scaffolding/ preparing pre-assembly bed etc.

1.16 For any class of work for which no specifications have been laid down in these specifications, work shall be executed as per the instructions of BHEL.

1.17 The contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before these equipments are erected in position.

1.18 The Contractor shall have total responsibility for all equipment and materials in his custody, including those loose, semi-assembled, assembled or erected by the Contractor at site and shall preserve these. He shall effectively protect the finished works from action of weather and from damages or defacement and shall also cover the finished parts immediately on completion of work as per BHEL engineer's instructions. The machined surfaces/ finished surfaces should be greased and covered. Overhauling, cleaning, servicing of equipments during erection and commissioning stages will be arranged by the contractor.

1.19 The contractor shall make adequate security arrangements including employment of security personnel and ensure protection of all materials/ equipments in their custody and the installed equipments from theft, fire, pilferage and any other damages and losses. Special care shall be taken to guard against pilferage/ theft of steel, cables/ conductors, brass fittings.

1.20 Contractor shall ensure proper housekeeping and remove all scrap materials periodically from various work area covered in the scope and deposit the same at the place earmarked for this purpose. In case of contractor's failure to do the same, BHEL reserves the right to remove scrap at contractor's cost and risk.

1.21 The weight and dimension as mentioned against the individual items in Price Bid/ Rate Schedules or elsewhere in the tender specification are indicative approximate and there may be variation in dimension and weight in actual supply of equipment. No rate variation shall be considered on this account.

1.22 The entire surplus, unused materials, damaged materials, packaging materials/ containers, special transporting frames, gunny bags, etc. shall be returned to BHEL stores by the contractor.

1.23 Contractor will be required to maintain in his site office at least one PC along with minimum accessories like printer etc. to enable him to carry out site activities in a planned, well-coordinated and smooth manner.

1.24 Access to site for inspection by BHEL and Customer engineers shall be made available by the Contractor at all times. The Contractor shall carry out the rectification pointed out without any extra cost to BHEL/ Customer. No cost whatsoever due to such duplication of inspection of work shall be entertained.

1.25 Contractor shall prepare Marked-Up drawings incorporating modifications and deviations from original drawings or prepare fresh sketch for actual installation/ connection details if need be, that can be converted to "As-Built" drawing. These drawings shall be endorsed by site engineer and handed over to BHEL.

1.26 Indicative Field Quality Plans are attached with the NIT.

The Contractor shall carry the work as per the Field Quality Plans issued by BHEL/ Customer.

1.27 Calibration of equipments should be done by NABL/ NPL accredited laboratories.

1.28 Welding procedure shall be followed as per Field Quality plan. Welding procedure and prequalification of welder are required to be produced, if required.

2.0 SUPPLY, ERECTION, INSTALLATION & COMMISSIONING (I&C) FOR ELECTRICAL WORKS:

2.1 Erection Contractor scope includes:

- The scope of work under this specification broadly covers the receipt of materials from BHEL/Customer stores/storage yard, handling at stores/storage yard, transportation to site of work, preassembly, erection, calibration, testing, pre-commissioning tests and checks, commissioning, trial run of various auxiliaries and equipment as defined in scope of work Chapter-2, Part-I of TCC document, Bill of Quantities.
- Supply, installation/Erection, unloading/ safe storage of Erection Contractor supplied items.
- Coordination / liaison activities (related to clearance / approval) with concerned state / central authorities such as CEIG/CEA etc, including renewal of CEIG license every year as applicable.
- Pre commissioning, Start up, performance test run, trouble-free operation and successful commissioning of the SRU plant.

2.2 Detailed Specification:

Erection Contractor scope – breakup of supply, E&C:

The table below indicates the scope of work for the Erection Contractor, as briefly outlined.

a)	**Supply**
1	Items as per Annexure-II
b)	**E: Erection, T: Testing, I: Installation and C: Commissioning:**
1	E&C: 6.6kV HT Switchboard after necessary Modification in 2 Feeders
2	E&C: 415V LT Switchboards Extension of Panels and necessary Modification
3	T&C: 110V UPSDB & 230V UPS DB and 220V DCDB Switchboards and other electrical panels Erection and Commissioning Works

4	I&C: Laying of cables for LT power cables, HT (6.6kV) cables, data communication / control / PMS/ OFC cables in RCC cable Trench/ overhead Cable Trays/ducts, Cable glanding and termination through lugs/Cable kits
5	E&C: Preparation/ Fabrication of cable support structures & Erection and Installation of cable supports and cable trays
6	E&C: Erection and commissioning of Earthing system
7	E&C: Erection and commissioning of lightning protection system
8	E&C: Erection and commissioning of illumination system
12	E&C: Erection and commissioning of LCS,PDBs/JBs
13	E&C: Erection and commissioning of PA System
14	E&C: Erection and commissioning of IP based telephone system
15	E&C: Erection and commissioning of CCTV System
16	E&C: Erection and commissioning of UPS for FDA System and it's accessories
17	I&C: Installation of fire proof sealing materials
18	T&C : Testing & Commissioning of Motors (HT/LT),MOVs/ Actuators
19	E&C: Erection and commissioning of miscellaneous electrical activities and safety items
20	T&C: Pre-commissioning inspections / checks / site tests
21	Coordination with state / central departments / CEA/ CEIG etc. for necessary approvals / clearances for commissioning
22	Handing over of mandatory spare/any other spares and special tools to customer
23	Post-commissioning operation of the plant

Note: In case of any contradiction between BHEL Specification and Customer Job Specification/ Installation Details, most stringent clause will be taken into consideration. Erection Contractor shall quote accordingly.

3.0 TECHNICAL SPECIFICATION FOR DESIGN, SUPPLY, ERECTION AND COMMISSIONING:

3.1 HT Switchgear:

Design & Supply: The existing 6.6 kV Motor feeders (Panel No. 33 & 64) at existing 6.6kV Switchboard (331S-SG-301) shall be used to feed the proposed Incinerator motors. HT Switchgear OEM shall do necessary Modification in the HT Switchgear Motor Feeders.

The above feeders are to be interfaced with existing PMS system for Control, Monitoring & load Shedding and with existing DCS system through IRP. Necessary configuration shall be done at existing PMS & DCS systems for the above interface as per contract. PMS System OEM shall do the necessary interface for PMS System interface.

Required assistance is to be extended by Erection contractor for HT Switchboard OEM for HT Switchgear modification works, PMS System OEM for PMS interface works.

For DCS System interface, erection contractor shall do the necessary cabling works as per cable schedules provided by BHEL during detailed engineering.

In addition to above, Erection Contractor shall consider the following:

1. Transportation & Storage of HT Switchgear components at intended location (if required).
2. Arranging labour/ worker/ electrician personnel (if required) to HT Switchgear Service Engineer, PMS System Service engineer during testing of HT Switchgear panels after installation of components & required modification done in the panels.
3. HT Cable Termination works in the panels after laying of HT cables.
4. Testing & Commissioning of HT Switchgear panels after installation of HT Drives in the field.
5. Coordination of customer & Drive vendors during testing & Commissioning of HT Switchgear panels & HT Drives in the field.

Testing:

For testing of HT Switchboard after modification, please refer Cl. No. 9.1 of Job specification for electrical installation, testing, Pre Commissioning and commissioning (Doc No: 080557C-000-JSD-1600-003, Rev No. A) for further details & tests applicable to HT Switchboard.

3.2 LT Switchgear Extension Panels:

Design & Supply: LT Switchboard Extension Panels as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Erection Contractor shall organize necessary resources such as labour/ worker/ electrician, cranes, hydra, forklifts, transportation trucks/ trolleys and other accessories for movement and positioning of the panels at the required location.

Panels have to be shifted to their locations through floor openings, temporary openings like floor grills, door etc. which shall be part of work and no claim whatsoever will be entertained with regard to non-availability of opening as per shortest route etc.

Switchgear panels are normally supplied in suit of either one/two/three or loose shipping sections with integral base frame or loose supplied.

Panels shall be moved to the respective positions and installed over the cutouts in Switchgear/ Substation room, in the exact sequence and locations as per approved drawings to suit layout and foundation arrangements.

Dragging of the panels directly on floor is not allowed. Roller bars must be used for shifting of panels. Use of crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboard panels shall be lifted after ensuring the panel supports, nut and bolts are all intact. While lifting the panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment.

Installation of panels shall include fixing of base frame, fabrication of base frame if required, leveling, alignment, fixing of anti-vibration pads, removal of side covers, fixing of cubicle interconnection hardware, bus bar jointing, wiring interconnection, welding and grouting of panels and base frames, mounting of panel canopy wherever supplied as part of panel, drilling of gland plates and sealing of cable entries. In certain case where canopies are not supplied but have to be fabricated out of MS sheets provided by BHEL, payment will be done on square meter basis.

Panels shall be suitably grouted using welding/ bolting methods as appropriate. BHEL approval shall be obtained for the grouting arrangement. All necessary hardware for the same shall be within Contractor's scope of supply.

Panel and instruments once erected in position should be properly protected using necessary care to prevent ingress of dust/moisture. This will have to be periodically cleaned and surroundings have to be kept tidy.

Wherever the panels to be mounted on cable trenches, channel supports have to be provided across the cable trench over which the base frame of panel shall be mounted. For such work, structural steel fabrication, installation rates shall be applicable.

Normally the panels shall be supplied with instruments, relays, meters, electronic modules etc. mounted and pre-wired. However, if these are supplied loose / separately for safety in transit, contractor shall mount/wire such devices as part of the panel installation work and no separate rates shall be applicable unless otherwise specially listed in the rate schedule.

No separate payment shall be made for replacement of any devices like electronic modules, relays, conductors, terminal block, push buttons etc. which are found defective during pre-commissioning / post-commissioning of any equipment / item.

Minor civil works like drilling, chipping, punching holes and opening in concrete floors, slabs and brick walls, grouting, related to Rack, support installation, minor civil works required for installation of control panels, Junction boxes etc., shall be included in the erection cost of such items. Also all miscellaneous civil works like chipping away and making good as necessary in floor slab/wall for cabling / earthing etc., as required are included in the scope for which no separate payment is applicable. The scope also includes supply of grouting material, if any.

Supplier's instruction manuals, packing slips, door keys etc. received along with the panels should be promptly handed over to BHEL's engineer on opening of the panels.

Testing:

After completion of installation of switchboards, all the cubicles, switchboard components such as switches, starters, CT and PT chambers, bus bar chamber shall be cleaned and checked for tightness of all the components.

All the wiring connections shall also be checked. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with Carbon Tetra Chloride (CTC) where required.

All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required, shall be done as per the directions of Engineer- in-charge. Special attention shall be paid to CT circuit's polarity, wiring continuity and correctness in the protection as well as measurement circuits. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced.

Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire switchboard shall be dried- up according to the instruction of the Engineer-in-charge for the IR value to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.

All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in-charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer- in- charge.

All moving parts, of closing/tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.

All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.

Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.

Pre-Commissioning Checks:

Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

a) That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to make the enclosure vermin proof.

b) That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.

c) That the polarity test and ratio test of all the PTs and CTs is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits is correct.

d) That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.

e) That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault

annunciations, data logging, and display of switchboard SLDs shall be verified from HMI in case the same is provided.

f) That IR Value has been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

g) Following tests shall be ensured for all CTs

- Insulation resistance test
- Ratio test through primary injection
- Polarity test
- Knee point voltage for class PS CTs

j) Following tests shall be ensured for all meters

- Calibration of meters
- Functional verification and settings

k) Following tests shall be ensured for all relays

- Secondary injection test
- Relay settings
- Timing check with timers
- Any other test recommended by the supplier

l) Following tests shall be ensured for all bus bars

- Tightness of all nuts/bolts using Torque wrench
- IR value
- Contact resistance
- Cleaning of bus bar chamber using vacuum cleaner
- Conducting jelly shall be applied on Al/Cu joints as per manufacturer's recommendations
- HV test in case of HV switchboard.

m) Following tests/Checks shall also be performed on the switchboards

- Functional verification of individual feeders including all spare feeders
- Simulation test for under voltage tripping of related feeders such as motor feeder, capacitor feeders etc.

- Verification of control supply schemes
- Stability test for all differential protections
- Checks for all panel illuminations, indicating lamps, sockets
- All upstream and downstream interlocks

3.3 110V UPSDB & 230V UPS DB and 220V DCDB Switchboards:

- **110V UPS DB in SR-111:**

6 Feeders need to be added in existing UPS DB in SR-811 (Addition of 2 nos. of 63A power feeder & 1 no. of 100A power feeder in each bus section; Total number of bus sections – 2 Nos.). Make of UPS DB is M/s Emerson. Contractor shall execute the above job through M/s Emerson only.

- **Testing & Commissioning of Existing Feeders in UPSDB & DCDB:**
- 2 No. of existing feeders in 331S-INST-UPS-001.
- 2 No. of existing feeders in 331S-INST-UPS-002.
- 2 No. of existing feeders in 220V DCDB.

3.4 UPS for FDAS:

Design & Supply: UPS for FDAS as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

The installation and commissioning of the UPS System shall be in Contractor's scope.

1. HDP Tubular or Ni-Cd (or similar type) or Lead acid Batteries will be supplied loose along with battery interconnection in the series/parallel links/bus bar, lugs, steel/wooden battery stand either assembled or knocked down condition, cables and associated charger and UPS system.

2. In case of Ni-Cd (or similar type) batteries are normally supplied in charged condition, due care shall be exercised while handling/installation of the same. If the battery charge is found to be less than the required level, the charging/discharging cycle shall be carried out as per instruction of BHEL engineer.

3. Battery charging/discharging is a continuous process and skilled manpower shall be deployed by the contractor round-the-clock.

4. Contractor shall arrange suitable load, cables, safety equipment's and consumables for discharging the battery during charging and discharging cycle at his cost.

5. Contractor shall provide skilled manpower for periodic maintenance after the battery are fully charged for the activities such as checking of electrolyte level, specific gravity, topping up with distilled water and cleaning till the set is handed over to customer and record of the same shall be maintained and submitted before handing over of the system.

Testing:

The Contractor shall also carry out the site tests on equipments/systems as specified below. However, these shall not be limited to this specification only and in case any other site test is required to be conducted as a standard practice of the Contractor or deemed necessary by the Employer and mutually agreed between the Contractor and the Employer, the same shall also be carried out.

Functional Test

On completion of installation and commissioning of the equipment the following tests/checks shall be carried out with the max. available load, which does not exceed the rated continuous load. These tests/checks shall include but not limited to the tests as indicated below.

The details of the tests are as indicated below:

1. Light Load Test

This test is carried out to verify that the UPS is correctly connected and all functions operate properly. The load applied is limited to some percent of rated value. The following points should be checked:

(a) Output voltage, frequency and the correct operation of meters;

(b) Operation of all control switches and other means to put units into operation.

(c) Functioning of protective and warning devices.

(d) Operation of remote signaling and remote control devices.

2. Checking of Auxiliary Devices

The functioning of auxiliary devices, such as lighting, cooling, pumps, fans, annunciation, etc., should be checked, if convenient, in conjunction with the preliminary light load test.

3. Synchronization Test

If possible, frequency variation limits should be tested by use of a variable frequency generator, otherwise, by simulation of control circuit conditions. If applicable the rate of change of frequency during synchronization shall be measured.

4. AC Input Failure Test

The test is performed with a fully charged battery and is carried out by tripping input circuit breakers or may be simulated by switching off all UPS rectifiers and bypass feeder as at the same time. Output voltage variations are to be checked for specified limits with an oscilloscope or equivalent. Frequency variation is defined as the steady state frequency of the UPS with and without AC input. The rate of change of frequency is measured by the time it takes to reach steady-state values.

5. AC Input Return Test

AC input return test is performed by closing AC input circuit breakers, or is simulated by energizing rectifiers and bypass feeders.

Proper operation of rectifier starting and voltage and frequency variations are to be observed.

Note: This test is normally performed with a fully of or partially charged battery.

6. Simulation of Parallel Redundant UPS Fault

This test is applicable for UPS with parallel redundant connections. Faults of rectifier or inverter units may be carried out by simulation. Output transients are to be observed.

7. Transfer Test

This test is applicable for UPS with bypass, particularly in the case of an electronic bypass switch. Transients shall be measured during load transfer to bypass caused by a simulated fault and load retransfer after clearing of the fault.

8. Full load test

Load tests are performed by connecting the actual load to UPS output.

Large UPS in parallel connection may be load tested by testing the individual UPS units separately. Load tests are necessary for testing output voltage and frequency, rated stored energy, recharge time, ventilation, temperature rise and determination of efficiency. Load tests are performed to prove transient voltage deviations specified under step load conditions.

9. Rated Stored Energy Time (Battery Test)

This test is a load test to prove the actual possible time of battery operation.

If rated load is not available in the case of large UPS, it is possible to apply a partial load to check the actual battery discharge characteristics and compare these with characteristics specified by the battery manufacturer. Discharge time with rated load shall then be calculated. The test shall be performed with a fully charged battery and also may be done under other battery conditions to be specified, if so agreed. Active power output of the UPS and the battery voltage shall be recorded during the test.

Since new batteries often do not provide full capacity during a starting up period, the discharge test may be repeated after a reasonable recharge time if the original test has failed.

10. Earth Fault Test

If the DC Power Supply/ UPS output is isolated from earth, then an earth fault can be applied to any output terminal. DC Power Supply/ UPS output transients (if any) shall be measured.

If the battery is isolated from earth, then an earth fault can be applied to any output terminals. DC Power Supply/ UPS output transient (if any) shall be measured.

The arrangement of Load bank for Load tests is in Erection Agency scope.

3.5 Cables Trays, Cable Ducts and Accessories:

Cable Tray & Cable Trench works comprises of following major Activities:

Scope for construction of RCC cable trench, sand filling & supply of red brick is in BHEL/civil contractor scope & same is excluded from scope of this enquiry.

1) Erection & installation of Cable Tray Support structure and Cable trays in SS-331S.

2) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in SRU area.

3) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in SRR-811.

4) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts from SRR-811 to MCR.

4) Erection & installation of Cable Tray Support structure and Cable trays/cable ducts in Outdoor area as per Drawings mentioned in Annexure-1 (List of Drawings).

Design & Supply: Various types of GI/ FRP Cable Trays, FRP Cable Ducts and Accessories like hardware(bolts, nuts and washers), bends, reducers, coupler plates, tray covers, tray clamps etc. as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

(1) Erection Contractor shall install cable trays, fittings and accessories as per approved Notes and Details for Cabling System. Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001) are enclosed for reference. Approved Notes & details for cabling system shall be provided to the erection contractor after award of contract/during execution.

(2) Installation of cable tray/cable duct shall include cutting, laying, jointing, supporting, drilling holes in the support, providing tees/reducers/bends/clamps as per cable tray/duct layout.

(3) Erection Contractor shall place and fit these cables trays over the steel support structure (angles, sections etc.). Steel supports shall be installed at every 1.5 meter for horizontal cable trays and at every 1 meter for vertical cable trays.

(4) Suitable cutouts, wherever applicable, shall be made in the cable trays to provide path for the cable to reach the lower level trays.

(5) Adjacent cable trays shall be interconnected using suitable hardware items.

(6) Installation of tray/duct covers, wherever provided, will be done as a part of tray erection and no extra rates will be payable.

(7) Cable trays shall be earthed as per approved Notes and Details for Earthing System.

(8) In certain cases, it may be necessary to site fabricate portions of trays, supports and other non-standard bends where the normal prefabricated trays, supports and accessories may not be suitable. Fabrication of bends/tee/ reducers from straight length of tray is within the scope of work and rate quoted shall be inclusive in unit rate (in running meter). Fabricated sections of trays, supports and accessories to make the installation complete at site shall be neat in appearance and shall match with the prefabricated sections in the dimensions. They shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminum paint.

(9) Cable trays/ ducts have to be routed underground in cable trench, over head on structure, along walls, floors, structure etc. for various applications.

(10) Welding of cable trays to structural steel is not allowed. All cable trays shall be bolted to the structural supports. Bolts, nuts & washers for installation is in BHEL Scope of Supply & same shall supplied along with Cable trays.

Wherever supplied, GI cable trays/Ducts/FRP cable Trays/FRP cable Ducts shall be of bolted construction only with fixing screws and coupler plates.

Sharp bends of cable trays shall be avoided in all type of cable trays.

Steel embedment shall be provided in the cable trenches, ceiling slabs and concrete blocks for installing the cable racks and support structures.

3.6 HT/ LT/ Control/ Communication Cables:

Design & Supply: Various types of LT power cables, HT (6.6kV) cables, data communication / control /signal/ PMS/ OFC cables/Armoured/Unarmoured cable as per BoM specified elsewhere will be supplied by BHEL.

Erection Contractor Scope of Supply: Copper tinned lugs of various types (pin, ring, fork etc.,) upto 4 sq.mm (as required in case of any contingency), PVC cable ties, PVC ferrules, PVC tapes, cable identification tag of Stainless steel, clamping and dressing material with hardware, PVC sleeves, sealants etc. shall be supplied by the contractor within the quoted rates for cable laying. The quality of material shall be got approved from BHEL engineer prior to their use on job.

Erection & Commissioning:

Cable laying includes cutting to the required length, laying in overhead/underground cable trench/RCC Sand filled cable trench/through pipes/flexible conduits, dressing/clamping in tray, drilling of holes in gland plates in panels and junction box, glanding, splicing, dressing of spliced wire inside the panel and JBs, providing PVC numerical/alphabetical / printed ferrules, termination by using crimp type copper tinned/aluminium lugs, insulated/un-insulated, termination (crimp, soldering, etc.), plug-in connections with insert type crimping, providing identification tags of Stainless Steel (at both the ends and at 30 m intervals throughout the route length and also at each bend).

Note: - Damaged cable drums also to be used within the quoted rates. No extra compensation for difficulty in cable laying due to damaged drums shall be done.

Cable Routing, Laying, Dressing:

Erection Contractor shall perform cable laying, dressing and termination as per approved Notes and Details for Cabling System. Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001) are enclosed for reference. Approved Notes & details for cabling system shall be provided to the erection contractor after award of contract/during execution.

Cable installation shall be carried out as per IS: 1255 and other applicable standards.

The installation work shall be carried out in a neat workman like manner & areas of work shall be cleaned of all scraps, water, etc. after the completion of work in each area every day. Contractor shall replace RCC/Steel trench covers after the Installation work in that particular area is completed or when further work is not likely to be taken up for some time.

Cable drums shall be unloaded, handled and stored in an approved manner on hard and well drained surface so that they may not sink. In no case, shall drum be stored flat i.e. with flange horizontal. Rolling of drums shall be avoided as far as possible. For short distances, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cables.

For unreeling the cable, the drum shall be mounted on suitable jacks or on cable wheels and shall be rolled slowly so that cable comes out over the drum and not from below. All possible care shall be taken during unreeling and laying to avoid damage due to twist, kink or sharp bends. Cable ends shall be provided with sealed plastic caps to prevent damage and ingress of moisture.

While laying cable, ground rollers shall be used at every 2 meter interval to avoid cable touching ground. The cables shall be pushed over the rollers by a gang of people positioned in between the rollers. Cables shall not be pulled from the end without having intermediate pushing arrangements.

Pulling tension shall not exceed the values recommended by cable manufacturer. Selection of cable drums for each run shall be so planned so as to avoid using straight through joints. Care should be taken while laying the cables so as to avoid damage to cables.

Cable schedules indicating cable sizes and tentative routes will be furnished by BHEL at site to the contractor. Required steel inserts(if any) in substation building & SRR-811 will be provided by BHEL.

All the cables (HT, LT, communication, control etc.) shall be properly laid, in line with cable schedules, on cable trays in separate tiers with appropriate spacing.

Many of the cable trays and cables have to be laid in existing cable trenches. For this purpose, the cover of the trenches have to be opened for working in site and whenever the cables are to be laid in existing cable tray, all safety precautions have to be observed. After completing the work, the trenches have to be cleaned and covers put back into position. Contractor shall also carry out de-watering from the trenches if required and arrange pumps etc., at his cost.

Contractor shall carefully plan the cutting schedule of each cable drum in consultation with site engineer such that wastages are minimized. Recovery will be made in case the wastages are exceeding the wastage allowances fixed in this contract.

All care should be taken to avoid abrasion, tension, twisting, kinking, and stretching of cables during installation.

Care shall be taken to avoid short bending and kinking of conductor damaging insulation and stressing the cable beyond pulling force recommended by the manufacturer. Cable shall be protected at all times from mechanical damage.

Cables entering into rooms from outside shall be bunched appropriately. The multiple bunches shall be routed through conduit pipes (PVC/Hume pipes etc.) of appropriate type, diameter and length that shall be fixed below the plinth level.

When cables pass through floors, walls etc., it shall be passed through a pipe for mechanical protection and the pipe ends sealed suitably.

While crossing the floors, unarmoured cables shall be protected in conduits upto a height of 500 mm from floor level if not laid in tray.

Where cable passes through brickwork or concrete work, the contractor shall provide suitable local protection against mechanical damage wherever necessary.

Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/HDPE pipe.

Wherever few cables are branching out from main trunk route troughs shall be used.

The minimum radius of formed bend of an insulated cable shall be 12D for un-armoured cables and 15D for armoured cables where 'D' is the overall diameter of the cables.

In each cable run, some extra length shall be kept at suitable point to enable one LT/ two HT straight through joints to be made, should the cable develop fault at a later stage. Control cable termination

inside equipment enclosure shall have sufficient lengths so that shifting of termination in terminal blocks can be done without requiring any splicing.

No cable shall be laid in ducts or trenches where other services such as oil pipes, steam or water pipes are laid.

The layout of all cables shall be arranged to give adequate clearance from other services and cables shall be routed to avoid hot zones. No extra cost shall be considered for rework.

Jointing of cables shall be avoided as far as practicable. However, jointing if at all necessary shall be done by crimping type cable joints after getting approval of BHEL engineer.

No joints shall be allowed in trip circuits, protection circuits and CT/PT circuits. Also joints in critical equipment in main plant area shall not be permitted.

Looping wire at terminal block of panels and electrical actuator as shown in the inter-connection diagrams or as required is to be done by contractor at no extra cost.

Directly Buried Cables:

Cable trenches shall be constructed for directly buried cables. Construction of cable trench for cables shall include excavation, preparation of sieved sand bedding, riddled soil cover, supply and installation of brick or concrete protective covers, back filling and compacting, supply and installation of route markers and joint markers. Laying of cables and providing protective covering shall be as per IS: 1255.

RCC cable route and RCC joint markers shall be provided wherever required. The voltage grade of the higher voltage cables in route shall be engraved on the marker. Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable Joint". The marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road crossings and drain crossings. Top of cable marker/joint marker shall be sloped to avoid accumulation of water/dust on marker.

The erection contractor shall make every effort to minimize wastage during erection work. In any case, the wastage shall not exceed the following limits:

Sl. No.	Item	% Wastage on issued Qty.
1.	Fabrication steel	2
2.	Each size of power cables	1
3.	Each size of control/Inst cables	2
4.	Impulse pipe/tubes/GI pipes/copper tube	1

If however, the Erection Contractor quotes for more wastage than specified above, the excess portion will be considered for adjustment during the tender evaluation at the quoted supply rate of material.

If the actual wastage is more than the specified figure, then equivalent price of the excess portion will be deducted from the contractor's bill.

Cables shall be dressed using appropriate cable ties at appropriate intervals to ensure firmness of their position over the trays.

Trefoil clamps shall be used wherever single core cables are used for three-phase system. These clamps shall be fixed at appropriate intervals to ensure firmness of bunching of cables.

All necessary resources such as labour/worker/electrician, tools and accessories required carrying out laying and termination works etc. shall be within scope of Contractor.

Conduits/Pipes/Ducts Installation:

a) The Contractor shall ensure for properly embedding conduit pipe sleeves wherever necessary for cabling work. All openings in the floor/roof/wall / cable tunnel/cable trenches made for conduit installation shall be sealed and made waterproof by the Contractor.

b) GI pull wire of adequate size shall be laid in all conduits before installation. Metallic conduit runs at termination shall have two lock nuts wherever required for junction boxes etc.

c) Conduit runs/sleeves shall be provided with PVC bushings having round edge at each end. All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed with Glass wool/Cement Mortar/Putty to prevent entrance of moisture and foreign material.

d) Exposed conduit/pipe shall be adequately supported by racks, clamps, straps or by other approved means. Conduits /pipe support shall be installed square and true to line and grade with an average spacing between the supports as given below, unless specified otherwise

Conduit / Pipe Size (Dia.)	Spacing
Upto 40 mm	1 m
50 mm	2.0 m
65-85 mm	2.5 m
100 mm and above	3.0 m

e) For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.

Cable Terminations & Connections:

The termination and connection of cables shall be done strictly in accordance with cable termination kit manufacturer instructions, drawings and/or as directed by Project Manager. Cable jointer shall be qualified to carryout satisfactory cable jointing/termination. Contractor shall furnish for review documentary evidence/experience reports of the jointers to be deployed at site.

Work shall include all clamps, fittings etc. and clamping, fitting, fixing, plumbing, soldering, drilling, cutting, taping, preparation of cable end, crimping of lug, insulated sleeving over control cable lugs, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job to the satisfaction of the Project Manager.

The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for punching of gland plates, painting and touching up. Holes shall not be made by gas cutting. The holes shall be true in shape. All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively sealed by 2 mm thick aluminium sheets/rubber grommets/dummy plugs.

Control cable cores/pairs entering control panel/switchgear/MCC/miscellaneous panels shall be neatly bunched, clamped and tied with self-locking type nylon cable ties with de interlocking facility to keep them in position.

All the cores/pairs of the control cable to be terminated shall have identification by providing ferrules at either end of the core. Each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, etc. along with cable numbers and coiled up after end sealing.

All cable terminations shall be appropriately tightened to ensure secure and reliable connections.

The cable will be terminated at both ends with suitable lugs and printed ferrules and will be glanded properly.

Suitable equipment and consumables for ferrule printing has to be arranged by the contractor at his own cost.

Entry to the panels and JBs may be at top, sides or bottom. All cables are required to be properly supported and clamped near to the JB/panel. Spare holes of JB/Panels are to be sealed as per the requirement.

Wherever cable glanding is not possible, either due to the gland plate size limitations or more number of cable entries, prefab plug-in cables, etc., for such cases cables may have to be lifted inside the panel by either making cut-out in gland plate and providing rubber profile for sharp edge protection or alternatively, providing 4” or 6” PVC pipe coupling gland and these pipe coupling gland shall be supplied by contractor within the quoted rate of cable laying.

Cable shielding – all signal cables are supplied with bare shielded copper wire/with braided wire shield. Generally shield wire is kept isolated at instrument/field device end and continuity is maintained through JBs and grounded at panel end only. While terminating the shield wire either in panel or JBs, PVC sleeves are to be used to avoid two-point earthing.

3.7 Cable Markers and Cables Tags:

Design & Supply and Erection & Commissioning:

Cable markers and joint markers for underground cables shall be supplied and installed along the route of the cables as per section "Typical Power Installation standard for construction (Doc No: 080557C001-000-STC-1692-001)" of this specification.

Cable tags shall be provided at either end of the cable (at the entry point to the panel/ equipment to which it is connected/ terminated) as per section "Typical Power Installation standard for construction (Doc No: 080557C001-000-STC-1692-001)" of this specification.

Erection Contractor shall submit the respective schemes of marking and tagging for BHEL approval during detailed engineering.

Testing:

All electrical connections shall be tested for polarity and proper connections.

The checking of operation of individual equipment and instruments to which the cabling/wiring connected shall also be done by the contractor.

Before energizing, the insulation resistance of every circuit shall be measured from phase to phase, phase to neutral and from phase/neutral to earth.

Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or terminating. After completion of splices and /or terminations measurements shall be repeated.

The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.

For cables, up to 1100V grade 1000 V Megger and for H.V. Cables 2.5 KV / 5 KV Megger shall be used.

DC High Voltage test or AC High Voltage test shall be conducted on cables given below after installation.

- All 1100-volt grade power cables in which straight through joints have been made.
- All cables above 1100 V grade.

The DC High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from other equipment and framework to prevent flash over. In each test, the metallic

sheath/screen/armor shall be connected to earth.

3.8 Illumination System:

Design & Supply: Illumination System materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Installation of illumination fixtures, panels, junction boxes, cabling etc. shall be in the scope of Contractor. Erection shall be carried out as per approved Notes and Details for Plant Illumination System.

Testing:

The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 5 mega ohms. (Between phases, phases to neutral, phase/neutral to Earth).

- Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.
- The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
- It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
- Operation of ELCBs shall be checked.

3.9 Lightning Protection System:

Design & Supply:

Lightning Protection materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

a. Erection and Commissioning of Lightning Protection system including erection of poles/masts, down conductors, all related accessories and hardware, earth connections, earth pits etc. for complete SRU shall be in Contractor's scope. However, construction of foundation/ earth pit shall be in BHEL scope. Earth pit back filling with salt and charcoal is in the scope of Contractor.

b. Erection shall be carried out by Contractor as per the approved Notes and Details for Earthing and Lightning Protection System and approved FQP that shall be provided to the successful Erection Contractor after award of contract.

Commissioning and handing over of Lightning Protection system is in Contractor's scope.

Testing:

In case lightning related earth pits are not connected to main earth grid, for lightning protection, the value of earth pit resistance shall be 5 ohms, but in no case, it shall be more than 10 ohms.

If lightning earth pits are connected to main earth grid, individual earth pit resistance

3.10 Earthing System:

Design & Supply:

Earthing materials as per BoM specified elsewhere will be supplied by BHEL.

Supply of following items is in the scope of Contractor:

- Back filling material for all the treated earth pits in plant area. Quantity of earth pits for back filling: 10 nos. approx.

Erection & Commissioning:

Excavation and laying of underground earth mat & provision of risers is in BHEL/Civil contractor scope.

Construction of Earthing pit as per drawing with charcoal & salt, GI pipes, GI earth electrodes, GI wire, GI strips, brick chamber with covers including associated earthwork is in BHEL/Civil contractor scope.

However, any additional earth pits required may be provided by contractor as per Cl. No. 8.9 & 8.10 of Erection BOM.

However, auxiliary earth mat with in SRU/SS-331 (if required) shall be provided by contractor. Any additional risers required as per site requirement shall also be in contractor scope.

Earthing of metallic frames of all electrical equipments, electrical panels, support steel structures, lightning arrestors, cable trays, steel columns, lighting poles, motors, equipments, metallic structures etc. as applicable to nearby riser/earth pit/auxiliary mat shall be by Contractor.

1. All joints in the earthing system shall be welded type. Earthing connections to all equipments including motors shall be bolted type.

2. Earthing connections shall be free from tinning scale paint, enamel, grease, rust or dirt at the time of making joint.

3. Metallic sheaths, screens/shields and armour of all multicore cables shall be bonded and earthed.

4. Earthing conductors along their run on columns, beams, walls etc. shall be supported by suitable cleats at intervals of 750 mm.

Welded joints on GI earthing conductors shall be painted. Refer clause no. 2.1.14 for details.

Generally risers are provided near the structure / equipment foundation, In case risers are not visible and buried below the foundation level, contractor shall carry out necessary earth excavation for connecting the above ground earthing strips. Wherever welding is involved necessary protective coating shall be applied on weld joints.

If the equipment is not available at the time of earthing conductor laying tap connections from the main earthing conductor shall be brought out up to slab equipment foundation level with at least 200 mm spare length left for further connections to equipment earthing terminals.

Erection shall be carried out by Contractor as per the approved Notes and Details for Earthing and Lightning Protection System and approved FQP that shall be provided to the successful Erection Contractor after award of contract.

Water has to be poured by Contractor for first 15 days after installation and then once in six months.

Testing:

On completion of installation, continuity of earth conductors and efficiency of all bonds and joints shall be checked.

Resistance of individual earth electrode shall be measured after disconnecting it from the grid by using standard Earth Test Megger / Resistance Tester.

Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid.

The resistance to earth shall be measured typically at the following points:

- At each electrical system, neutral earth.
- At each earth provided for structure lightning protections.
- At points on earthing system used to earth electrical equipment enclosures.
- At points on earthing system used to earth wiring system such as metal conduits and cable sheaths or armour.
- At points on fence enclosing electrical equipment.

All equipment required for testing shall be furnished by contractor.

3.11 PA System:

Design & Supply: PA system equipment as per BoM specified elsewhere will be supplied by BHEL.

Erection:

PA system equipment like amplifiers including PA instruments like Field Call Station (FCS), loud speakers suitable for mounting in Zone-1 hazardous area, all hardware/software and associated cables within field, from field to SS-331S, within SS-331S shall be supplied by PA system vendor. The scope of vendor also includes supply of required equipment to interface with existing PA system and integrate with existing Neumann make PA system at site.

All the above PA system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include PA System erection works such as installation of PA System equipment in the intended locations including fabrication of base frames(if required) for installation, transportation of these base frames to the indented locations, providing man-power assistance to PA System vendor for smooth commissioning of PA System & other works as applicable for completeness of PA System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of PA system, supervision during erection of PA system equipment is in the scope of PA system vendor.

3.12 Telephone System:

Design & Supply: Telephone System equipments as per BoM specified elsewhere will be supplied by BHEL.

Erection:

Telephone System vendor shall supply telephone system equipment like cards / modules, MDF, IDF Field Exd telephones and associated telephone cabling within field, from field to SS-331S, within SS-331S. The scope of vendor also includes supply of required equipment to interface with existing system and integrate with existing AVAYA make Telephone system at site.

All the above Telephone system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include erection works such as installation of Telephone System equipment in the intended locations including fabrication of base frames(if required) for installation, transportation of these base frames to the indented locations, providing man-power assistance to Telephone System vendor for smooth commissioning of Telephone System & other works as applicable for completeness of telephone System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of Telephone system, supervision during erection of Telephone system equipment is in the scope of Telephone system vendor.

3.13 CCTV System

Design & Supply: CCTV System equipment as per BoM specified elsewhere will be supplied by BHEL.

Erection:

CCTV System vendor shall supply CCTV system equipment like LIU, converters, amplifiers including PTZ CCTV cameras suitable for mounting in Zone-1 hazardous area, all hardware/software and associated cabling within field, from field to SS-331S, within SS-331S. The scope of CCTV system also includes supply of required CCTV System equipment compatible to interface with existing system and to integrate with existing CCTV system at site.

All the above CCTV system equipment as per BOM shall be issued to Erection contractor for erection & installation at intended locations.

The erection contractor shall include erection works such as erection of CCTV Poles (if applicable), water connection installation for CCTV Camera, installation of CCTV System equipment in the intended locations including fabrication of base frames (if required) for installation, transportation of these base frames to the indented locations & providing man-power assistance to CCTV System vendor for smooth commissioning of CCTV System & other works as applicable for completeness of CCTV System.

Transportation assistance of the materials from BHEL stores to the intended locations, lifting facilities (cranes), supervision during erection, supervision during commissioning and other co-ordination are in scope of erection contractor.

Testing & Commissioning:

Testing & commissioning of CCTV system, supervision during erection of CCTV system equipment is in the scope of CCTV system vendor.

3.14 Insulating Mats:

Design & Supply:

Insulating Mats as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Laying of Insulating Mats in front of all indoor electrical panels (newly supplied in this project) viz. LT Switchgear extension panels, UPS panels etc.

3.15 Fire Proof Sealing Materials:

Design & Supply:

Fire Proof Sealing Materials as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

All entry and exit openings for cables passing through GI/ PVC conduits, cable trenches in substation, control room etc. shall be provided with fire barrier. Erection and commissioning shall be carried out strictly as per manufacturer recommendation.

All cable entry openings of conduit pipes, after laying/ termination of the cables, shall be sealed using fireproof sealing material.

3.16 Chequered Plates:

Design & Supply and Erection & Commissioning:

Chequered Plates minimum 6 mm thick MS for closing the cable trenches, cutouts, and other open trench areas shall be supplied and installed by the Contractor.

The design of the Chequered Plates shall be such that the maximum allowable deflection is L/200 (where L is the span of the chequered plates in meters) for a live load of 500 kg/sq. meters.

Chequered Plate shall have suitable handle welded to the Plate to facilitate ease of lifting and movements. Width and length of the Plates shall be selected so as to neatly seal the required areas without any gaps. Additional stiffeners shall be provided at the bottom, if required. Plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation followed by black painting. BHEL approval shall be obtained for overall arrangement of the Chequered Plates.

3.17 Structural Steel for Supports:

Design & Supply:

Structural Steel as per BoM specified elsewhere will be supplied by BHEL.

Erection & Commissioning:

Erection of above Structural support material is in the scope of the Contractor. This shall be used for fabrication of cable tray supports, panel base frame, JB supporting frames, LCS supporting frames etc.

1. Structural steel material like MS angles, channels, beams, flats, plates etc. shall be supplied in running meter and the same shall be used for misc fabrication if required and the same shall be used for fabrication of Local Instrument Racks, panel base frame, cable tray supports, Canopies for instruments/panels/ drives/JB"s/Push Buttons etc., Instrument/Junction box frames, Impulse Pipe/Instrument Air Pipe supports and instruments etc.

2. This shall include cutting to size, contouring of ends for connections if required, welding, grinding of excess weld deposits/burrs, drilling of holes for mounting of device/instrument, installation at location, levelling, alignment, providing bracings and painting etc. No gas cut holes will be permitted.

3. All the fabricated supports/frames for instruments, trays, pipes, electrical equipment's, etc., shall be epoxy painted after sand blasting / shot blasting (as applicable) and surface preparation as per painting specifications. Paints and other associated items are in the scope of the contractor.

4. Frame installation at site may involve mounting either on concrete floor by grouting / using anchor fasteners or on steel structure by welding etc. All consumables including anchor fasteners shall be arranged by the contractor. Where required, as part of work, concrete floors may have to be chipped out to reinforcement depth for anchoring the frames. Wherever grouting is required, contractor shall arrange all the required material including cement / grout mix, shuttering etc., necessary labour/worker/electrician and meet all other requirements as part of work.

5. In case, structural cable trays, bends, tees, reducers etc., are required to be fabricated from structural steel and installed, unit rate applicable for fabrication and installation of structural steel shall be applicable in such instances.

6. In certain packages, members of frames/rack for mounting of junction boxes/ instruments may be supplied readymade. These have to be assembled prior to installation. The installation rate as quoted shall include assembly of the frames.

7. Gas cutting of tray/impulse pipe support and holes in frame is not permitted. Only hacksaw cutting/ drilled hole shall be permitted.

8. Hardware for erection (Like Nuts, Bolts and Washers, etc.) Where ever is required shall be in the scope of the contractor.

9. In this project, Welding is not allowed for cable tray support structures. Required SS nuts, bolts, washers shall be considered in contractor scope.

3.18 Junction Boxes (JB) and Local Control Stations (LCS)/Local Push Button Stations(LPBS):

Design & Supply:

JBs and LCS as per BoM specified elsewhere will be supplied by BHEL.

Hardware for erection (like Nuts, Bolts and Washers etc.) wherever required shall be in the scope of the Contractor.

Erection & Commissioning:

Erection & Commissioning of JBs and LCS is in the scope of the Contractor. The locations are to be jointly decided at site during erection. The JBs and LCS are to be erected on the frames fabricated at site.

Testing:

Checking of installation for correctness.

Functional checking/ adjustment of JB / PB for their system.

3.19 Display Boards and Sign Boards:

Design & Supply and Erection & Commissioning:

Supply and Installation of the following are in Contractor's scope:

Board displaying instruction chart for restoration of person from Electric Shock

Board displaying instruction chart for artificial respiration

Board displaying dos and don'ts

Danger boards with details such as value of voltage etc for string monitoring boxes, PCUs, LT panels, Transformers, HT panels, Four pole / two pole structures in switchyard etc.

3.20 Other Safety Related and Miscellaneous Items:

Design & Supply and Erection & Commissioning:

Following Safety Related Items and Miscellaneous Items shall be supplied by the Contractor. Make/ Part number of each item shall be submitted to BHEL for approval prior to procurement.

1	Round bottom fire buckets filled with clean dry sand.	Quantities shall be as per price bid
	Adequate number and size of CO2 fire extinguishers and dry chemical powder suitable for dealing with fire.	
2	Easily accessible first aid box containing ointments and medicines for treatment of electrical burns, conforming to IE rules.	
3	Framed laminated shock treatment chart, conforming to IE rules, in English and local language. Name, address and telephone number of nearest doctor shall be mentioned in it.	

4	Danger boards on switchboards and at other places as required by Engineer-in-charge.	
5	Caution notices for all energized electrical equipment.	
6	Instruction plate containing location of isolation point for incoming power supply, name and contact no. of the contact person in emergency	
	Self-contained portable hand lamp, complete with rechargeable battery.	
	Portable battery operated emergency light.	
	Artificial respiration system	
	Face shield	
	HV and MV insulated gloves	
	Framed single line diagram	

3.21 Pre-commissioning / commissioning and post commissioning activities:

- ✓ The work is also inclusive of various commissioning activities of SRU package along with its auxiliaries and station C&I package. The various activities, tests, trial runs may have to be repeated till satisfactory results are obtained and also to satisfy the requirements of customer/consultant/ statutory authorities like boiler inspector, electrical inspector etc.

- ✓ In case any malfunctioning and/or defects are found during tests, trial runs such as loose components, undue noise or vibration, strain on connected equipments etc., the contractor shall immediately attend to these defects/ malfunctions and take necessary corrective measures. If any readjustment and realignment is necessary, the same shall be done as per BHEL engineer's instructions.

- ✓ During each stage of commissioning, if any part of the instrument needs repair/rectification/rework/replacement, the same shall be done expeditiously and promptly by the contractor. Contractor's claim, if any, for such repair/rectification/ rework/replacement etc. for reasons not attributable to contractor will be governed by the GCC. The parts to be replaced shall however be provided by BHEL free of cost.

- ✓ The pre-commissioning activities will start prior to steam blowing activity and various trials, commissioning operations shall continue until the unit is handed over to customer. Simultaneous commissioning activities will be in progress in various areas, checking of equipments erected, making ready for trial runs, alkali flushing, chemical cleaning, mass flushing etc. All these works need specialized gangs including electricians/instrument mechanics in each area. Contractor shall earmark separate manpower for various commissioning activities. This manpower shall not be disturbed or diverted.

- ✓ The mobilization of these commissioning gangs shall be such that planned activities are taken up in time and also completed as per schedule and the work undertaken round the clock if required. It is the responsibility of contractor to discuss on day to day / weekly / monthly basis the requirement of manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T&P are not arranged then BHEL shall make alternate arrangements and necessary recoveries with overhead cost will be made from the bills of the contractor.

- ✓ Contractor shall cut open works if needed as per BHEL engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over without any extra payment.

- ✓ In case any rework / repair / rectification / modification / fabrication etc. is required because of contractor's faulty erection which is noticed during commissioning or at any stage, the same has to be rectified by the contractor at his cost. If any improvement /repair /rework/rectification/ fabrication/ modification due to design improvement/ requirement is involved, the same shall be carried out by the contractor promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by GCC.

- ✓ It is the responsibility of contractor to provide for necessary labour/worker/electrician, tools and tackles and consumables till the completion of work under these specifications even in case erection, testing and commissioning of this work is delayed due to reasons not attributable to the contractor.

- ✓ During commissioning activities and carrying out various tests, minor items like gauges, manometers, etc., have to be temporarily erected and put in service to suit the commissioning activities. BHEL will provide the necessary gauges and equipment. Contractor has to carry out the erection, calibration, dismantling of the same. After completion of activities the temporary systems have to be removed and returned to stores. No extra charges will be payable towards these.

Commissioning:

During pre-commissioning, commissioning, post commissioning and trial operation stages of various systems, certain category of manpower with T&P and consumables will have to be provided to BHEL commissioning engineers exclusively at their disposal. It shall be the responsibility of the contractor to provide Engineers, Electricians, technicians, Helpers, Fitters etc along with necessary consumables, hand tools, calibration equipment etc, for the various commissioning activities in progress. During peak months there could be requirements of separate commissioning gangs simultaneously in even upto 12 to 15 areas. Contractor has to augment the manpower as and when required as per work demand and necessity at site. The quoted rates shall include this.

- ✓ It shall be specifically noted that contractor manpower may have to be engaged round the clock simultaneously at different areas and hence considerable number of personnel and their overtime payment may be involved. This aspect must be considered by the contractor while quoting their rate. No additional compensation by for the same shall be payable, irrespective of number of persons engaged or number of working hours per day.

- ✓ For electrical works, 415 volts and above, the contractor has to bring qualified electricians.

- ✓ Certain systems may be supplied with portable programming units, which are to be connected at various locations during pre-commissioning to handing over. Necessary cabling interconnecting the programming units and other connected panels has to be carried out by the contractor and are to be dismantled after work. For the purpose of testing, monitoring, commissioning, etc., these programming units will have to be repeatedly connected and disconnected at various locations. These will be considered as part of commissioning activities and no separate payment will be entertained for the above.

Calibration, Testing & Commissioning:

- ✓ Calibration, testing & commissioning activity as specified in this technical specification and rate schedule against various equipments, devices, systems etc. are broadly classified below. However, there may be some overlapping between the

activities (erection, calibration and testing, commissioning.) The classification of activity is only a guideline for understanding the total volume of work in each activity. The contractor shall have no claim for performing or providing manpower for such overlapping work, which is also within the scope of the work.

A. Calibration

Verification after drawing of material of various types, range of the field devices with respect to instrument schedule, data sheet or system document.

- Codification of instruments as per system tag numbers
- Calibration / adjustment of instrument as per system requirement / set values.
- Providing head correction in case of pressure measurement as per calculated values or actual measured value for the instrument, which are used for interlock protections / monitoring. This is generally applicable for turbine / generator, lube oil systems, lube oil system of fans etc.
- Verification of installation of instruments for range, type, tag number as per physical location of process point as per process, instrumentation diagram.
- Checking and ensuring the proper function of instrument.
- All the recorders shall be made functional with proper chart movement and ink marking.
- Preparation of computerized calibration certificates in the formats specified by BHEL Engineers and getting those signed by the customer is in the scope of the contractor.

B. Erection

- ❖ Withdrawal of material from store, verification, inspection as per shipping list, drawings and documents.
- ❖ Preservation, up keeping, safe custody of the erected equipments till handing over to the customer.
- ❖ Verification of installation as per drawing and document for the correctness of cabling, JBs, impulse pipe, various field device, panels, instruments etc.
- ❖ Continuity check and IR value check of cables.
- ❖ Verification of correction of cable termination with respect to instrument, electrical hook-up diagram, panel interconnection diagram, JB schedule.
- ❖ Checking earthing of the equipments and cable shield wire continuity.

- ❖ Energizing the functional group control panels and field devices.
- ❖ Flushing of impulse pipe before making the instruments process connections through.
- ❖ Any leakages, damages to impulse pipe, field device connections, air connections etc. Shall be fully attended by contractor.
- ❖ All cable glands/piping/tubing to be fixed as per installation requirement before commissioning.

C. Testing, Commissioning & Trial Operation

- ➢ Checking/verification of binary/analogue input and output signal from field and panel and upto recording/indicating instrument/HMI monitors.
- ➢ Adjustment, testing, calibration of pneumatic drive (control valve, trip valve, power cylinder for gate/dampers), electrical actuator operated valve/gate/dampers of other functional elements.
- ➢ Checking the interlock, protection and alarm for various processes by simulation of field devices/process changes.
- ➢ Functional check of sub-loop control, sub group control and auto loop and fine tuning.
- ➢ Adjustment of limit switches/feed back position transmitter checking the actuator for correct Limit switch operation for correct position indication and repeatability shall be ensured.
- ➢ Motor IR value measurement, bearing/winding RTD checking, drying out of motor, providing assistance for trial run of motor which includes monitoring temperature rise winding/bearing during trial run.
- ➢ Contractor shall prepare calibration/testing report/protocols.
- ➢ During trial run of various systems, if the performance of any instrument is found erratic, un-satisfactory and requires re-adjustment, re-calibration etc., and the defect shall be attended by contractor.
- ➢ Observing and checking the performance of the various devices on load/process variation. Any deficiencies/defect noticed during the variable load conditions, the same should be attended properly.
- ➢ Observe the proper functioning of sub-group/sub-loop control.

- Check the operation of various controls in manual/auto mode for smooth functioning.
- Clearing of all bad / invalid signals noticed during commissioning.
- Providing necessary assistance for Trial Operation of the unit is in scope of this specification. Smooth operation and availability of all instrument/controls of the systems installed under the scope herein, shall be ensured by the contractor. Contractor shall provide adequate number of skilled manpower and T&P for this purpose. Interruption in Trial Operation for reasons attributable to the Contractor shall result in re-start of the Trial Operation all over again; consequential extension in Time Schedule / Contract Period shall be to the contractor's account.
- If any small wiring correction or minor modification in control panel wiring is noticed during the commissioning, it shall be carried out as a part of commissioning activity.

D. Post-commissioning

- Contractor shall rectify the defect observed/informed by customer during the trial run.
- Contractor shall submit the as- built drawing as per guidelines and instruction of BHEL engineer.
- After trial run/handing over of the equipment, if due to unforeseen reasons, certain works crop up; the contractor shall provide all the assistance.

3.22 General conditions applicable during supply, installation and commissioning phase

1	As already mentioned in previous clauses, three-phase power supply will be made available by IOCL on chargeable basis at three points for construction purposes. Contractor has to make the required lines, power conversion, control and distribution network for meeting construction loads.
2	All machinery such as cranes, hydra, JCBs, forklifts, transport trucks, trolleys etc necessary for movement and installation of materials / panels / equipment etc shall be organized by the Erection Contractor.
4	All necessary tools and tackles such as crimping tool (including heavy duty tools for crimping copper/aluminium cables up to 300 sq-mm), screw driver set, power screw drivers, cutting pliers, nose pliers, spanner sets, adjustable spanners, hole saw cutter set, bending tools, torque wrenches, hack saw blades, pipe wrenches, flat / round files, HV termination tools, drilling machines, welding machines, concrete mixers, steel bar bending tools / templates for RCC works, spade, shovel, hammer etc. shall be organized by the Erection Contractor.

5	All necessary measuring instruments such as digital multimeters, electrical testers, digital meggers (1kV, 2.5kV, 5kV), lamp load testers, earth resistance meters, weighing machines, water level indicators etc. shall be organized by the Erection Contractor.
6	Erection Contractor shall maintain updated labour/worker/electrician register, with name, age, qualification, salary, attendance details etc. at the site.
7	Erection Contractor shall use danger boards, wherever required, to ensure safety of the persons during the work at site.
8	Erection Contractor shall adhere to all necessary safety norms such as use of helmet, goggles, hand gloves, gumboots, aprons etc. It is the ultimate responsibility of the Erection Contractor in all respect to prevent accidents at the site and safeguard their labour/worker/electrician from accidents.
9	Erection Contractor shall, at the completion of every work, clear off the debris, which resulted out of the work. In case of excavation work such as cable trench etc. Erection Contractor shall finish the land neatly with necessary leveling, rolling etc.
10	Erection Contractor shall carry out the work without causing inconvenience to other contract groups at the site. In case of conflicts with other groups, Erection Contractor shall ensure that the matter is resolved at once amicably so that the progress of work is not affected.
11	Any damages on the building, structures etc. attributable to the acts of labour/worker/electrician/ employees of Erection Contractor shall be rectified and made good by the Erection Contractor at their own cost.
12	Any miscellaneous materials, which are found essential for technical completion of the contract but not mentioned explicitly in this specification, shall be deemed to be included in the specification. Accordingly, such materials shall be included by the Erection Contractor as part of the offer.
13	For the items to be supplied by Erection Contractor, test certificates, as per relevant IS / IEC standards, as issued by manufacturer shall be submitted to BHEL. However, prior approval shall be obtained from BHEL/IOCL for procurement of these items.
14	Field Quality Plan / Quality control system Erection Contractor shall erect and commission the equipments/ items in accordance with FQP (Field quality control plan) as approved by BHEL/IOCL. Erection Contractor shall deploy a well-experienced quality control engineer to monitor all QC activities at site as per approved FQP.
15	Any deviations shall be discussed with BHEL / IOCL site engineers and implementation shall be taken up only after approval from BHEL / IOCL.
16	Erection Contractor shall submit periodic status report, on daily as well as weekly-consolidated basis, to BHEL on the progress of the contract.

4.0 DOCUMENT SUBMISSION:

4.1	**Documents to be submitted along with the offer**: ➢ Signed and stamped No deviations schedule ➢ Signed and stamped Un price schedule format ➢ Type test reports (as applicable)
4.2	**Documents to be submitted after award of Purchase order:** Following documents shall be submitted by Erection Contractor after the placement of order. ➢ MDL Master document list shall be submitted by Erection Contractor within 1 week after the award of contract to BHEL for approval. ➢ Design documents (GA, Calculations, layouts, Datasheets, erection drawings, schemes, BOM etc.) Refer to respective package section of this specification for the list of documents to be submitted by Erection Contractor to BHEL for approval. However, in addition to these documents wherever BHEL finds applicability, Erection Contractor shall carry out design and prepare additional documents for BHEL approval. ➢ Manufacturing Quality Plans for the Erection Contractor supplied items ➢ Field quality plan for the field work ➢ Detailed activity-time chart for project implementation. ➢ Detailed manpower deployment schedule. ➢ As built documents

HIERARCHY

In case of any conflict/deviations amongst various documents, the order of precedence shall be as follows:

- Statutory Regulations
- IOCL specification
- Items in Schedule of quantities
- IS/BS/IEC standards
- BHEL's standard specification (with prior approval of Engineer-in-charge).

NOTE: The above technical specification is not exhaustive. In case for any item of work, technical specification is not available, such items of works will be carried out in conformance to technical specification of manufacturer's recommendations/best engineering practice. In case of any dispute between two specifications or non-availability of specifications, customer's specification will prevail. Decision on applicability of any particular specifications will rest with BHEL engineer and his decision in the matter will be final & binding on the contractor. Contractor has to make himself well conversant with the Customer specification.

Annexure-I

LIST OF DRAWINGS

S. No	Title
1.	Plot Plan
2.	SS-331S Equipment Layout
3.	SRR-811 Equipment Layout
4.	SRU-3 Equipment Layout
5.	SS-331S Earthing Layout
6.	SS-331S Floor Cutout Drawings
7.	Outdoor area Cable Tray/Trench Layout
8.	SRU area Cable Tray/Trench layout
9.	SRR-811 area cable Tray layout
10.	Job Specification
10.1	Typical Earthing and Lighting Protection Installation Standards For Construction (Drg No: 080557C-000-STC-1691-001)
10.2	Typical Power Installation Standards for Construction (Drg No: 080557C-000-STC-1692-001)
10.3	Typical Lighting Installation Standards for Construction (Drg No: 080557C-000-STC-1693-001)
10.4	Job Specification for Electrical Installation, Testing, pre commissioning and Commissioning (Doc No: 080557C-000-JSD-1600-003)
10.5	Job specification for Site testing of electrical equipment & Installation (Doc No: 080557C-000-JSD-1600-103, Rev No. A)
11.	Soil investigation report
12.	Control Room layout
13.	B366-088-16-50-00010 Rev0_SLD

Annexure-II (ERECTION BOM)

Annexure-1 & Annexure-3 of Annexure-II: LIST OF ITEMS BEING SUPPLIED BY BHEL

Note: Quantities may vary between annexure-1, annexure-2 and price bid format. Similar items are considered as a single line item in price bid format. In such cases, quantities/ items of price bid format shall prevail.

Annexure-2 & Annexure-4 of Annexure-II: LIST OF ITEMS TO BE SUPPLIED BY CONTRACTOR

Note: Quantities may vary between annexure-3, annexure-4 and price bid format. Similar items are considered as a single line item in price bid format. In such cases, quantities/ items of price bid format shall prevail.

DEVIATION SCHEDULE (TECHNICAL)

Sl.No.	Cl. No./ Page No./Sec No.	Description as specified	Deviation taken	Remarks/ Reason for Deviation
fhg				

NOTES:

1. Erection Contractor may give a consolidated list of deviations in this form only. Only the deviations listed here in conjunction with the original tender, shall constitute the contract document for the award of the job to the Erection Contractor.
2. Deviation listed elsewhere shall be ignored & will be summarily rejected.
3. If there are no deviations, Erection Contractor shall submit signed copy of this format, mentioning "No Deviations" & it shall be henceforth implied that Erection Contractor is complying with all the clauses of the bidding document.
4. Attach more sheets in this format, if required.

(Signature of the Erection Contractor)

Volume IA
Part III
Technical Specification: C&I Works

1. Introduction

The document elaborates the details of Bill of Material for Instrumentation and control's scope of Balance of plant area for erection purpose.
The erection agency shall carry out the complete erection and commissioning of the system including material receipt at site, unloading and transfer to site, safe storage, unpacking, transport to site location, installation, testing, calibration, commissioning, minor defects, repair as possible, co-ordination with vendors/ customers, making as built documents, final testing to the client satisfaction and handing over to site in-charge/ client in safe and operational condition.

Note:
1. Quantity indicated below is preliminary based on basic engineering documents & it may vary during actual erection work.

2. General conditions for Erection agency

Following section provides the details of construction, erection, installation and commissioning work involved with respect to supplies to be made by BHEL HYD (PE&SD) for the above-referred project. Following activities will be part of the erection agency:

a. Erection/installation works
b. Commissioning/field testing
c. Site support inclusive of following works
d. Receipt of material at site from BHEL stores
e. Transportation to plant site
f. Loading & Handling of material at site inclusive of all necessary handling equipments
g. Covered storage facilities at site
h. Obtaining of necessary statutory approvals in line with the local regulations
i. Complete civil works required for the installation of electrical and instrumentation packages
j. Preparation of as built markup drawings for all equipments and packages
k. Supply of all necessary commissioning & installation tools/tackles & test equipment

The work detailed below is in addition to any other arrangement considered elsewhere and is to be followed as a minimum. The concerned E&C agency is to ensure that the below mentioned work is covered in their scope while identifying their overall scope of the above referred project.

2.1 C&I Supplies for EPC Package:

All loose C&I supplies like local instruments, cables, Flow meters, Hook up items, DCS / PLC Package, SWAS package, etc. are to be received FROM BHEL/ IOCL stores, stored and erected as per applicable engineering documentation. These supplies are generally supplied from various BHEL units or from different vendor works.

The supervision and administration of the packages vendor's work and human resources to ensure that the work is completed in time and as per approved documentation to be included in Site Erection & Commissioning agency scope. The site is to ensure that vendor's work progress and completion is facilitated by providing necessary administrative and logistics based support, as required.

S. No.	Equipment /Package Description	Qty (No's)	Weight (each) KGs	Remarks
[B]	**INSTRUMENTS**			
(1)	Flow Nozzle assemblies	10	35	
(2)	Flow Orifice Assemblies	12	20	
(3)	Flow venture assemblies	5	140	
(4)	Rota meters	35	7	
(5)	Rupture Disc	2	10	
(6)	Mass flow meter	2	20	
(7)	Ultra Sonic Flow meter	0	45	
(8)	RADAR Level Transmitter	15	7	
(9)	SMART transmitters (PT, DPT, FT, LT, TT)	160	5.4	
(10)	Hand Held Communicator	2	0.5	
(11)	Pressure Gauges	90	1.1	
(12)	Differential Pressure gauges	5	1.1	
(13)	Level Gauges	15	15	
(14)	Temperature Gauges with Thermowell	46	1.1	
(15)	Temperature Elements (Thermo Couple, RTD, Multipoint thermocoples)	45	1.2	
(16)	Thermowells	12	1.75	
(17)	FRP Canopies	500	5	
(18)	Remote Indicators	2	5	
(19)	Junction Boxes (WP & ExP)	180	12	
(20)	Instrumentation items for on skids/Packages and their other auxiliary packages	1 Lot	-	
(21)	Equipments & items supplied by ERECTION AGENCY contractors, if any	1 Lot	-	
(22)	MCT Blocks	1 Lot	-	

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

3. Scope of Instrumentation Package

Following table consists of typical **Bill of Quantity** instrumentation supplied by BHEL for **this tender**, which is to be erected and commissioned by Erection Agency. ERECTION AGENCY shall be responsible for erection & commissioning of all the equipments or items supplied by BHEL as per detail engineering and construction document, which deems to be part of this project & necessary for successful operation of the plant.

3.1 Instruments:

The BHEL shall supply following items/ instruments in loose condition from various vendors work to the project site. ERECTION AGENCY shall carry out erection & commissioning of these item/instruments as per Owner's approved drawing, input documents from BHEL.

3.2 Instrument Installation materials, pipes, tubes and fittings:

Following material shall be supply by BHEL/ Vendor in loose condition. Erection contractor shall fabricate and assemble the instrument impulse line connections at project site, as per provided design document.

S. No.	Equipment /Package Description	Qty (No's)	Weight (each) KGs	Remarks
[C]				
(1)	Tubes	4000 meters	0.2	
(2)	Female Connector	250	0.21	
(3)	Male Connector	382	0.24	
(4)	Air Manifolds	30	6	
(5)	Valves (ball)	235	0.5	
(6)	Manifolds	350	0.9	
(7)	Unions	360	0.23	
(8)	Caps	120	0.22	
(9)	Reducers	250	0.4	
(10)	Nipples	300	0.1	
(11)	TEE	220	0.35	
(12)	Elbow	210	0.33	
(13)	Plugs	105	0.2	
(14)	Coupling	230	0.26	
(15)	Syphon	20	0.55	
(16)	Condensate Chamber	25	1.2	
(17)	Pipes	2000	0.8	
(18)	Flanges	1 Lot	1.5	

(19)	Gaskets	1 Lot	0.03	
(20)	Stud 2 Nuts M20x90	1 Lot	0.3	
(21)	Cable Glands	1 Lot	0.35	
(22)	Cable Lugs	1 Lot	0.1	
(23)	Pre-fab hook-ups for PT	45	12	
(24)	Pre-fab hook-ups for FT	35	18	
Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.				

3.2 Raw material shall be supplied by BHEL and to be fabricated, erected & commissioned by erection agency:

a) BHEL HYD (PE&SD-C&I) shall supply the following raw material for various instrument supports,

b) C&I contractor shall fabricate the instrument supporting structures, stands. Contractor can use modified drawing as per site convenience, to meet the mounting location, elevation, space availability etc. in consultation with site- in charge

S. No.	Equipment /Package Description	Qty	Weight (each) KGs	Remarks
[D]	**RAW MATERIALs**			
(1)	2" pipe for transmitter and JB mounting & Support set up	1 Lot	2	
(2)	MS angle iron- 50x50x6 mm for panel base frame & its site fabrication	1 Lot	0.8	
(3)	MS Angle (75x75x6)	1 Lot	1.5	
(4)	Impulse line supporting clamps	1 Lot	-	
(5)	STR STL 6MM (1500x5000X6)	1 Lot	1	
(6)	ISMC MS CHANNEL (100x50)	1 Lot	6	
(7)	Nuts & Bolts, Clamps	1 Lot	0.3	
(8)	Nut , bolts, washers	1 Lot	0.2	
(9)	False flooring Base frame stand for panels	1 Lot	5	
(10)	Cable Fastening Material			By Erection Agency

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

4. Special Requirements

a. Instrument impulse lines are piping based with welded end connections. The pipe & pipe fitting shall be as per piping specification.
b. Painting of impulse line, instrument / JB supports etc shall be in erection agency scope. Painting procedure as per main piping/ Customer specification.
c. The supply of paint, primer, painting tools shall be in erection agency scope.
d. The entire site erected impulse lines are subject to hydro test, radiography test in line with approved field quality plan (FQP) requirements. It shall be in erection agency scope.
e. Mounting of Pre-fabricated canopies supplied by BHEL, shall be in the scope of erection agency.
f. Statutory approvals like IBR, local agencies etc as required shall be in erection agency scope.
g. Calibration of instruments before erection shall be carried out and relevant documents to be submitted to BHEL/IOCL by erection agency.
h. The all skid mounted impulse lines are subject to hydro test, radiography test in line with mother pipe requirements at site. Same shall be in erection agency scope
i. Calibration of skid mounted instruments before commissioning shall be carried out by erection agency.
j. Instrument Air line 1" up to 6 mm are SS.
k. Instrument cable support system from instrument to Junction box shall be fabricated at site by erection agency.

5. Packages to be Erected & Commissioned by ERECTION AGENCY

BHEL shall supply following instrument packages/ panels. Erection, installation and commissioning shall be in ERECTION AGENCY scope.
The scope of ERECTION AGENCY shall be as per scope matrix given in this document. Scope includes transportation from store to site location, placing in the location & alignment as per design documents, co-ordination with client/ OEM vendor, wiring, power on, testing, loop testing, functional testing, minor modifications as feasible, if required etc. as per OEM and BHEL design documents and handing over to customer in working condition.

S. No.	Equipment /Package Description	Qty	Dimension (each) LxBxH (M)	Weight (each) KGs	Remarks
1	**Process Gas analyzers & Gas Chromatograph**	1 Set	Panel - 2400X800X1200 [3 No's] (or) pre-fab Shelter of 4 x 5 meters	2 Tons	
2	**MCMS system**	1 Set	Panel - 2400X800X1200 [1 No's]	850 kgs	
2	**DCS + PLC SYSTEMs** consisting of (located at SRR-811 & MCR-815) • Operator consoles; Engg consoles; Printers • marshalling panels, & system panels • networking cables, Inter panel cables hardwired consoles etc	1 Set	Panel - 2400X800X1200 [30 No's] Work stations / HWC / printers / furniture's / etc. – 1 Lot	15 Tons	

	• Furniture • Cabling from field to panel in control room & to other panels.				

Note: The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.

6. Instrumentation control & signal Cables

BHEL shall supply following cables rolled in wooden/steel drums. Erection & installation shall be in ERECTION AGENCY scope. Erection contractor's scope shall be to lay and terminate the cables at both the ends as per BHEL design documents.

S. No.	Equipment /Package Description	Quantity (meters)	Weight (each) KGs / meter	Remarks
[A]	**Instrumentation CABLEs**			
(1)	12P x 1.5 mm2	40000	1.52	
(2)	12P x 2.5 mm2	3600	1.86	
(3)	8T x 1.5 mm2	7000	1.97	
(4)	1P x 1.5 mm2	46000	0.39	
(5)	1P x 2.5 mm2	6000		
(6)	1T x 2.5 mm2	4000	0.63	
(7)	2P x 20 AWG	2000	0.43	
(8)	Field bus cables	30000	0.45	

Note:

1. The above quantities/ Items are indicative and not actual. Please refer price bid format for actual quantities/ Items.
2. Supply and installation of cable lugs, tags, cable-dressing material shall be in erection agency scope.
3. Cable glands at the both the equipment ends shall be supplied by BHEL/Vendor. In case of misplacement/ misuse of cable glands at site, erection agency shall supply and complete the respective cable installation.

7. Erection Specification for Instrumentation Work

1.0 GENERAL

1.1 This specification is applicable for Control and Instrumentation of BOP area only supplied by BHEL.
The intending bidder shall be deemed to have visited the site and familiarized themselves thoroughly with the site conditions before submitting their tender.

1.2 The work is generally complete one for design, manufacture and supply to site under supply contract and storage, erection testing and commissioning under erection contract. The Agency shall make his own arrangement for all material and shall furnish a list of all erection and handling equipment, he proposes to employ in the work. He will, provide and maintain at site all equipment, necessary to complete the work in time.

1.3 The bidder is expected to be fully familiar with the local regulations and statutory requirements and any rework, if insisted by the local authorities, the same will be carried out by the Agency at no extra cost.

1.4 It shall be the responsibility of the Agency to obtain necessary license/work permits from the licensing board of the locality/state/country.

2.0 Scope of Work

2.1 The Agency shall employ skilled technicians and shall be in a position to carry out the work as per the furnished drawings. The Agency at his own cost shall redo any work, which is not as per the drawings or does not conform to good workmanship, within the stipulated time. The Agency shall also arrange all materials required for redoing the work. The working personnel at site must be familiar with the relevant instrumentation standards.

2.2 The supply, Erection/Commissioning work shall be carried out in accordance with the specifications/drawings furnished. The layout drawing furnished is intended to give the bidder a general idea of the type and extent of work involved. Final drawings shall be issued to the successful bidders before the start of the work at site. All equipment, materials provided by the Agency shall conform to relevant project specified & international Standard.

2.3 The scope of work includes the following:

Complete assembly, erection, calibration, testing, commissioning and putting into successful and satisfactory commercial operation of the control and Instrumentation materials as given in Price bid format:

a) Installation of field instruments, control valves, safety valves etc. along with necessary impulse pipes and mounting materials as per the installation drawings.
b) Installation of Junction boxes along with supply of necessary angles/channels etc.
c) Installation and termination of cables and the supply of lugs, tag plates etc.
d) Installation of Transmitters along with necessary support/ bracket.
e) Field instruments such as transmitters, gauges, and switches shall be grouped and mounted on a rack. This rack along with the supply of angles and channels will have to be fabricated and painted at site by Agency as per the space available. The exact grouping and rack details will

be mutually worked out during the execution stage and the Agency will carry out the same at no additional cost implications.

f) BHEL/ Mechanical Erection agency will lay 2" Instrument air header. Further distribution starting from 2" air header upto the instrument/valve shall be done by the Agency with proper supports and fixture of the tube/fittings as per the hookup diagrams.
g) Branch trays of 50 mm or 100 mm size trays wherever required for laying one or two cables between the field instrument and the nearest Main tray will be erected by Agency (supply by ERECTION AGENCY).
h) The Agency will do complete loop-checking starting from primary field instrument up to the secondary instrument.
i) Laying of sample pipes from terminal point to sample handling system/Analyzers.
j) E&C of Control valve includes the erection and wiring/tubing of related I/P convertors, Solenoid valves, limit switches that may be supplied loose.
k) All site mounted/fabricated structures/impulse lines shall be painted after applying two coats of primer. The final paint shall be epoxy based and the shade shall be as approved by BHEL/IOCL.
l) Making the necessary excavations and back filling to the original level after the cables are laid wherever buried cabling is specified.
m) Taking delivery of the materials from the owner's stores and safe transportation upto the place of erection and excess material back to owner's stores.
n) Opening of packing cases and inspection of the equipment and materials at site.
o) Trial operation of each equipment as per specification, rectifying defects if any and making adjustments as necessary.
p) Handing over of installation for commercial operations.
q) Rerolling of cables on drums if so required by site engineer.
r) Arranging plate inserts wherever required.
s) Making as built drawings.
t) Cleaning of all equipment under erection and work area at regular intervals to the satisfaction of owner's engineer.
u) Carrying out of Touch up painting of equipment, including the supply of paint.

3.0 Foundation and Civil works

3.1 Equipment foundations, concrete part of the cable trenches and other civil works will be carried out by the civil Agency.

3.2 The erection Agency shall check those foundations before commencement of erection to ensure their suitability.

3.3 All final adjustment of foundation level, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts sills, inserts and fastening devices shall be carried out in coordination with the civil Agency.

3.4 Any cutting of masonry work, which is necessary shall be done by the Agency at his own cost and shall be made good to match the original work. The Agency shall obtain prior approval before cutting any masonry/concrete work.

3.5 The Agency shall make his own arrangement for pumping out water that may accumulate in any excavation or Trenches.

3.6 All cable entry openings shall be properly sealed to prevent water seepage from outside trenches/conduits into the building. The required materials for doing so shall be included by Agency in the cable laying prices.

4.0 Instrument Calibration Procedure

Note: Erection Agency shall ensure the availability of O&M manuals and Manufactures test certificates for all instruments/ equipment's under calibration. Erection Agency shall calibrate all field instruments in workshop, before field installation.

4.1 Necessary calibration report shall be generated for each tag/instruments and shall obtained BHEL/IOCL approval before installation.

4.2 Transmitters & gauges- It shall be calibrated for 5-point calibration i.e. raising 0%-25%-50%-75%-100% and back as per calibration range. Repeating the calibration thrice shall check output repeatability. All calibration ranges for transmitters shall be as per relevant project specific document (Instrument index). It shall be calibrated by connecting air or nitrogen to transmitter process flange. Electronic calibration by connecting external signal source to transmitter's electronic is not allowed. Agency shall arrange nitrogen cylinders/pressure regulators etc. For displacer type level transmitters, electronic calibration is allowed.

4.3 All gauges shall be calibrated with reference to Master test gauge. Test Header etc. shall be arranged by contactor.

4.4 Smart type transmitters- First transmitter shall be calibrated with calibrator and it shall be verified by physical calibration using air or nitrogen. Calibrated information shall be stored in calibrator, for each tag.

4.5 Field switches- It shall be calibrated for its raising/lowering set point as per relevant project document. Repeatability shall be checked thrice, for its operation. Calibration report shall be generated for each tag.

4.6 Control Valve/On-Off SOV Valves – Its leakage class, stoke length, actuator & positioner operation shall be checked in workshop. It shall calibrated for 5-point calibration i.e. raising 0%-25%-50%-75%-100% and back as per calibrated range. Repeating the calibration thrice shall check output repeatability. Valve shall be calibrated by connecting 0.2 to 1 kg/cm2 air or nitrogen signals to its positioner and valve strokes for 0%-25%-50%-75%-100% input signals should be verified. At the same time, output from its position transmitter shall also be verified and correction shall be carry out, if required. All results shall be recorded. For SOV operated valves, operation of SOV shall be checked by energizing & de- energizing SOV coil by connecting the required voltage. SOV port operation, vent & manual reset functions shall be checked and shall be recorded accordingly.

4.7 Mass/ Vertex/turbine flow meters – Electronic calibration shall be carried out by connecting electrical signals to its electronics and 4-20 mA output shall be verified with respect to calibration certificate provided by manufactures.

4.8 Safety Valves- It shall be calibrated for its raising/lowering set point as per relevant project document. Repeatability shall be checked thrice, for its operation. Calibration report shall be generated for each tag.

4.9 I/P or P/I Converter- It shall be calibrated by connecting 4-20 mA electrical signals and its pneumatic output shall be checked. Repeatability shall be carried out thrice. Its air pressure regulator shall be verified and pressure shall be set to required value.

4.10 Analyzer system- All analyzers shall be calibrated along with its sensor/electrode connected to transmitter. Sensor/electrode shall be immersed in Standard solution of various known values and transmitters output & display shall be checked for its correct indication. Repeatability to be checked for a thrice. Results shall be recorded.

4.11 RTD/Thermocouple- It shall be calibrated by connecting the assembly in std. Bridge/signal source and output shall be verified at 5 points (0%-25%-50%-75%-100%) of measuring range with respect standard charts for that type of RTD/Thermocouple. These shall also be calibrated using Hot Bath equipment.

5.0 Equipment Installation

The Erection Agency shall carryout following:

5.1 Unpack and check the system hardware/field instruments/equipments and transport it from site stores and installation at its intended locations.
5.2 Erection of impulse lines from process connection to upto field instruments.
5.3 Carry out the laying of field cables upto control room, system communication network cables (for PLC/DCS) & fabricate and install all supplies, connections and accessories necessary to provide a complete interconnection between all equipments.
5.4 Terminate all interconnecting cables between field and control room, communication network, and power & earth cable.
5.5 Test the hardware, power supplies, cabling and connections.
5.6 Termination of all field cables in vendor's marshalling cabinets, ferruling of cables, loop checking from field sensor to system.

6.0 **Equipment Commissioning**

The erection Agency shall carryout the following:
6.1 Loop checking from control room upto final control element & vice versa as required.
6.2 Performing continuity and insulation test for all cables.
6.3 Cable & cores dressing inside the control room & Junction boxes.
6.4 Re-calibration of field instruments /loop if required.
6.5 Agency shall provide necessary assistance /co-operation to other vendors for system integration, as required.

7.0 Cabling Methods & Scope

7.1 All above ground cables from filed instruments to junction box shall be supported by suitable size of MS angle/ perforated tray. Cable shall be fasten to tray at the interval of ½ meter.
7.2 All underground cables from filed instruments to junction box shall be routed through buried cable conduit. Conduit shall be thoroughly cleaned before laying the cable into it.
7.3 For cables from Junction Box to Control room /field instruments shall be marked at each end close to the gland with cable no. as per cable schedule. Multicore cable shall be marked before entry to cabinet/junction box and also inside the cabinet above & below the gland plate.
7.4 Cross and Direct ferruling philosophy shall be followed for ferruling inside instrument/ the Junction box/cabinet as follows:

Location	Ferrules
At Instrument end	JB No+JBTB+JBTE + Inst Tag+Inst TB+Inst TE
At Junction Box, for cable from field Instrument	Inst Tag+Inst TB+Inst TE + JB No+JBTB+JBTE
At Junction Box, for outgoing multipair cable	Control room panel no+TB No.+TE no. + JB No+JB TB+ JBTE
At control room Panel	JB No+JB TB+ JBTE + Control room panel no+TB No.+TE no.

7.5 Erection Agency shall prepare JB terminal drawing for each JB, indicating tag nos. for instruments, JB TB &TE no, core/pair no of all incoming/outgoing cables. Such drawing shall be laminated and pasted inside the respective field junction box.
7.6 All cable entry openings shall be properly sealed to prevent water seepage from outside trenches/conduits into the building. The required materials for doing so shall be included by Agency in the cable laying prices.

8.0 Cabling & Impulse Piping

8.1 Routing of cables between control room & junction box and within control room panel/switchgear room panels shall be as per project specific cable tray layout drawing.
8.2 Routes of cables & air supply lines to individual instrument from junction box/air-header to be decided at site to suit conditions.
8.3 All cables rising from trenches shall be run in trays.
8.4 All cables from control room panel to junction boxes or direct run to field instrument and from junction boxes to field instrument shall be installed in uninterrupted lengths.
8.5 All junction boxes/Inst air headers shall be located to nearest pillar/ structure/ column.
8.6 Junction boxes/Inst air headers installations shall not obstruct any traffic/passage way nor interface with accessibility or removal of process equipment
8.7 All Junction boxes/inst. Air header shall be easily accessible for maintenance purpose.
8.8 For cables raising from trench & terminating in JB, trays shall terminate 400mm below/up bottom/ top of junction box.
8.9 Whenever possible, air supply lines shall be run below cable tray, using same support. All cables shall be clamped to tray.
8.10 Trays to individual instruments shall terminate as close as possible to instrument. Instrument support may be used to secure tray.
8.11 Tray & airline routes shown on layout are for major routes and shall be followed where possible, but if a route is not practical, an alternative route can be decided at site.
8.12 All site fabricated items, all supports or brackets needed for Installation shall be fabricated and painted by the Agency with two coats of red chromate Zinc primer and two coats of epoxy based paint of shade 631 of IS-5.
8.13 Directly buried cables shall be laid on and covered with sand/riddle with mud protected by brick barriers at sides and pre-cast concrete slabs on top. Location of buried cables shall be indicated clearly by cable marker, made of galvanized from interval of 30 meters and at every change of direction.
8.14 The location of cable Joint if any shall be clearly indicated with cable marks with an additional inscription "Cable Joint".
8.15 Cable termination at the equipment end shall be done by the following methods:
a) Power cables: Crimping (Hydraulic/Manual)
b) Control cables & Signal cables: Manual crimping.
8.16 Each control cable core entering panel / Junction box shall be neatly dressed and served with Nylon cord to keep it in position at the terminal block.
8.17 All cable entry points shall be sealed and made vermin and dust proof. Unused opening, if any shall be effectively closed.
8.18 Damaged galvanized surface shall be coated with cold galvanized paint.
8.19 All equipment after erection shall be touched up where required with coats of finishing paint.

9.0 Mounting of JB's, Cable Trays & Air headers

9.1 Junction box/ Air Header normally shall be mounted to nearest column at operating height. Otherwise it shall be mounted on standpipe.
9.2 Generally, JB's & instrument air headers shall be supported by 50x50x6 mild steel angle frame

10.0 Erection Agency shall arrange their own test equipments, erection tools, workshop equipments, erection consumables etc.
11.0 Erection agency shall carry out cable termination at bother ends of cables/ tubes as specified above

12.0 Documentation

12.1 The erection contractor shall furnish the following along with the Bid without fail.

a) Clause wise Deviation list, if any
b) Testing equipment available list.
c) Material handling equipment availability.
d) References where such works are executed earlier.
e) List of items to be supplied by erection Agency.

13.0 All the items under the Agency's scope of supply shall be of reputed Indian make or imported and shall be indicated in the bid in the sub-vendor's list for each and every item and prior approval of the sub-vendors shall be taken from the owner before taking any procurement action.

14.0 As built drawings

Erection Agency shall incorporate all corrections done during erection & commissioning of the plant and as-built drawing shall be furnished in 6 sets. Typical list is given below, however any other doct required by site in charge/end user shall be furnished by Agency.

a) Cable tray layout drawing.
b) Cable interconnection drawings.
c) Cable schedule/JB grouping.
d) Instrument Hookup drawings.
e) Instrument sub-header drawings
f) Control room Layout.
g) Instrument Tags list

15.0 Impulse Line Erection and Testing

15.1 Impulse line shall be of Alloy steel, Carbon steel, SS pipe & SS tubes as per detail engineering drawing to be forwarded to contractor around one month before actual work.

15.2 The pipe routing after first root valve, supporting, welding, any special test required as per piping welding/ erection procedure etc. & connecting to instrument shall be in C&I contractor scope

15.3 All the testing shall be as per project piping specification & specification for Erection specification for BOP Piping (Spec no. GT57167, Rev 00, Clause- 15) & all the impulse lines are subject to hydro test at pressure same as mother pipe hydro test pressure.

15.4 Welding procedure shall be as issued for piping work for this project & specification for Erection specification for BOP Piping (Spec no. GT57124, Rev 02, enclosed with BOP piping erection specification)

15.5 All weld joint in CS, SS, AS line are subject to 100% radiography test with min two shots per joint

15.6 The impulse line shall be supported at regular interval of 200- 300 mm with U bolts / angles etc.

15.7 Vendor shall generate all testing reports/ documentation required for final acceptance of customer.

16.0 Painting of Impulse line & supporting structures.

16.1 The all non- Stainless steel impulse lines & fittings for instrumentation connection shall be painted as per client's specification. Surface preparation. Primer coating etc as required shall be in contractor's scope.

16.2 Painting shall also have applied for impulse line structure, supports, running channels etc.

16.3 Scope of supply of painting material, execution tools/ devices etc shall be in contractor scope.

16.4 The method of painting, color, quality shall be identical to main mother pipe.

16.5 Steam jacketing, insulation etc if required to meet mother pipe requirements shall be contractor scope.

17.0 GUARANTEE:

The erection contractor shall stand guarantee for all the items supplied by him for 12 months from the date of the completion of the contract and shall procure and install any defective material found during that period.

18.0 Responsibility chart for Turnkey/Supervision packages

For following items, scope of each activity and supply of material is as shown below.

S.No	Activity during material handling	Scope
1	Supply of main equipments as per scope, purchase order & approved drgs	Vendor
2	Supply of Erection material as per scope & approved drawings (cable glands, lugs, cable dressing/ tagging material)	Vendor/ Erection Agency
3	Supply of consumables for commissioning	Vendor
4	Transportation upto Stores	Vendor
5	~~Unloading at site and documentation for material receipt~~	~~Erection Agency~~
6	Supply Verification as per packing list, Transit damage inspection	Erection Agency
7	System Storage at site	Erection Agency
8	~~Custody of items in stores~~	~~Erection Agency~~
9	Issue of Items from BHEL Stores	Erection Agency
10	Shifting of equipments to Intended Locations	Erection Agency
11	Provision of Crane/ handling equipments for Shifting of the equipments	Erection Agency
12	Unpacking of equipments in control room	Erection Agency
13	Base frames stand below false floor fabrication and installation	Erection Agency
14	Installation of equipments at intended location	Erection Agency
15	Supply of Accessories for installation of equipments	Erection Agency
16	Inter equipment Cables, cable glands supply	Vendor
17	Inter equipment/Panel Cable laying and terminations	Erection Agency
18	Connecting power supply to System under the supervision of vendor.	Erection Agency
19	Cable glanding, Lugging, Ferruling, Terminations with in package for signal/ control cables	Erection Agency
20	Cable Lugging, Ferruling, Terminations with in package for Special/ network cables	Vendor
21	Laying of cable from field/ other panels to system	Erection Agency
22	Termination of cable at Field/ other panels	Erection Agency
23	Termination cable at control room panels	Erection Agency
24	Cable trays laying in field	Erection Agency
25	Cable trays laying in control room	Erection Agency
26	~~Erection of system and power on~~	~~Vendor~~
27	Erection Supervision	Erection Agency
28	Commissioning of system	Vendor
29	Commissioning Support	Erection Agency
30	Erection & Commissioning coordination with vendors, customers, BHEL HQ	Erection Agency

31	Loop checking in control room from system to marshalling panel	Vendor
32	Loop checking from field to control room & upto system	Erection agency in co-ordination with Vendor
33	Supervision and acceptance of loop function	Erection Agency
34	General Erection & commissioning tools & tackles for packages	Vendor
35	Provision of Power supply, Inst air, other Utilities	Erection Agency
36	Administration of vendors staff	Erection Agency
37	Special proprietary commissioning tools, tackles on returnable basis	Vendor
38	System handover to customer and protocol with customer	Erection Agency
39	As built documents	Erection Agency
40	Storage and handing over of ordered spares	Erection Agency

***** Erection Agency shall provide Stores, in a closed area with **dust free & rainproof** environment.

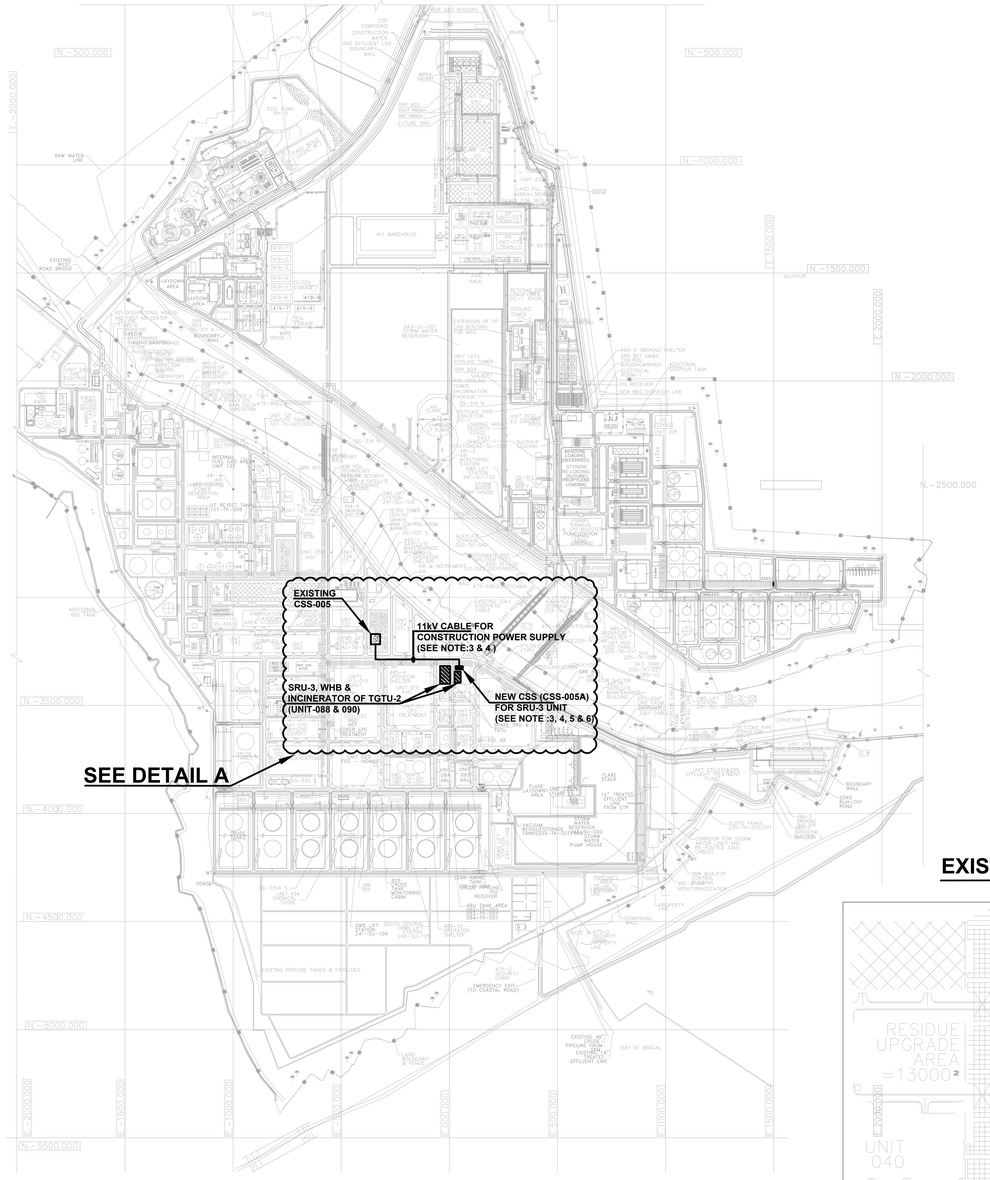
19.0 ACTIVITIES REQUIRED TO BE DONE BY VENDOR / ERECTION AGENCY DURING SHUTDOWN

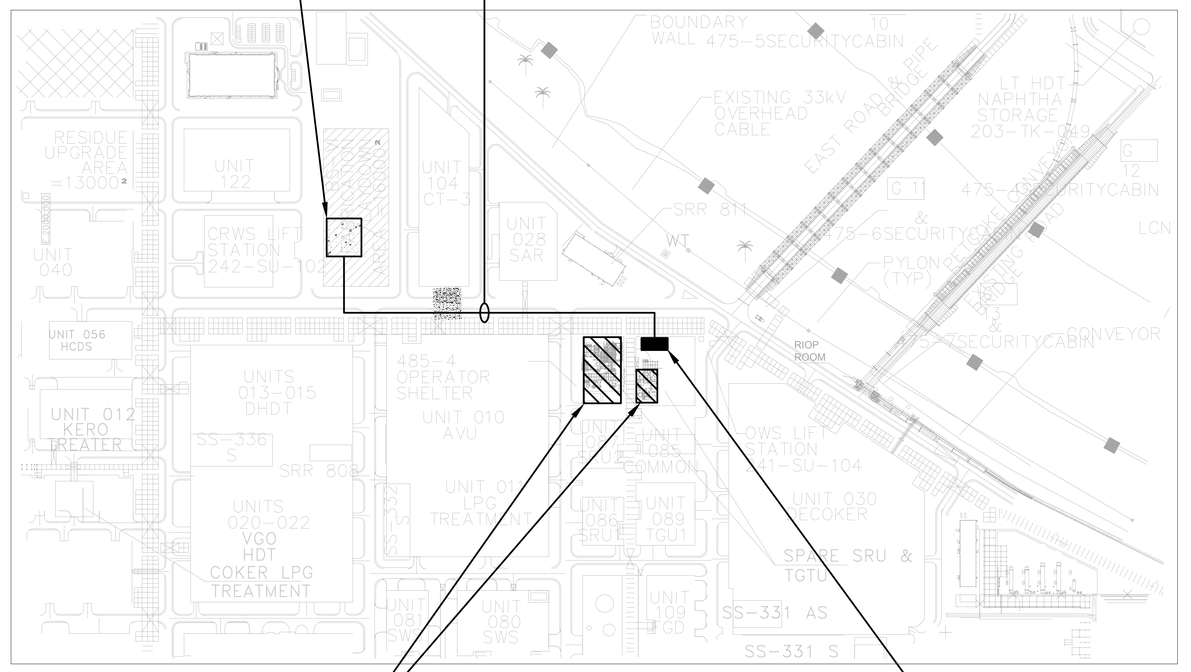
SL No.	Activity of Work	Control System	Shutdown / Post-Shutdown	Responsibility [Vendor / Erection Agency]
1	Installation of add on DCS Controllers of C3000 with required IO's	DCS	Shutdown	Vendor
2	Installation of dedicated Panels and Operating workstations	DCS	Shutdown	
3	Installation of dedicated PDB for new DCS System	DCS	Shutdown	Vendor
4	Installation of controllers and cards selected as per IOCL existing setup [Redundant, Series C and PMIOs].	DCS	Shutdown	Vendor
5	Installation of foundation Field Bus modules (1) considered for hooking up exiting modules (3)	DCS	Post shutdown	Erection Agency
6	Installation of existing HARDWARE modified for inclusion of TGTU-1 package Incinerator & WHB	DCS	Shutdown	Vendor

7	Installation of dedicated Safety Manager Controllers with required IO's for ESD, BMS	PLC	Shutdown	Vendor
8	Installation of dedicated Panels and Operating workstations	PLC	Shutdown	Vendor
9	Installation of controllers and cards are selected as per IOCL existing setup	PLC	Shutdown	Vendor
10	Installation of line monitoring functions in DI's and DO's as per existing IOCL setup	PLC	Shutdown	Vendor
11	Installation of existing HARDWARE modification in TGTU-1 package BMS	PLC	Shutdown	Vendor
12	Addition of IO cards in TGTU-1 BMS package.	PLC	Shutdown	Vendor
13	Interaction of ESD system with DCS through SCADA.	PLC	Shutdown	Vendor
14	Installation of Hard wired Consoles [HWC] of 2 Numbers	DCS/PLC	Shutdown	Vendor
15	Modification of existing HWC for FS-407 & FS-408	DCS/PLC	Shutdown	Vendor
16	Installation of New Common UPS PDB for DCS and ESD system	DCS/PLC	Shutdown	Erection Agency
17	Installation of Existing PDB for non-UPS for DCS & PLC	DCS/PLC	Shutdown	Erection Agency
18	Installation of Dedicated mini UPS for FDAS	DCS/PLC	Shutdown	Erection Agency
19	Inter panel cabling and earthing requirements etc.,	DCS/PLC	Shutdown	Vendor
20	Safenet Network Switch (with SFP) to be replaced in the existing system	DCS/PLC	Shutdown	Vendor
21	Installation of 20% wired spares for IO's	DCS/PLC	Post shutdown	Vendor
22	Installation of field devices IS / NIS / FF / WP / Ex-Proof as per existing philosophy.	DCS/PLC	Post shutdown	Erection Agency
23	Installation of Dedicated HAIL Proprietary firmware software for DCS and PLC as applicable to SRU-3 & TGTU-2.	DCS/PLC	Shutdown	Vendor
24	Integration of new points in the existing systems software such as – IAMS, AMS, SOE, History node, History server, Back up server, OPC server, Large Video screens, Domain	DCS/PLC	Shutdown	Vendor

	controller, RTD BMS, ESD HMI's and DCS HMI etc.			
25	Latest add on licences / patches as released by DCS vendor to be updated in all the existing systems like DCS, PLC and other dedicated systems ex: Historian, AMS etc.	DCS/PLC	Shutdown	Vendor
26	Importing of new devices database in SCADA and uploading in the each controller for DCS and ESD separately.	DCS/PLC	Shutdown	Vendor
27	Third party software's required for HART MUX, FF, Wireless transmitters which were part of new system supplies shall be installated and integrated to all the backend systems.	DCS/PLC	Post shutdown	Vendor
28	Integration of different locations of controllers, Remote IO's through dedicated softwares along with SCADA points.	DCS/PLC	Shutdown	Vendor
29	Replacement of FTE switches (with SFP ports) at supervisory level	DCS/PLC	Shutdown	Vendor
30	Modification of existing TGTU-1 BMS system.	DCS/PLC	Shutdown	Vendor
31	Integration of proposed Fibre network at supervisory level to existing network.	DCS/PLC	Shutdown	Vendor
32	SCADA Points integration of existing and new additions in the common network.	DCS/PLC	Shutdown	Vendor
33	Modification of different hierarchy level physical communication to suit SFP Ports.	DCS/PLC	Shutdown	Vendor
34	Integration of new Controller with existing Controllers of DCS & ESD.	DCS/PLC	Shutdown	Vendor
35	Integration of New Operating System with existing operating station through new SCADA Points / Graphic interfaces.	DCS/PLC	Shutdown	Vendor
36	Accommodating the Third Party signals in the existing and new controllers	DCS/PLC	Post-shutdown	Erection Agency
37	Modification of existing Non-UPS PDB for new panels / workstations / HWCs.	DCS/PLC	Shutdown	Erection Agency

38	Integration of FDAS, GDS, BMS and ESD points in existing safenet Controllers.	DCS/PLC	Shutdown	Vendor
39	Removal of the duplicate tags from Global tags in SCADA point database.	DCS/PLC	Shutdown	Vendor
40	Existing control room layout having Cable trays, base frames, density of each tray to be made handy before shipping of the DCS / ESD Panels.	DCS/PLC	Shutdown	Erection Agency
41	Placing of DCS / ESD Panels directly on the base frame instead of storage.	DCS/PLC	Shutdown	Erection Agency
42	Making availability of OFC cables network prior to FTE switch installation	DCS/PLC	Post-shutdown	Erection Agency
43	Making Availability of new Controllers, IO Cards and marshalling on board for supervisory level verification.	DCS/PLC	Shutdown	Vendor
44	Time Synchronization for all new and add on systems.	DCS/PLC	Shutdown	Vendor
45	Field cabling works, loop checking with DCS / ESD	DCS/PLC	Post-shutdown	Erection Agency
46	Termination of field devices in marshalling cabinets	DCS/PLC	Post-shutdown	Erection Agency
47	Conducting SAT	DCS/PLC	Post-shutdown	Vendor / Erection Agency





NOTES:

GENERAL:

1. THIS DRAWING SHALL BE REFERRED FOR CONSTRUCTION POWER DISTRIBUTION FOR SRU-3, WHB & INDCINERATOR OF TGTU-2 (UNIT-088 & 090).
2. FOR SINGLE LINE DIAGRAM FOR CONSTRUCTION POWER DISTRIBUTION, REFER DWG. NO.080557C-088-DW-1652-001.

ENABLING CONTRACTOR SCOPE:

3. THE LOCATION SHOWN FOR NEW CSS FOR SRU-3 UNIT (CSS-005A) IS INDICATIVE ONLY. THE SAME SHALL BE LOCATED IN NON-HAZARDOUS AREA.
4. THE 11KV CABLE ROUTING SHOWN IN THIS DRAWING IS INDICATIVE ONLY. NECESSARY SITE SURVEY SHALL BE PERFORMED BY ENABLING CONTRACTOR FOR FINALIZING THE LOCATION OF NEW CSS (CSS-005A) AND THE 11 kV CABLE ROUTING ON EXISTING PLANT FROM EXISTING CSS (CSS-005) TO THE NEW CSS-005A ACCORDING TO ACTUAL SITE CONDITIONS.
5. THE NEW CSS (CSS-005A) WILL BE SUPPLIED BY IOCL. SUPPLY & INSTALLATION OF 11KV CABLE FROM CSS-005 TO CSS-005A & INSTALLATION OF NEW CSS (CSS-005A) FOR SRU-3 UNIT SHALL BE IN ENABLING CONTRACTOR SCOPE.

LSTK CONTRACTOR SCOPE:

6. THE BATTERY LIMIT FOR LSTK-1 CONTRACTOR SCOPE IS AT THE OUTGOING TERMINALS OF NEW CSS NEAR SRU-3 UNIT (CSS-005A), WHICH IS INSTALLED BY ENABLING CONTRACTOR. FOR DETAILS REFER 080557C-088-DW-1652-001.

FURTHER DISTRIBUTION COMPLETE WITH ALL NECESSARY EQUIPMENT INCLUDING SUPPLY & INSTALLATION AND TERMINATION OF CABLES FROM CSS-005A, REQUIRED NUMBER OF FEEDER PILLARS, CABLING, LIGHTING, EARTHING & LIGHTNING PROTECTION SYSTEM ETC FOR CONSTRUCTION POWER AND CONSTRUCTION LIGHTING FOR LSTK PACKAGE SCOPE LIMIT IS UNDER RESPECTIVE LSTK CONTRACTOR's SCOPE.

LEGEND :

▬	NEW CSS FOR SRU UNIT
CSS	EXISTING CSS (11kV POWER SOURCE)
CSS	COMPACT SUBSTATION

REFERENCE DRAWINGS / DOCUMENTS

080557C-088-JSD-1600-001	ELECTRICAL DESIGN BASIS
080557C-088-DW-1652-001	SINGLE LINE DIAGRAM CONSTRUCTION POWER DISTRIBUTION

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	28.11.2019	ISSUED FOR DESIGN	BR	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: CONCEPTUAL CABLE ROUTING GUIDE DRAWING CONSTRUCTION POWER DISTRIBUTION SRU-3, WHB & INCINERATOR OF TGTU-2 (UNIT 088 & 090)

DRAWING NO.						PAGE	REV.
SCALE	080557C	088	DW	1622	003	01 OF 01	A
1:10	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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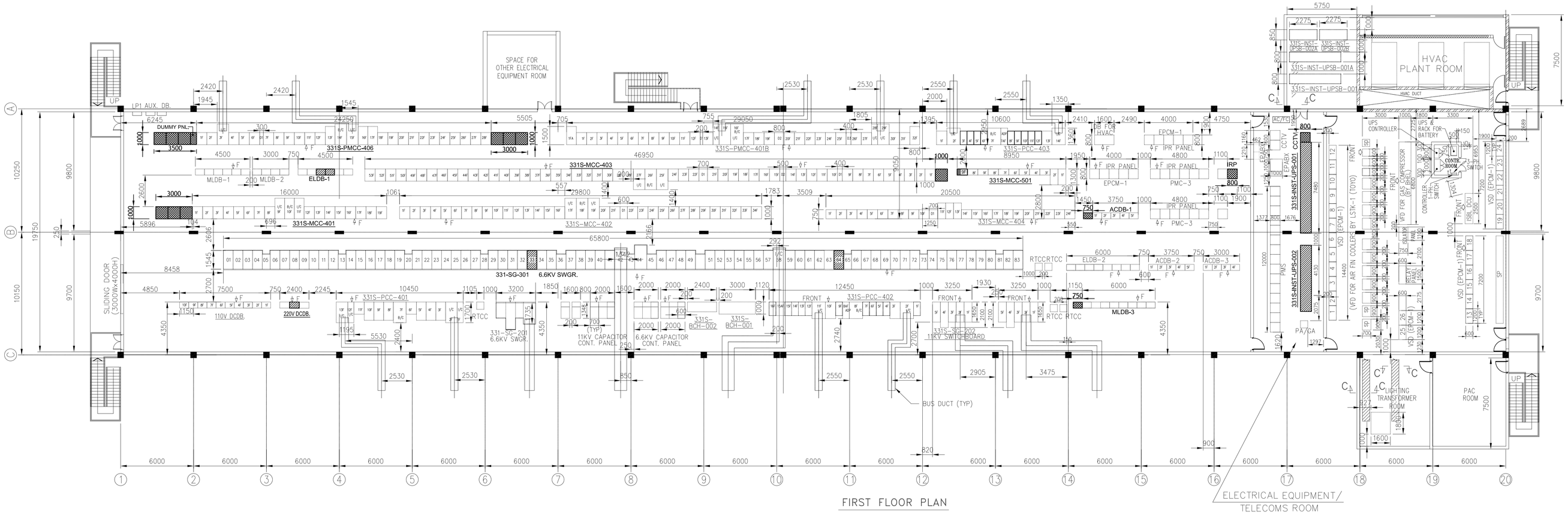
CAD FILE NAME : 080557C-088-DW-1622-003_A.DWG

SHEET SIZE : A0

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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

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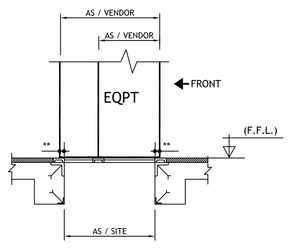


FIRST FLOOR PLAN

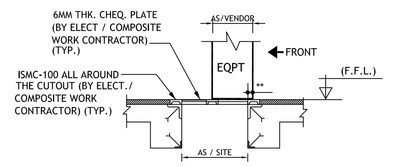
SUBSTATION EQUIPMENT LAYOUT (SS-331S)

MAKE OF EXISTING EQUIPMENT TO BE MODIFIED:

S.NO	EXISTING EQUIPMENT	MAKE
1	331-SG-301 (6.6 KV SWBD)	ABB
2	331S-PMCC-406	C & S ELECTRIC LTD
3	331S-MCC-403	C & S ELECTRIC LTD
3	331S-MCC-401	C & S ELECTRIC LTD
4	MLDB-3	C & S ELECTRIC LTD
5	ACDB-1	C & S ELECTRIC LTD
6	331S-MCC-501	C & S ELECTRIC LTD
7	ELDB-1	C & S ELECTRIC LTD
8	220V DCDB	ABB
9	331S-INST-UPS-002	EMERSON
10	331S-INST-UPS-001	EMERSON
11	811-INST-UPS-002	EMERSON



TYPICAL EQUIPMENT INSTALLATION DETAIL
(CUTOUT < EQPT.)
(NOT TO SCALE)



TYPICAL EQUIPMENT INSTALLATION DETAIL
(CUTOUT > EQPT.)
(NOT TO SCALE)

NOTES:

1. ALL UN-USED CUTOUTS SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATE.
2. THE DIMENSIONS SHOWN FOR ELECTRICAL EQUIPMENTS MODIFICATION ARE INDICATIVE ONLY. SAME SHALL BE FURNISHED AFTER FINALISATION OF VENDORS DRAWINGS.

EQUIPMENT LIST

EQUIPMENT NAME	VENDOR	DRAWING NO.	REV.
331S-SG-301	HOLD	HOLD	
331S-PMCC-406L	HOLD	HOLD	
331S-PMCC-406R	HOLD	HOLD	
331S-MCC-403L	HOLD	HOLD	
331S-MCC-401L	HOLD	HOLD	
331S-MCC-501	HOLD	HOLD	
331S-MLDB-3R	HOLD	HOLD	
331S-ELDB-1	HOLD	HOLD	
ACDB-1L	HOLD	HOLD	
DCDB	HOLD	HOLD	
331S-INST-UPS-001	HOLD	HOLD	
331S-INST-UPS-002	HOLD	HOLD	
IRP PANEL	HOLD	HOLD	
CCTV PANEL	HOLD	HOLD	

BILL OF MATERIAL

TENDER ITEM NO.	DESCRIPTION	UNIT	QTY.
HOLD	STRUCTURAL STEEL (FOR BASE FRAME OF PANELS)	KGS	800
HOLD	6 MM THK. CHEQUERED PLATE	M^2	15

LEGEND:-

- EXISTING FACILITIES
- NEW VERTICAL PANELS TO BE EXTENDED ON EXISTING SWITCHBOARD
- EXISTING SPARE FEEDER AT EXISTING SWITCHBOARD
- EXISTING EQUIPMENT TO BE MODIFIED

HOLD:-

-TENDER NO.
-EQUIPMENT LIST (VENDORS DETAILS)
-BILL OF MATERIAL

SPECIAL NOTE:-

THIS EQUIPMENT LAYOUT DRAWING IS APPLICABLE FOR THE NEW FACILITIES UNDER JOB NO. B366 ONLY.

TENDER NO.:-
HOLD

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
[X] APPROVAL [ ] REVIEW [ ] INFORMATION	

CLIENT: INDIAN OIL CORPORATION LIMITED, PARADIP REFINERY PROJECT, PARADIP, ORISSA

CONSULTANT: TECHNIP INDIA LIMITED

PROJECT: 525 TPD STANDBY SRU PROJECT, IOCL PARADIP REFINERY, ODISHA, INDIA

ENGINEERS INDIA LIMITED, NEW DELHI

BHARAT HEAVY ELECTRICALS LTD., HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.				
CHD.				
APPD.				

REV.	DATE	ALTERED	YS
A	19.05.21	CHD/APPD	AR / SV
		ISSUED FOR APPROVAL	

DEPT. ELECT. CODE 16-50 | UNTOL. DIMS. OR: -D/M/F- | SCALE 1:150 | WEIGHT (KG) | REF. TO ASSY. DRG. -N.A.- | ITEM NO. -N.A.- | NO.OF ITEMS -N.A.-

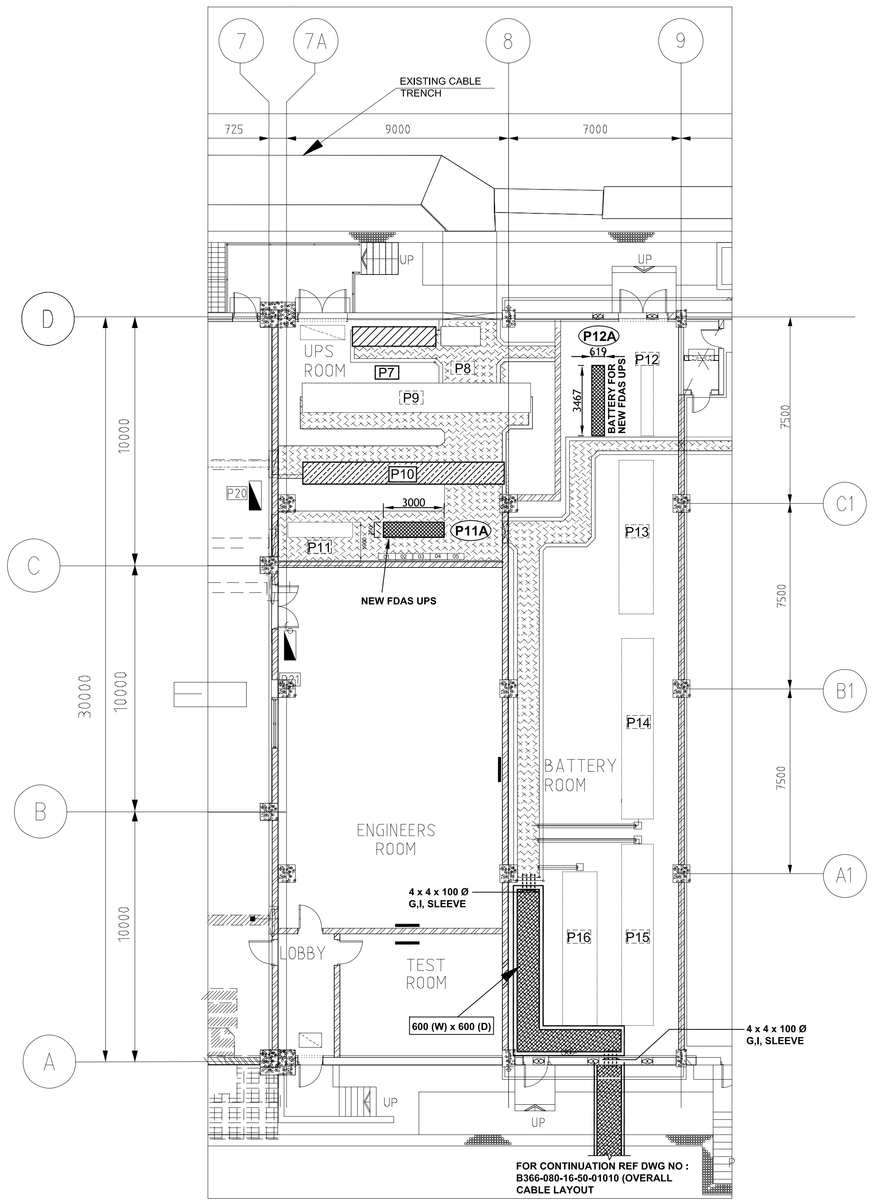
TITLE: EQUIPMENT LAYOUT SS-331S (MODIFICATION)

CARD CODE N.A.

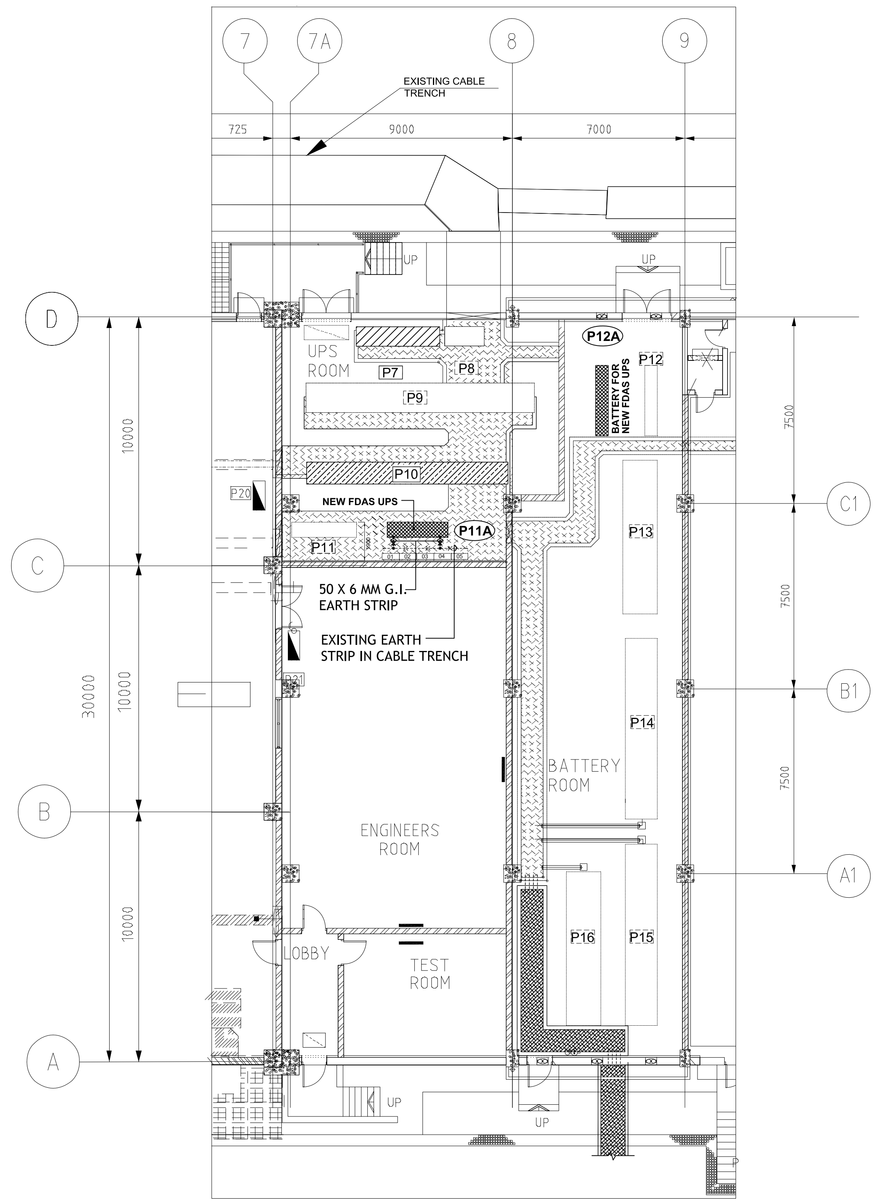
BHEL DRG NO. B366-080-16-50-04010
CUST DRG NO. 0R05570-26899053-ELE-A4225-002

REV. A

SHT. No 1 NO. OF SHT. 1



EQUIPMENT AND CABLE LAYOUT
UPS / BATTERY ROOM AT EXISTING SRR-811



EARTHING LAYOUT
UPS / BATTERY ROOM AT EXISTING SRR-811

ITEM NO	EQUIPMENT TAG	REMARKS
P7	811-PDB-001	EXISTING EQUIPMENT
P8	811-PDB-003	
P9	811-INST-UPS-001 (100 KVA)	
P10	811-INST-UPS-002 (50 KVA)	
P11	811-FDAS-UPS-001	
P12	811-FDAS-BATTERY-UPS-001	
P13	811-INST-UPS-BATTERY-002 / 01	
P14	811-INST-BATTERY-UPS-001 / 01	
P15	811-INST-BATTERY-UPS-001 / 02	
P16	811-FDAS-BATTERY-UPS-002 / 02	
01	811-INST-UPS001-BATTERY-001-BCB	
02	811-INST-UPS001-BATTERY-002-BCB	
03	811-INST-UPS002-BATTERY-001-BCB	
04	811-INST-UPS002-BATTERY-002-BCB	
05	811-FDAS-UPS001-BATTERY-001-BCB	
P11A	**811-FDAS-UPS-002**	**NEW EQUIPMENT**
P12A	**811-FDAS-BATTERY-UPS-002**	

NOTES:

1. ALL UN-USED PORTION OF CABLE TRENCH SHALL BE COVERED WITH 6 MM THICK CHEQUERED PLATE.
2. THE DIMENSIONS SHOWN FOR NEW BATTERY AND NEW FDAS UPS MODIFICATION ARE INDICATIVE ONLY. SAME SHALL BE FURNISHED AFTER FINALISATION OF VENDORS DRAWINGS.

EQUIPMENT LIST

EQUIPMENT NAME	VENDOR	DRAWING NO.	REV.
P11A 811-FDAS-UPS-002	HOLD	HOLD	
P12A 811-FDAS-BATTERY-UPS-002	HOLD	HOLD	

BILL OF MATERIAL

TENDER ITEM NO.	DESCRIPTION	UNIT	QTY.
HOLD	STRUCTURAL STEEL (FOR BASE FRAME OF PANELS)	KGS	100
HOLD	6 MM THK. CHEQUERED PLATE	M^2	04
HOLD	100 Ø G.I. SLEEVE	MTR	20
HOLD	50 x 6 MM G.I. EARTH STRIP	MTR	10

LEGEND:-

- EXISTING EQUIPMENTS
- NEW VERTICAL PANELS TO BE EXTENDED ON EXISTING SWITCHBOARD
- EXISTING SPARE FEEDER AT EXISTING SWITCHBOARD
- EXISTING EQUIPMENT TO BE MODIFIED
- RCC CABLE TRENCH SIZE AS INDICATED
- 100 Ø G.I. SLEEVE
- 50 X 6 MM G.I. EARTH STRIP

HOLD:-

-TENDER NO.
-EQUIPMENT LIST (VENDORS DETAILS)
-AS MARKED

SPECIAL NOTE:-

THIS LAYOUT DRAWING IS APPLICABLE FOR THE NEW FACILITIES UNDER JOB NO. B366 ONLY.

TENDER NO.:-
HOLD

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☒ REVIEW ☐ INFORMATION	

CLIENT: INDIAN OIL CORPORATION LIMITED, PARADIP REFINERY PROJECT, PARADIP, ORISSA
CONSULTANT: TECHNIP INDIA LIMITED
PROJECT: 525 TPD STANDBY SRU PROJECT, IOCL PARADIP REFINERY, ODISHA, INDIA

ENGINEERS INDIA LIMITED, NEW DELHI
BHARAT HEAVY ELECTRICALS LTD., HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.				
CHD.				
APPD.				

REV.	DATE	ALTERED	ZONE
A	20.05.21	CHD/APPD AR / SV ISSUED FOR REVIEW	

DEPT. ELECT. CODE 16-50 | UNTOL. DIMS. OR ~~C/M/F~~ | SCALE 1:100 | WEIGHT (KG) | REF. TO ASSY. DRG. ~N.A.~ | ITEM NO. ~N.A.~ | NO.OF ITEMS ~N.A.~

TITLE: EQUIPMENT, CABLE & EARTHING LAYOUT SRR-811 (MODIFICATION)

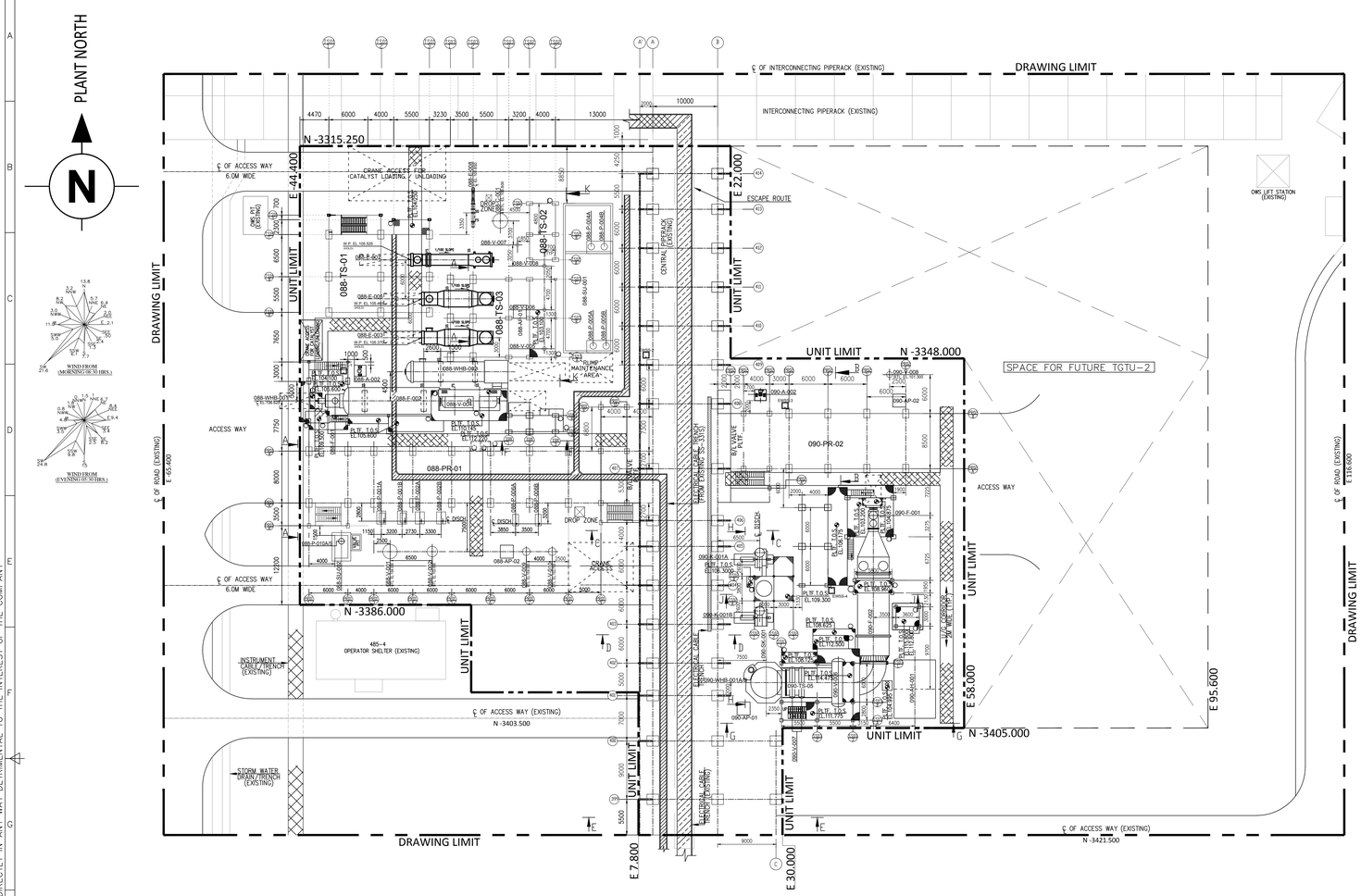
CARD CODE N.A. | BHEL DRG NO. B366-080-16-50-04015 | CUST DRG NO. ORISS/C-26899053-ELE-A4227-003 | REV. A | SHT. No 1 | NO. OF SHT. 1

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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY023026I
SIGN. AND DATE | COMPUTER FILE NAME | REF. DRG. NO. | INVENTORY NO

FIRST ANGLE PROJECTION

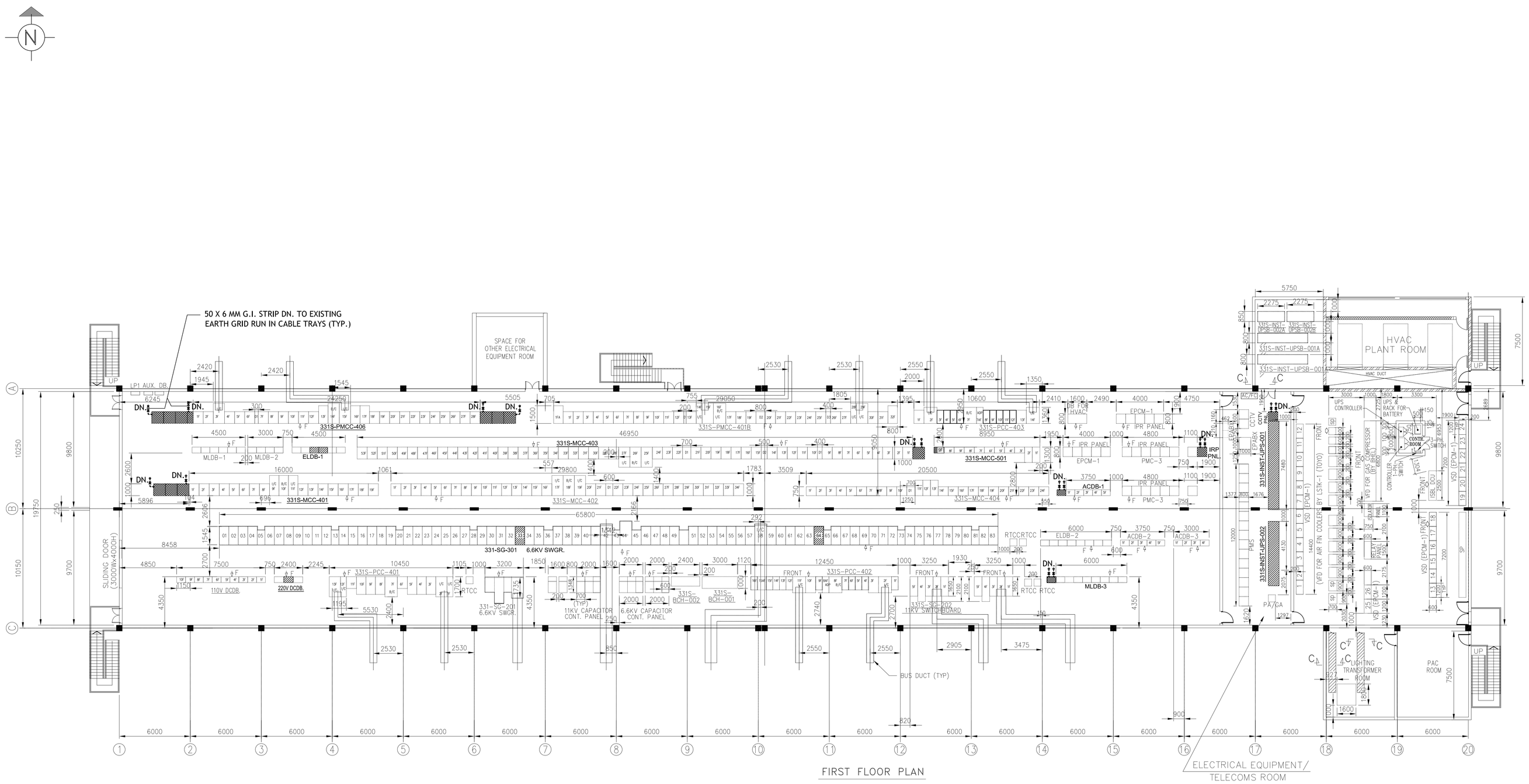
(ALL DIMENSIONS ARE IN mm)

ESP-001-12A



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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY023026I



FIRST FLOOR PLAN

SUBSTATION EARTHING LAYOUT (SS-331S) MODIFICATION

No Comments

NOTES:

1. 50 X 6 MM G.I. STRIP SHALL BE CONNECTED TO EXISTING EARTH GRID RUN IN CABLE TRAYS BELOW NEW EQUIPMENTS AT MIN. TWO POINTS AS SHOWN IN PLAN.

BILL OF MATERIAL

TENDER ITEM NO.	DESCRIPTION	UNIT	QTY.
HOLD	50 X 6 MM G.I. EARTH STRIP	MTR.	100

LEGEND:-

- EXISTING FACILITIES
- NEW VERTICAL PANELS TO BE EXTENDED ON EXISTING SWITCHBOARD
- EXISTING SPARE FEEDER AT EXISTING SWITCHBOARD
- EXISTING EQUIPMENT TO BE MODIFIED
- 50 X 6 MM G.I. EARTH STRIP

HOLD:-
-TENDER NO.

SPECIAL NOTE:-

THIS EARTHING LAYOUT DRAWING IS APPLICABLE FOR THE NEW FACILITIES UNDER JOB NO. B366 ONLY.

TENDER NO.:-
HOLD

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
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CLIENT: INDIAN OIL CORPORATION LIMITED, PARADIP REFINERY PROJECT, PARADIP, ORISSA

CONSULTANT: TECHNIP INDIA LIMITED

PROJECT: 525 TPD STANDBY SRU PROJECT, IOCL PARADIP REFINERY, ODISHA, INDIA

ENGINEERS INDIA LIMITED, NEW DELHI

BHARAT HEAVY ELECTRICALS LTD., HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.				
CHD.				
APPD.				

REV.	DATE	ALTERED	CHD/APPD
A	20.05.21	ISSUED FOR REVIEW	CHD/APPD AR / SV

DEPT. ELECT | CODE 16-50 | UNTOL. DIMS. GR. C/M/F | SCALE 1:150 | WEIGHT (KG) | REF. TO ASSY. DRG. –N.A.– | ITEM NO. –N.A.– | NO.OF ITEMS –N.A.–

TITLE: EARTHING LAYOUT SS-331S (MODIFICATION)

CARD CODE N.A. | BHEL DRG NO. B366-080-16-50-03020 | CUST DRG NO. 080507C-2689903-ELE-A4213-002 | REV. A | SHT. No 1 | NO. OF SHT. 1

JOB SPECIFICATION FOR ELECTRICAL INSTALLATION, TESTING, PRECOMMISSIONING AND COMMISSIONING

			Written By: Sowndharya Baskaran 2019.11.11 19:44:33 +05'30'	Checked By: Gopi Chellappa 2019.11.11 19:45:49 +05'30'	Approved By: Velmurugan Shanmugam 2019.11.12 09:22:37 +05'30'	Authorized By: Monschristopher Jesumarian 2019.11.12 09:37:49 +05'30'
A	11.11.2019	ISSUED FOR DESIGN	SB	CG	SV	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS

Wherever used in this procedure, the following words shall have the meaning as given hereunder

Abbreviation	Definition
IOCL / CLIENT / OWNER	Indian Oil Corporation Limited
PMC / CONSULTANT	Technip India Limited
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
VENDOR	Any third party supplying the equipment / materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Indicates Paradip Refinery in Paradip, Odisha State, India
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related

3. GENERAL

3.1 Scope

This job specification for electrical installation work covers the requirement of materials, installation, site fabrication, testing & commissioning of electrical items / systems.

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3.2 Specifications

3.2.1 This job specification for electrical installation work shall be read in conjunction with relevant drawings and documents.

3.2.2 The contractor must declare in the offer any exception and / or deviation from the job specification for electrical installation work. The lack of any declaration and / or deviation will be considered as full compliance with the job specification.

3.3 Standards

3.3.1 The electrical installation work shall comply with the latest edition of relevant specifications, codes of practice of Bureau of Indian Standards and OISD standards listed below.

IS:1255	Code of practice for installation and maintenance of power power cables up to and including 33 KV rating.
IS:1646	Code of practice for the safety of buildings - Electrical installation
IS/IEC : 62305	Protection against Lightning
IS:3034	Code of practice for fire safety of industrial buildings – Electrical generating and distributing systems
IS:3043	Code of Practice for earthing.
IS:5216	Guide of safety procedures and practices in electrical work
IS:7689	Guide for control of undesirable static electricity
IS 7816	Guide for testing Insulation resistance of rotating machines
IS 10028 (Part-2)	Code of practice for selection, installation and maintenance of transformers: Part 2 Installation
IS 10028 (Part-3)	Code of practice for selection, installation and maintenance of switchgear: Part 3 Installation
IS:10810 (Part-43)	Method of Test for cables; Part 43 Insulation resistance
IS 10810 (Part-45)	Method of test for cables, Part 45 High Voltage Test
OISD 110	Recommended practices on static electricity
OISD 137	Inspection of Electrical Equipment
OISD 147	Inspection and safe practices during electrical installations
OISD 149	Design Aspects For Safety In Electrical Systems
OISD 173	Fire prevention and protection system for electrical installation
OISD 192	Safety practice during construction
OISD 180	Lightning Protection
SP-30	National Electrical Code (NEC), BIS Publication

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3.3.2 The electrical installation shall also confirm to the requirement of the following as applicable

- Regulation laid down by State Electrical Inspectorate / CEA
- Indian Electricity Act & Rules
- Regulation laid down by CCoE / PESO
- The Petroleum Rules
- Any other regulation laid down by central/ state/ local authorities & Insurance agencies

3.4 Abbreviations

The acronyms used in this document have the meaning defined below:

CCoE	-	Chief Controller of Explosives
CEA	-	Central Electricity Authority
GI	-	Galvanized Iron
IS	-	Indian Standards
IEC	-	International Electrotechnical Commission
IP	-	Ingress Protection
LCS	-	Local Control Stations
PESO	-	Petroleum and Explosives Safety Organisation
PVC	-	Poly Vinyl Chloride
SWG	-	Standard Wire Gauge
XLPE	-	Cross Linked Poly-ethylene

4. EARTHING & LIGHTNING PROTECTION

4.1 Basis of Design

4.1.1 It is recommended that all electrical equipment be suitably earthed. Earthing system shall, in general cover the following:

- Equipment earthing for personnel safety.
- System neutral earthing
- Protection against Static and Lightning discharges.
- Protection against electromagnetic interference.

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- To limit the voltage on a circuit when exposed to a higher voltage than that for which the circuit is designed.

4.1.2 Plant earthing design shall generally be carried out in accordance with the requirements of Indian Electricity Rules and IS 3043, IS 1646, BS 7430 & BS 7671. Earthing of Tanks shall comply to OISD-STD-173. The earthing system shall have an earthing network with required number of earth electrodes connected to it. The following shall be earthed:

- System Neutral
- Current and potential transformer secondary neutral.
- Metallic non-current carrying parts of all electrical apparatus such as transformers, Switchgears, motors, lighting/power panels, terminal boxes, control stations, lighting fixtures, receptacles etc.
- Steel structures, loading platform etc.
- Cable trays and racks, lighting mast and poles.
- Storage tanks, spheres, vessels, columns and all other process equipment.
- Cable shields and armour.
- Flexible earth provision for wagon truck.
- Pump handling Hydrocarbon if it's base plate is separate from motor's base plate.
- Turbo driven pump handling Hydrocarbon.

4.2 Material Specification

4.2.1 All materials and hardware to be supplied by the contractor shall be new, unused and of best quality and shall conform to the specifications given here under / installation Standard and to latest specifications of Bureau of Indian Standards.

4.2.2 The main earth grid conductor shall be hot dip galvanized M.S. flat unless otherwise specified. Copper flat or cables shall be used if specified.

4.2.3 Sizes for main conductors shall be as indicated on the earthing layout drawing. Amount of galvanising shall be 610 gm per square meter. Earth electrodes and Earth plate shall be as per Earthing Installation Standards.

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4.2.4 All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections shall be adequately locked against loosening.

4.3 Installation

4.3.1 The earth conductor shall be laid along cable trays / cable trench / pipe racks as indicated on the earthing layout drawing. Where concrete trenches are available, the earth conductor shall be laid in the trenches and shall be firmly cleated to the sidewall of concrete trench using GI clamps or welded with insert plates (if available) at interval of 500 mm and near to the termination end.

4.3.2 The earthing conductor on above ground shall run along one of the cable trays along a cable route or as specified in earthing installation layout. The earthing conductor shall be suitably cleated / welded and electrically bonded to all the other cable trays on the same cable route at a regular interval of 20 meter.

4.3.3 In general earth conductor when laid underground shall be at a depth of minimum 500mm below finished grade level. For exact depth refer earthing installation layout.

4.3.4 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen / applying cold galvanization treatment and covering with Hessian tape.

4.3.5 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

4.3.6 Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. Cadmium coated nuts and bolts shall be used at tapping points where welding is not envisaged.

4.3.7 When two earth strips are to be joined by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides (three on the Top and one bottom) shall be continuously welded. All joints at tappings above ground shall be by means of connector/lugs. Earthing strip joints at earth plate and equipment shall be as per Earthing Installation Standard.

4.3.8 All process pipelines shall be bonded and earthed at the entry and exit points of battery limit of hazardous area. All utility / process pipelines shall be bonded to a common conductor by means of

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earth bars or pipe clamps. Earth continuity shall be ensured across all flanges. Earth continuity conductors across pipe line flanges shall be provided as per OISD.

4.3.9 All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth. Lighting fixtures and receptacles shall be earthed through the extra core provided in the cable inside the terminal box.

4.3.10 At least two nos. of earth strips of adequate size shall be tapped from the main earth grid and taken to the top of all tall structures, platforms, and a ring shall be made at the highest point

4.3.11 Steel pipe rack in the process units and offsite area shall be earthed at every 25 meters or less.

4.3.12 In remote located area, equipment / street light pole may be earthed by means of individual earth electrode and earth conductor.

4.3.13 Independent earthing network shall be provided for lightning protection and this shall be bonded at least at two points with the main earthing network below ground. Lightning down conductor shall be brought to earth electrode in shortest straight path.

4.3.14 UPS, DCS, PLC, and other electronic instruments, including electronic relays, shall be provided with copper plate clean earth. This shall be kept galvanically isolated from the system and safety earthing.

4.3.15 Metallic sheaths, screens and armour of all multicore cables shall be earthed at both equipment and switchgear ends. Sheath and armour of single core cables shall be earthed at switchgear end only. Armour shall be earthed outside panel in cable cellar for easy approach.

4.3.16 Earthing system for plant instrument, UPS system, VFD, Data concentrator panel, HMI etc. shall in general be separate from the common electrical earthing system, until and unless specific consent for common earthing has been taken from manufacturers. The earthing requirement for the VFDs & motor shall be strictly adhered as per OEM recommendations.

4.3.17 In plant area all stair cases, railings, monkey ladders shall be earthed at least at two points.

4.3.18 Transformers shall be provided with two dedicated earth electrodes for earthing of neutral and transformer tank earthing. All earth connections should be visible for inspection.

4.3.19 Normally earthing system shall comprise of main earth grid along with suitably located disconnecting plates to provide multiple earth connections between earth grid and equipment and for connections between main earth grid and electrodes.

4.3.20 Earth electrodes shall be galvanized after fabrication. No welding and drilled holes are to be left without galvanization. The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity. All earth electrodes shall be tested for earth resistance

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by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.

4.3.21 Tanks, piping and process vessels and equipment containing flammable liquids or gas shall be earthed by a connection to the earth network, or by bonding to an earthed metal structure. Metal enclosures in intimate contact with the ground (for example, tanks) may be considered to be adequately protected without additional bonding. Bonding straps shall be applied across in-line insulating devices on lines handling materials which give rise to significant amounts of static charge.

4.3.22 The Earth Pits for the Storage tanks shall be located outside DYKE wall.

4.3.23 The exact location of earth electrode in the field shall be determined by contractor in consultation with the engineer in charge and shall be located avoiding interfaces with road, building or other civil foundation, columns, pipelines etc. The distance between two electrodes shall not be less than twice the depth of electrode.

4.3.24 For installation of earth electrode soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil shall be packed by watering and ramming as tight as possible. The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.

4.3.25 Earth rods and conductors shall be designed to cope with the conditions imposed. The earth conductor shall be adequately sized to carry the applicable maximum earth fault current without undue temperature rise. All joints shall be protected against corrosion.

4.3.26 A single earth pit shall not be used for any system. Instead, an Earth-grid (earth-pit network) shall be made of minimum two numbers of earth pits connected in parallel. (Number of earth pits required for an earth-grid will depend on the permissible earth-resistance specified by the respective system manufacturer). Suitable distance shall be maintained between various earth pits (minimum 3 meters) as per guidelines of API RP550.

4.3.27 All earth pits shall be marked with earth pit number for easy identification. In addition, metallic tag is also to be fastened with the earth electrode inside the pit as a permanent identification. Unit wise

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segregation of earth-pit network is desirable for higher reliability and ease of shut down maintenance of these earth-pit networks.

4.3.28 When terminating glands into a thermoplastic enclosure, earth continuity of the gland bodies shall be maintained using an internal jumper conductor or internal earth continuity plate.

4.3.29 Refer to Quality control plan doc. no. 080557C-000-QCP-1610-001 for earthing and lightning system installation.

4.4 Testing and Commissioning

4.4.1 Resistance of individual earth electrodes shall be measured after disconnecting it from the grid by using standard earth test megger / Resistance Tester.

4.4.2 Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid. The resistance value of an earth grid to the general mass of earth shall be as follows:

- For the electrical system and equipment, a value that ensures the operation of the protection device in the electrical circuit but not in excess of 4 ohms. However, for generating stations and large sub-systems, the value shall not be more than 1 ohm.
- For lightning protection, the value of earth resistance shall be 5 ohms, but in no case, it shall be more than 10 ohms.
- All joints in pipelines, valves, plants, storage tanks and associated facilities and equipment for petroleum shall be made electrically continuous by bonding or otherwise; the resistance value between each joint shall not exceed 1 Ohm.

4.4.3 The resistance to earth shall be measured typically at the following points:

- At each electrical system, neutral earth.
- At each earth provided for structure lightning protections.
- At points on earthing system used to earth electrical equipment enclosures.
- At points on earthing system used to earth wiring system such as metal conduits and cable sheaths or armour.
- At points on fence enclosing electrical equipment

4.5 Lightning Protection System

4.5.1 Lightning protection shall be provided as per the requirements of following codes & standards.

- OISD-GDN-180 (R1, Oct'18)
- IS/ IEC-62305 - Protection against lightning
- API Recommended Practice 2003: Protection against ignition arising out of Static, Lightning and Stray Currents -

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- NFPA 780: Standard for the installation of Lightning Protection Systems
- BS 6651 Code of Practice for Protection of Structures against Lightning.
- Electrical Safety Code - Institute of Petroleum, U.K.
- API-545 : Recommended Practice for Lightning Protection of Aboveground Storage Tanks for Flammable or Combustible Liquids
- ATEX certification for "Equipment or Protective systems intended for use in Potentially Explosive Atmospheres Directive 94/9/EC"

5. CABLING

5.1 Material Specification

5.1.1 All materials and hardware to be supplied by the contractor shall be new, unused and of best quality and shall conform to the latest specifications of Bureau of Indian Standards. The cable ladders/trays & accessories shall comply with the requirements specified in the installation standard of power.

5.1.2 The material of glands shall be nickel plated brass. Single compression type cable glands shall be used for indoor panels / equipment and for outdoor, it shall be weather protected, double compression type. Cable glands used with equipment installed in hazardous area shall be of flame proof type and shall have valid certificate as per requirement of statutory authority.

5.1.3 Cable lugs shall be crimped type, tinned copper solderless / aluminium / bimetallic. Bimetallic cable lugs or bimetallic strip shall be provided in case of different material i.e. Al or Cu at the point of termination.

5.1.4 End termination kit for HV cable shall be ‘heat shrinkable’ type or ‘push-on’ type

5.1.5 Cable trays near cooling tower / CBD (Closed Blowdown) / DM plant area shall be of FRP material. All cables and cable joints shall be rated for unearthed system. Proper grade of end terminations and cable jointing kits shall be used. For example, in 6.6 kV (UE) systems, 11 kV (E) Grade cable jointing kit to be used.

5.2 Installation

5.2.1 Cables shall be laid in directly buried trench or in RCC trench or in cable tray along pipe sleepers or in overhead trays as detailed in power layout drawings. Overhead trays shall be installed at minimum

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2700 mm above grade level and 300 mm above FGL in case cable trays are installed along with pipe sleepers. At road crossing overhead trays shall be minimum at 7000 mm above grade level.

5.2.2 Minimum depth of directly buried cable shall be 900 mm for high voltage cables and 600 mm for medium voltage cable. In case of concrete trench minimum depth shall be 500 mm for all voltage level with 300 mm clearance between the bottom of the trench cover and bottom of the cable.

5.2.3 All cables shall be laid as per IS:1255 specifications and contractors shall use rollers/ other laying tools to ensure proper laying.

5.2.4 Cable installation shall include power, control and lighting cables. Cable routing given on the power layout drawings shall be checked in the field so as to avoid interference with structures, heat sources, drains, piping, air- conditioning duct etc. Any change in routing shall be done to suit field conditions wherever deemed necessary, after obtaining approval of Engineer-in-charge.

5.2.5 High voltage power, medium voltage power, control cables & communication cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on layout drawings/installation standards.

5.2.6 The clearance between electrical and instrumentation cables shall be maintained as per the details shown in installation standards.

5.2.7 The minimum clearance between electrical power cables and piping shall be as shown in installation standard drawings.

5.2.8 Single core cables, laid in trefoil formation shall be braced by suitable GI clamps at a distance, not exceeding 3 meters along the cable routing, however in case of flat formation the fixing clamp shall be of non-magnetic material. The sheath of single core cable shall be earthed at one point/ end to keep it at earth potential unless otherwise stated. Where long runs of single core high voltage cables are required, an evaluation of the installation shall be carried out to determine if intermediate cross-bonding of armouring is required to avoid the heating effect of sheath losses.

5.2.9 The armour and semiconductor screen of single core cables shall be earthed at one end. The continuity of armour and semi conductor screen shall be broken at each joint. The unearthed end of

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armour and screen shall be insulated. Proper TRIFOIL formation of the single core cables of the different phases is to be done by using clamps with transposing of the cable bunch at regular intervals.

5.2.10 Out of two NO contacts of Emergency Stop Push button & LCS Stop push button of all HV & MV motors, one NO contact shall be wired to trip breaker directly & other shall be wired to binary input of numerical motor protection relay.

5.2.11 The lengths indicated in the cables schedule are only approximate. The contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. Extra loop length shall be given for feeder cables where required as per the directions of Engineer-in-charge to meet contingencies.

5.2.12 Cables shall be neatly arranged in the trenches / trays in such a manner that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be in line with power layout drawings.

5.2.13 Each row of cables in cable trench shall be laid in place before covering with sand. All wall openings / pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building / RCC trench.

5.2.14 Every cable shall be given an insulation test in presence of Engineer-in-charge/Owner before filling the cable trench with sand. Any cable which is found defective shall be replaced.

5.2.15 Cable routing between cable trench and equipment / motors shall be taken through GI pipe sleeves of adequate size. The pipe sleeve shall be laid at an angle of maximum 45 deg. to the trench wall with a minimum bending radius of 12D. However underground sleeves provided from cable trench if any, shall be of PVC. In case of PVC sleeves contractor to supply & provide PVC to GI coupler and then GI sleeves shall be used for routing of cables to equipment / motors.

5.2.16 In case of buried cables as shown in the power layout drawings the contractor to ensure that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand. This sand shall be levelled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the cable and sand shall be lightly compacted and then covered with red interlocking warning tiles, and PVC warning tape, and then back filled to grade level with soil, rammed and levelled. The horizontal and vertical clearance between cables shall be followed as per details shown in installation standards.

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5.2.17 A Continuous yellow PVC tape of 150mm wide, indelibly and continuously marked in black lettering "CAUTION BURIED ELECTRICAL CABLE" (or similar) shall be laid approximately 150mm below ground level and directly above cable route Formed trenches shall have red concrete screeding at grade level.

5.2.18 Concrete cable trenches shall be filled with sand in hazardous area to avoid accumulation of hazardous gases and oil. RCC covers of trenches shall be effectively sealed to avoid ingress of liquid and gases wherever the trenches leave or enter a control room or substation and in process area.

5.2.19 Concrete lined trenches shall have suitable drainage arrangement to avoid water collection, or these trenches shall be connected to nearest storm water drain.

5.2.20 The top of cable trenches before entering the substation shall be maximum 1 m above the ground level. All cutouts shall be properly sealed by a sealing compound. Pipes laid for mechanical protection shall be sealed at both ends. All entry and exit openings for cables crossing in substation, control room etc shall be provided with fire barrier and it shall have minimum three hours rating.

5.2.21 Cables installed above grade shall be run in heavy duty hot dipped galvanized cable trays, clamped on walls, ceiling or structures and shall be run in parallel or at right angles to beams, walls or columns beams, walls or columns. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air-conditioning duct etc (or) places subject to fire risk. Each cable tray shall contain only one layer of cables (with touching each other) as far as possible for power cables. However, control cables may be laid in double layer in the cable trays. The trays shall not show deflection / bend / deformation after laying of cables. The cables shall normally be secured at 750mm intervals on horizontal runs and every 450mm on vertical runs.

5.2.22 Individual cable or small group of cables (up to 3 cables) which run along structures / walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively, small group of cables can be taken through preferably 50/100/200 mm perforated trays. Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300 mm for cables up to 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia. to prevent sagging of cables.

5.2.23 Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection up to a minimum of 300 mm above grade. Cable ends shall be carefully pulled through conduit to prevent damage to cable. Necessary supports shall be provided

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for the Conduits. Care shall be taken to give sufficient space in the trench to give required bending radius for the cable and spare loop.

5.2.24 In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/ wiring/inter-connection diagram. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends, for future use.

5.2.25 Separate control cables shall be used for each of the following;

(a) CT secondary circuit.
(b) PT secondary circuits.
(c) Interlocking circuits.
(d) DC signals between instrumentation & electrical equipment.
(e) AC signals between instrumentation & electrical equipment.
(f) Switchboard to each local control stations.

5.2.26 Where cables pass through foundation walls, the necessary openings shall be provided in advance by another agency. However, should it become necessary to cut holes in existing structures for example floor, slab etc., the contractor shall determine their location and obtain approval of the Engineer-in-charge before carrying out the same.

5.2.27 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/ fireproof sealing compound. Alternatively, rubber bushes shall be employed for the purpose of sealing. The same shall be supplied by contractor.

5.2.28 Vertical supports for cable tray shall be fabricated out of ISMC 100 and horizontal supports shall be with 65 x 65 x 6 mm angle iron section unless otherwise specified. For other sizes of cable tray supports, Site Engineer In charge consent/ approval shall be taken by contractor.

5.2.29 GI or FRP cover shall be considered for top most cable tray for protection against physical damage to cables. Also bottom most cable tray shall also be covered with GI or FRP sheet from the bottom side. GI or FRP type sheet shall be selected based on the type of cable trays. Tray cover shall be provided for the outermost trays of vertical droppers

5.2.30 All cable tray supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, de-rusted, descaled and cleaned. The painting shall be done with one

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coat of red oxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminium paint unless otherwise specified.

5.2.31 Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Also for cable pulling, rollers shall be used. Cables shall not be taut to straighten them after laying. Cable stockings shall be used for cable hauling.

5.2.32 Contractor to maintain minimum bending radii during cable installation as per cable manufacturer recommendation.

5.2.33 All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on stainless steel (2mm thick, 20 mm wide and of enough length) securely fastened to the cable and wrapped around it. In addition, each underground cable shall be provided with cable tags securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground and also at splice points.

5.2.34 In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be provided at

- at intervals of not more than 30 m
- Changes of route direction
- Road and pipe crossings
- Entrances to buildings
- All jointing points
- One side only for cable formations upto 2m wide
- Both sides for cable formations wider than 2m

5.2.35 Cable joints shall be avoided to the extent possible. If it is unavoidable, it is recommended to have a separate concrete chamber for all cable joints. This shall ensure monitoring health of the cable joints, traceability etc. In no case the joint shall be located in hazardous area.

5.2.36 Maintenance of cable trenches shall be the responsibility of the Contractor from the initial excavation until back-filling is complete. This activity includes trench wall consolidation and putting steel plates

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at points of pedestrian and vehicle crossing. The Contractor shall maintain the cleanliness and physical protection of cabling in open trenches at all times.

5.2.37 All removable cable trench cover joints inside the battery area shall be sealed with bituminous compound to prevent ingress of any liquid hydrocarbon in the trench.

5.2.38 All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap.

5.2.39 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.

5.2.40 Fire proofing of cables shall be done for 3 m length at indoor equipment entry point, and similarly for outdoor equipment entry point and same shall be carried out as per the recommendation of the paint supplier. Fire barriers shall be installed at substation building cable entry points. All entry and exit openings for cables crossing in substation shall be provided with fire barrier and it shall have minimum 3 hours rating. Fire proof coating shall be applied to the cable passing through electrical store room/battery bank room also.

5.2.41 Linear Heat sensing cable shall be provided on all cable trays in substation cable cellar room.

5.2.42 Contractor shall drill holes for fixing gland wherever necessary. Gland plate shall be of non-magnetic material / aluminium sheet in case of single core cables. All unused cable entries on equipment / panels shall be plugged / sealed.

5.2.43 The cable shall be terminated at electrical equipment / switchboards through glands of proper size as required. The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per manufacturer's instructions. Cable armour shall not be exposed after termination is complete.

5.2.44 Crimping of lugs to cable leads shall be done by hand crimping / hydraulically operated tool as per requirement. Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of strands shall not be allowed.

5.2.45 No unauthorized repairs, modifications shall be carried out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall be brought to the

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notice of Engineer-in-charge by contractor. After termination is complete, all the bolts, nuts, hardware of terminal box shall be properly placed in its position and tightened.

5.2.46 All power and control cables glands installed outdoor shall be provided with suitable sized PVC shrouds.

5.2.47 Bends, tees, reducers, crosses, droppers etc. shall have the required bending radii as recommended by the manufacturer with 10% allowance for various cable sizes with a minimum of 300 mm.

5.2.48 Cable trays, racks and trenches shall be sized to allow for 20% space for future cables. Cable installations shall provide minimum cable bending radii as recommended by cable manufacturer

5.2.49 All cables shall be properly supported by clamps at the panel entry to avoid tension on cable lugs.

5.2.50 Use of colored adhesive marking tapes on cable end termination insulation for phase marking is to be avoided as reaction of the adhesive material with the end termination insulation can result in partial discharge.

5.2.51 All cable trays and accessories shall be prefabricated, G.I. ladder type. For tray system design, in addition to self-load and wind forces, following guidelines for design shall be considered.

a) Maximum Support span 3000 mm

b) Cable load for

i) 150 mm wide cable tray 30 kg/linear meter

ii) 300 mm wide cable tray 60 kg/linear meter

iii) 600 mm wide cable tray 75 kg/linear meter

iv) 750 mm wide cable tray 75 kg/linear meter

c) In addition to this, 70 kg concentrated load at center span shall be considered. All structural steel design shall be as per Indian Standards. and shall be suitable / designed to withstand fire for a minimum period of 30 minutes.

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5.2.52 Refer to Quality control plan doc. no. 080557C-000-QCP-1630-001 for power system installation.

5.3 Testing & Commissioning

5.3.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase, phase to neutral and from phase/neutral to earth.

5.3.2 Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or terminating. After completion of splices and /or terminations measurements shall be repeated.

5.3.3 The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.

5.3.4 For cables, up to 1100V grade 1000 V Megger and for H.V. Cables 2.5 KV / 5 KV Megger shall be used.

5.3.5 DC High Voltage test or AC High Voltage test shall be conducted on cables given below after installation.

- All 1100-volt grade power cables in which straight through joints have been made.
- All cables above 1100 V grade.

The DC High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representative only.

Cables shall be installed in final position with the entire straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from other equipment and framework to prevent flash over. In each test, the metallic sheath/screen/armour shall be connected to earth.

6. LIGHTING

6.1 General

6.1.1 Plant lighting system shall comprise:

a. Normal lighting
b. Emergency lighting
c. Critical lighting.

Normal lighting shall be fed by AC supply (415/240V, 3 phases, 4 wires). Emergency lighting shall be fed from separate 3-phase source indicated. For this purpose separate ELDB shall be provided.

Critical lighting shall be fed from separate DC supply system comprising battery, chargers & DCDB.

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6.1.2 Normal lighting system shall provide enough illumination so as to enable plant operators to move safely within the accessible areas of plant to perform routine operation including reading of field instruments, operation of all valves etc. and to carry out all the necessary maintenance and adjustment to equipment.

6.1.3 Normal lighting shall comprise 75% of total lighting. Emergency lighting shall comprise of 25% of total lighting. Also, critical lights shall be provided in addition to above for entry points & escapes routes as required

6.1.4 Critical lighting shall be fed from battery charger & battery system through DCDB, and shall employ LED lamps.

6.1.5 Areas requiring AC emergency lighting shall include, but not be limited to, the following:

- All Areas requiring DC critical lighting.
- Strategic locations in process, utility areas where specific safety/shutdown operation are to be carried out.

6.1.6 Areas requiring DC critical lighting shall include, but not be limited to, the following:

- Control rooms
- Substations
- DG shed
- Central fire station
- Fire water pump house
- First aid center

DC critical lighting shall be provided in the pipe rack, exit/entry point only in case considered for process units

6.1.7 LED lighting shall generally be used for indoor & outdoor plant lighting as per area classification. DC critical lighting shall employ LED lamps. Tall structures shall have LED aviation obstruction lighting as per statutory requirements. All Lighting fittings shall be of energy efficient type.

6.1.8 Lighting system shall consist of lighting transformers, Main lighting distribution boards (MLDBs), lighting and power panels, fixtures, junction boxes etc. as specified. All outdoor lighting shall be automatically controlled by means of photoelectric cell/synchronous timers with manual overriding

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control as specified. Lighting and power panels shall be fed from MLDB through 415/415V, Dyn11, dry type lighting transformer having taps upto ±5%.

6.1.9 Each lighting transformers shall be sized to feed the entire plant normal lighting load with 30 % as a minimum spare capacity.

6.1.10 Separate Main Lighting Distribution Boards shall be provided for normal and emergency lighting in each substation to meet the lighting requirements. These shall receive power from 415V switchboards through lighting transformers of suitable rating

6.1.11 MLDB shall be of two bus sections with bus coupler. Normally both the incomers shall be 'ON' with buscoupler in open condition. In case of any problem to any of the incomer, tripping of the affected incomer followed by closing of bus coupler shall be done manually.

6.1.12 An Auxiliary Switchboard (ASB) shall be provided in each substation to supply power to welding sockets, EOT crane, power outlets for hydro jetting and other auxiliary loads.

6.1.13 The MLDB and ASB shall be single front, non-draw out type. Lighting and small power panels shall be supplied by MLDB.

6.1.14 The lighting panels shall be provided with MCB and ELCB (100mA Sensitivity) as incomer and MCBs in outgoing feeders for control and protection of lighting circuits.

6.1.15 The small power panels shall be provided with MCB and ELCB (100mA Sensitivity) as incomer and MCB + ELCB (30mA Sensitivity) in outgoing feeders for control and protection of power circuits.

6.1.16 MCBs shall not be loaded beyond 80% of rated capacity. A minimum of 20% of miniature circuit breakers of each panel shall be left as spares. In general, the load on each circuit shall be limited to 1.5 kW.

6.1.17 Adjacent light fittings shall not be fed from the same circuit.

6.1.18 All chemical handling facilities shall be provided with chemical resistant fixtures

6.1.19 Lighting design shall conform to relevant Indian and International Codes and Standards, IES Hand Book and shall take into consideration the requirements from point of view of safety and ease in operation and maintenance. A maintenance factor of 0.7 shall be assumed for lighting illumination

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level calculations for normal areas. However for dusty areas, maintenance factor as per relevant codes and standards shall be considered.

6.1.20 Battery room shall have fixtures mounted on wall in order to facilitate easy replacement of fused lamps. Switches controlling the lighting fixtures and exhaust fan shall be installed outside the battery room.

6.1.21 Power supply to auxiliary services board where single phase / lighting loads are connected shall be through lighting / isolation transformer only.

6.1.22 For indoor lighting, minimum lux level shall not be less than 80% of the average illumination level.

6.1.23 For outdoor lighting, minimum lux level shall not be less than 40% of average value and 25% of maximum value.

6.1.24 Material of Construction shall be as follows;

1) Body – aluminium alloy pressure die-cast LM6/ADC12/LM24 for outdoor and flameproof lighting fixtures. CRCA/PC/Aluminium extrusion housing for indoor non-weatherproof fixtures.

2) Generally Industrial and outdoor fixtures must have secondary lens / optics of type PMMA/ Borosillicate glass / Polycarbonate.

3) However outdoor industrial luminaires like well-glass, flat glass may not have secondary lens optics. Indoor lights like bulbs, tube, down-lighters may not have secondary lens.

4) Cover type- toughened glass or UV stabilized polycarbonate for outdoor type fixtures and UV stabilized polycarbonate for indoor non-weatherproof type fixtures.

5) Impact resistance- IK-05 or better for outdoor fixtures, not required for indoor type fixtures

6.2 Material Specification

All materials, fittings and appliances to be supplied by the contractor shall be new, unused and of the best quality and shall conform to the specifications given hereunder. These shall be manufactured in accordance with the latest revision of the specifications of Indian Standards/International standards. In the absence of any specifications for a particular item, contractor shall bring material samples along with proven track record to site and get the same approved by Engineer-in-Charge/Owner before installation.

6.2.1 Lighting and Power panel

Lighting and power panels shall be as per relevant job specifications. Panels shall be installed on wall / column either on surface or flush mounting (indoor) as per installation standards / layout drawings.

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6.2.2 Switches

Switches, manufactured in accordance with IS: 13947 shall be used for non-hazardous areas. Switches in areas where concealed wiring has been adopted, shall be flush mounting piano type unless otherwise specified. Modular switches along with required boxes shall be provided for indoor application in case shown in the layout. For surface conduit wiring, piano type switches in surface mounted box shall be provided. Industrial type switches (weather protected) shall be used for outdoor areas.

6.2.3 Receptacles

Three pin type 5A/15A receptacles manufactured in accordance with IS: 1293 shall be used for non-hazardous areas. The receptacles and the controlling ON/OFF switch shall be mounted in the same enclosure box but these shall be in separate units to facilitate replacement by parts. Flush mounting type receptacles shall be used in areas where concealed wiring has been adopted and surface type shall be used in other areas. For exhaust fans and wall mounted air circulators, socket and switch enclosures shall be separate. Modular type receptacles along with required boxes shall be provided for indoor application in case shown in the layout. In buildings such as sub-station, DG Shed, Workshop, maintenance shop etc. industrial type metal clad socket outlets and plugs shall be provided. These sockets shall be supplied complete with plugs.

6.2.4 Outlet Boxes

The outlet boxes used as point outlets shall be prefabricated type 65mm deep junction boxes. Outlet boxes custom fabricated for sockets, switches, fixtures and fan regulators etc. shall be made of MS sheet having minimum thickness of 1.6mm. Outlet boxes shall be galvanized / nickel plated after fabrication. These shall be complete with terminal block suitable for connection of wires up to 4 sq. mm. Front cover plate shall be of 3mm thick Bakelite/PE sheet. The colour shall suit the shade of the walls. The sheet shall extend at least 2 cm on all sides of outlet box. Cover plate shall be fixed by cadmium plated brass screws and cup washers.

Outlet boxes shall be provided with adequate number of knock outs on all the sides for ease of wiring either with conduits or without conduits.

6.2.5 Conduit and Accessories

Conduits for electrical installations shall conform to IS: 9537. The type of conduit (Steel/GI/ PVC) shall be as specified on the drawing. Heavy duty PVC conduits shall be provided for concealed condit. Black enameled steel or GI conduit shall be of 1.6mm thick and the minimum wall thickness of PVC conduit shall be 1.6mm. Generally, PVC conduits shall be used in concealed wiring and for surface

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wiring GI conduit (in plant buildings) and black enameled steel conduit (in non-plant buildings) shall be used.

6.2.6 Wires

Wires shall be PVC insulated and shall be of 660 Volts grade as per IS: 3035. Conductor shall be of stranded copper and size shall be minimum 1.5 Sq. mm for lighting, 2.5 Sq. mm for 15A power socket circuits and 4 sq. mm for split AC, power socket circuits. Red/Yellow/blue wires for phases, black wire for neutral and green wire for earth shall be used. Size of earth wire shall be same as for phase and neutral size. Wire size for air conditioning circuit feeders shall be as indicated in the lighting panel schedule.

6.2.7 Ceiling fan / Exhaust fan

Ceiling fans shall be of 1200mm sweep unless otherwise specified with double ball bearing and regulator. The suspension down rod shall be sturdy mild steel rod of adequate diameter and of minimum length of 300mm with shackles suspension arrangement as per IS. For exhaust fans, the sweep dia. and air CFM shall be as specified in job specification. Exhaust fans for battery room shall be with anticorrosive blades suitable for use in acidic fumes.

6.2.8 Decorative switches and sockets

Decorative lighting switches and sockets where specified, shall be modular in design. All these items shall fit into the same frame with overall standard dimensions. Frames shall be suitable for surface and flush mounting in brick / concrete wall. The frames shall be suitable for conduit entry from all the sides. Switches and sockets shall match colors of the frame and cover plates to obtain a combination which shall match decor of the interiors of Control Room, Administrative buildings, offices rooms, etc.

6.2.9 High Mast Lighting

The high masts shall be of continuously tapered polygonal cross section and fabricated out of steel plates. The masts shall be provided with motorized racking mechanism for lowering and hoisting lantern carriage. The mast shall be minimum 30m height and shall have a capacity of 24 fixtures complete with LED lamps.

For equipment and components for which makes are not specified, CONTRACTOR shall furnish credentials from customers on the successful installation, commissioning and 2 years operational certificates, along with valid type test certificates for approval from OWNER/PMC.

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6.3 Installation

6.3.1 The lighting fixtures in the plant shall be fed from local lighting panel. All outdoor lighting shall be group controlled manually or photocell or through synchronous timer. In addition, it shall be possible to switch ON/ OFF entire lighting from PMS/ECS and local switchboard. Lighting wiring between panel and lighting fixtures shall be done with XLPE insulated 3-core (phase, neutral and earth) copper conductor, armoured cable for hazardous areas. Wiring in the building shall be done by means of 3-core copper, conductor PVC insulated, un-armoured cables, or PVC insulated copper conductor wires in conduit as specified. All joints of conductors in Switch boards/JBs/ Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted anywhere in the wiring system.

6.3.2 The lighting layouts will indicate approximate locations of lighting fixtures. The contractor shall determine, with approval of Engineer-in-Charge, the exact locations of each fixture in order to avoid interference with piping or other mechanical equipment and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows.

6.3.3 All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the glands shall be covered with PVC or rubber shroud. All unused cable entries shall be plugged with suitable blanking plugs.

6.3.4 Mounting height of equipment shall be as under: -

Top of Switch Box	:	1200 mm from FFL (Finished floor level)
Top of Lighting/Power Panel	:	1800 mm from FFL
5/15 Amp Receptacle	:	300 mm (CL) from FFL unless otherwise specified (inside building) and 1200 mm (CL) for process areas and industrial sheds
Lighting fixture	:	As indicated in layout drawing (LED Type)
Exhaust fan	:	In the cutout provided / as indicated in

6.3.5 Mounting type for light fixtures shall preferably be followed as indicated below:

- Platforms with handrail - Pole mounting
- Grade level - Pole mounting
- Other cases - Bracket or Ceiling mounting type with access

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6.3.6 Flood lights (when provided) on the pipe rack shall be approachable from platform access or permanent ladder. Locally mounted lighting fixtures on platforms, walkways, stairs shall be mounted in such a way that, relamping can be done without use of ladders

6.3.7 Recess mounting shall be considered to mount on false ceiling.

6.3.8 Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases, special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.

6.3.9 All lighting shall be hooked up with centralized lighting system. Control from centralized lighting system will be provided from the nearest existing substation. This will be in the form of potential free control contact.

6.3.10 Lighting control scheme shall also be designed to trip the entire lighting system in case of air raid warning. Tripping signal for the lighting system shall be wired from the nearest existing substation.

6.3.11 Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.

6.3.12 All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.

6.3.13 The cable shall be straightened after unwinding it from the drum. All cables are clamped/laid in straight run without any sag and kink.

6.3.14 For location where fan points are shown, fan hooks with junction box shall be provided during concreting.

6.3.15 Where fan hooks and JBs are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

6.3.16 Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanised or zinc passivated. Underground lighting cables (in paved areas) shall be taken in suitable PVC/ GI pipe sleeves buried at a minimum depth of 300mm from FFL. GI pipe sleeves shall be extended to 300mm above FFL. Exact termination/layout of GI pipes

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(for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in-charge.

6.3.17 Industrial type plug sockets with 20A MCB or rating as per SLD/ lighting schematics shall be provided at a height of 500mm from FFL for window AC units.

6.3.18 Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches.

6.3.19 Street lighting fixture shall be mounted on steel tubular poles as per standard drawings. The foundation for the street lighting poles will be made by contractor. Street lighting poles shall be supplied with a base plate and earthing lugs.

6.3.20 Each street lighting pole shall be earthed at two points by connecting to the plant earth grid as shown in installation standards.

6.3.21 The street lighting poles shall be numbered as per the drawings/ directions of Engineer in charge.

6.3.22 All lighting poles near cooling tower / DM Plant shall of FRP material.

6.3.23 The lattice structure masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The masts shall be numbered as per drawings. The masts shall be connected to the plant earth grid at two points.

6.3.24 The main feeder up to the distribution board of lighting mast shall be through XLPE insulated armoured cable of size as specified in the respective drawings. Wiring from distribution board to each flood light fixture shall be by means of 3 core 2.5 mm2, copper conductor XLPE insulated armoured cable. All the cables shall be neatly clamped to the structure at intervals not exceeding 300 mm.

6.3.25 Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

6.3.26 Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be prepared by contractor as per

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site conditions. Drop conduits for switch boards shall be decided by contractor as per wall locations shown in drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

6.3.27 Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sq.mm/1.5 sq.mm. respectively.

6.3.28 The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti- corrosive preservative or covered with approved plastic compound.

6.3.29 Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

6.3.30 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. Conduits shall be laid above reinforcement. All conduit connections shall be properly screwed and junction box covers shall be properly fitted so as to avoid entry of concrete slurry.

6.3.31 Conduit pipes shall be fixed by 1.6mm thick GI saddles on 3mm thick GI. saddle bars of required width in an approved manner at intervals of not more than 500mm for straight run. At places near junction boxes, bends, or similar fittings, saddle and bars shall be provided on either side.

6.3.32 All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.

6.3.33 After erection, the entire conduit and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

6.3.34 Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run, contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked

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with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by contractor after completion of the work.

6.3.35 Wiring in hazardous area shall be done by using minimum 2.5mm2 copper conductor armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).

6.3.36 Correct type of lighting equipment (fixtures and JBs) with regard to hazardous protection as specified in the drawing shall be installed for the classified area.

6.3.37 Wherever separate control gear boxes (CG box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of an additional junction box. All unused cable entries shall be sealed with suitable plugs.

6.3.38 Contractor to ensure that after the terminations are made the cover of the junction boxes and the lighting fittings are closed properly with all bolts and hard wares in correct position, retaining its explosion and weather protections.

6.3.39 Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 3 mm thick GI saddle bar at intervals of 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Engineer-in-charge. Where required 4 or less of cables shall be taken in perforated 50/100 mm cable tray after getting the approval of Engineer-in-charge. Cables shall not be routed along hand rails.

6.3.40 Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly, equipment such as lighting fixture, control gear box, lighting/ power panels, junction boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

6.3.41 The type of wiring system shall comprise surface / concealed conduit system or cable wiring as specified on layout drawings.

6.3.42 Mounting details of fixtures shall be indicated on the drawings. If specified on the drawings, a group of lighting fixtures which are to be mounted end to end shall be fixed to a channel (mild steel cold rolled sections of 50mm x 50mm and of 1.2mm thick). The entire assembly shall be fixed to the ceiling with necessary number of supports which may be by means of steel conduit or chromium plated chain link as required. The channel shall run continuously in suitable sections from one end to the other

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end of wall. The complete channel shall be spray painted, with approved colour as per the directions of Engineer-in- Charge. All wires inside channel shall be neatly bunched by nylon tape and buttons.

6.3.43 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm dia. GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm dia. PVC conduit concealed in walls up to switchboards/panels. Lighting fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalized in co-ordination with air-conditioning duct diffuser layout, panel's layout and false ceiling grid layout. To facilitate easy maintenance 'Looping back system' of wiring shall be followed throughout. Accordingly supply tapping and other interconnections including earthing are made only at fixture connector blocks or at switch boards. Required number of junction boxes shall be used at intervals for wire pulling and inspection.

6.3.44 All wires in conduit shall be colour coded as specified. Each circuit shall have independent phase neutral and earth wire. However, when group of circuits are run in a single conduit the earth wire can be common.

6.3.45 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.

6.3.46 Refer to quality control plan doc. no. 080557C-000-QCP-1680-001 for lighting system installation.

6.4 Testing and commissioning

6.4.1 Pre-commissioning checks/ tests shall include but not be limited to the following:

- The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 5 mega ohms. (Between phases, phases to neutral, phase/neutral to Earth).
- Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.
- The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
- It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
- Operation of ELCB's shall be checked.

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7. ELECTRICAL HEAT TRACING SYSTEM

Contractor shall adhere to Manufacturer's instruction and requirements given in their technical manuals for installation, pre-commissioning and commissioning. Also refer to quality control plan doc. no. 080557C-000-QCP-1650-001 for heat tracing system installation.

8. ELECTRICAL CATHODIC PROTECTION SYSTEM

Contractor shall adhere to Manufacturer's instruction and requirements given in their technical manuals for installation, pre-commissioning and commissioning. Also refer to quality control plan doc. no. 080557C-000-QCP-1670-001 for heat tracing system installation.

9. ELECTRICAL EQUIPMENT INSTALLATION

Prior to start of installation of the electrical equipment, contractor shall verify that equipment and complete materials have been received. Handling, shifting to required site location, installation, testing and commissioning of all electrical equipment shall be done by contractor with utmost care. Manufacturer's instruction and requirements given in their technical manuals shall be strictly adhered to. The substation/Switchgear room wherein the equipment to be installed shall be kept clean, dry and free from all debris. Panel floor cut-out not in immediate use shall be suitably covered to avoid any mishap. When handling switchboard panels, care shall be taken to observe correct lifting arrangements is made and make sure that slings are attached to the manufacturer's lifting points. No parts shall be subjected to undue strains or sudden stresses that could cause damage to equipment. Lifting position mark indicated on packing casing shall be adhered to strictly, for keeping it in required vertical position. Refer to quality control plan doc. no. 080557C-000-QCP-1620-001 and 080557C-000-QCP-1640-001 for electrical equipment installation.

9.1 Switchboards

9.1.1 The term switchboard here includes all HV / MV switchboards, Power and Lighting distribution boards, VFDs, AC/ DC UPS panels, AC / DC DB, etc.

9.1.2 The switchboard panels shall be handled with care, avoiding any impact on to the equipment. Dragging of the panels directly on floor shall be avoided. Roller bars may be used for shifting of panels. Use of crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the ruck or trailer by means of ropes to avoid any chance of tilting. The switchboard panels shall be lifted after ensuring the panel supports, nut and bolts are all intact. While lifting the panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment.

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9.1.3 The panels shall be preferably kept inside the packing cases till foundations are ready. Proper rain/sun/dust protection shall be ensured till switchboards are installed.

9.1.4 The switchboard panels shall be installed on prepared foundations or floor cut-outs. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required. It shall be ensured that the base plate level of HV switchboard shall match with the finished floor level.

9.1.5 The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours. Proper level of base frames shall be maintained throughout and shall be checked with water level/spirit level. Steel shims shall be provided below base frame wherever required.

9.1.6 All the panels shall be assembled, aligned and levelled. Alignment of panels shall be checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for joining of the panels other than those recommended by the vendor shall be drilled. No gaps shall be left between the panels. Gap if any found between panels shall be suitably sealed using sealing compound or T-profile. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.

9.1.7 The panels shall be checked for correct vertical position using plumb line and spirit levels. The switchboard panels shall be tack welded at suitable intervals at base channel.

9.1.8 After erection of switchboard panels, all uncovered portions of floor cut-outs shall be covered with 6 mm thick removable chequered plates (with suitable lifting arrangement) finished with floor level. The design of the chequered plates shall be such that the maximum allowable deflection is L/200 (where L is the span of the chequered plates in meters) for a live load of 500 kg/sq. meters.

9.1.9 Additional stiffeners shall be provided at the bottom, if required. Suitable lifting arrangement shall be provided for chequered plates. The chequered plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications. Where specified, panel's cut-outs provided for future use shall be filled with lean concrete.

9.1.10 After completion of installation of switchboards, all the cubicles, switchboard components such as switches, starters, CT and PT chambers, bus bar chamber shall be cleaned and checked for tightness of all the components.

9.1.11 Vacuum circuit breakers shall be checked for integrity of bottle seals. All loosely supplied items shall be fitted up.

9.1.12 Interconnection wiring between shipping sections shall be made by contractor as per respective vendor drawings.

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9.1.13 All the wiring connections shall also be checked. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with Carbon Tetra Chloride (CTC) where required.

9.1.14 All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

9.1.15 Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required, shall be done as per the directions of Engineer- in-charge. Special attention shall be paid to CT circuit's polarity, wiring continuity and correctness in the protection as well as measurement circuits. Auto transfer scheme shall be simulated and verified. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced.

9.1.16 Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire switchboard shall be dried- up according to the instruction of the Engineer-in-charge for the IR value to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.

9.1.17 All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in- charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer-in- charge.

9.1.18 All moving parts, of closing/tripping mechanism, racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up, cleaned and contact pressure measured.

9.1.19 All the control wiring, PTs, bushings, bus bars, other live parts of switchgear, incoming and outgoing cables shall be meggered.

9.1.20 Electrical simulation tests shall be carried out for all the protective, alarm and annunciation relays and external interfaces to ascertain proper functioning.

9.1.21 Safety insulation mats of approved make and of required voltage grade shall be supplied and installed by contractor in the sub-station. For insulation purpose, in front of all switchgears dielectric paint shall be provided on floor. Floor of substation shall be cota stone based for smooth and clean look.

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9.1.22 Switchboard - Pre-Commissioning Check List: Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

a) That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to make the enclosure vermin proof.

b) That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.

c) That the polarity test and ratio test of all the PTs and CTs is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits is correct.

d) That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.

e) That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging, and display of switchboard SLDs shall be verified from HMI in case the same is provided.

f) That IR Value has been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

g) Following tests shall be ensured for all CTs
   - Insulation resistance test
   - Ratio test through primary injection
   - Polarity test
   - Knee point voltage for class PS CTs

h) Following tests shall be ensured for all PTs
   - Insulation resistance test
   - Ratio test through primary injection
   - Polarity test

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i) Following tests shall be ensured for all breakers
- Insulation resistance test
- Breaker closing, opening sequence using 3 pole timers
- High voltage test both in open and close condition for HV breaker
- Contact resistance of all three poles using 100A DC Kit

j) Following tests shall be ensured for all meters
- Calibration of meters
- Functional verification and settings

k) Following tests shall be ensured for all relays
- Secondary injection test
- Relay settings
- Timing check with timers
- Any other test recommended by the supplier

l) Following tests shall be ensured for all bus bars
- Tightness of all nuts/bolts using Torque wrench
- IR value
- Contact resistance
- Cleaning of bus bar chamber using vacuum cleaner
- Conducting jelly shall be applied on Al/Cu joints as per manufacturer's recommendations
- HV test in case of HV switchboard.

m) Following tests/Checks shall also be performed on the switchboards
- Functional verification of individual feeders including all spare feeders
- Simulation test for under voltage tripping of related feeders such as motor feeder, capacitor feeders etc.
- Verification of control supply schemes
- Stability test for all differential protections
- Simulation test for bus auto/manual change over scheme
- Checks for all panel illuminations, indicating lamps, sockets
- All upstream and downstream interlocks

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9.2 Bus Duct

9.2.1 The bus ducts as per issued drawings will be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made. The bus duct enclosure shall be checked for earth continuity and then earthed at two places. The bus duct shall be properly supported between switchgear and transformer. The opening in the wall where the bus duct enters the switchgear room shall be completely sealed to avoid rain water entry. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected. The bus duct levelling shall be checked with spirit level and pendulum weight.

9.2.2 Bus Duct - Pre-commissioning check list: Before commissioning any bus duct, following points shall be checked and ensured for safe energizing of the bus ducts

- All joints are tightened using torque trench.
- Cleaning of bus duct chamber with vacuums cleaner.
- Silica gel breather shall be connected if supplied. If required, silica gel shall be reactivated as per the instruction of engineer in charge.
- Space heater circuit shall be checked and tripping through thermostat shall be ensured.
- Contact resistance shall be measured for all phases/neutral using 100 A DC kit.
- High voltage test in case of HV bus ducts.

9.3 Transformers

9.3.1 Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.

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9.3.2 Transformers shall be examined, for any sign of damage in transit. Particular attention shall be given to the following in this regard.

- Dents on tank wall or cooling tubes, radiators
- Damage to protruding parts like valves, sight glass etc.
- Loosening of bolts due to vibration in transit.
- Cracked or broken bushings.
- Oil leakage particularly along welds.

If anything, adverse is noted the same shall be brought to the notice of Engineer- in- charge.

9.3.3 Contractor shall examine the transformer base, oil pit, fire walls and foundations laid. It shall be ensured that oil spills cannot propagate along cable trenches. Any discrepancy noted will be brought to the notice of Engineer- in- charge. Transformers shall be placed on channels or rails over concrete foundations. The transformers shall be levelled, aligned and checked for free movement on the channels or rails. Stoppers shall be provided to the transformers immediately to prevent any movement.

9.3.4 Normally transformers up to 1000 kVA rating shall be received duly fitted with radiator tubes, conservator tanks, valves, wheels and other accessories. While the transformers of above 1000 kVA rating may be supplied with loose accessories. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied in different packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals / drawings and documents. All the connections for CTs, bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts. Gravels shall be filled in the transformer bay, soak pit as per requirement.

9.3.5 Topping of transformer with oil: Before topping up with oil, transformer shall be fitted with all accessories such as valves, gauges, thermometers etc. Oil samples shall be taken from each drum and tested for determination of dielectric strength or as advice by engineer-in charge. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported. It is necessary to filter the oil before the transformers are filled. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil. All air vents shall be opened. Oil shall be filled through a streamline oil filter using metal hose. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve. In a transformer with conservator tank, the rate of oil flow shall be reduced when the level is almost up to the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm. Sufficient time shall be

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allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape. Any air accumulation in the buchholz relay shall be released.

Sample of oil from the transformer shall be taken from the bottom of the tank. For dielectric test, the oil shall be tested as described in IS: 335. The oil shall also be tested for acidity in accordance with the methods prescribed.

9.3.6 Drying out of the transformers, if required, shall be carried out and record maintained in accordance with IS: 10028. Normally a streamline filter shall be used for drying-up. IR value versus time of both windings along with OTI/WTI and filtrations machine temperature curve for IR value Vs time shall also be plotted and recorded during the drying-up process. Precautions when drying

a) The maximum sustained temperature to which transformer oil may be subjected shall be limited to 80 ˚C.

b) The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded.

c) Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the Engineer-in-charge. Generally, a megger reading of 2 mega ohms / kV at 60° C temperature with a 5 kV Megger may be a rough indication for stopping the dehydration.

9.3.7 The following work on transformers shall be performed by the contractor if specifically called for:

a) Before finally commissioning the transformer, it may sometimes be desired to run it for a few hours on short-circuit, applying a low voltage, approximately equal to the impedance voltage of the transformer. During this process, regular readings of the insulation resistance of the winding to earth and winding to winding and temperature against time shall be recorded.

b) Testing of radiator tubes for any leakage and rectifying these by welding / brazing.

9.3.8 Transformer - Pre-commissioning Check List: Before commissioning of any transformer, the following points shall be checked for safe energization of the transformer:

a) All the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Engineer-in-charge. In case transformers are idle for more than one month after dehydration, transformer oil has been given at least two circulations.

b) Oil level, in the transformer conservator tank and all the bushings is up to the marked point and the oil has been tested for dielectric strength and acidity.

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c) Silica gel is in reactivated condition. The breather pipe is clear from any blocking and contains oil up to the proper level.

d) The explosion vent diaphragm does not have any dents. Accumulation of any oil and air had been released.

e) Operation of off-load and on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Motor IR value has been taken and found satisfactory. Tap position mechanical indicator on the transformer and tap position indication meter on the control panel are reading the same tap positions. Tap changer limit switches are operating satisfactorily on the maximum and minimum tap positions. On-load tap changer contact pressure and resistance is as per manufacturers recommendations. Oil level of tap changer tank is up to the required level and oil has been tested for dielectric strength. The tap setting on which the off-load tap switch is locked shall be recorded. Generally, the off-load tap switch shall be kept on nominal tap.

f) Buchholz relay has been tested and checked up for any friction in the movement, and floats are free. All the other protective relays, alarm and annunciation relays have been tested.

g) Metering equipment has been tested and polarity test of PT's and transformer winding is satisfactory. Phase sequence and connections have been checked for proper vector group.

h) Ratio test and winding resistance on all the tap positions is satisfactory.

i) Gaps of arcing horns for the bushings where provided are in order and earth connections for the surge diverters have been checked.

j) Winding and oil temperature thermometer pockets contain oil and the winding and oil temperature settings on dial gauges are in order.

k) Transformers fitted with fans for forced air cooling have been checked up for starting and stopping of the fans both in manual and auto mode and air-displacement has been verified.

l) Simulation tests for all external interface connection alarm, annunciation and trip circuits have been checked and are in order.

m) Insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked.

n) Valves in the cooling system and valve between the buchholz relay and the conservator tank are in open position.

o) Setting of all the protective relays is at the desired value and DC Trip supply is healthy.

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p) Magnetic, current and magnetic balance test have been conducted.

q) Simulation test for WTI, OTI, PRV, OSR.

r) Settings of WTI/OTI as per the instruction of the manufacturer

s) Earthing resistance value for the neutral earthing

9.3.9 Observations after Commissioning: After switching on the transformer, the following points shall be observed and recorded.

a) The inrush magnetizing current and no-load current.

b) Alarm, if any, or if any relay flag has operated.

c) Voltage and current on all the three phases.

d) Transformer hum or abnormal noise.

e) Circulation of oil and leakages.

f) Record current, voltage, cooling air temperature, winding temperature and oil temperature readings, hourly for 24 hours.

g) Cable end boxes for any over-heating.

9.4 HV and MV Motors

9.4.1 All the motors generally would be erected by the mechanical contractor. Electrical contractor shall keep the motor space heater energized as per the directions of Engineer-in-charge. Electrical contractor shall measure the insulation resistance of motor windings and PI in case of HV motors. Insulation resistance of the motors shall be measured between the winding of the machine and its frame by means of a 500 / 1000 V megger in case of 415 V motors. A minimum value of 1 meg-ohm for 415 V motors shall be considered a safe value.

9.4.2 In case the insulation is low, the following method of drying has to be adopted, after consultation with Engineer-in-charge. During drying the temperature rise of winding shall not exceed the permissible value for the class of insulation used.

a) By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals so as to pass full load current in the stator keeping the stator winding temperature below 90° C . In this case, a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. value becomes steady.

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b) By blasting hot air from external source, Maximum temperature of winding while drying shall be 70° C to 80° C (thermometer) or 90° C to 95° C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached after 4 to 5 hours, and for large machines after 10 hours. A record has to be kept for drying process, with half an hour readings and, till steady temperature is reached. In case it is essential, the drying process can be supplemented by blower.

9.4.3 It shall be ensured that the motor leads are correctly connected in the terminal box, as indicated in the 'Name Plate'. The covers of all terminal boxes shall be properly fixed, the gaskets intact. The control circuit shall be tested for proper functioning as per circuit diagram.

9.4.4 In case of synchronous motor, slip rings and brush gear shall be polished and brushes shall be fixed in their holders with clearance and pressure as recommended by the manufacturer.

9.4.5 Before commissioning, the ventilation and cooling system of the motor must be inspected. In case of motor with forced ventilation the air inlet shall be examined to ensure that it is free from moisture and any foreign material. It shall also be ensured that recommended flow and pressure of air is available to produce the required cooling effect.

9.4.6 The motor control gear shall also be carefully examined, the over-load settings may be reduced or time lags bypassed from protective gear to ensure rapid tripping of switchgear in event of faults. The direction of rotation of a new motor especially of large capacity and phase sequence of supply shall be kept in view while joining and connecting to the motor terminals.

9.4.7 Finally, the motor shall be started on no-load after decoupling, and shall be allowed to run for a minimum period of 4 hours, or for a time as instructed by Engineer-in-charge. Attention shall be given to the proper running of the bearings, vibration or unusual noises if any. Voltage, starting current, no load current, stator winding and bearing temperature shall be recorded after every 1 hour during this test. Direction of rotation shall be checked and recorded. Normally the motors run in clockwise direction as viewed from the driving end with reference to the phase sequence RYB.

9.4.8 After switching off the motor, the insulation resistance of the motor shall be recorded under hot and cold conditions.

9.4.9 If the no load test run is found satisfactory, the motor shall be allowed to run for 8 hours and all readings shall be recorded. The following work on motors may be performed by the contractor if specifically called for.

a) The proper level of bearing oil has to be checked. The condition of grease in bearings shall be checked and in case it is necessary, complete replacement of bearing with specified grade

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of grease after proper cleaning of the bearing shall have to be done. Wherever external greasing facility exists, the condition of grease may be checked by pumping some new grease of specified grade at start. If the grease coming out is deteriorated grease shall be replaced.

b) All the motors directly coupled or coupled through reduction gears shall be checked for abnormal vibration, if any, Large rated HV motors with journal type bearings are liable to get damaged from shock, rough handling during transit. Any minor defect in a race or roller may give rise to considerable amount of vibration and noise. Contractor shall check and bring to the attention of Engineer-in-charge any defect noticed in this regard.

c) Due care shall be taken to avoid any damage to bearing insulation wherever provided.

9.5 Batteries

Battery (Lead acid, Nickel Cadmium or VRLA type as specified) shall be erected on stands and insulators supplied by the manufacturer of the batteries. The installation shall be done as per the layout drawings and manufacturer's instructions. Electrolyte if required / as applicable shall be filled as per manufacturer's instructions. Inter row connections shall be made with the leads supplied by the manufacturer.

9.6 Neutral Grounding Resistor

The neutral grounding resistor shall be inspected for any damage to the resistor grid and other components. The resistor shall be levelled and installed. All covers etc. shall be checked for tightness to ensure that the enclosure of the resistor is dust, vermin and weatherproof. Earthing conductors shall be taken from the outer end terminal of the resistor for connection to earth electrodes and to the main grid. Check such as IR, operation of space heater, earth resistance shall be done before the commissioning.

9.7 Field electrical equipment (Local distribution panels, Local control stations, Welding Receptacles, Power Junction boxes)

Field electrical equipment shall be erected on steel/concrete structures as per the drawings. In isolated places a separate support shall be fabricated and installed. Local control stations shall be installed near to the motors to be controlled. Individual channel supports shall be installed as per Installation standard. All outdoor equipment shall have integral canopies for additional weather protection. Canopy shall be made of 2 mm thick galvanized sheet steel or FRP where these are not integral with the equipment.

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10. FIELD INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT

10.1 Contractor shall carry out complete field inspection, testing and commissioning of electrical equipment. The pre-commissioning inspection among other requirements shall include visual inspection, checking the workmanship of the installation, the rating of equipment, safety clearances, sizes of cables installed, conformance to the latest drawings / documents, soundness of switchgear and bus duct bus connections, terminal connections of equipment / motor, wiring properly dressed and labeled, sealing of unused cable entries, checking of all safety interlocks, control / interface functions as per requirement etc. Refer to quality control plan doc. no. 080557C-000-QCP-1600-051 for Electrical equipment pre-commissioning and doc. no. 080557C-000-QCP-1600-052 for commissioning.

10.2 The Contractor shall supply and install all labels and notices required to complete the Works to the satisfaction of IOCL.

These shall include but not be limited to;

- Equipment identification and duty labels.
- Functional description labels on all distribution boards, switch and fuse units, contactors, starters, grouped lighting switches, etc.
- Labels on all equipment.
- Warning labels on covers and enclosures containing live connections as necessary.
- Labels required to describe isolation requirements.
- Warning labels to inform of external voltage sources in equipment.
- Notices requesting that primary electrical earths and main equipment bonding are not removed.
- Notices regarding cable segregation

Labels shall be of a non corrodible material, having black letters not less than 3mm high engraving on a white background, except for warning and danger labels which shall have black letters on a yellow background for approval prior to manufactures.

10.3 For the following equipment contractor shall ensure testing and commissioning of the equipment at site shall be done under the supervision of the respective equipment manufacturer.

1. 33 kV GIS Isolating breaker panels (If Applicable)
2. HV Switchboards
3. 415V switchboard (PMCC)
4. DC / AC UPS system
5. Soft-starters (If Applicable)

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6. Variable frequency drive system (If Applicable)
7. Electrical heater control panels (If Applicable)
8. Synchronous motors and Emergency DG sets (If Applicable)
9. Data concentrators for HV and MV switchboards, desktop HMI, etc.
10. Electrical heat tracing system and cathodic protection system (If applicable)

10.4 All the covers of terminal boxes, inspection chambers etc. of equipment shall be refitted with gaskets, bolts and nuts as per equipment manufacturer's instruction. In case of any defects being found, the same shall be rectified by the contractor.

10.5 Pre-commissioning test shall include but not limited to the following:

- Continuity test for power and control circuits.
- Insulation test for power and control circuits.
- Earth continuity test for all circuits.
- High voltage test for cables.
- Verification of phase sequence.
- Dielectric strength test on transformer oil.
- Testing of all type of relays / releases for required operations
- Testing of measuring instruments for proper functioning.
- Checking correctness of wiring schemes, control circuit interlocks etc.
- Checking of all safety features for correctness of operation etc.
- Checking of all wiring interface with DCS / ECS etc.
- Earth resistance measurement for each earth electrode and earthing system as a whole.
- Lighting installation shall be tested for correct illumination levels.

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10.6 The control circuit shall be tested for correct operation under all operating combinations before applying power to main circuit.

10.7 Electrical equipment installed in hazardous area shall be paid especial attention to ensure its suitability. Also, contractor to ensure that all covers, bolts, nuts and hardware are intact and there is no physical damage mark seen on the enclosure.

10.8 The contractor shall provide necessary assistance to the equipment vendor to perform site acceptance testing.

10.9 All protective relays shall be tested by secondary injection current. Primary injection tests shall be carried out for differential protection, restricted earth fault protection at full / reduced current to ensure correctness of complete wiring.

10.10 All protective relays shall be tested by secondary injection current. Primary injection tests shall be carried out for differential protection, restricted earth fault protection at full / reduced current to ensure correctness of complete wiring.

10.11 The insulation resistance test values for various electrical equipment shall be as below, contractor to ensure that during insulation tests, electronic devices and components that are liable to get damaged on applied test voltage shall be disconnected from circuit. The instruction of equipment / panel manufacturer shall be followed strictly in this regard:

a) Cables

Cable voltage rating	**DC test voltage(Volt)**	**Minimum insulation resistance (mega ohm)**
650 / 1100 V	1000	10
1.9 / 3.3 kV	1000	200
3.8 / 6.6 kV	1000	200
6.35 / 11 kV	5000	200
19 / 33 kV	5000	200
Lighting and power circuit	250	1

b) HV / MV Switchboards

Rated voltage of switchboard	**DC test voltage(Volt)**	**Minimum insulation resistance (mega ohm)**
110 V	500	10
240 V	500	10

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415 V	1000	100
3.3 kV	1000	200
6.6 kV	1000	200
11 kV	5000	200
33 kV	5000	200

c) Motors and Generators

Rated voltage of Equipment	**DC test voltage(Volt)**	**Minimum insulation resistance (mega ohm)**
240 V	500	10
415 V	1000	15
3.3 kV	1000	50
6.6 kV	1000	80

d) Transformers

Rated voltage of Equipment	**DC test voltage(Volt)**	**Minimum insulation resistance (mega ohm)**
Up to 600 V	1000	100
3300V	2500	1000
6600V	5000	5000
11000V	5000	5000
33000V	5000	10000

10.12 High Voltage testing: DC high voltage test shall be conducted as per below table on all HV feeder cables and also on 1100 V grade cables where straight through joints have been made.

Rated voltage of cable (kV)	**Test Voltage (kV) between**		**Duration (minutes)**
Phase voltage / line voltage	**Any conductor and Metallic sheath/ screen/ armour**	**Conductor to conductor (for unscreened cable)**	
0.65 / 1.1	3	3	5
1.9 / 3.3	5	9	5
3.3 / 3.3	9	9	5
3.8 / 6.6	10.5	18	5

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6.6 / 6.6	18	18	5
6.35 / 11	18	30	5
11 / 11	30	30	5
12.7 / 22	37.5	-	5
19 / 33	60	-	5

The cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.

10.13 A.C High Voltage test shall be conducted as per below table on all HV switchboards.

Rated voltage of cable (rms. value in kV)	**Rated 1 min. power frequency withstand voltage (rms value in kV)**		**Duration (minutes)**
	To earth between poles and across open switching device	**Across the isolating distance**	
3.6	10	12	1
7.2	20	23	1
12	28	32	1
24	50	60	1
36	70	80	1

Before energizing any equipment. Formal approval shall be obtained from Owner/PMC.

Contractor shall keep records of all tests carried out along with test results. Field inspection/ test reports shall be submitted by contractor to Owner/PMC as final documentation.

11. CONSTRUCTION EQUIPMENT

The contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection work and to commission the system as specified. Contractor shall use only calibrated measuring and test instruments and shall maintain valid calibration records. The construction equipment shall include but not limited to the following, and these shall be brought to site by contractor before the start of work.

Equipment

- Portable grinder
- Portable welding machine
- Pipe threading machine
- Pipe bending machine (hydraulic)

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- Portable drill machine
- Dewatering pump set.
- Power hacksaw
- Conduit dye set
- Hydraulic crimping machine with round / hexagonal dye set
- Hand crimping tool
- Portable electric blowers, vacuum cleaners.
- Slings, tarpaulins, wooden sleepers, ladders, etc.
- All PPE including safety belts, safety goggles and hand gloves.
- Hydraulic / hand held grease gun
- Oil filtration machine of adequate capacity.

Test Instruments

- Insulation tester 1000 V hand driven.
- Insulation tester 2500 V motor/hand driven.
- Insulation tester 5000 V motor/hand driven
- Phase sequence indicator.
- Earth Resistance tester.
- Single phase variac
- 3 phase variac of adequate capacity.
- Secondary and primary injection testing kit.
- Multimeter, both analogue and digital
- Portable Ammeters, Watt meters, P.F. meters.
- Portable Voltmeters.
- Clip on meters of different ranges.
- Tacho-meter.
- Kelvins double bridge for measurement of very low resistance.
- D.C. high -pot test kit
- A.C. high -pot test kit.
- Transformer oil BDV test kit.
- Lux Meter to measure illumination levels.
- Breaker timing 3 pole kit
- Timers
- 100A DC millivolt drop (Contact resistance) kit
- Vibration measuring Instrument
- Infrared Thermometers

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12. SAFETY EQUIPMENT AND DEVICES

Contractor shall provide the following items in substation, as per Indian Electricity Rules:

- Round bottom fire buckets filled with clean dry sand.
- Adequate number and size of CO2 fire extinguishers and dry chemical powder suitable for dealing with fire.
- Easily accessible first aid box containing ointments and medicines for treatment of electrical burns, conforming to IE rules.
- Framed laminated shock treatment chart, conforming to IE rules, in English and local language. Name, address and telephone number of nearest doctor shall be mentioned in it.
- Danger boards shall be provided on transformer gate, switchboards, entrance to switchgear room and at other places as required by Engineer-in-charge.
- Caution notices shall be provided for all energized electrical equipment.
- Instruction plate containing location of isolation point for incoming power supply, name and contact no. of the contact person in emergency
- Self-contained portable hand lamp, complete with rechargeable battery.
- Portable battery operated emergency light.
- Artificial respiration system
- Face shield
- HV and MV insulated gloves
- Rubber mats (Elec Grade)

13. SPECIAL TOOLS AND TACKLES

Contractor shall provide the following items as minimum in the substation to facilitate testing and maintenance of various electrical equipment.:

- Breaker lifting trolley
- Earthing truck (for both circuit and bus).
- One no. earthing rod.
- HT line tester
- Insulation tester
- Battery impedance tester
- HT megger
- LT megger
- Tong tester
- Framed single line diagram (AC and DC).

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JOB SPECIFICATION FOR
SITE TESTING OF ELECTRICAL EQUIPMENT & INSTALLATION

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A	13.03.2020	ISSUED FOR DESIGN	SB	CG	SV	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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1. INTRODUCTION

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS

Wherever used in this procedure, the following words shall have the meaning as given hereunder;

Abbreviation	Definition
IOCL / CLIENT / OWNER	Indian Oil Corporation Limited
PMC / CONSULTANT	Technip India Limited
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
VENDOR	Any third party supplying the equipment / materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
SITE	Sulphur Recovery Unit
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related

3. GENERAL

3.1 Scope

Site Testing of Electrical Equipment shall be in accordance with Specification No. PDRP-8531-SP-0025, Rev.F1 which is attached as Annexure-1 with this document.

4. ANNEXURES

ANNEXURE – 1 : SITE TESTING OF ELECTRICAL EQUIPMENT & INSTALLATION (DOC. No. PDRP-8531-SP-0025, REV F1

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Client's Name:	Indian Oil Corporation Limited (IOCL)
Project Title:	Paradip Refinery Project (PDRP)
Project Location:	Paradip, Orissa State, India
Document Category	Class 1

REVISION	F1	SIGNATURE
DATE	12 Aug 09	
ORIG BY	P. Rush	
APP. BY		
APP. BY		

REVISION HISTORY			
Revision	**Date**	**Reason for Issue**	**Originator**
O1	08.01.08	First Issue for Comment	M. Alam
A1	29.01.08	Approved for Design	M. Alam
A2	11.03.08	Approved for Design	M. Alam
F1	12.08.09	For Project Implementation Phase	P. Rush

This document was previously issued under document number 3210-8531-SP-0025 Rev A2 (i.e. the original FEED document). This document has been revised to incorporate a change in document numbering only – changes are highlighted

DSN 1977

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ATTACHMENTS

ATTACHMENT 1 TEST RESULTS RECORD FORMS

1.0 SCOPE

This Standard specifies the tests which shall be carried out at site to prove that an Electrical Installation and the Electrical Equipment is of a standard to permit energising, commissioning and operation. It excludes material and equipment identification and its correlation with the Construction documentation and the determination of non-tested quality.

This Standard pre-supposes that satisfactory and material performance at the Vendor's works has been achieved by the completion of type and routine tests and that installation inspection (i.e. Inspection to the IEE Requirements for Electrical Installations, BS 7671 and relevant Indian Standards, Indian Electricity Rules and Codes) has been completed. Visual checks shall have ensured compliance with wiring diagrams and confirmed marking and tightness of all terminations and connections.

It shall also be ensured that the statutory clearances from the Electrical Inspectorate/ Director General Mines Safety are obtained for the scheme and installations.

Sophisticated equipment such as Uninterrupted Power Supply (UPS), Variable Speed Drives (VSD) and power electronics shall be tested in accordance with Supplier recommendations, usually under Supplier supervision.

2.0 TEST PROCEDURES

2.1 Insulation Resistance Testing

Insulation resistance shall be measured while applying a dc voltage across the insulation to be tested for a period of at least 1 minute. The test voltage levels shall be as follows:-

System Voltage (rms)	Up to 1kV	Up to 3.6kV	Above 3.6kV
Test Voltage (dc)	500V	2500V	5000V

Unless otherwise specified this test shall be carried out with the insulation at ambient temperature.

2.2 Polarisation Index (PI) Measurement

The PI measurement is a ratio metric test used to assess the performance of winding insulation. The PI is the ratio of insulation resistance measured after ten minutes and one minute. For moist and dirty windings, the relatively

constant surface leakage component of the current will predominate over the time varying components.

2.3 Pressure Testing

Pressure testing shall be carried out using AC power frequency, low frequency or DC. Testing at power frequency is preferable, though may not be practical on site.

As repeated pressure tests may damage winding insulation, for transformers, generators, motors and other equipment containing main coils or windings or solid state components, tests shall only be repeated at site with the specific approval of the manufacturer and only the voltage level and in the manner thus recommended.

2.4 Testing of Electric Strength of Insulating Oil

Tests for the electric strength of insulating oil shall be carried out employing the test cell method defined in BS EN 60156 or equivalent Indian Standard.

The tested breakdown voltage shall be equal to or greater than 30kV for new unfiltered oil. After filtration, the value shall be more than 60kV.

2.5 Earth Continuity Testing

Earth continuity tests shall be carried out by passing a current of 25A minimum (AC or DC) to measure the resistance of the earth protective conductor or equipotential bond. Earth continuity 'Megger' instruments are satisfactory for this purpose.

Earth loop impedance of all socket outlets shall be tested using a proprietary earth loop tester.

2.6 Earth Electrode Testing

Tests shall be carried out on each electrode or electrode group as detailed in BS 7430 or equivalent Indian Standard.

2.7 Phasing Tests

Phasing tests shall be carried out using a voltmeter or other appropriate indicator to prove that individual phases are energised when a known phase upstream is made live.

2.8 Conductivity Tests

Tests shall be made on all switchgear busbar joints using a low resistance test set, i.e. Ductor.

2.9 Functional Tests

A functional test of all protection, control and metering circuits shall be made. Tests shall prove functional design requirements as defined in cause and effect diagrams or protection and metering single line diagrams. Signals that interface with external equipment and systems shall be checked thoroughly prior to equipment energisation.

3.0 TEST INSTRUMENT CALIBRATION

Instruments employed in testing shall be appropriately calibrated by a registered test authority. Alternatively, pressure test sets may be directly calibrated by the sphere-gap breakdown method (BS EN 60052).

Proprietary megohmmeters for insulation resistance testing, e.g. 'Meggers', do not require calibration provided a zero resistance reading can be obtained when they are on short circuit.

4.0 APPLICATION OF TESTING

4.1 Power Transformers

The following tests shall be carried out on all transformers above 5kVA whether single or 3 phase.

4.1.1 Insulation Resistance Tests

This shall be applied to each winding, preferably with the cables disconnected. Windings which are internally connected e.g. to form a neutral point, need not be disconnected and tested separately.

For oil cooled transformers shipped without oil, this test shall be carried out before the tank is filled.

For windings where the 3 phases are measured in parallel, results exceeding 6 megohms if the transformer is oil cooled and filled with oil, and 1 megohm per rated line kV for other cases, are satisfactory. For windings where the insulation resistance is measured per phase, the corresponding satisfactory values are 12 megohms and 2 megohms per rated line kV.

4.1.2 Testing of Electric Strength of Insulating Oil

Electric strength of insulating oil tests shall be carried out as applicable. All separate oil chambers such as disconnecting link chambers or tap changer tanks shall be individually tested. Oil in factory-sealed chambers shall not be tested.

4.1.3 Earth Continuity Tests

Earth continuity tests shall be carried out to include:-

a) Between the transformer tank and other extraneous conductive parts, and the main earthing system earth bar or other connection on the main earth ring.

b) Between the star point and the main system earth bar or connection.

c) All other equipotential bonding and protective conductors required by the installation drawings for the transformer.

The maximum allowable value for the resistance of such connections shall be 1 ohm for each separate circuit, as noted above.

4.2 Assemblies of Switchgear and Control Gear

The following tests shall be carried out on all assemblies of switchgear and controlgear including distribution boards, fuse boards, inverters and tap change controls.

4.2.1 Insulation Resistance Tests

Insulation resistance tests shall be carried out between the phases and earth and where practicable between each phase and earth and between phases. They shall be applied inclusive of the outgoing and incoming equipment within the assembly in the case of LV assemblies (1000V and below). In the case of HV assemblies equipment such as circuit breakers and voltage transformers which are withdrawable shall be separately tested.

It is preferable that cables be disconnected during these tests.

Tests shall include all separate control and ancillary circuits.

Results which exceed 3 megohms for LV equipment and circuits and 50 megohms for HV equipment are satisfactory.

4.2.2 Earth Continuity Tests

Earth continuity tests shall be carried out to include:-

a) Between the extraneous conductive parts of the assemblies and the main earthing system earth bar or other connection at the main earth ring.

b) Any other equipotential bonds and protective conductors required by the installation drawings for the assembly.

These tests shall include all scraping earth or plug contacts that form a part of the protective paths.

The maximum allowable value for the resistance of such connections shall be 1 ohm for each separate circuit.

4.2.3 Phasing Tests

Phasing tests shall be carried out on the incomers to assemblies forming main switchboards and motor control centres and on the output of inverters and chargers.

4.2.4 Pressure Tests

AC pressure test voltage of 2 x Rated Voltage +1000 V or appropriate to the following table, which one is more, shall be applied for 1 minute to the main circuits of HV assemblies including the outgoing and incoming equipment.

Maximum Rated Insulation Voltage (rms)	Test Voltage (rms)
1,000	3,500
3,600	10,000
7,200	20,000
12,000	28,000
24,000	50,000
36,000	70,000
72,500	140,000
245,000	460,000

The test is satisfactory if no disruptive discharge occurs for 1 minute.

4.2.5 Functional Tests

Tests for correct operation shall be performed twice on each function which is wholly within the assembly from initiation to action, such as local closing and tripping, automatic transfer between incomers and load shedding. Testing shall be carried out by operating the initiating device or contacts and be acceptable if the correct action results. These tests shall be repeated for each combination of operating and inhibiting devices and timings inherent to the function being tested.

These tests need not be carried out if certificates of works tests incorporating them are available and the shipping and reassembly of the assembly on site has not disturbed any of the bus-wiring, plug-in contacts or other parts of the circuits associated with the functions.

4.2.6 Protection System Tests

Protection relay testing shall be limited to spot-checks on their correct operation at the specified operational settings.

Current tests shall employ primary injection except where this is impractical without the dismantling of sections of the main circuit. Where such dismantling would be required for primary injection, secondary injection shall be employed at the current transformers. Secondary injection may also be employed for voltage circuits. Where secondary injection is employed flick testing for polarity between the main primary circuit and the point of secondary injection shall be carried out.

The secondary injection tests shall be carried out for all relays.

The tests are satisfactory when the relay is operated within the values shown on the protection study curves or schedules and the appropriate contactor, circuit breaker etc. is operated.

4.3 Rotating Electrical Machines

The following tests shall be carried out on all rotating electrical machines rated at 1kW and above. No tests however, shall be carried out on wound

rotor machines with rotating rectifier equipment except as allowed and in the specific manner detailed by the Vendor.

4.3.1 Insulation Resistance Test

These shall be applied to all winding and auxiliary circuits such as heaters and RTD's, preferably with the cables disconnected. Windings which are internally disconnected e.g. to form a neutral point, need not be disconnected and tested separately.

For windings where the 3 phases are measured in parallel, results exceeding 1 megohm per rated line kV are satisfactory. For windings where the insulation resistance is measured per phase, the satisfactory value is 2 megohms per rated line kV, or higher. For wound rotors, a value of 0.5 megohms or higher is satisfactory.

4.3.2 Earth Continuity Tests

The tests shall be carried out between the machine carcass and other extraneous conductive parts and the main earthing system earth bar or other connection at the main earth ring. Any other equipotential bonds and protective conductors required by the installation and manufacturer's drawings (e.g. on oil pipework or bearing pedestals) shall also be tested.

The maximum allowable resistance of such connections shall be 1 ohm for each separate circuit.

4.4 Electrical Installations and Cabling

The following tests shall be carried out on all sections of the plant electrical installation not covered elsewhere in this Standard, and shall be applied to cabling, lighting and small power installations (including fittings) electric surface heaters and control devices, process heaters, sootblowing equipment and all other electrical systems, sub-systems, equipment and material whether site-assembled erected as a package on site or forming part of such a package.

4.4.1 Earth Continuity Tests

All materials and equipment shown as requiring equipotential bonding or connection to the main earth system shall have the resistance of such bonds or protective conductors measured.

The test is satisfactory if the resistance of such conductors does not exceed 1 ohm.

4.4.2 Insulation Resistance Tests

All sections of the installation shall be tested to determine the insulation resistance between each phase and earth and between phases. 'Earth' shall include cable sheath or armour, enclosure (if metallic) or local protective conductor as appropriate.

These tests shall be carried out without disconnection of cables on LV systems and the whole of a 'system' e.g. one circuit of a lighting installation shall be subject to one test. On HV systems only the cables shall be tested.

Resistances exceeding the values given in the following table shall be considered satisfactory:-

≤ 100m: 10 mega ohm minimum

> 100m 10 x kV/km mega ohm

LV systems including connected devices: 1 mega ohm.

4.4.3 Pressure Tests

Pressure tests (dc) shall be carried out on all new HV cables. They shall be disconnected from the associated equipment for these tests. Repaired or used cables should be tested at 50% of tabulated values only.

The test voltage shall be applied between phases and between phases and earth for 3 minutes at a value appropriate to the voltage grade as follows:

Cable Voltage Designation KV rms	Test Voltage kV dc	
	Between Conductors	Conductors to Earth
1.9/3.3	10	7
3.8/6.6	20	15
6.35/11	34	25
8.7/15	37	37
12.7/22	50	50
19/33	75	75
38/66	90	90
220	318	318

The test is satisfactory if no disruptive discharge occurs for 3 minutes.

4.4.4 Functional Tests

Tests for correct operation shall be performed on each function required of items within the installation such as start/stop control stations, tap change position indication etc. These shall be carried out by operating the initiating device or contacts and be acceptable if the correct action results. These tests shall be repeated for each combination of initiating and inhibiting devices and timings inherent to the function being tested. They shall include functions at the electrical/instrument installation interface.

Where the installation is required to transmit analogue signals and direct use of the transmitting device is impractical for this test (e.g. in the case of winding temperature detectors) the test may be executed by proving conductor continuity from the transmitter to the receiver by a ringing out or similar test.

4.4.5 Protection System Tests

Protection systems and components within the installation shall be tested as in Section 4.4.4.

4.4.6 Earth Electrode Tests

The resistance of each earth electrode shall be measured from the point of connection to the main earthing system or ring including any conductor between that point and the electrode.

The acceptable value for earth electrode resistance shall be given on the appropriate construction drawing.

TYPICAL POWER INSTALLATION STANDARDS FOR CONSTRUCTION

			Written By: Pavithra Gunasekaran	Checked By	Approved By	Authorized By
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC
Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: COVER SHEET

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	01 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-01_0.DWG

SHEET SIZE : A3

PAGE	REVISION			STC No.	TITLE
	0	1	2		
01	X			-	COVER SHEET
02	X			-	INDEX SHEET
03	X			-	LEGEND
04	X			P01	TYPICAL INSTALLATION DETAIL FOR DIRECTLY BURIED CABLE TRENCH IN UNPAVED AREA
05	X			P02	TYPICAL INSTALLATION DETAIL FOR RCC TRENCH
06	X			P03	TYPICAL INSTALLATION DETAIL FOR RCC TRENCH WITH CABLE LADDERS
07	X			P04	TYPICAL CABLE ROUTE MARKER FOR DIRECTLY BURIED CABLE TRENCH
08	X			P05	TYPICAL INSTALLATION DETAIL FOR ELECTRICAL ROAD CROSSING (ERC) BELOW GRADE LEVEL
09	X			P06	TYPICAL CABLE DROPPING FROM VERTICAL CABLE LADDER TO CONCRETE CABLE TRENCH PRINCIPLE
10	X			P07	TYPICAL INSTALLATION OF LOCAL CONTROL STATION (LCS)
11	X			P08	TYPICAL INSTALLATION OF GROUP OF LOCAL CONTROL STATION (LCS) ON STAND
12	X			P09	TYPICAL INSTALLATION OF CABLING FOR MV MOTOR AND LOCAL CONTROL STATION
13	X			P10	TYPICAL INSTALLATION OF CABLING FOR HV MOTOR AND LOCAL CONTROL STATION
14	X			P11	TYPICAL INSTALLATION OF CABLING FOR AIR COLLER MOTOR AND LOCAL CONTROL STATION
15	X			P12	TYPICAL INSTALLATION OF CABLING FOR MOVS
16	X			P13	TYPICAL INSTALLATION OF LOCAL LIGHTING & SMALL POWER DISTRIBUTION PANEL
17	X			P14	TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET CONCRETE / STEEL COLUMN
18	X			P15	TYPICAL INSTALLATION OF CONVENIENCE SOCKET ON OUTLETS ON HAND RAIL
19	X			P16	TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET OUTLETS / JUNCTION BOX ON STRUCTURAL SUPPORT IN PAVED / UNPAVED AREA
20	X			P17	TYPICAL INSTALLATION DETAIL FOR TRANSFORMER RECTIFIER UNIT PANEL ON STRUCTURAL CHANNEL IN UNPAVED AREA.
21	X			P18	TYPICAL INSTALLATION DETAIL FOR MOV PANEL ON STRUCTURAL CHANNEL IN UNPAVED AREA
22	X			P19	TYPICAL INSTALLATION OF HORIZONTAL CABLE TRAYS OR LADDERS
23	X			P20	TYPICAL INSTALLATION OF VERTICAL CABLE TRAYS OR LADDERS
24	X			P21	TYPICAL INSTALLATION FOR HOT DIP GALVANIZED LADDER TYPE CABLE TRAYS & ACCESSORIES
25	X			P22	TYPICAL INSTALLATION FOR HOT DIP GALVANIZED LADDER TYPE CABLE TRAYS & ACCESSORIES
26	X			P23	TYPICAL INSTALLATION DETAILS FOR POWER JUNCTION BOX ON STRUCTURAL SUPPORT IN UNPAVED AREA
27	X			P24	SPARE
28	X			P25	SPARE
29	X			P26	SPARE
30	X			P27	SPARE

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: INDEX SHEET

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	02 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-02_0.DWG

SHEET SIZE : A3

LEGEND :

: DIRECT BURIED ELECTRICAL CABLE TRENCH

: CONCRETE ELECTRICAL CABLE TRENCH

: DUCT BANK AT ROAD CROSSING

: GI CONDUIT

: ELECTRICAL CABLE TRAY

: CABLE TRAY RISER

: CABLE TRAY DROPPER

: HV MOTOR

: MV MOTOR

: WELDING OUTLET (63A)

: HYDRO BLASTING OUTLET (250A)

PJB : POWER JUNCTION BOX

H : ELECTRIC HEATER

XX : LOCAL DISTRIBUTION PANEL

- NORMAL LIGHTING PANEL (LP)
- EMERGENCY LIGHTING PANEL (ELP)
- SMALL POWER PANEL (SPP)
- MOV DB (MOV)

: EMERGENCY STOP PUSH BUTTON

: LOCAL CONTROL STATION

A : LOCAL CONTROL STATION WITH AMMETER

CABLE TAG :

XXX-XXX-XXXX-P : POWER CABLE

XXX-XXX-XXXX-SH : SPACE HEATER CABLE

XXX-XXX-XXXX-C : CONTROL CABLE

END CONSUMER TAG

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: LEGEND

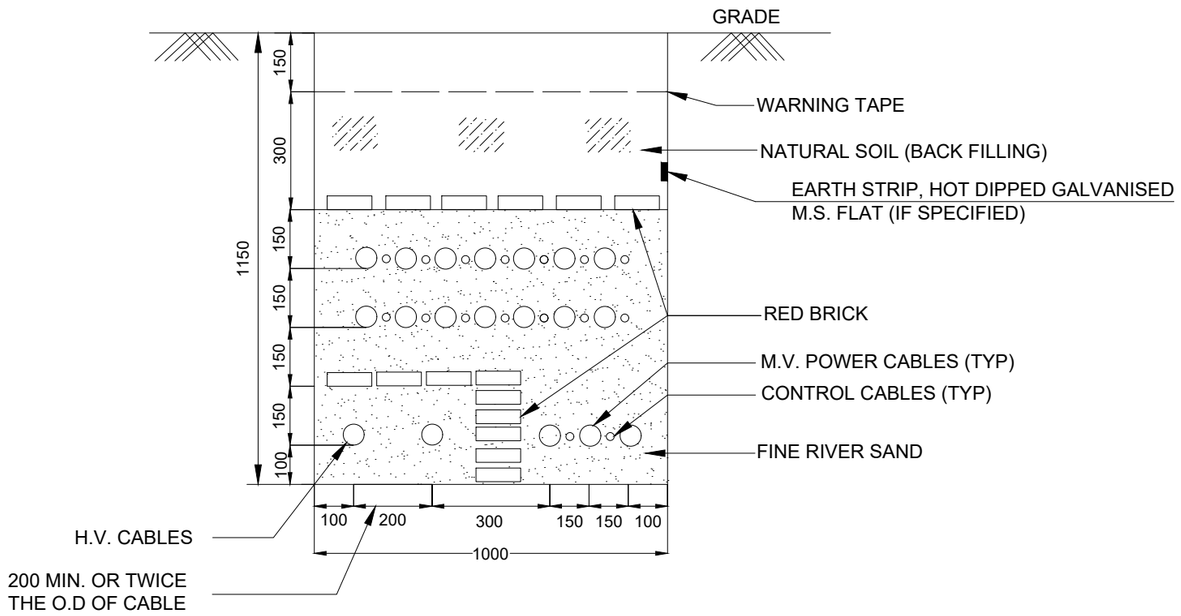
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	03 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-03_0.DWG

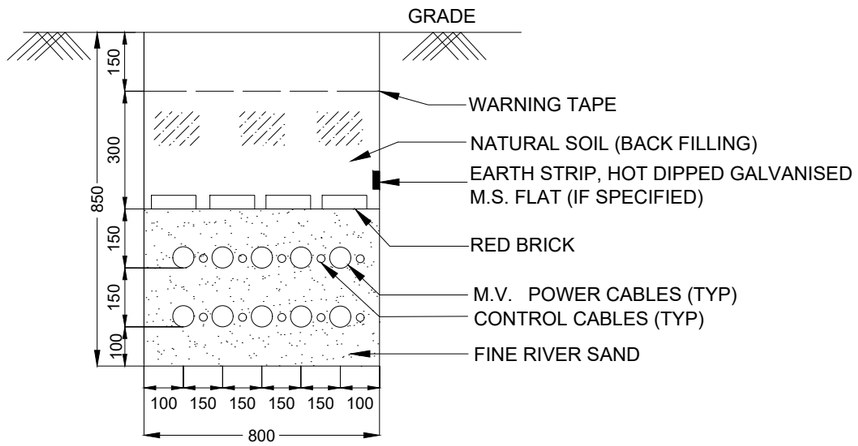
SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
P01



ARRANGEMENT OF H.V. AND M.V. CABLES IN UNPAVED AREA



ARRANGEMENT OF M.V. CABLES IN UNPAVED AREA

NOTES :

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. ROUTE MARKERS SHALL BE PROVIDED AS PER STD-P04.
3. SUFFICIENT CARE SHALL BE TAKEN WHILE LAYING CABLES TO AVOID FORMATION OF TWISTS, SHARP BENDS ETC.
4. CABLE INSTALLATION SHALL BE IN ACCORDANCE WITH MINIMUM CABLE BENDING RADIUS AS RECOMMENDED BY CABLE MANUFACTURER.
5. EACH CABLE SHALL BE PROVIDED WITH CABLE TAGS OF NON FERROUS MATERIAL SECURELY FASTENED AT EVERY 30 METERS OF ITS UNDERGROUND LENGTH WITH AT LEAST ONE TAG AT EACH END BEFORE THE CABLE ENTERS/LEAVES THE GROUND.
6. AN AVERAGE OF 20% SPARE SPACE SHALL BE PROVIDED IN THE TRENCH TO ACCOMMODATE FUTURE CABLES.
7. CLEARANCE BETWEEN ELECTRICAL POWER CABLES AND PIPING SHALL BE OF 500mm MINIMUM.
8. INSTRUMENT CABLES SHALL BE ROUTED SEPARATELY FROM ELECTRICAL POWER CABLES WITH THE CLEARANCE AS SPECIFIED IN INSTRUMENT INSTALLATION SPECIFICATION (DOC NO. 080557C-000-JSS-1590-001).
9. CABLE INSTALLATION SHALL BE GENERALLY IN ACCORDANCE WITH DOC.NO: 080557C-000-JSD-1600-003.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

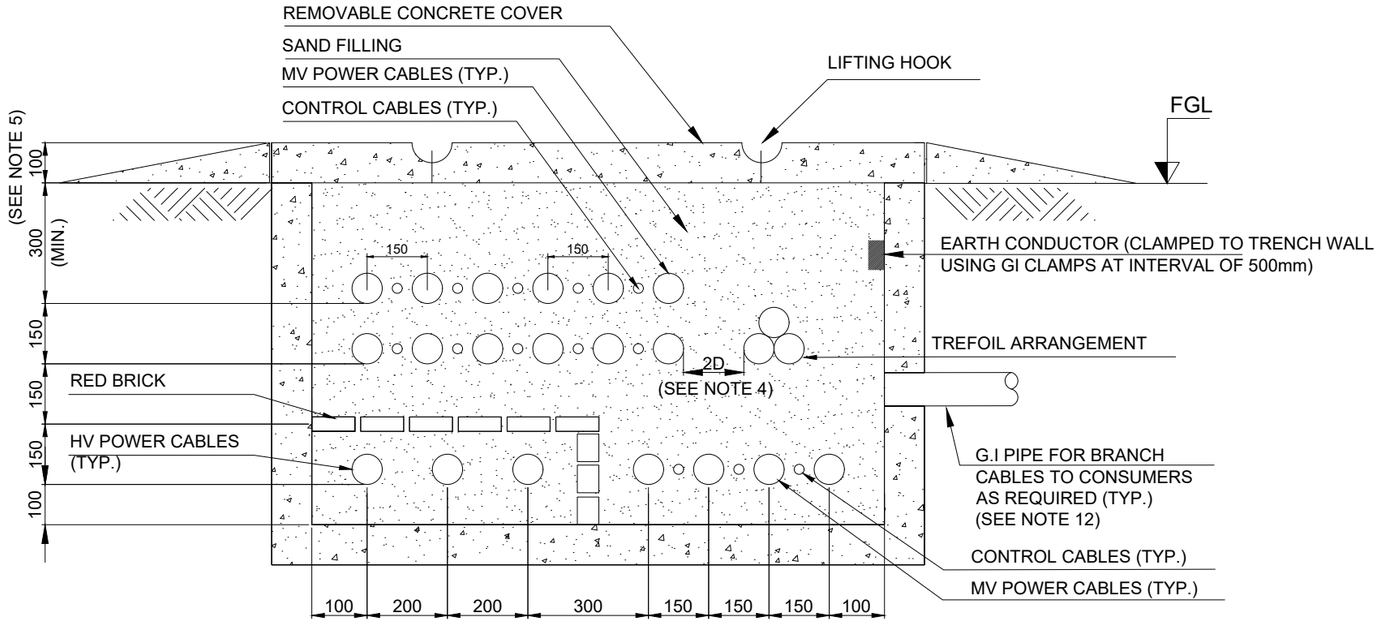
CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION DETAIL FOR DIRECTLY BURIED CABLE TRENCH IN UNPAVED AREA

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	04 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

STANDARD IDENTIFICATION SYMBOL

STC
P02



NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. THE MINIMUM DEPTH OF CABLES SHALL BE 500mm FOR ALL VOLTAGE LEVEL WITH 300mm CLEARANCE BETWEEN THE BOTTOM OF THE TRENCH COVER AND BOTTOM OF THE CABLE.
3. MINIMUM CLEARANCE OF 300MM SHALL BE MAINTAINED BETWEEN HV AND MV CABLES, 200MM BETWEEN HV AND HV CABLES AND 150MM BETWEEN MV AND MV CABLES.
4. IN CASE SINGLE CORE CABLES ARE TO BE LAID, IT SHALL BE LAID IN TREFOIL FORMATION WITH A SPACING OF 2D FROM THE ADJACENT CABLES.
5. TOP OF THE TRENCH SHALL BE MIN.100MM ABOVE THE FINISHED GRADE LEVEL(F.G.L) IN CASE OF UNPAVED AREAS AND SHALL BE FLUSHED WITH FINISHED FLOOR LEVEL(F.F.L) IN CASE OF PAVED AREA.
6. AN AVERAGE OF 20% SPARE SPACE SHALL BE PROVIDED IN THE TRENCH TO ACCOMMODATE FUTURE CABLES.
7. SPACE HEATER CABLE SHALL BE PROVIDED FOR MOTORS OF RATING 30kW & ABOVE.
8. EACH UNDERGROUND CABLE SHALL BE PROVIDED WITH CABLE TAGS OF NON FERROUS MATERIAL SECURELY FASTENED EVERY 30m OF ITS UNDERGROUND LENGTH WITH ATLEAST ONE TAG AT EACH END BEFORE THE CABLE ENTERS / LEAVES THE GROUND.
9. CLEARANCE BETWEEN ELECTRICAL POWER CABLES AND PIPING SHALL BE OF 500mm MINIMUM.
10. INSTRUMENT CABLES SHALL BE ROUTED SEPARATELY FROM ELECTRICAL POWER CABLES WITH THE CLEARANCE AS SPECIFIED IN INSTRUMENT INSTALLATION SPECIFICATION (DOC NO. 080557C-000-JSS-1590-001).
11. REMOVABLE CONCRETE COVER SHALL BE SEALED WITH BITUMINOUS COMPOUND TO PREVENT INGRESS OF WATER / HYDROCARBONS IN CABLE TRENCH.
12. THE EXACT HEIGHT OF OPENING IN TRENCH WALL FOR G.I PIPE FOR TAKING CABLE SHALL BE SUITABLY DECIDED AT SITE.
13. CONCRETE TRENCHES SHALL HAVE SUITABLE DRAINAGE ARRANGEMENT TO AVOID WATER COLLECTION (OR) THESE TRENCHES SHALL BE CONNECTED TO NEAREST STORM WATER DRAIN.
14. CABLE INSTALLATION SHALL BE GENERALLY IN ACCORDANCE WITH DOC.NO: 080557C-000-JSD-1600-003.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION DETAIL FOR RCC TRENCH

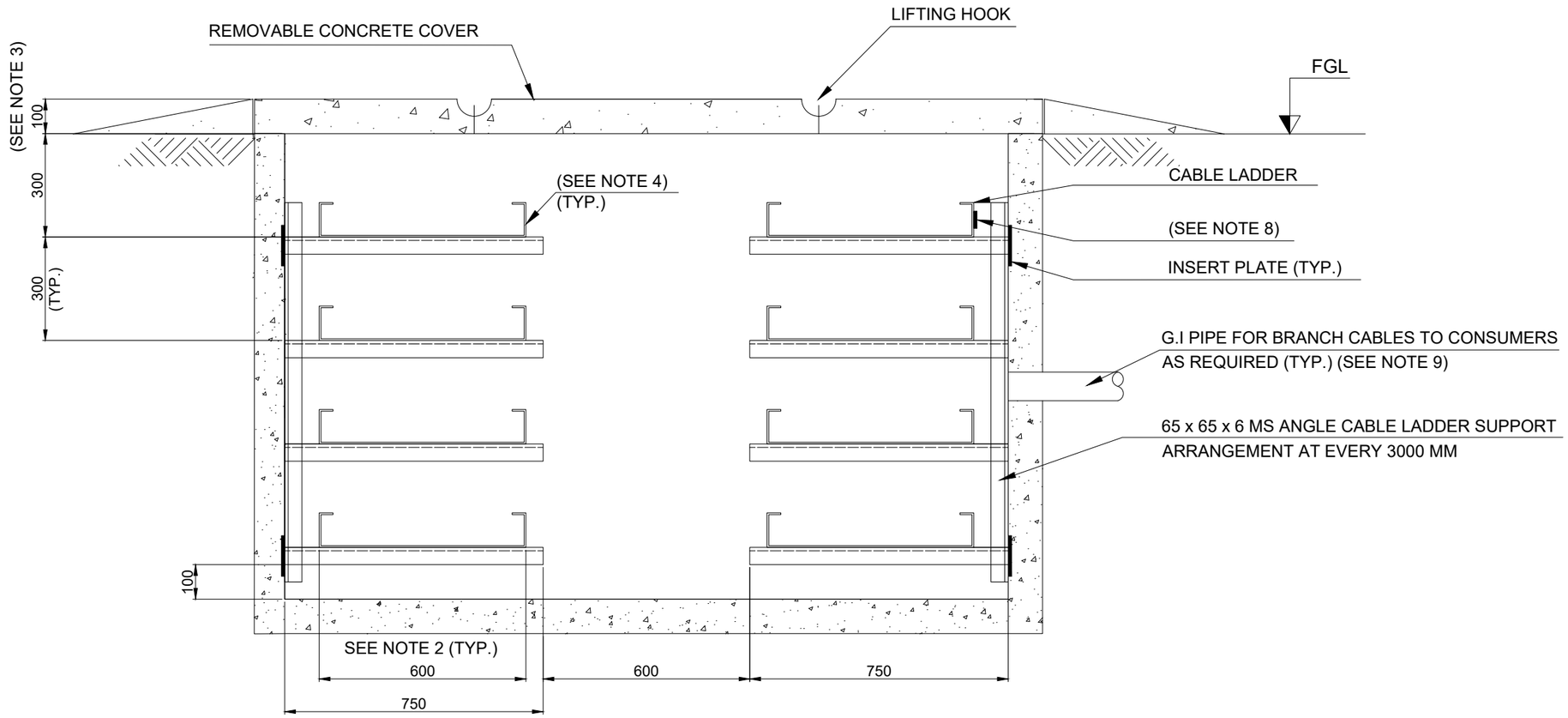
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	05 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-05_0.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
P03



NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SPECIFIED.
2. WIDTH OF CABLE LADDER SHALL BE DECIDED AS PER THE PROJECT REQUIREMENT.
3. TOP OF THE TRENCH SHALL BE 100MM ABOVE THE FINISHED GRADE LEVEL(F.G.L)IN CASE OF UNPAVED AREAS AND SHALL BE FLUSHED WITH FINISHED FLOOR LEVEL(F.F.L) IN CASE OF PAVED AREA.
4. AN AVERAGE OF 20% SPARE SPACE SHALL BE PROVIDED IN THE CABLE TRAYS TO ACCOMMODATE FUTURE CABLES.
5. HV CABLES, LV CABLES AND CONTROL CABLES SHALL BE LAID IN A SEPARATE TRAYS.
6. SPACE HEATER CABLE SHALL BE PROVIDED FOR MOTORS OF RATING 30kW & ABOVE.
7. EACH UNDERGROUND CABLE SHALL BE PROVIDED WITH CABLE TAGS SECURELY FASTENED EVERY 30m OF ITS UNDERGROUND LENGTH WITH ATLEAST ONE TAG AT EACH END BEFORE THE CABLE ENTERS / LEAVES THE GROUND.
8. EARTH CONDUCTOR SHALL RUN ALONG ONE OF THE CABLE LADDER AND SHALL BE SUITABLY CLEATED / WELDED.
9. THE EXACT HEIGHT OF OPENING IN TRENCH WALL FOR G.I PIPE FOR TAKING CABLE SHALL BE SUITABLY DECIDED AT SITE.
10. REMOVABLE CONCRETE COVER SHALL BE SEALED WITH BITUMINOUS COMPOUND TO PREVENT INGRESS OF WATER / HYDROCARBONS IN CABLE TRENCH.
11. THE TOP OF CABLE TRENCH BEFORE ENTERING THE SUBSTATION SHALL BE MAXIMUM 1M ABOVE THE GROUND LEVEL. ALL CUTOUTS SHALL BE PROPERLY SEALED BY A SEALING COMPOUND. PIPES LAID FOR MECHANICAL PROTECTION SHALL BE SEALED AT BOTH ENDS.
12. CONCRETE TRENCHES SHALL HAVE SUITABLE DRAINAGE ARRANGEMENT TO AVOID WATER COLLECTION (OR) THESE TRENCHES SHALL BE CONNECTED TO NEAREST STORM WATER DRAIN.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

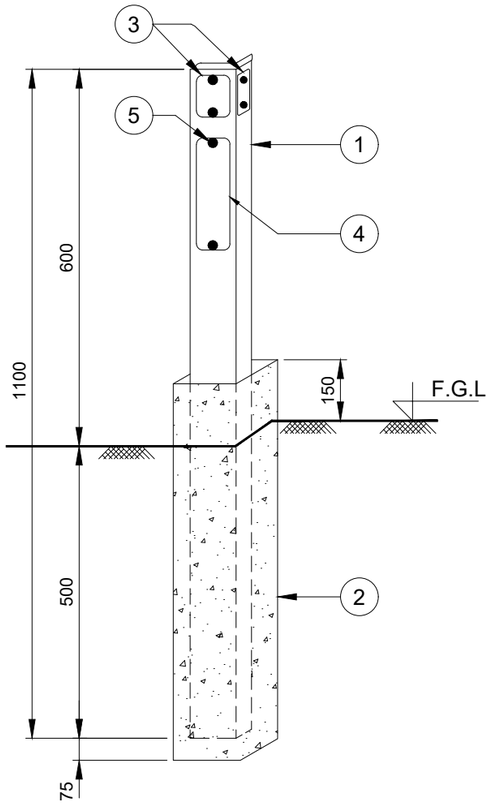
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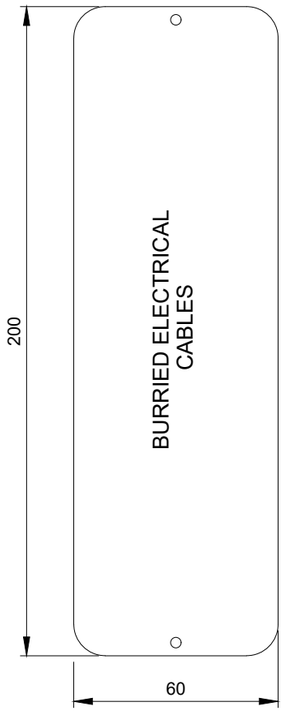
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

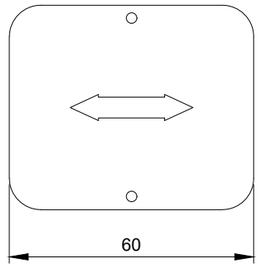
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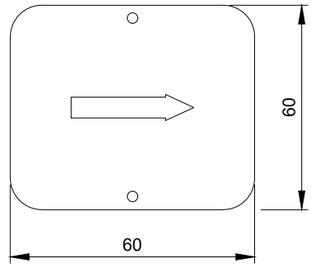




SIGN-`A'



SIGN-`B'

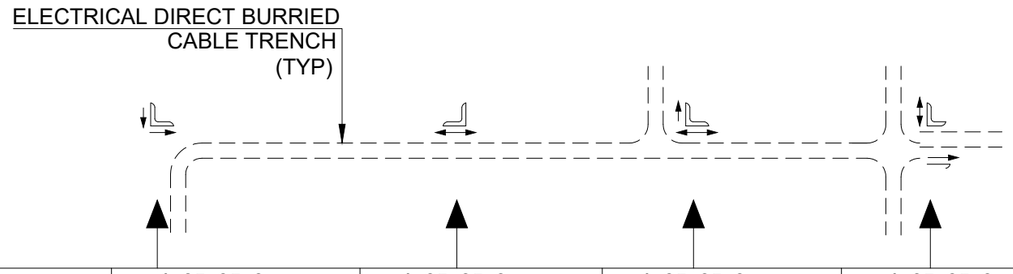


SIGN-`C'

STANDARD IDENTIFICATION SYMBOL

STC
P04

TYPICAL ARRANGEMENT OF MARKER



	L 65x65x6 (1.1m LONG)	L 65x65x6 (1.1m LONG)	L 65x65x6 (1.1m LONG)	L 65x65x6 (1.1m LONG)
ASSEMBLY CONSISTING OF	SIGN. - A - 1 NO. SIGN. - C - 2 NOS.	SIGN. - A - 1 NO. SIGN. - B - 1 NO.	SIGN. - A - 1 NO. SIGN. - B - 1 NO. SIGN. - C - 1 NO.	SIGN. - A - 1 NO. SIGN. - B - 2 NO.

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. BURRIED TRENCHES SHALL BE MARKED AT ALL DIRECTION CHANGES, INTERSECTIONS, AT CABLE JOINTS AND STRAIGHT RUNS @ 30 MTR.
3. SIGN. BOARDS SHALL BE MADE OF 14 GAUGE ENAMELLED STEEL PLATE WHITE LETTERING SHALL BE ON JADE GREEN BACKGROUND.

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	MARKER POST MADE OF ANGLE 65 x 65 x 6mm MS PAINTED WHITE	Nos.	1
2	200MM SQUARE CONCRETE (M15)	-	AS REQD
3	SIGN PLATE FOR SIGN-B/SIGN-C	Nos.	AS REQD
4	SIGN PLATE FOR SIGN-A	Nos.	AS REQD
5	FIXING FASTENER & ACCESSORIES FOR EACH PLATE	SET	AS REQD

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DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
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DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

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TITLE: TYPICAL CABLE ROUTE MARKER FOR DIRECTLY BURIED CABLE TRENCH

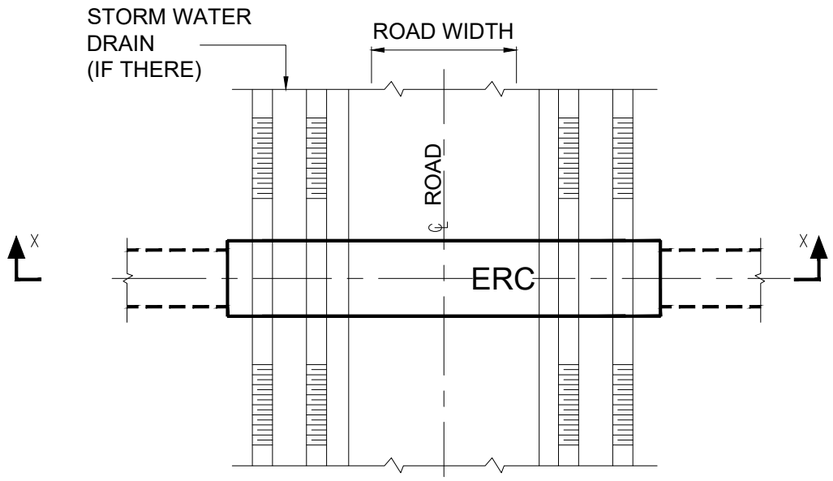
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-07_0.DWG

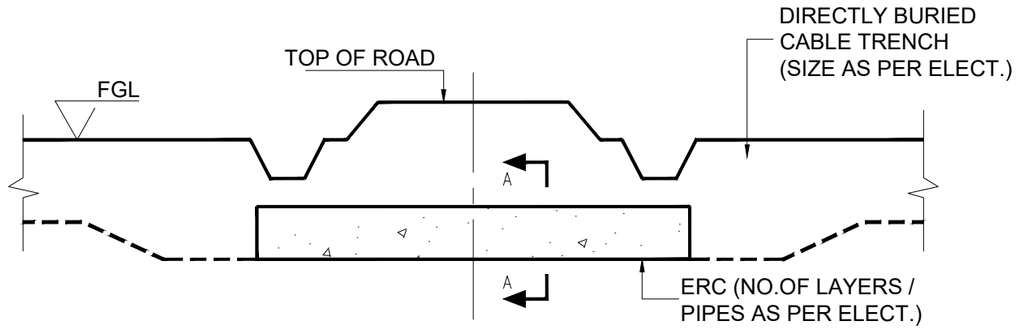
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STANDARD IDENTIFICATION SYMBOL

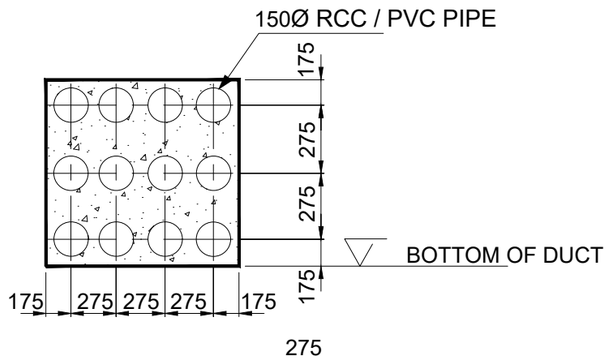
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P05



PLAN



SECTION X-X



SECTION A-A (ERC)

NOTES :

1. CO-ORDINATES OF TRENCHES. LENGTH & LEVEL OF EACH ERC SHALL BE DECIDED BY GEN. CIVIL & SHOWN IN RESPECTIVE AREA DRAWING.
2. NO.OF PIPES e.g. LAYERS & PIPES IN EACH LAYER SHALL BE AS PER THE REQUIREMENT OF ELECTRICAL.
3. ALL DIMENSIONS ARE IN MM.

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Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

2

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
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IOCL PARADIP REFINERY, ODISHA, INDIA

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1

TITLE: TYPICAL INSTALLATION DETAIL FOR ELECTRICAL ROAD CROSSING (ERC) BELOW GRADE LEVEL

DRAWING NO.						PAGE	REV.
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

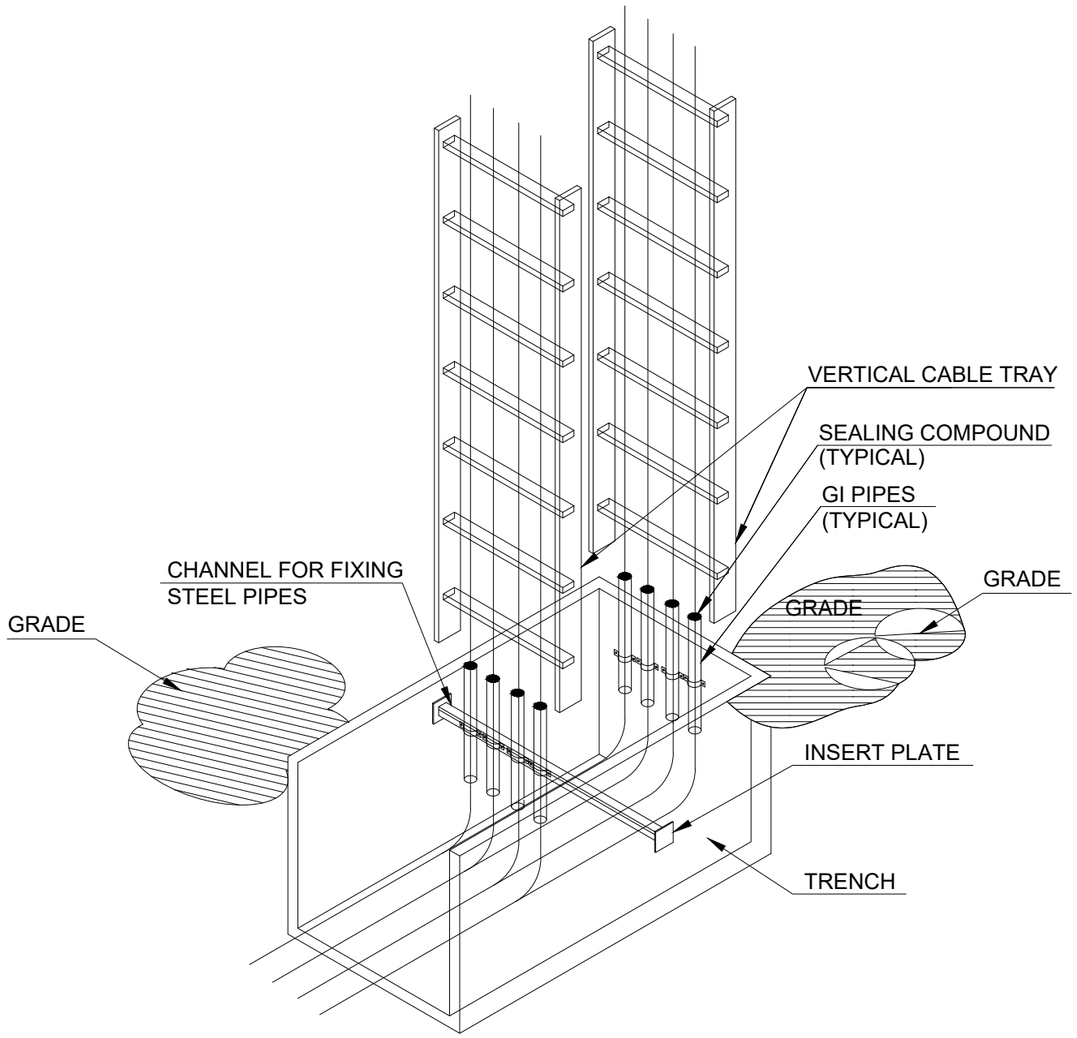
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SHEET SIZE : A3

STANDARD
IDENTIFICATION
SYMBOL

STC
P06



Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT
STANDBY SRU & ADDITIONAL TANKS
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PMC
TechnipFMC

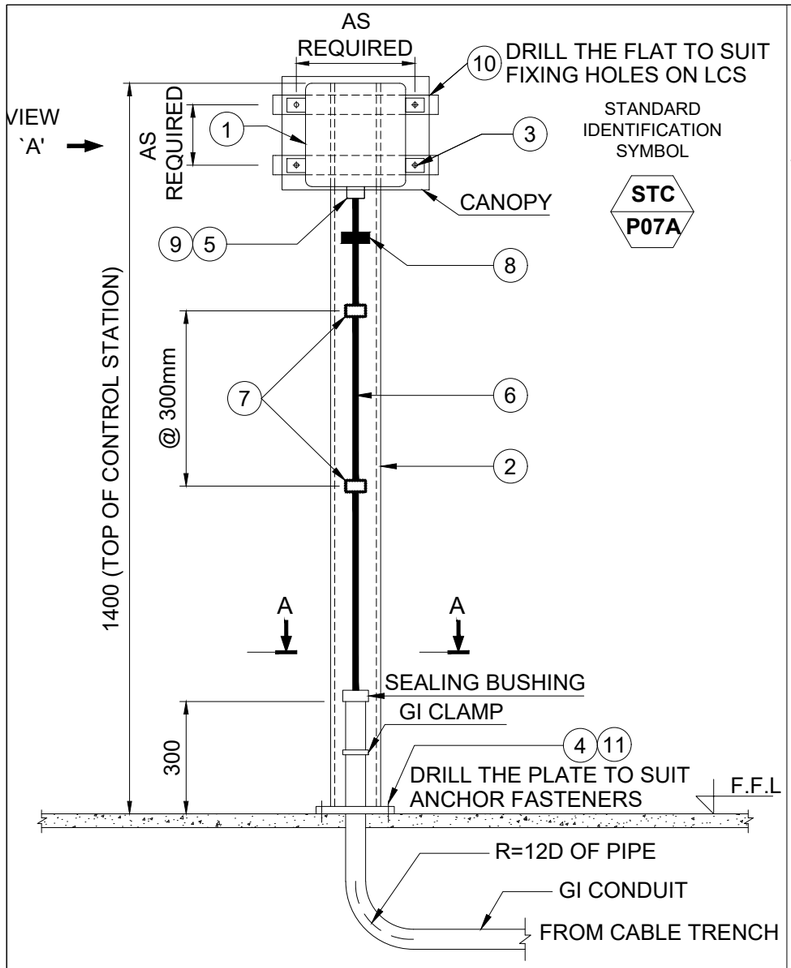
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TITLE
TYPICAL CABLE DROPPING FROM VERTICAL
CABLE LADDER TO CONCRETE
CABLE TRENCH - PRINCIPLE

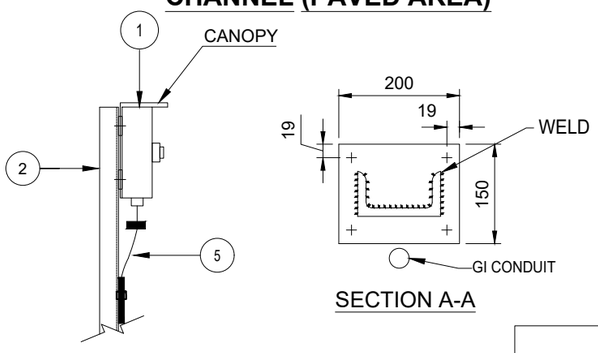
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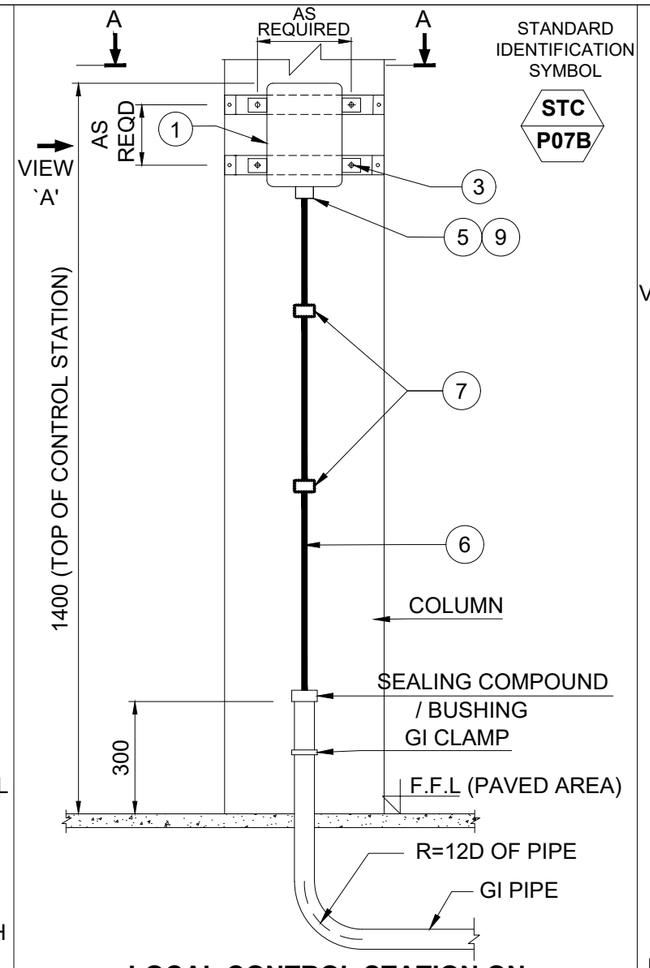
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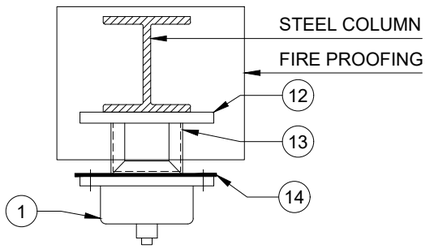


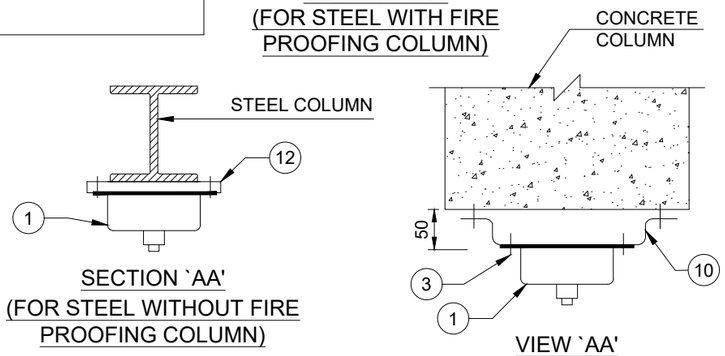
LOCAL CONTROL STATION ON STRUCTURAL CHANNEL (PAVED AREA)

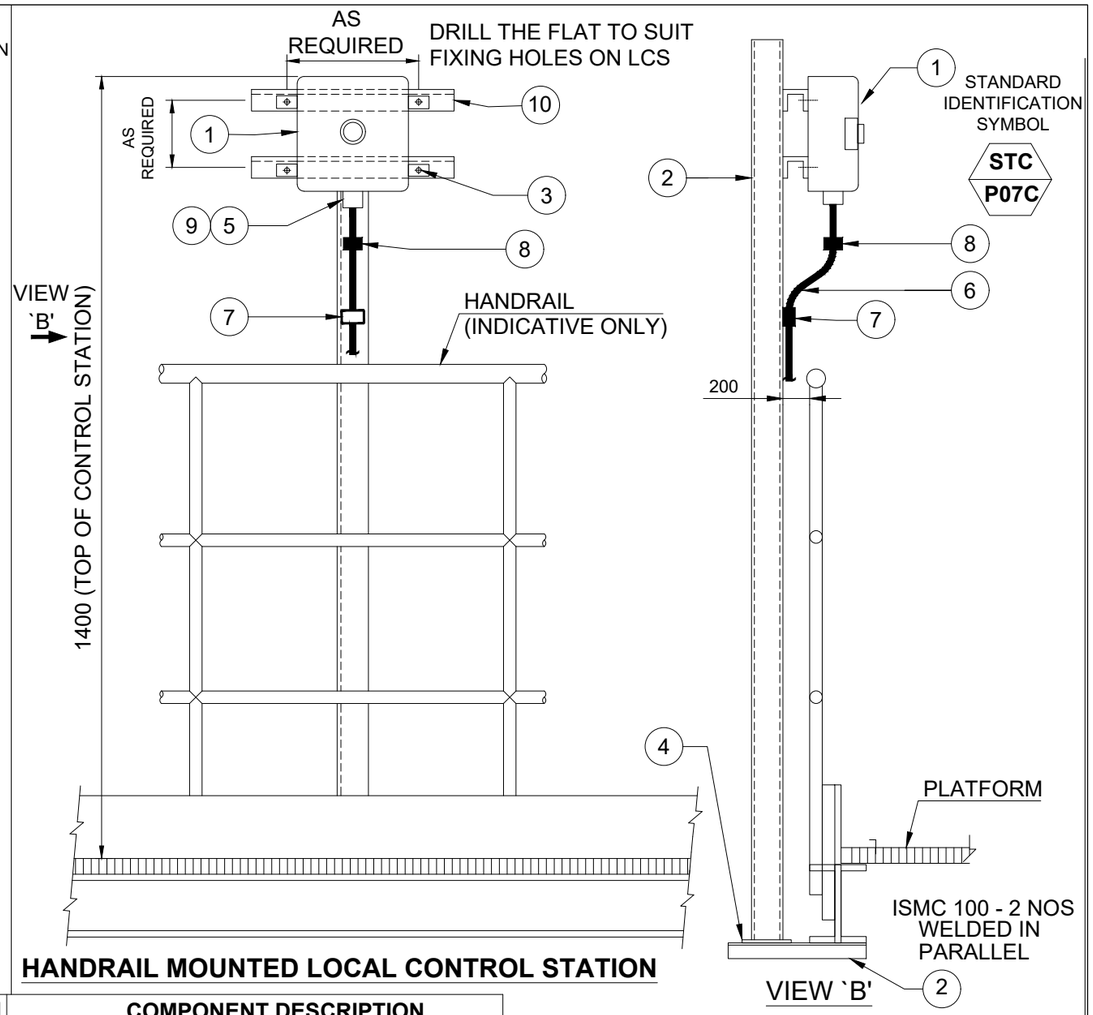




LOCAL CONTROL STATION ON CONCRETE / STEEL COLUMN







HANDRAIL MOUNTED LOCAL CONTROL STATION

ITEM	COMPONENT DESCRIPTION
1	LOCAL CONTROL STATION WITH SUITABLE CABLE GLAND
2	ISMC 100 CHANNEL
3	G.I. NUT, BOLT & WASHER FOR FIXING LCS WITH PLATE
4	200X150X8mm THICK GI PLATE
5	CABLE GLAND - TO SUIT CABLE
6	CABLE
7	G.I. CABLE SADDLE WITH FIXING FASTENER/ TO SUIT SITE CONDITION
8	CABLE MARKER
9	PVC SHROUDS FOR CABLE GLAND
10	75X10MM M.S. FLAT BEND TO SHAPE & FIXED TO COLUMN WITH 10 MM DIA ANCHOR FASTNER
11	10 MM DIA ANCHOR FASTNERS WITH ACCESSORIES
12	2NOS. 75X10 MM M.S FLAT WELDED TO STEEL COLUMN
13	FABRICATED BRACKET MADE OF ANGLE 75X75X8 WELDED TO STEEL COLUMN
14	75X10 MM THICK M.S FLAT (2NOS.) (LENGTH AS REQUIRED)

NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. CABLE SHALL NOT BE ROUTED THROUGH HANDRAIL.
3. CANOPY SHALL BE INSTALLED AS PER THE REQUIREMENT.

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0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL INSTALLATION OF LOCAL CONTROL STATION (LCS)

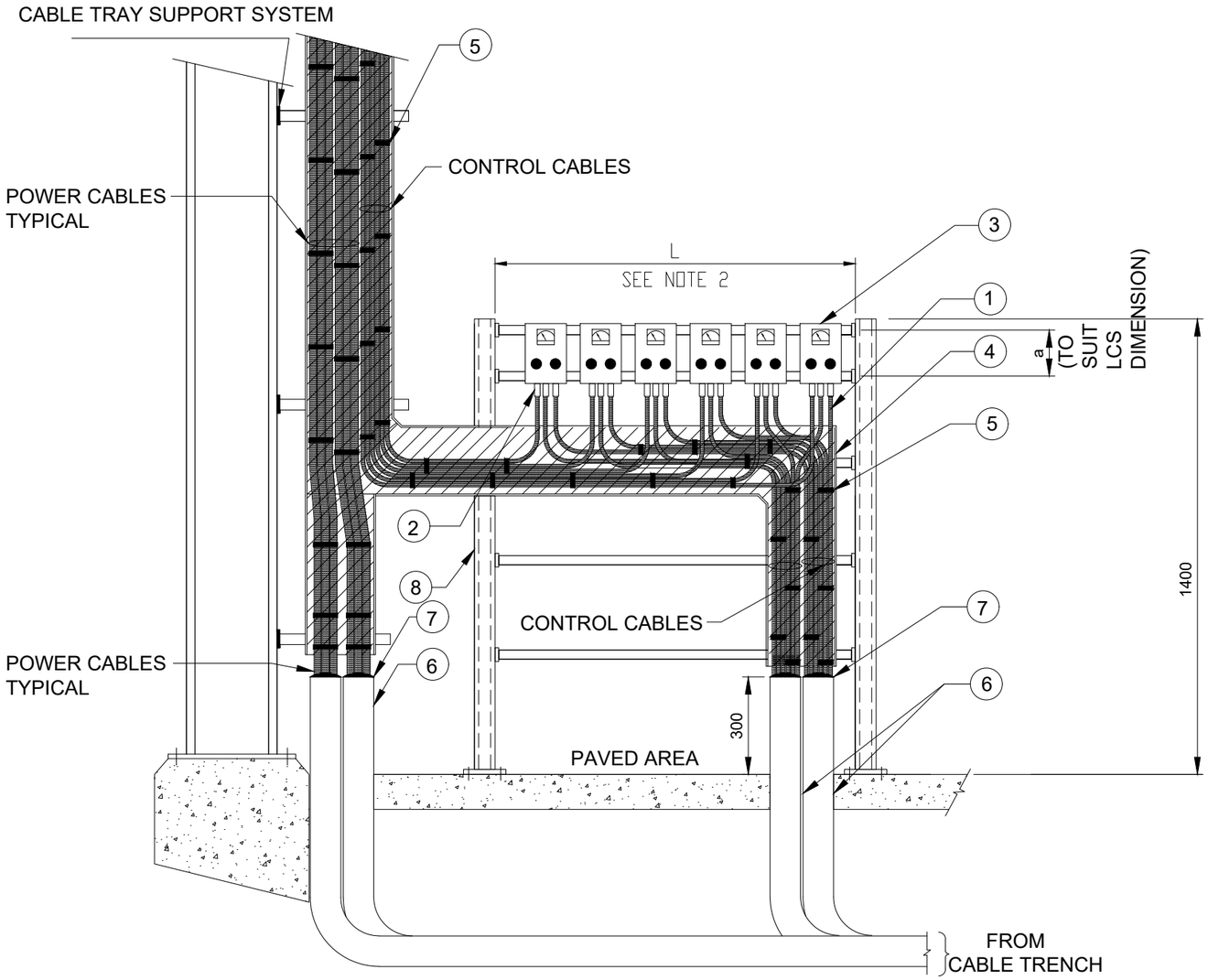
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CAD FILE NAME : 080557C-000-STC-1692-001-10_0.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
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NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. DIMENSIONS TO BE ADJUSTED ON SITE TO SUIT THE LCS REQUIREMENT AND RESPECTIVE SIZE.

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	CONTROL CABLE	M	AS REQD
2	CABLE GLAND	Nos.	AS REQD
3	LOCAL CONTROL STATION	Nos.	AS REQD
4	GI CABLE LADDER	M	AS REQD
5	CABLE TIE (FIXING)	Nos.	AS REQD
6	GI CONDUIT	M	AS REQD
7	SEALING COMPOUND	-	AS REQD
8	SUPPORT FRAME	Nos.	1

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PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF GROUP OF LOCAL CONTROL STATION (LCS) ON STAND

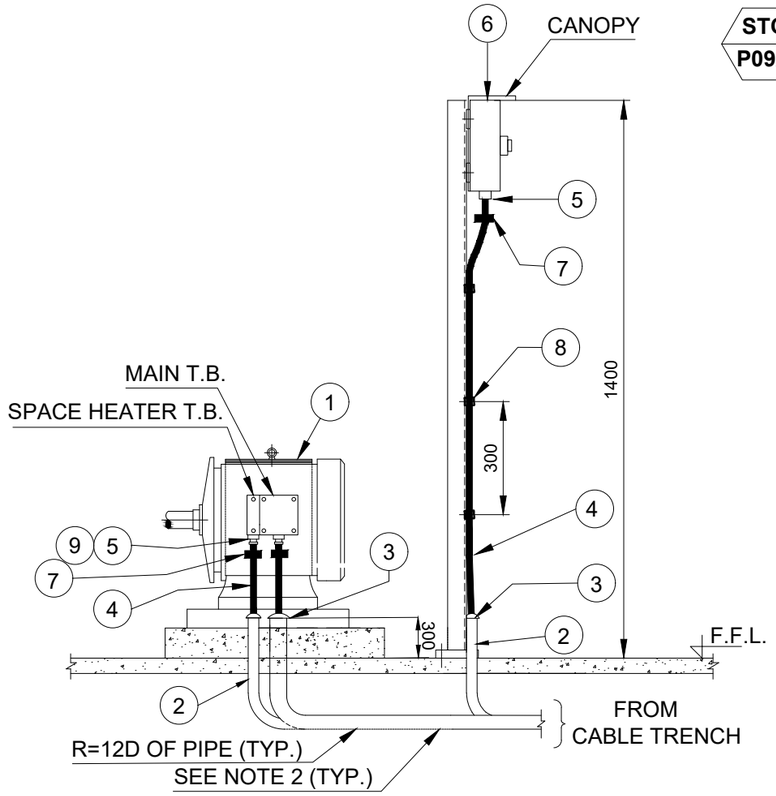
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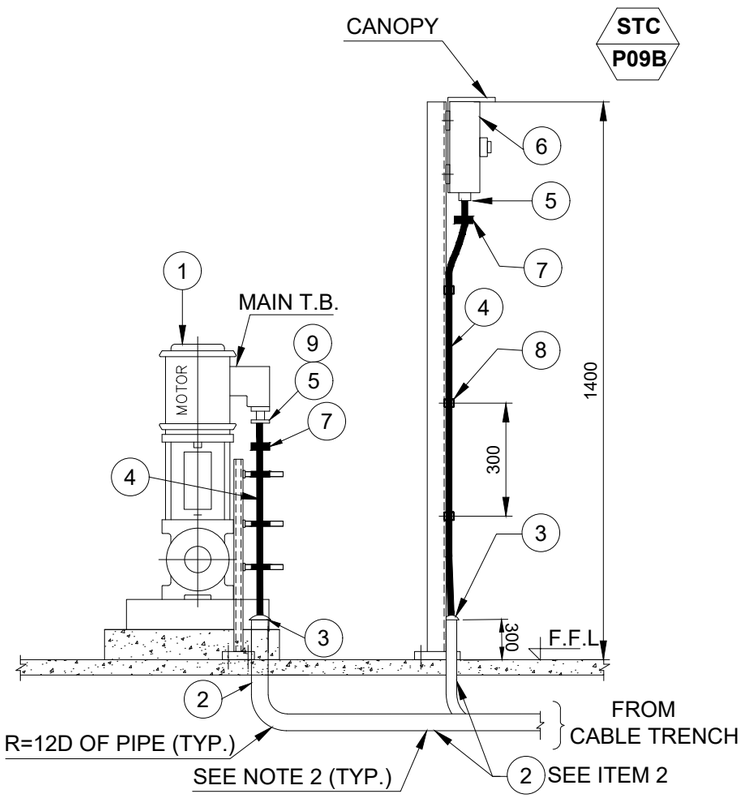
STC P09A



UNDERGROUND CABLING TO HORIZONTAL MOTOR AND LCS (BOTTOM ENTRY)

STANDARD IDENTIFICATION SYMBOL

STC P09B



UNDERGROUND CABLING TO VERTICAL MOTOR AND LCS (BOTTOM ENTRY)

NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. AFTER CABLE INSTALLATION, THE OPENING IN THE GI.CONDUIT SHALL BE PROPERLY SEALED.
3. IN CASE OF PAVED AREA, THE GI CONDUIT SHALL BE INSTALLED BEFORE CONCRETE PAVING AND AT EQUIPMENT END IT SHALL BE RAISED ABOVE PAVED SURFACE TO A HEIGHT OF 300mm.
4. ALL CABLES SHALL BE IDENTIFIED CLOSE TO THEIR TERMINATION POINT BY CABLE TAG NUMBERS AS PER CABLE SCHEDULE. CABLE TAGS SHALL BE PUNCHED ON STAINLESS STEEL (2mm THICK, 20mm WIDE AND OF ENOUGH LENGTH) SECURELY FASTENED TO THE CABLE AND WRAPPED AROUND IT.
5. QUANTITY & SIZE OF G.I CONDUIT SHALL BE AS PER LAYOUT DRAWING.

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	ELECTRICAL MOTOR WITH TERMINAL BOX	Nos.	1
2	G.I. CONDUIT TO SUIT CABLE	M	AS REQD
3	TERMINAL BUSHING/SEALING COMPOUND (SEE NOTE 2)	-	AS REQD
4	CABLE	M	AS REQD
5	CABLE GLAND - TO SUIT CABLE	Nos.	AS REQD
6	LOCAL CONTROL STATION	Nos.	1
7	CABLE MARKER (SEE NOTE 4)	Nos.	AS REQD
8	GI CLAMP @ 300mm INTERVAL	Nos.	AS REQD
9	PVC SHROUDS FOR CABLE GLAND	Nos.	AS REQD

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IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL INSTALLATION OF CABLING FOR MV MOTOR AND LOCAL CONTROL STATION

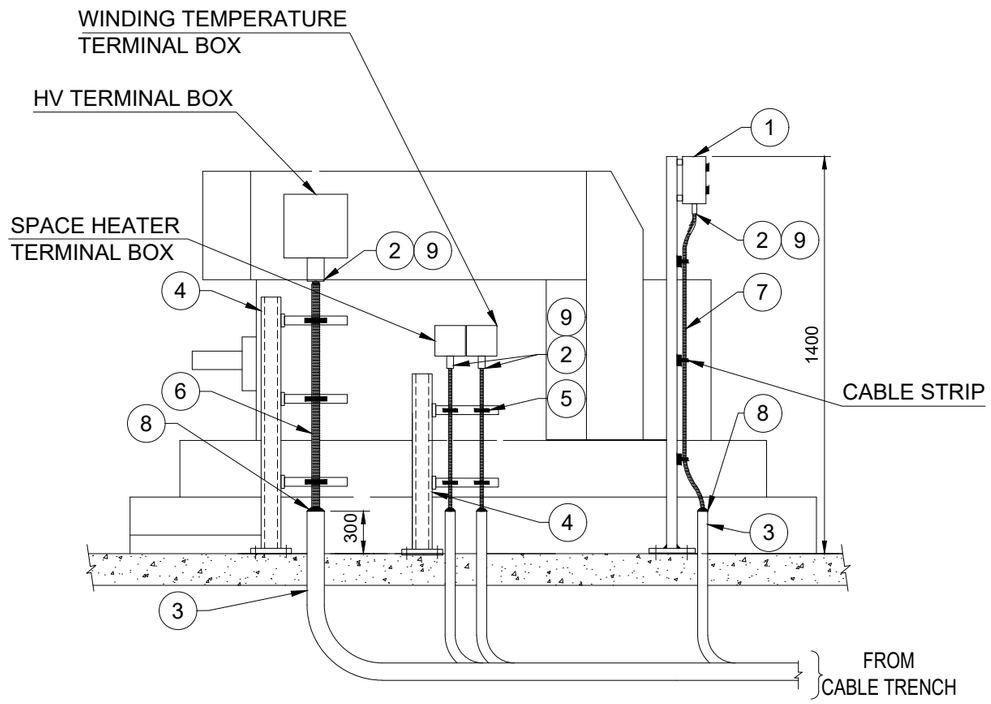
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CAD FILE NAME : 080557C-000-STC-1692-001-12_0.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

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ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LOCAL CONTROL STATION	Nos.	1
2	CABLE GLAND - TO SUIT CABLE	Nos.	4
3	G.I. CONDUIT TO SUIT CABLE	M	AS REQD
4	SUPPORT STRUCTURE	M	AS REQD
5	GI CLAMP @ 300mm INTERVAL	Nos.	AS REQD
6	HV CABLE	M	AS REQD
7	CONTROL CABLE	M	AS REQD
8	SEALING COMPOUND	-	AS REQD
9	PVC SHROUDS FOR CABLE GLAND	Nos.	4

NOTES:-

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. AFTER CABLE INSTALLATION, THE OPENING IN THE GI.CONDUIT SHALL BE PROPERLY SEALED.
3. IN CASE OF PAVED AREA, THE GI CONDUIT SHALL BE INSTALLED BEFORE CONCRETE PAVING AND AT EQUIPMENT END IT SHALL BE RAISED ABOVE PAVED SURFACE TO A HEIGHT OF 300mm.
4. ALL CABLES SHALL BE IDENTIFIED CLOSE TO THEIR TERMINATION POINT BY CABLE TAG NUMBERS AS PER CABLE SCHEDULE. CABLE TAGS SHALL BE PUNCHED ON STAINLESS STEEL (2mm THICK, 20mm WIDE AND OF ENOUGH LENGTH) SECURELY FASTENED TO THE CABLE AND WRAPPED AROUND IT.
5. QUANTITY & SIZE OF G.I CONDUIT SHALL BE AS PER LAYOUT DRAWING.

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TITLE
TYPICAL INSTALLATION OF CABLING FOR HV MOTOR AND LOCAL CONTROL STATION

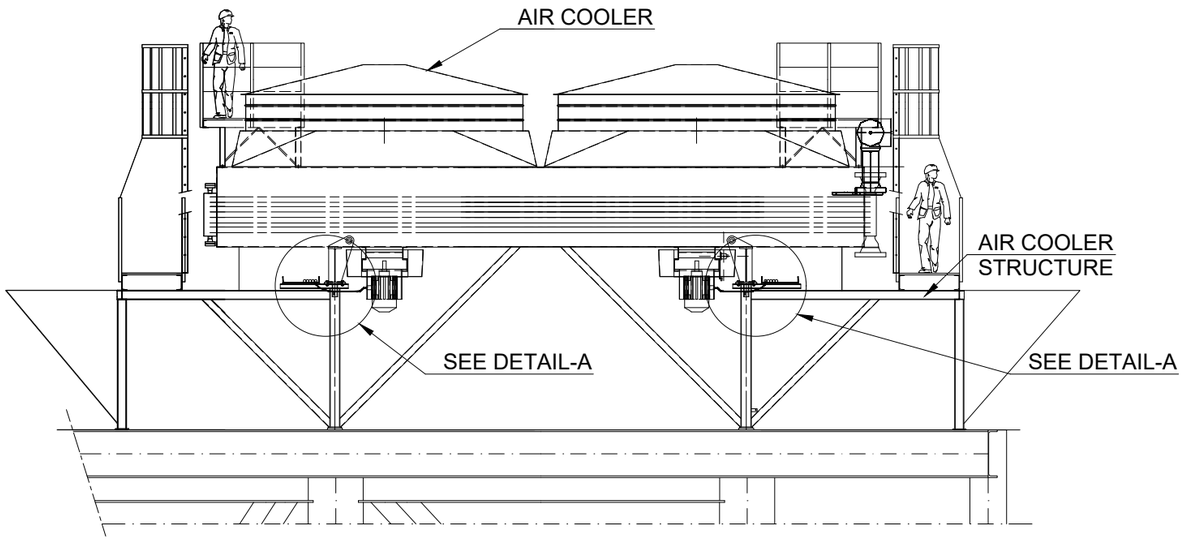
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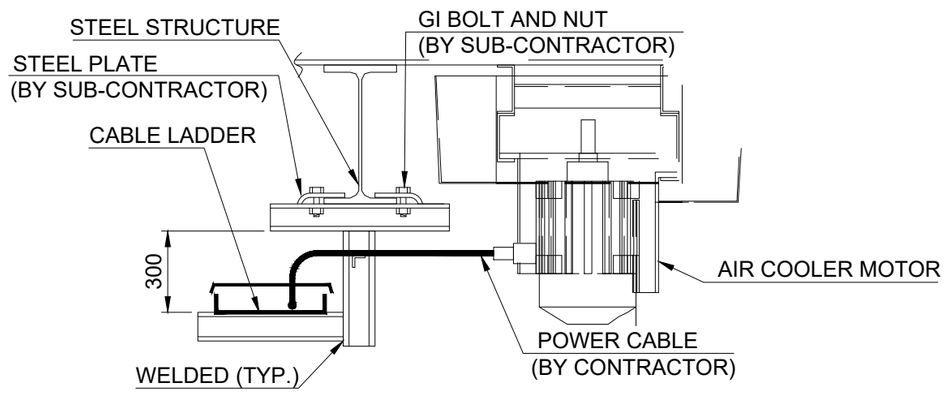
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SHEET SIZE : A3

STANDARD
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SYMBOL

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DETAIL A

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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TITLE
TYPICAL INSTALLATION OF CABLING FOR AIR COLLER MOTOR AND LOCAL CONTROL STATION

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SCALE	080557C001	000	STC	1692	001	14 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

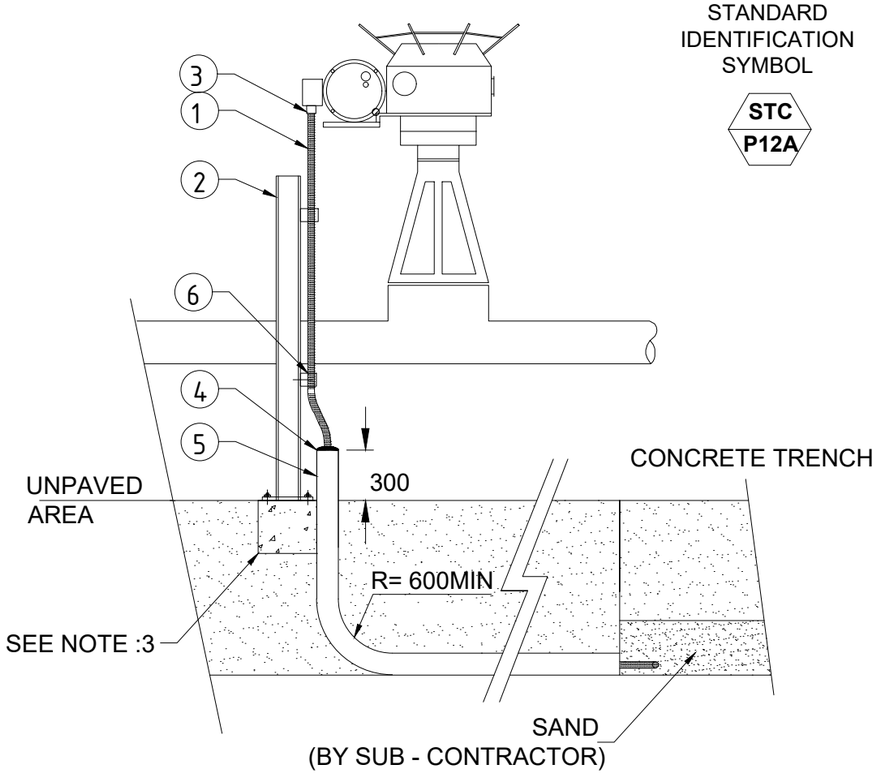
CAD FILE NAME : 080557C-000-STC-1692-001-14_0.DWG

SHEET SIZE : A3

AT GRADE ON UNPAVED AREA

STANDARD IDENTIFICATION SYMBOL

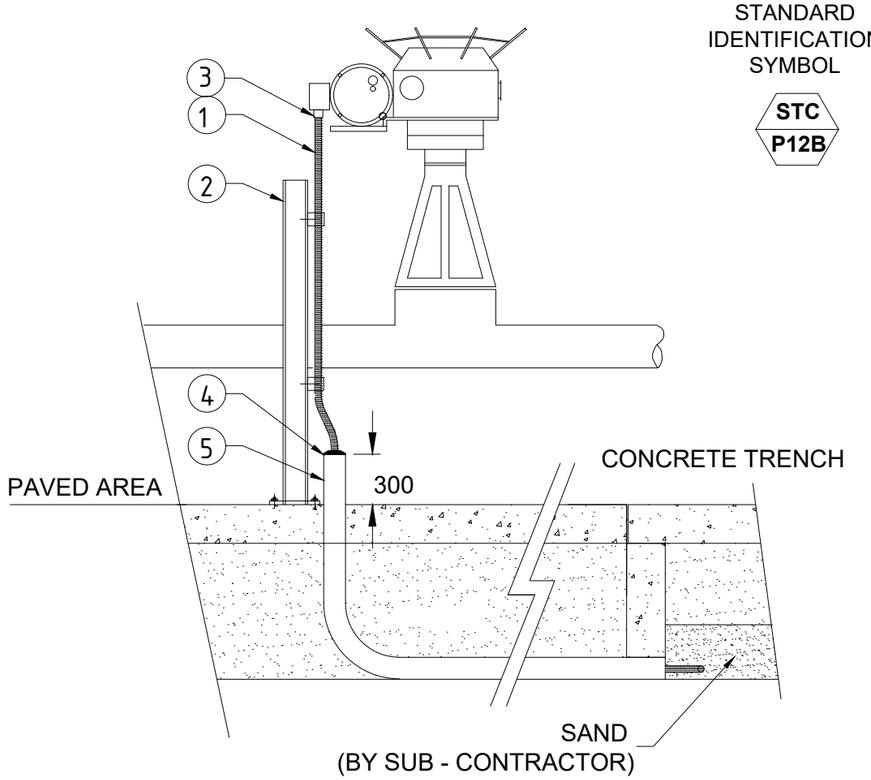
STC P12A



AT GRADE ON PAVED AREA

STANDARD IDENTIFICATION SYMBOL

STC P12B



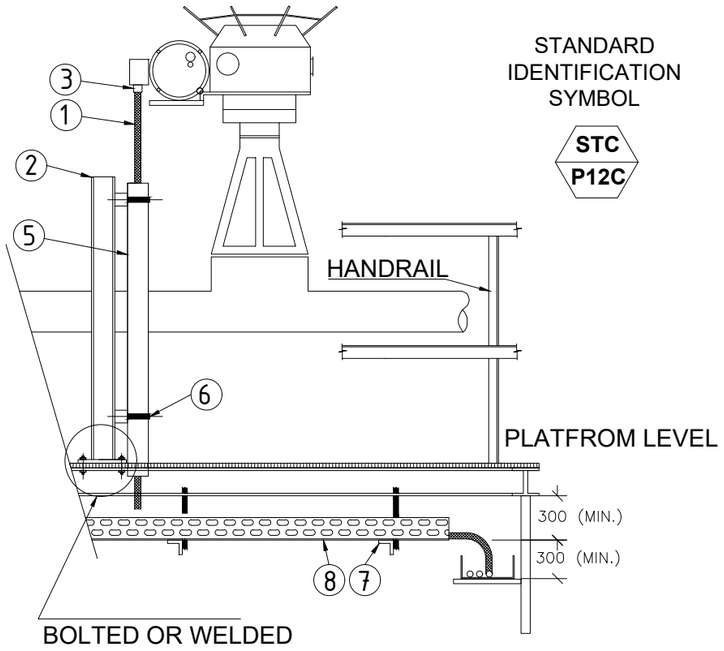
NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. LENGTH REQUIRED DEPENDING ON TERMINAL BOX LOCATION.
3. CONCRETE BLOCK SHALL BE PROVIDED (BY SUB-CONTRACTOR) IN UNPAVED AREA.

MOTOR OPERATED VALVE (MOV) ON PLATFORM

STANDARD IDENTIFICATION SYMBOL

STC P12C



ITEM	MATERIAL DESCRIPTION	UNIT	QTY
1	ARMOURED POWER CABLE	M	AS REQD
2	SUPPORT STRUCTURE (SEE NOTE:2)	M	AS REQD
3	BRASS CABLE GLANDS	Nos.	1
4	SEALING COMPOUND	-	AS REQD
5	G.I CONDUIT TO SUIT CABLE	M	AS REQD
6	CABLE TIE	Nos.	AS REQD
7	HOT DIP GALVANIZED STEEL TRAY / LADDER SUPPORT	Nos.	AS REQD
8	HOT DIP GALVANIZED STEEL TRAY / LADDER	M	AS REQD

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

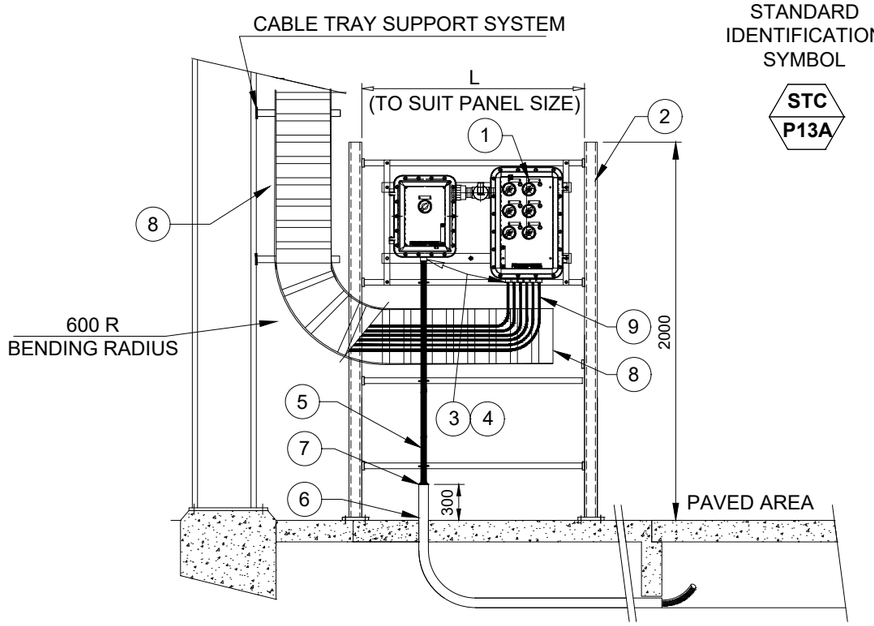
CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF CABLING FOR MOVs

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	15 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-15_0.DWG

SHEET SIZE : A3



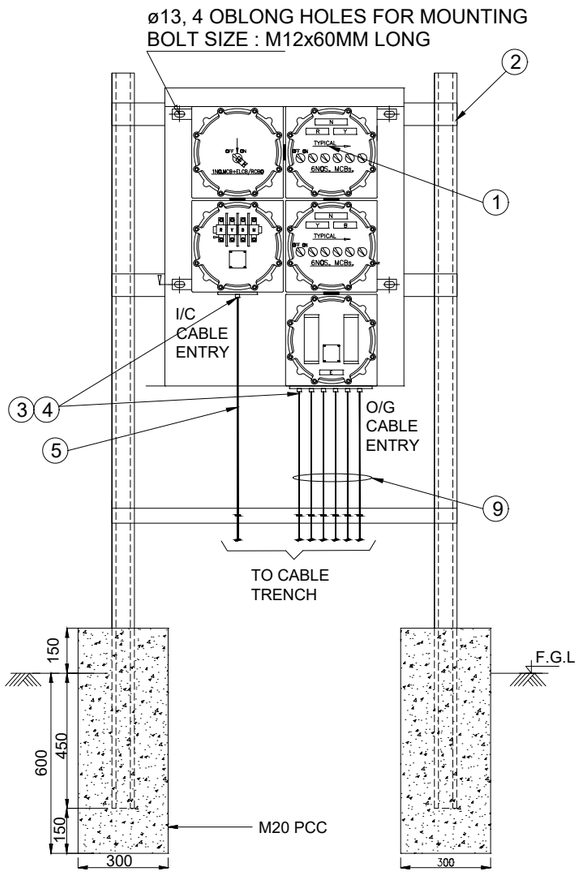
STANDARD IDENTIFICATION SYMBOL

STC P13A

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING PANEL / SMALL POWER PANEL	NOS.	1
2	SUPPORT STRUCTURE	NOS.	1
3	CABLE GLAND - TO SUIT CABLE	NOS.	AS REQD.
4	PVC SHROUDS FOR CABLE GLAND	NOS.	AS REQD.
5	ARMOURED POWER CABLE	M	AS REQD.
6	GI CONDUIT	M	AS REQD.
7	SEALING COMPOUND	-	AS REQD.
8	CABLE LADDER	M	AS REQD.
9	CABLES (OUTGOING CABLES)	M	AS REQD.

NOTES:-

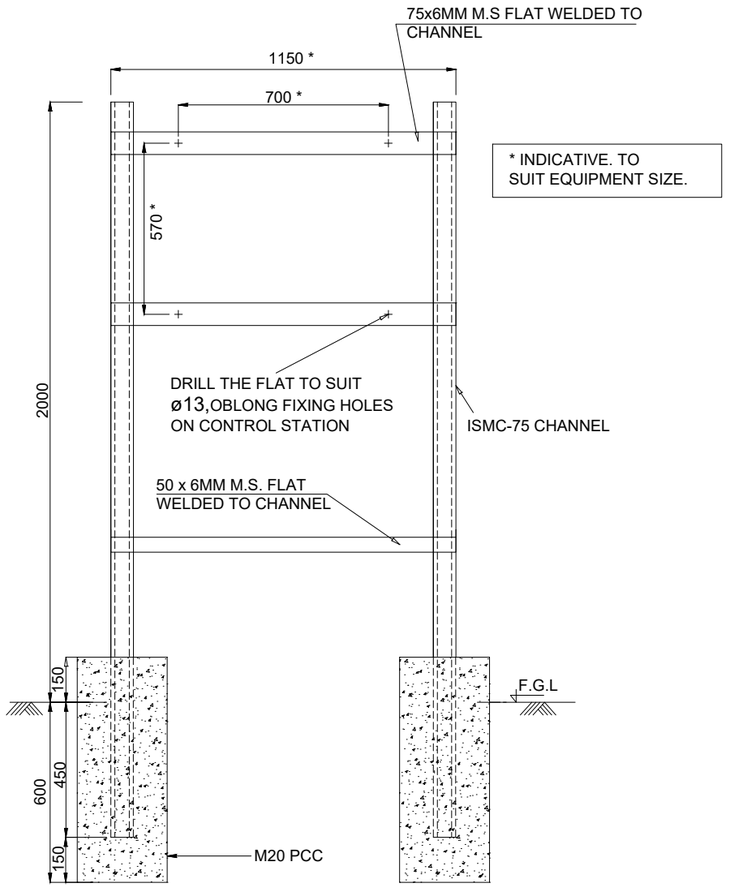
1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.



FRONT VIEW
(UNPAVED AREA)

STANDARD IDENTIFICATION SYMBOL

STC P13B



* INDICATIVE. TO SUIT EQUIPMENT SIZE.

STRUCTURAL DETAILS

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

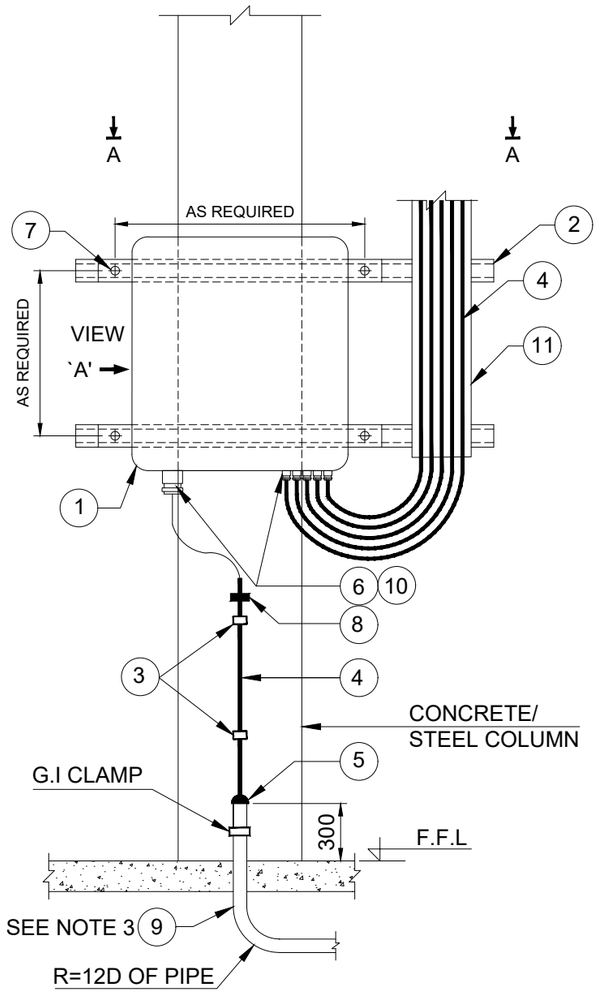
CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF LOCAL LIGHTING & SMALL POWER DISTRIBUTION PANEL

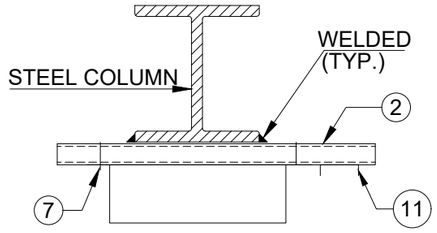
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	16 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-16_0.DWG

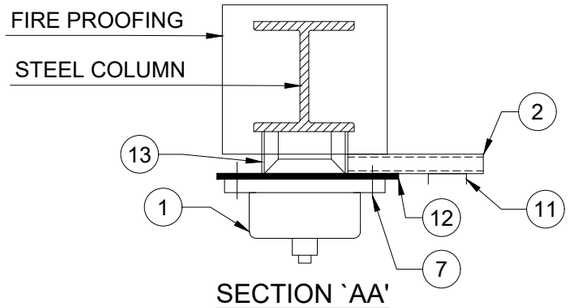
SHEET SIZE : A3



ELECTRICAL EQUIPMENT ON CONCRETE/STEEL COLUMN



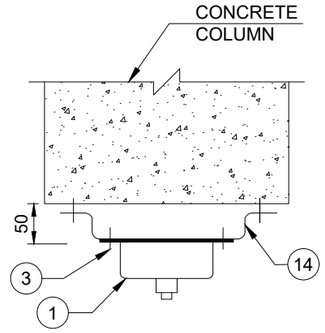
SECTION `AA'
(FOR STEEL COLUMN)



SECTION `AA'
(FOR STEEL COLUMN WITH FIRE PROOFING)

STANDARD IDENTIFICATION SYMBOL

STC
P14



(FOR CONCRETE COLUMN)

ITEM	COMPONENT DESCRIPTION	ITEM	ITEM
1	WELDING & CONVENIENCE RECEPTACLE / JUNCTION BOX / LOCAL DISTRIBUTION PANEL	Nos.	1
2	ISMC - 75 / ISMC - 100 WELDED TO COLUMN (LENGTH AS REQUIRED)	Nos.	2
3	G.I. CABLE SADDLE WITH FIXING FASTENER / TO SUIT SITE CONDITION	Nos.	AS REQD
4	CABLE	M	AS REQD
5	SEALING COMPOUND/TERMINAL BUSHING	-	AS REQD
6	CABLE GLAND - TO SUIT CABLE	Nos.	AS REQD
7	G.I. NUT, BOLT & WASHER FOR FIXING EQUIPMENT (TYP.)	SET	AS REQD
8	CABLE MARKER	Nos.	AS REQD
9	G.I. PIPE TO SUIT CABLE	M	AS REQD
10	PVC SHROUDS FOR CABLE GLAND	Nos.	AS REQD
11	CABLE TRAY	M	AS REQD
12	75/100X10MM THICK M.S. FLAT (LENGTH AS REQUIRED)	Nos.	2
13	FABRICATED BRACKET MADE OF ANGLE 75X75X8 WELDED TO THE STEEL COLUMN	Nos.	2
14	75X10MM M.S. FLAT BEND TO SHAPE & FIXED TO COLUMN WITH 10 MM DIA ANCHOR FASTNER	Nos.	2

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. CANOPY SHALL BE PROVIDED SUITABLY AS PER THE REQUIREMENT.
3. THE OUTGOING CABLES FROM LCS / PJB / LIGHTING DISTRIBUTION PANEL SHALL BE ROUTED THROUGH TRAYS / TRENCH AS PER ACTUAL REQUIREMENT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

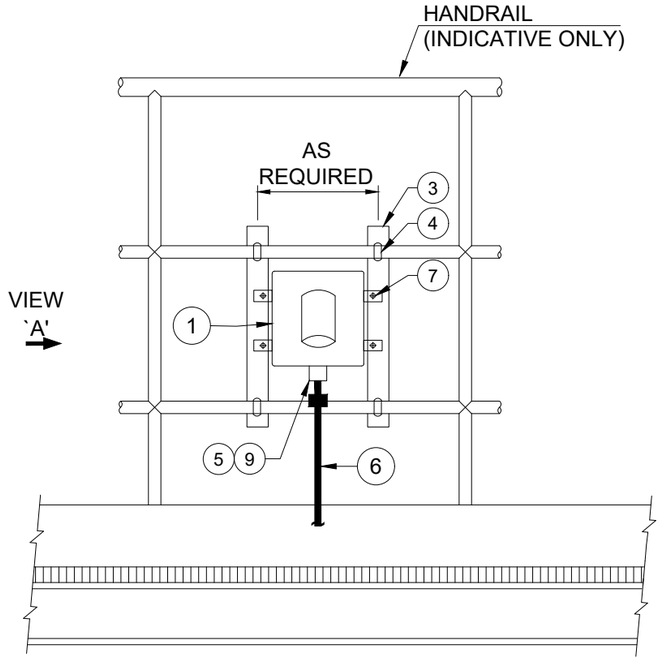
CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

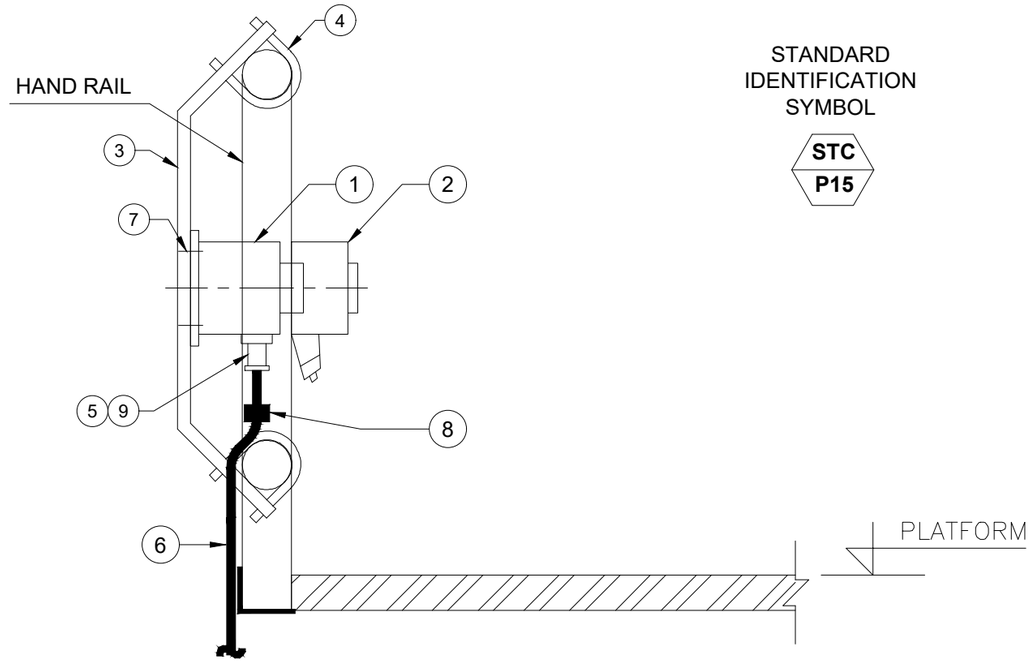
TITLE: TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET OUTLETS ON CONCRETE / STEEL COLUMN

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	17 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-17_0.DWG

SHEET SIZE : A3





VIEW `A'

STANDARD
IDENTIFICATION
SYMBOL

STC
P15

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	WELDING / CONVENIENCE SOCKET WITH SUITABLE CABLE GLAND	Nos.	1
2	PLUG	Nos.	1
3	50X6 MM M.S FLAT BOLTED TO HANDRAIL (LENGTH AS REQUIRED)	Nos.	2
4	U-BOLT C/W NUTS & WASHERS TO SUIT HANDRAIL	Nos.	4
5	CABLE GLAND - TO SUIT CABLE	Nos.	1
6	CABLE	M	AS REQD
7	G.I. NUT, BOLT & WASHER FOR FIXING WELDING / CONVENIENCE OUTLET	SET	AS REQD
8	CABLE MARKER	Nos.	1
9	PVC SHROUDS FOR CABLE GLAND	Nos.	1

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF CONVENIENCE SOCKET OUTLETS ON HAND RAIL

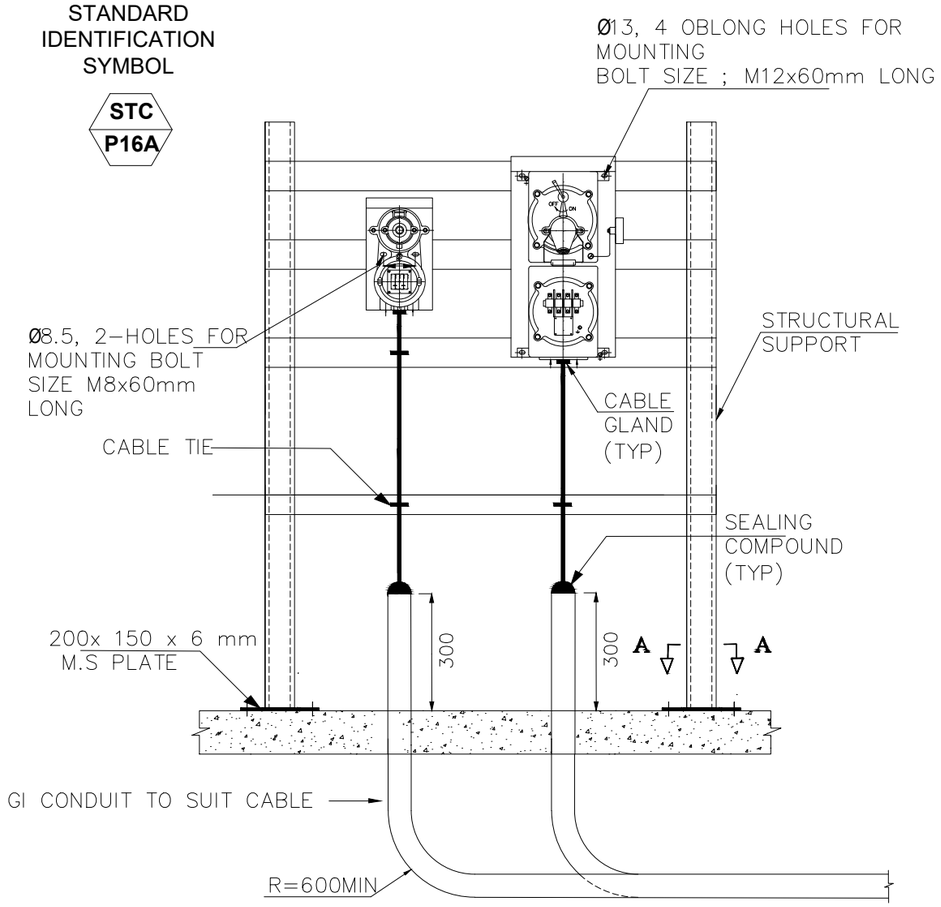
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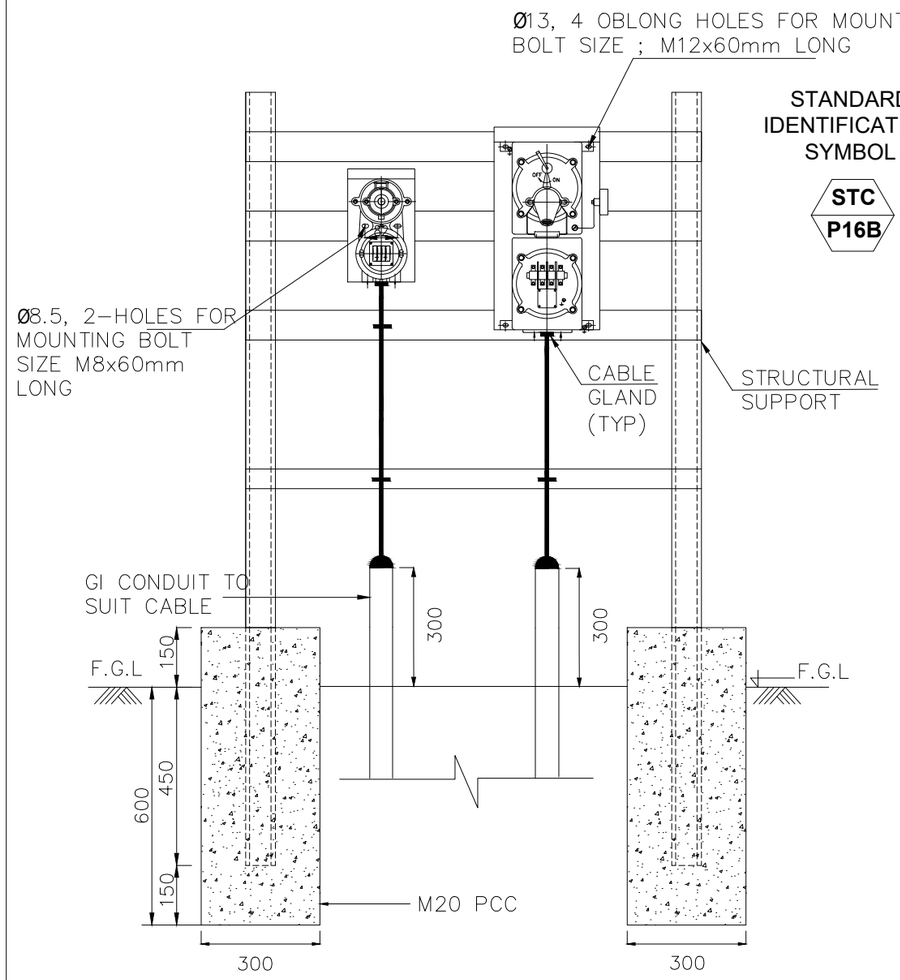
SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

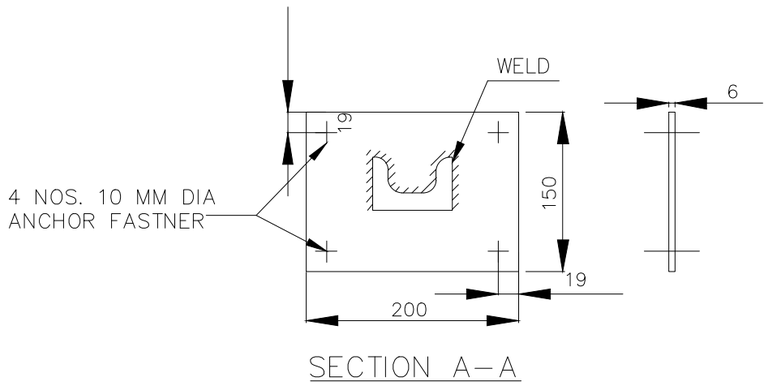
STC P16A



TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET OUTLETS ON PAVED AREA



TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET OUTLETS ON UNPAVED AREA



SECTION A–A

NOTES:

1. ALL DIMENSION ARE IN MM.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL INSTALLATION OF WELDING / CONVENIENCE SOCKET OUTLET /JUNCTION BOX ON STRUCTURAL SUPPORT IN PAVED / UNPAVED AREA

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	19 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

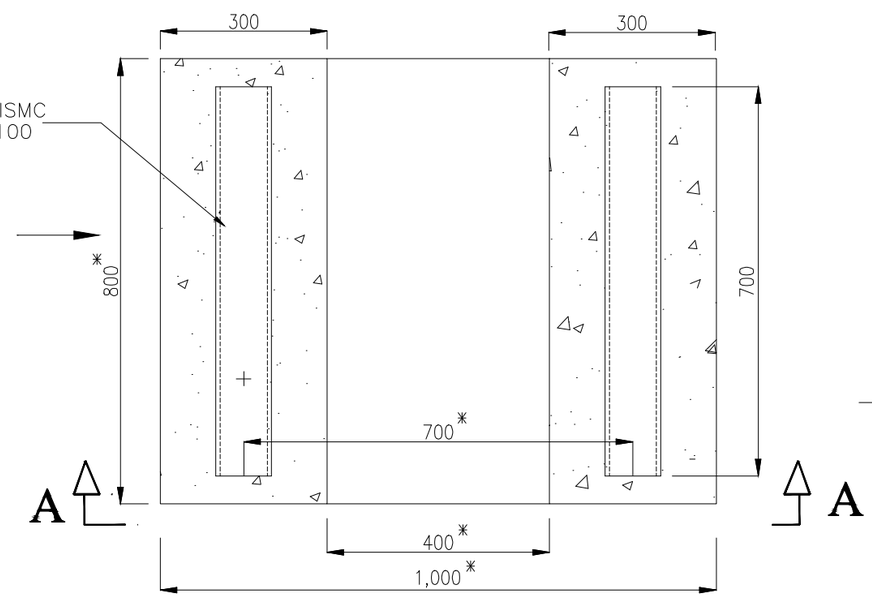
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SHEET SIZE : A3

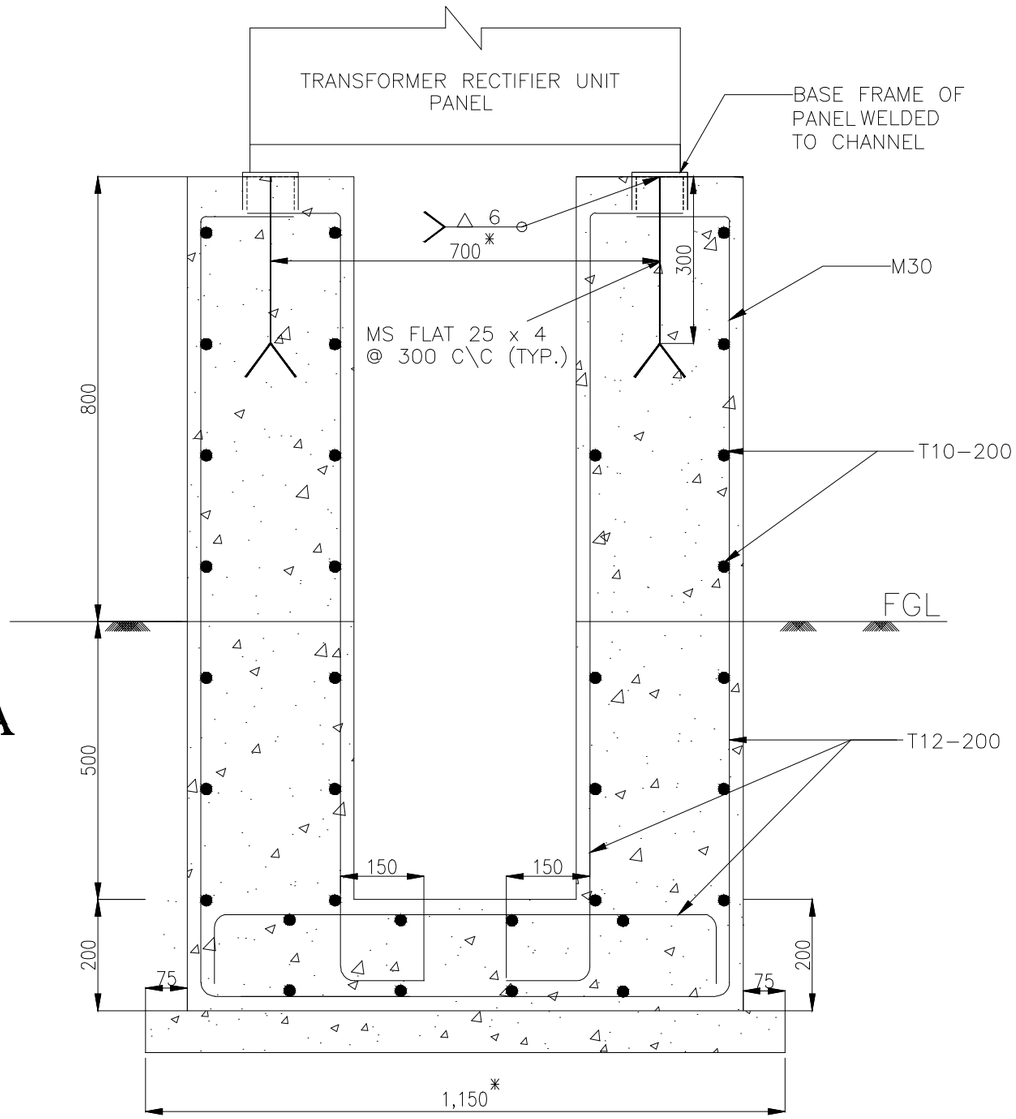
2 1 E

STANDARD IDENTIFICATION SYMBOL

STC
P17



PLAN



SECTION A-A

* INDICATIVE AND TO SUIT WIDTH OF EQUIPMENT.

NOTES:

1. ALL DIMENSION ARE IN MM.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

2

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

1

TITLE: TYPICAL INSTALLATION DETAIL FOR TRANSFORMER RECTIFIER UNIT PANEL ON STRUCTURAL CHANNEL IN UNPAVED AREA.

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	20 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

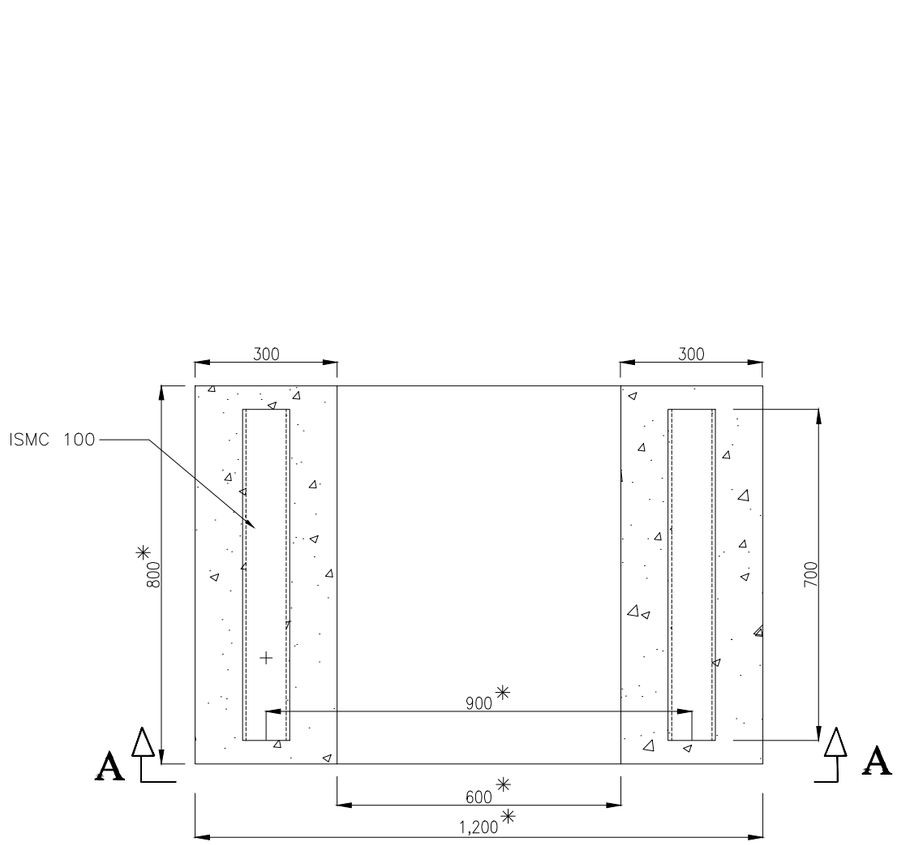
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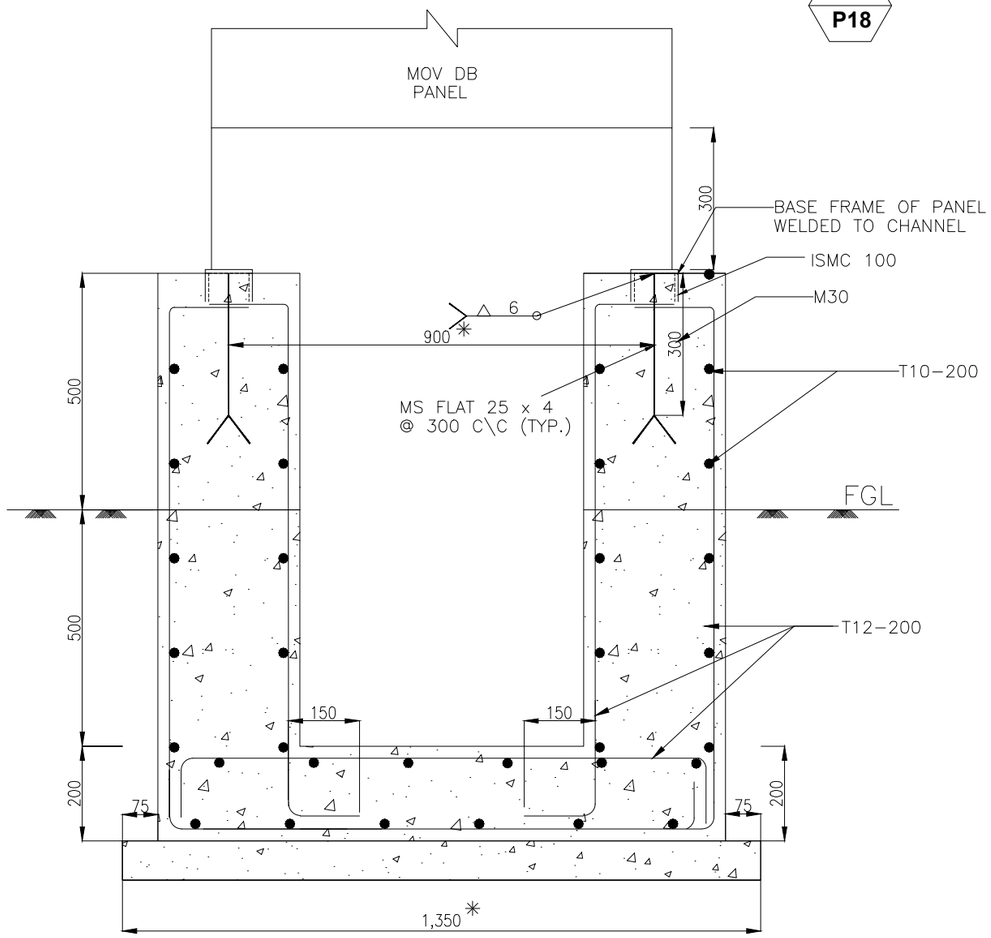
SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
P18



PLAN



SECTION : A-A

✳ INDICATIVE AND TO SUIT WIDTH OF EQUIPMENT

NOTES:

1. ALL DIMENSION ARE IN MM.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

2

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
TechnipFMC

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1

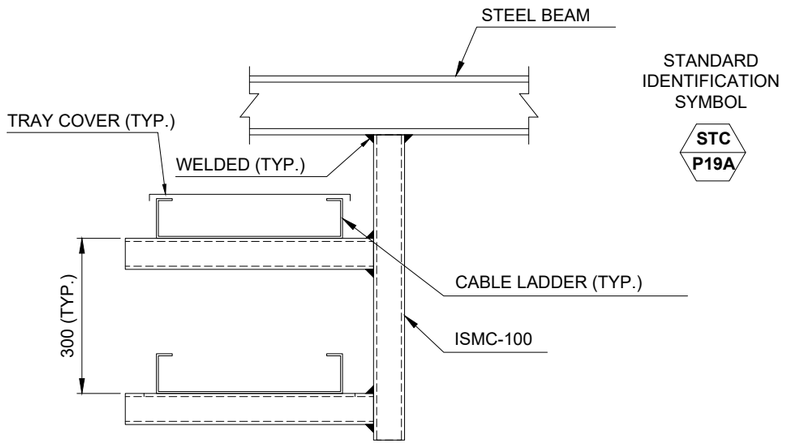
TITLE
TYPICAL INSTALLATION DETAIL FOR MOV PANEL ON STRUCTURAL CHANNEL IN UNPAVED AREA

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	21 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

E

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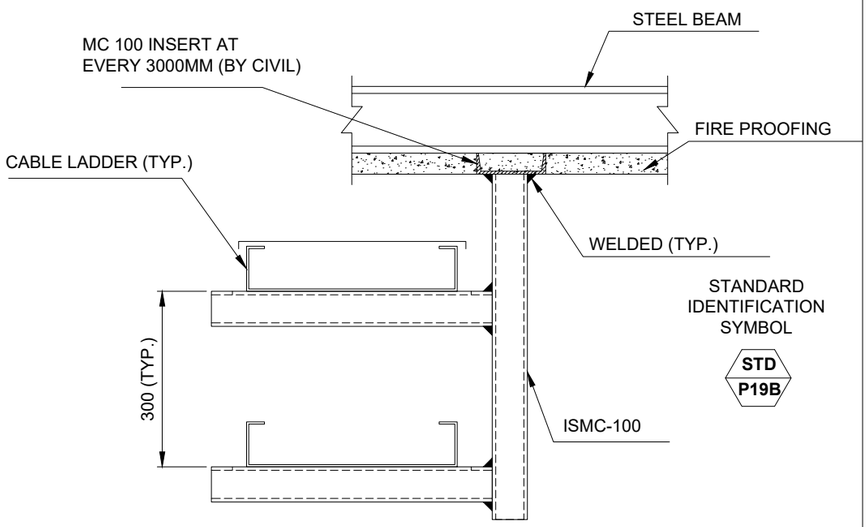
SHEET SIZE : A3



STANDARD IDENTIFICATION SYMBOL

STC
P19A

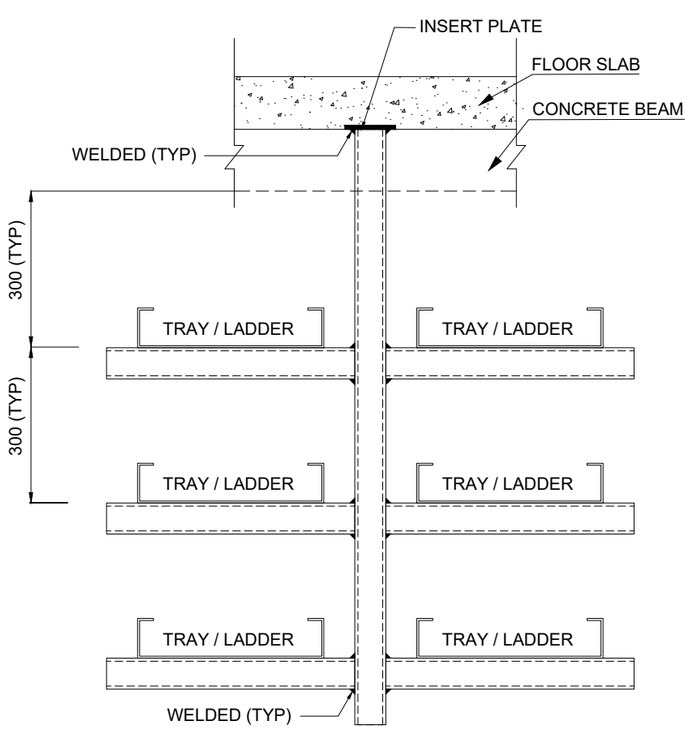
HORIZONTAL SUPPORT FROM STEEL BEAM WITHOUT FIRE PROOFING



STANDARD IDENTIFICATION SYMBOL

STD
P19B

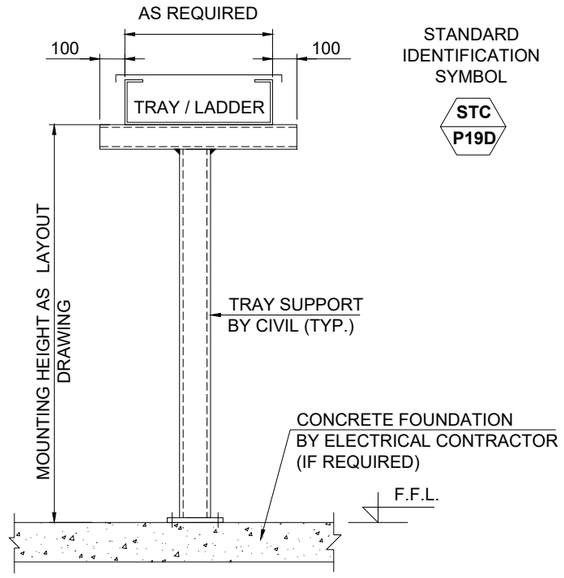
HORIZONTAL SUPPORT FROM STEEL BEAM WITH FIRE PROOFING



STANDARD IDENTIFICATION SYMBOL

STC
P19C

CABLE TRAY / LADDER SUSPENDED BELOW SLAB IN SUBSTATION



STANDARD IDENTIFICATION SYMBOL

STC
P19D

'T' SUPPORT

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. ALL HORIZONTAL CABLE TRAYS SHALL BE SUPPORTED AT EVERY 3M.
3. FIXING / INSTALLATION OF CABLE TRAYS & SUPPORT STRUCTURE SHALL BE DONE BY ELECTRICAL CONTRACTOR.
4. ALL DRILLED HOLES AND STEEL WORK TO BE PRIMED AND PAINTED TO SUIT EXISTING STEEL WORK.
5. FOR MOUNTING HEIGHT SEE LAYOUT DRAWINGS.
6. IN CASE CABLE TRAY SUPPORT NOT PROVIDED BY CIVIL & STRUCTURE SAME SHALL BE SUPPLIED & INSTALLED BY ELECTRICAL CONTRACTOR.

0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC
Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF HORIZONTAL CABLE TRAYS OR LADDERS

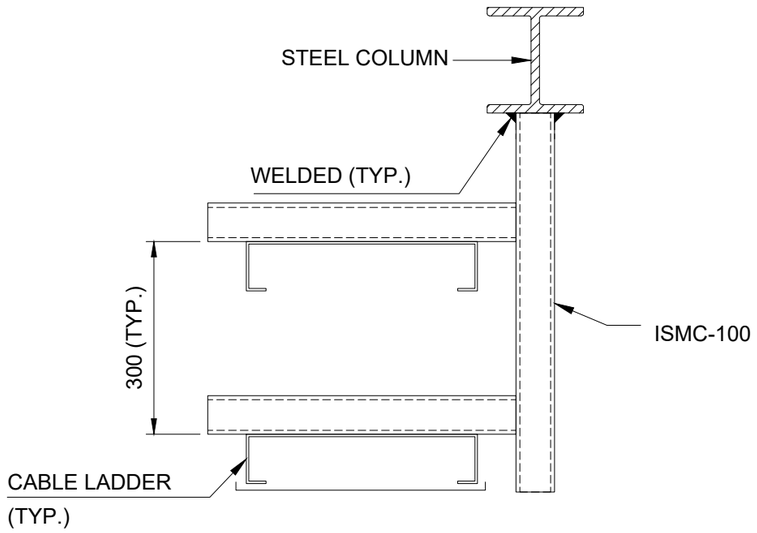
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	22 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-22_0.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

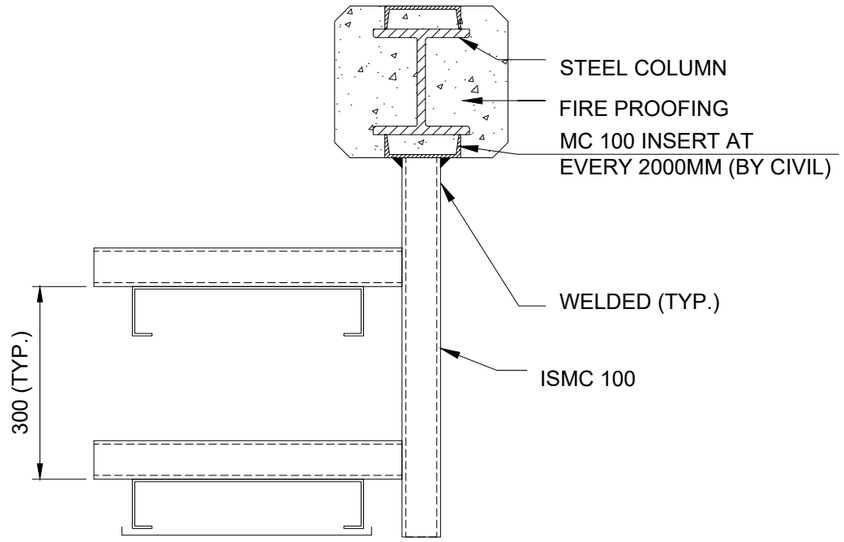
STC
P20A



VERTICAL SUPPORT FROM STEEL COLUMN WITHOUT FIRE PROOFING

STANDARD IDENTIFICATION SYMBOL

STC
P20B



VERTICAL SUPPORT FROM STEEL COLUMN WITH FIRE PROOFING

NOTES:

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE SHOWN.
2. ALL VERTICAL LADDER / TRAYS SHALL BE SUPPORTED AT EVERY 2m INTERVAL.
3. THE OUTGOING CABLES FROM LCS / PJB / LIGHTING DISTRIBUTION PANEL SHALL BE ROUTED THROUGH TRAYS / TRENCH AS PER ACTUAL REQUIREMENT.
4. ALL DRILLED HOLES AND STEEL WORK TO BE PRIMED AND PAINTED TO SUIT EXISTING STEEL WORK.
5. FOR MOUNTING HEIGHT SEE LAYOUT DRAWINGS.
6. IN CASE CABLE TRAY SUPPORT NOT PROVIDED BY CIVIL & STRUCTURE SAME SHALL BE SUPPLIED & INSTALLED BY ELECTRICAL CONTRACTOR.

0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC
Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by

DOCUMENT CATEGORY	DOCUMENT REVIEW STATUS (BY CLIENT)
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PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

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TITLE
TYPICAL INSTALLATION OF VERTICAL CABLE TRAYS OR LADDERS

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	23 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

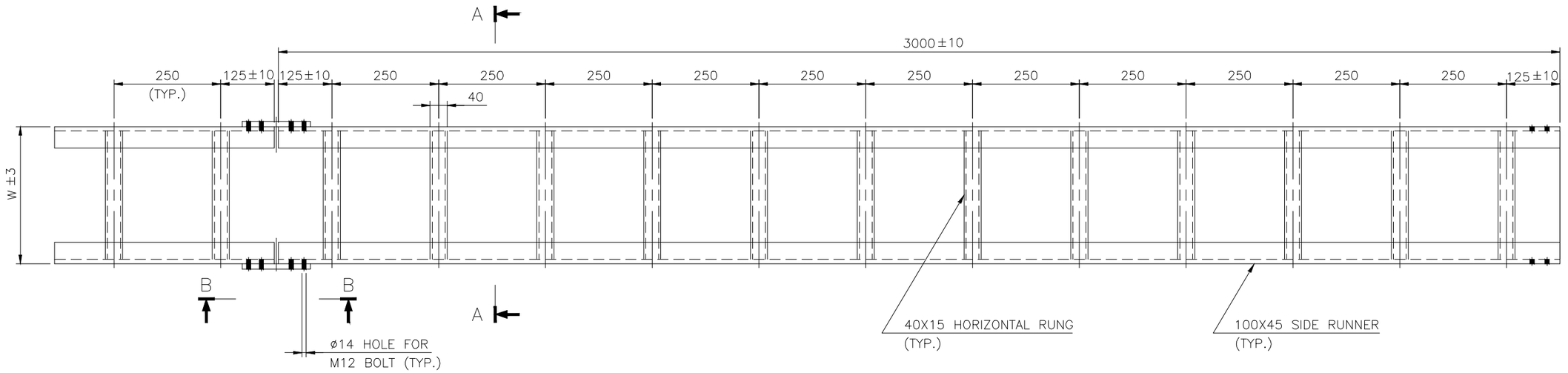
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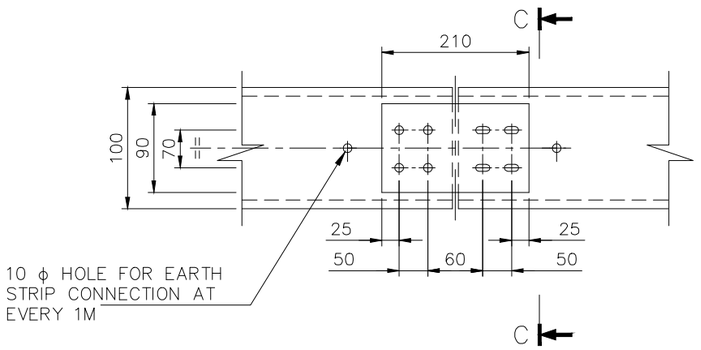
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STANDARD IDENTIFICATION SYMBOL

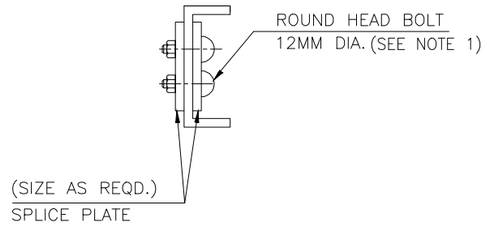
STC
P21

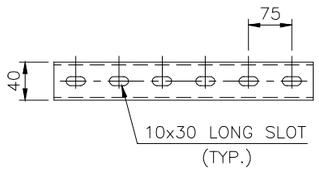


LADDER TYPE CABLE TRAY
(W=300/450/600/750)

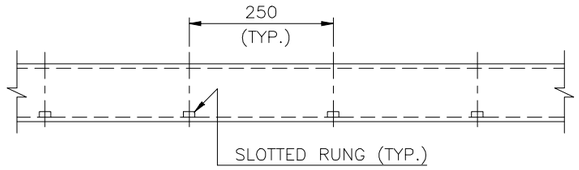


VIEW B–B

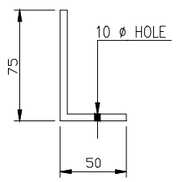




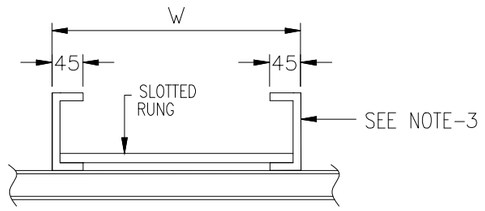
SLOTTED RUNG

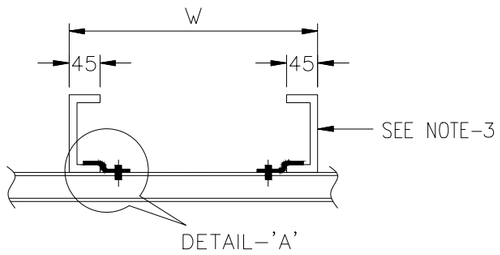


SIDE RUNNER



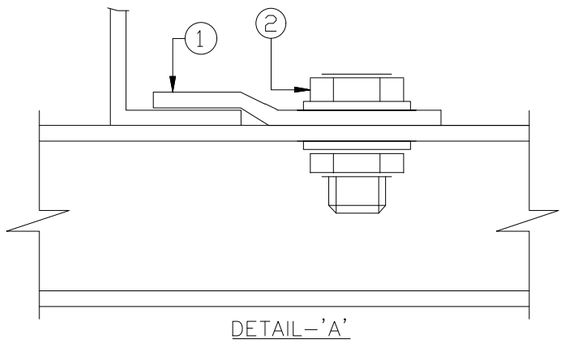
BARRIER PLATE





DETAIL–'A'

SECTION C–C



DETAIL–'A'

NOTE:–

1. 12MM DIA ROUNDHEAD BOLT WITH WASHERS & NUTS SHALL BE PREFERABLY SUPPLIED BY MANUFACTURER, CONFORMING TO IS : 1363 & 1367 SHALL BE USED FOR FIXING OF SPLICE PLATE.
2. FOR EXACT DETAILS CABLE TRAY MANUFACTURER DRAWINGS SHALL BE REFERRED.
3. LENGTH OF PREFABRICATED CABLE TRAY PIECE SHALL BE 3 MTR. SIDE RUNNER OF CABLE TRAY SHALL BE STRONG ENOUGH TO BE SUPPORTED AT 3 MTR. INTERVAL WITHOUT ALLOWING ANY SAG.
4. HOT DIP GALVANIZED SHALL BE MADE AFTER FABRICATION.
5. SUITABLE THREADED HOLES SHALL BE PROVIDED AT THE TOP AND BOTTOM OF SIDE RUNNERS TO FIX THE TRAY COVERS.
6. ALL DIMENSION ARE IN MM.

ITEM	COMPONENT DESCRIPTION
1	CABLE TRAY HOLD DOWN BRACKET
2	M10X35MM LONG G.I. BOLT,NUT & WASHER

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STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

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TITLE
TYPICAL INSTALLATION FOR HOT DIP GALVANIZED LADDER TYPE CABLE TRAYS & ACCESSORIES

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	24 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-24_0.DWG

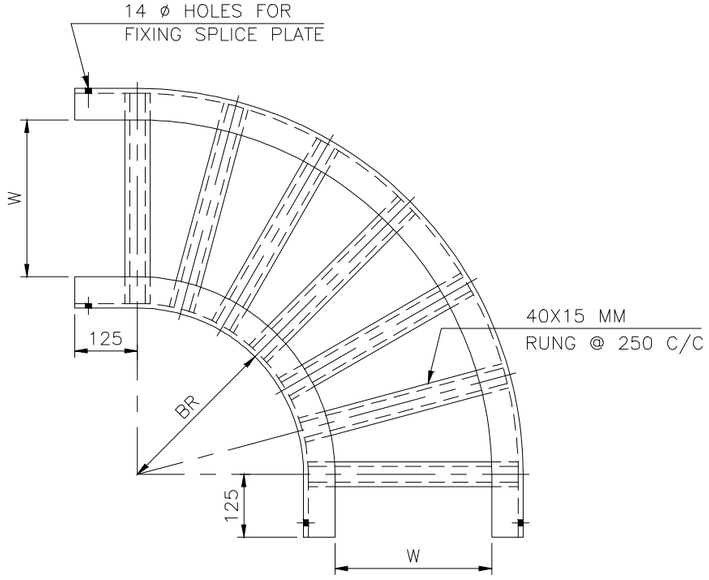
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2 1

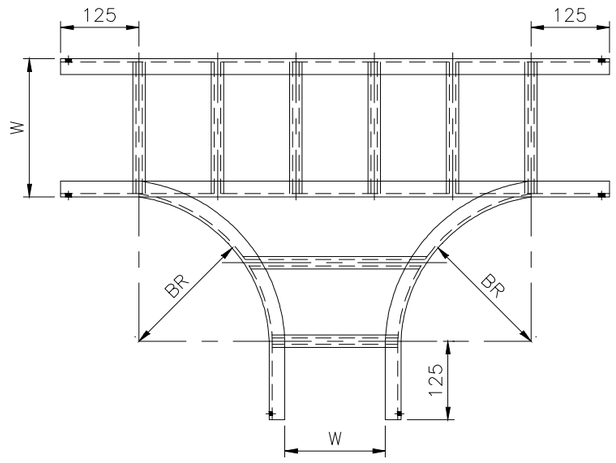
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STANDARD IDENTIFICATION SYMBOL

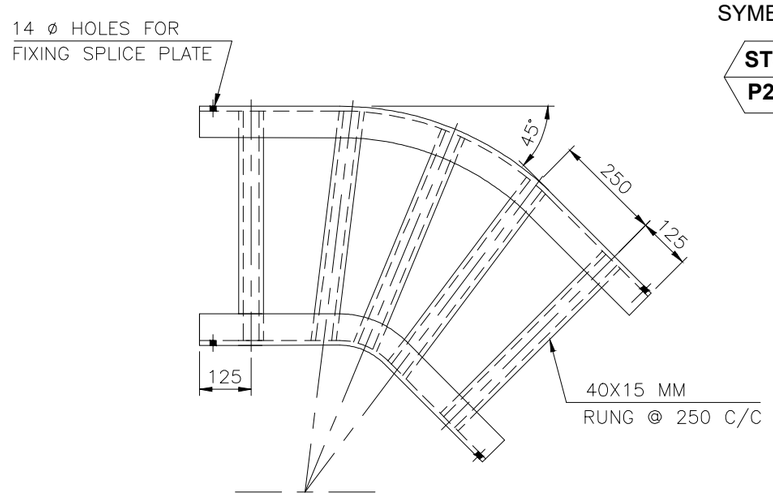
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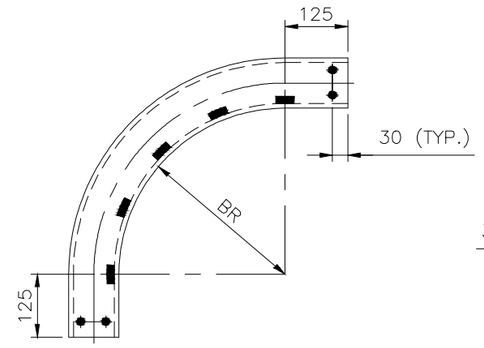
90 DEG. HORIZONIAL BEND



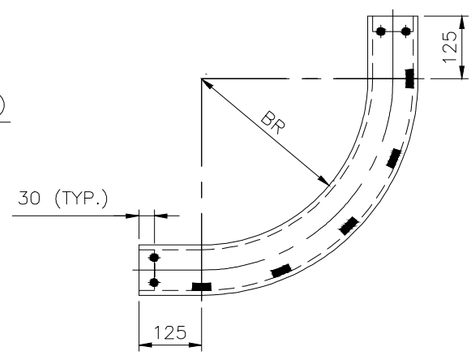
'T' JOINT



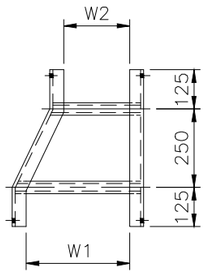
45°HORIZONTAL BEND



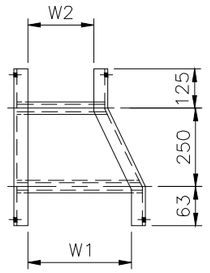
VERTICAL OUTSIDE BEND



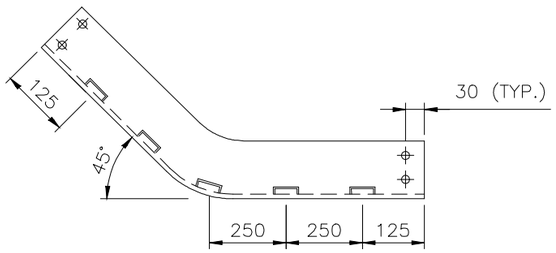
VERTICAL INSIDE BEND



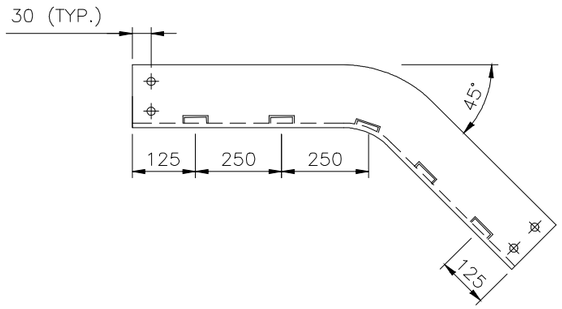
LEFT HAND REDUCER



RIGHT HAND REDUCER



45°VERTICAL INSIDE BEND



45°VERTICAL OUTSIDE BEND

W– WIDTH OF CABLE TRAY (300/450/600)
W1–WIDTH OF CABLE TRAY ON ONE SIDE
W2–WIDTH OF CABLE TRAY ON OTHER SIDE
BR–BENDING RADIUS (AS REQUIRED)

NOTE:–

1. FOR EXACT DETAILS CABLE TRAY MANUFACTURER DRAWINGS SHALL BE REFERRED.

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DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
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PROJECT: STANDBY SRU & ADDITIONAL TANKS
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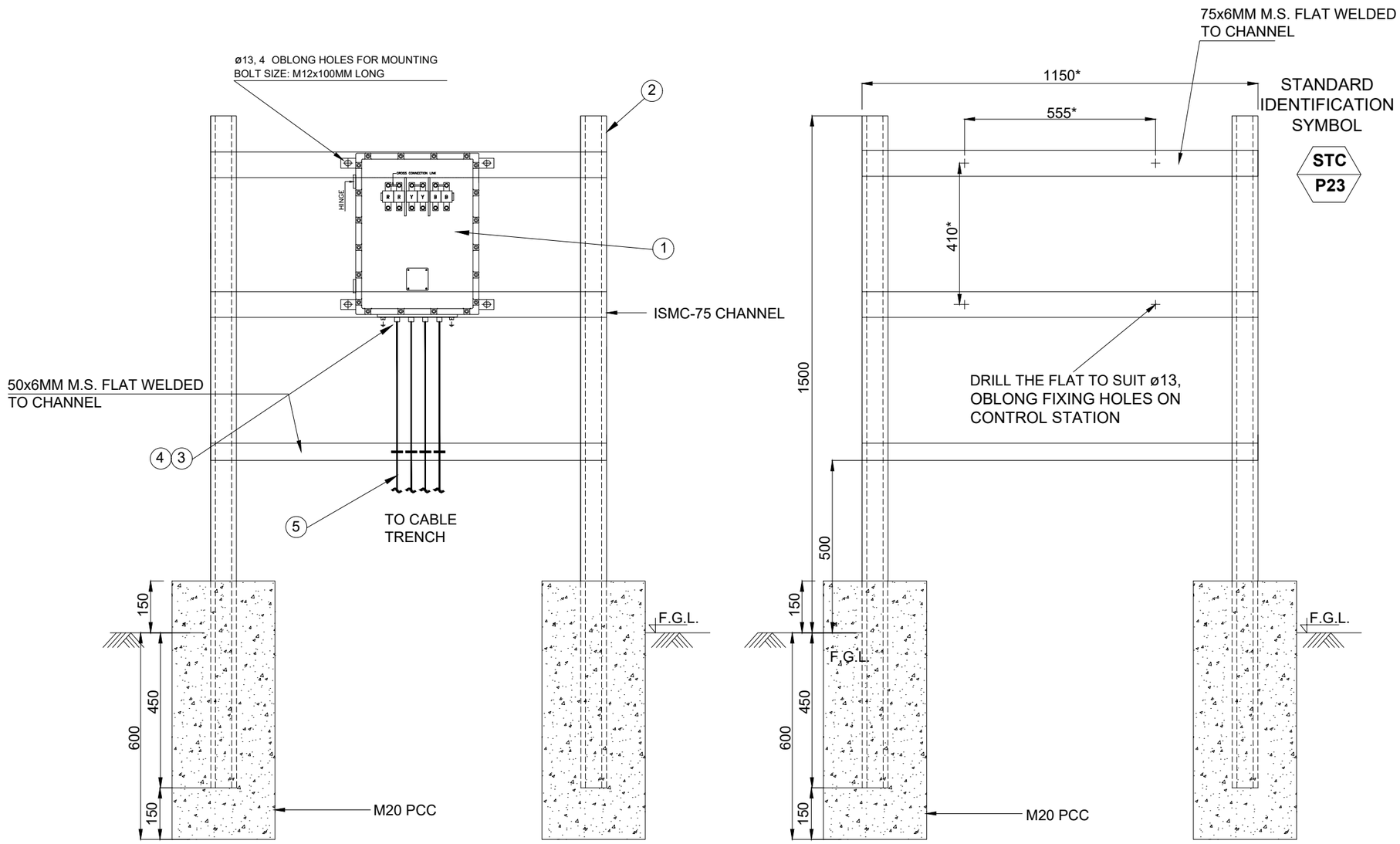
TITLE: TYPICAL INSTALLATION FOR HOT DIP GALVANIZED LADDER TYPE CABLE TRAYS & ACCESSORIES

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	25 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

2 1 E

CAD FILE NAME : 080557C-000-STC-1692-001-25_0.DWG

SHEET SIZE : A3



ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	POWER JUNCTION BOX	Nos.	1
2	SUPPORT STRUCTURE	Nos.	1
3	CABLE GLAND - TO SUIT CABLE	Nos.	AS REQ
4	PVC SHROUDS FOR CABLE GLAND	Nos.	AS REQ
5	ARMOURED POWER CABLE	-	AS REQ

* INDICATIVE. TO SUIT EQUIPMENT SIZE.

NOTES :-

1. ALL DIMENSIONS ARE IN MM.

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TITLE: TYPICAL INSTALLATION DETAILS FOR POWER JUNCTION BOX ON STRUCTURAL SUPPORT IN UNPAVED AREA

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	26 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

2 1 E

CAD FILE NAME : 080557C-000-STC-1692-001-26_0.DWG

SHEET SIZE : A3

STANDARD
IDENTIFICATION
SYMBOL

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P24

SPARE

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SCALE	080557C001	000	STC	1692	001	27 OF 30	0
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CAD FILE NAME : 080557C-000-STC-1692-001-27_0.DWG

SHEET SIZE : A3

STANDARD
IDENTIFICATION
SYMBOL

STC
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PROJECT
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DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	28 OF 30	0
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CAD FILE NAME : 080557C-000-STC-1692-001-28_0.DWG

SHEET SIZE : A3

STANDARD
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SYMBOL

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DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	29 OF 30	0
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2
1
E

CAD FILE NAME : 080557C-000-STC-1692-001-29_0.DWG

SHEET SIZE : A3

STANDARD
IDENTIFICATION
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DRAWING NO.						PAGE	REV.
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1692-001-30_0.DWG

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TYPICAL EARTHING AND LIGHTNING PROTECTION INSTALLATION STANDARDS FOR CONSTRUCTION

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
			Pavithra Gunasekaran			
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TITLE
COVER SHEET

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	01 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-001.DWG

SHEET SIZE : A3

PAGE	REVISION 0	1	2	STD No.	TITLE
01	X			-	COVER SHEET
02	X			-	INDEX SHEET
03	X			-	GENERAL NOTES
04	X			-	LEGEND
05	X			-	EQUIPMENT EARTHING SCHEDULE
06	X			E01	TYPICAL INSTALLATION OF EARTH PIT
07	X			E02	TYPICAL INSTALLATION OF EARTH ELECTRODE FOR EARTHING SYSTEM
08	X			E03	TYPICAL EARTH PLATE AND FIXING DETAILS
09	X			E04	TYPICAL INSTALLATION DETAIL FOR INSULATED EARTHING PLATE
10	X			E05	TYPICAL EARTHING OF ELECTRIC MOTOR AND PUSH BUTTON STATION
11	X			E06	TYPICAL EARTH CONNECTION FOR LOCAL PANEL/POWER JUNCTION BOX/WELDING RECEPTACLE
12	X			E07	TYPICAL EARTH CONNECTION FOR STREET LIGHT/FLOOD LIGHT POLE
13	X			E08	TYPICAL EARTH CONNECTION FOR VESSEL & SPHERE
14	X			E09	TYPICAL EARTH CONNECTION FOR TANK
15	X			E10	TYPICAL EARTHING/BONDING OF PIPES AND PIPE RACKS
16	X			E11	TYPICAL EARTH CONNECTION FOR PIPES
17	X			E12	TYPICAL EARTH CONNECTION FOR STEEL/METALLIC COLUMN
18	X			E13	TYPICAL EARTHING OF CABLE TRAY
19	X			E14	TYPICAL EARTHING/BONDING OF FENCE GATE
20	X			E15	TYPICAL EARTH CONNECTION FOR MOBILE LOAD & UNLOADING FACILITIES
21	X			E16	TYPICAL EARTH CONNECTION FOR BONDING OF STAIRWAY/LADDERS
22	X			E17	TYPICAL LIGHTNING PROTECTION OF BUILDING
23	X			E18	TYPICAL EARTHING OF SWITCHBOARD AND PANELS IN SUBSTATION
24	X			E19	TYPICAL EARTHING OF PACKAGE
25	X			E20	TYPICAL EARTHING CONNECTIONS FOR MOV's
26	X			E21	EARTHING CONNECTIONS AND CONNECTORS DETAILS
27	X			E22	SPARE
28	X			E23	SPARE
29	X			E24	SPARE
30	X			E25	SPARE

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TITLE: INDEX SHEET

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GENERAL NOTES :

1. EARTHING SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS LAID DOWN IN IS:3043, ENGINEERING DESIGN BASIS FOR ELECTRICAL (DOC. NO:080557C-088-JSD-1600-001), JOB SPECIFICATION FOR ELECTRICAL INSTALLATION (DOC. NO:080557C-088-JSD-1600-003).
2. WHEREVER G.I. IS MENTIONED IN THE NOTES & STANDARDS, THIS INDICATES THAT HOT DIP GALVANIZED MILD STEEL TO BE USED FOR EARTHING.
3. MAIN GROUNDING GRID SHALL BE INSTALLED AT A MINIMUM DEPTH OF 500MM (AS PER LAYOUTS) FROM FINISHED GRADE LEVEL.
4. CLEAN EARTHING GRID SHALL BE LAID 500MM AWAY FROM MAIN ELECTRICAL EARTHING GRID. ALSO CLEAN EARTHING GRID SHALL NOT BE CONNECTED WITH ELECTRICAL MAIN GRID.
5. ALL MEDIUM AND HIGH VOLTAGE EQUIPMENT (ABOVE 250V) SHALL BE EARTHED BY TWO SEPARATE AND DISTINCT CONNECTIONS WTH EARTH.
6. ALL LIGHTING FIXTURES/CONVENIENCE SOCKET OUTLET/LIGHTING JUNCTION BOX SHALL BE EARTHED THROUGH THE THIRD CORE OF THE FEEDING CABLE OR THIRD WIRE OF THE FEEDING CIRCUIT AS PER INDIVIDUAL LIGHTING LAYOUT DRAWING.
7. ALL PROCESS PIPELINES SHALL BE BONDED AND EARTHED AT THE ENTRY AND EXIT POINTS OF BATTERY LIMIT OF PROCESS AREA.
8. IN HAZARDOUS AREAS ALL PROCESS EQUIPMENT SHALL BE CONNECTED TO THE MAIN EARTH GRID AT TWO PLACES.
9. THE FLANGES OF THE PIPE LINES CARRYING HAZARDOUS LIQUID SHALL LOOPED BONDED TOGETHER IN ORDER TO PREVENT ACCUMULATION OF STATIC CHARGE & MAINTAIN CONTINUITY OF EARTHING.
10. CATHODIC PROTECTED PIPELINES OR EQUIPMENT SHALL BE EARTHED AS PER CATHODIC PROTECTION GUIDELINES & DRAWING.
11. FOR EQUIPMENT EARTHING, INDIVIDUAL EARTH CONNECTIONS SHALL BE TAPPED FROM NEAREST MAIN EARTHING GRID/EARTH PLATE AS PER LAYOUT DRAWING. THE SIZE OF THE GROUNDING CONDUCTOR FOR THE EQUIPMENT SHALL BE AS PER EQUIPMENT INSTALLATION/LAYOUT.
12. ALL OIL & GAS HEADER PIPE LINES SHALL BE DISTINCTLY EARTHED AT 2 LOCATIONS.
13. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE POLISHED GOOD WITH ZINC RICH PAINT.
14. ALL EARTH CONNECTIONS SHOULD BE VISIBLE FOR INSPECTION TO THE EXTENT POSSIBLE.
15. LIGHTNING PROTECTION SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS LAID DOWN IN IS/IEC:62305 AND ENGINEERING DESIGN BASIS FOR ELECTRICAL 080557C-088-JSD-1600-001. SELF-CONDUCTING STRUCTURES HAVING METAL THICKNESS OF MORE THAN 4.8mm MAY NOT REQUIRE LIGHTNING PROTECTION WITH AERIAL ROD AND DOWN CONDUCTORS. THEY SHALL HOWEVER BE CONNECTED TO THE EARTHING SYSTEM ATLEAST AT TWO POINTS AT THE BASE.

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0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

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TITLE: GENERAL NOTES

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	03 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-003.DWG

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LEGEND :

- : 75X10mm GI STRIP FOR MAIN EARTH GRID UNDER GROUND
- : 75X10mm GI STRIP FOR MAIN EARTH GRID ABOVE GROUND
- : 50X6mm GI STRIP FOR LIGHTNING PROTECTION
- : 40X5 GI STRIP
- : 25 Sq.mm INSULATED FLEXIBLE Cu.CABLE
- : 16MM DIA. GI WIRE ROPE FOR EQUIPMENT EARTH
- : 10MM DIA. GI WIRE ROPE FOR EQUIPMENT EARTH
- : 4MM DIA.(8 SWG) GI WIRE ROPE FOR EQUIPMENT EARTH
- : EARTHING BAR
- : INSTRUMENT EARTHING BAR
- : EARTHING CONNECTION (BOLTED /REMOVABLE)
- : EARTHING CONNECTION (WELDED)
- : EARTH PIT WITH TEST LINK
- LE : INDICATES EARTH PIT FOR LIGHTNING PROTECTION
- : EARTHING CABLE GOING UP
- : EARTHING CABLE COMING DOWN
- M : HV MOTOR
- M : MV MOTOR
- : LOCAL DISTRIBUTION PANEL
  - XX - NORMAL LIGHTING PANEL (LP)
  - EMERGENCY LIGHTING PANEL (ELP)
  - SMALL POWER PANEL (SPP)
- : EMERGENCY STOP PB
- : LOCAL CONTROL STATION
- 0 : LOCAL CONTROL STATION WITH AMMETER
- : WELDING OUTLET (63A)
- : HYDRO BLASTING OUTLET (250A)
- PJB : POWER JUNCTION BOX
- STC / XXX : SIGNIFIES EARTHING INSTALLATION DETAIL
- TYP x 2 : INDICATES STANDARD IS MULTIPLIED 2 TIMES.

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TITLE: LEGEND

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EQUIPMENT EARTHING SCHEDULE:

TYPE OF EQUIPMENT	EARTHING CONDUCTOR SIZES
MOTOR UP TO 3.7 KW	8 SWG SOLID G.I. WIRE
MOTOR ABOVE 5.5KW UPTO 30KW & WELDING RECEPTACLE	10 MM (3/8") DIA G.I WIRE ROPE
MOTOR ABOVE 30KW INCLUDING HV MOTORS	16 MM (5/8") DIA G.I WIRE ROPE/40 X 5 MM GI STRIP
BUILDING COLUMNS	40 X 5 MM GI STRIP
STORAGE TANKS (VERTICAL & HORIZONTAL)	40 X 5 MM GI STRIP
LOADING RACKS	40 X 5 MM GI STRIP
VESSELS & HEAT EXCHANGERS	40 X 5 MM GI STRIP
SMALL EQUIPMENTS & INSTRUMENTS	8 SWG SOLID G.I. WIRE
LIGHTING / POWER PANEL / INSTRUMENT PANEL	10 MM (3/8") DIA G.I WIRE ROPE
MAIN EARTH BUS / MV & HV SWITCHGEAR INTERCONNECTION / POWER TRANSFORMER	AS PER CALCULATION
EHV & HV SUB-STATIONS	AS PER CALCULATION
PUSH BUTTON STATIONS	8 SWG SOLID G.I. WIRE
STREET LIGHT POLES	10 MM (3/8") DIA G.I WIRE ROPE
LIGHTING TRANSFORMER	16 MM (5/8") DIA G.I WIRE ROPE
PIPE RACK	40 X 5 MM GI STRIP
BONDING OF PIPE	25 Sq.mm INSULATED FLEXIBLE CU.CABLE

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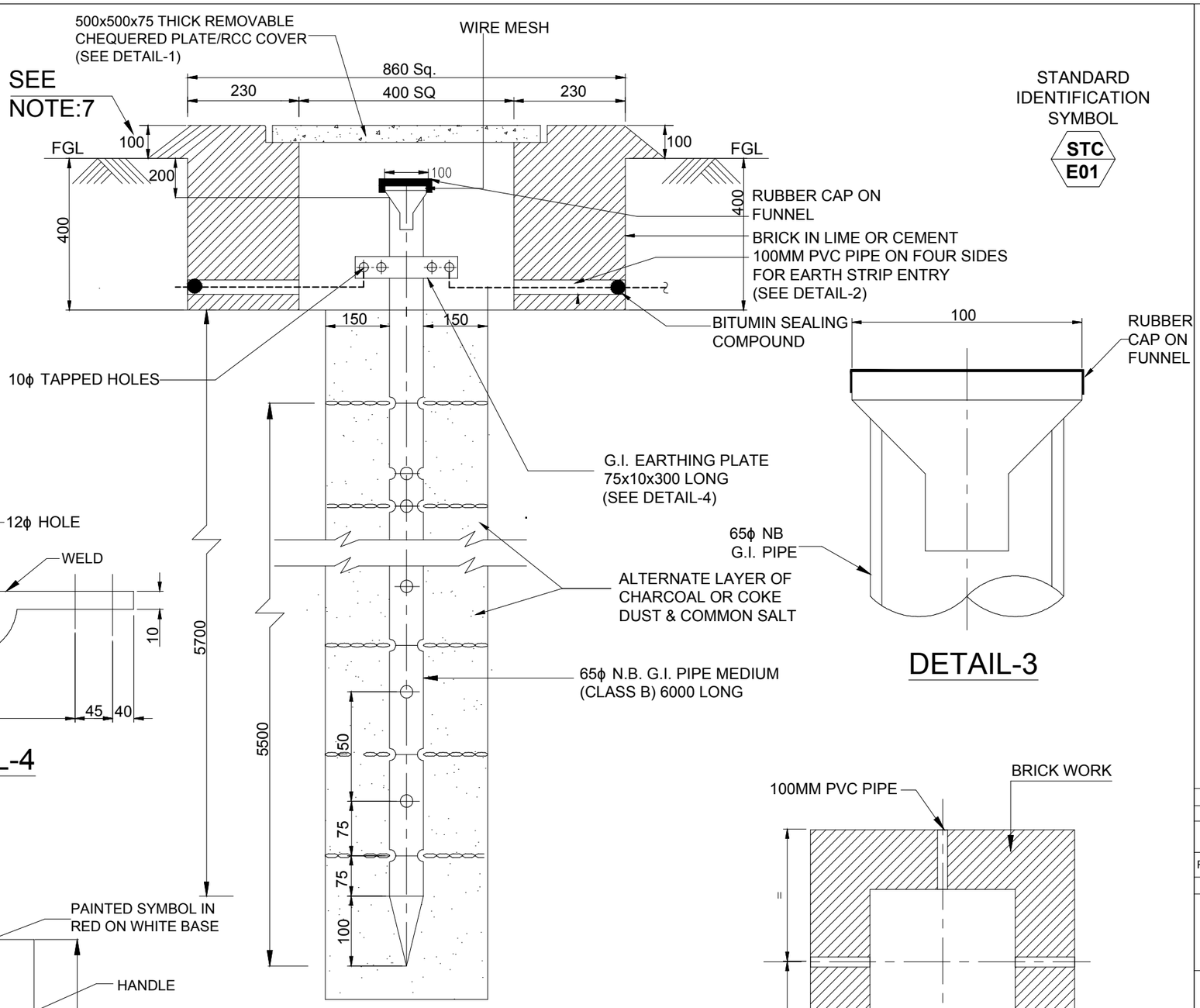
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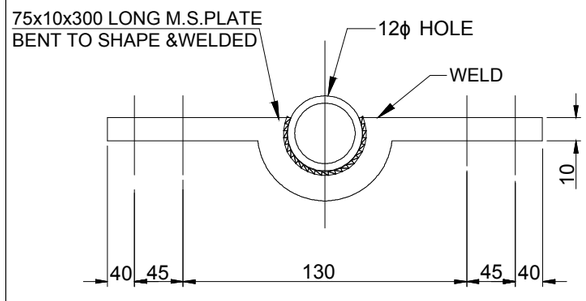
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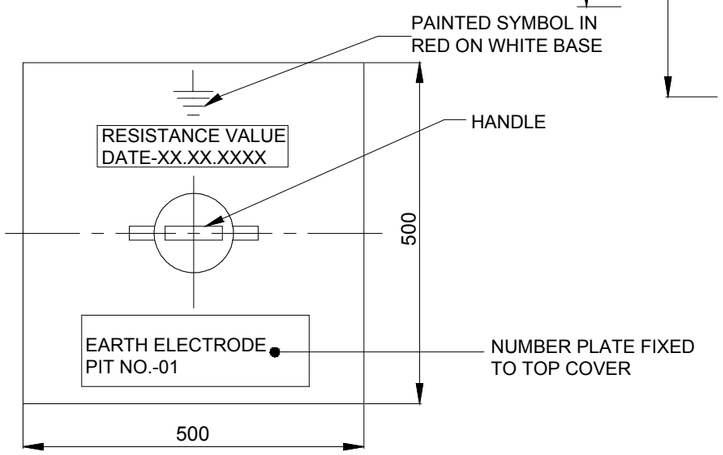
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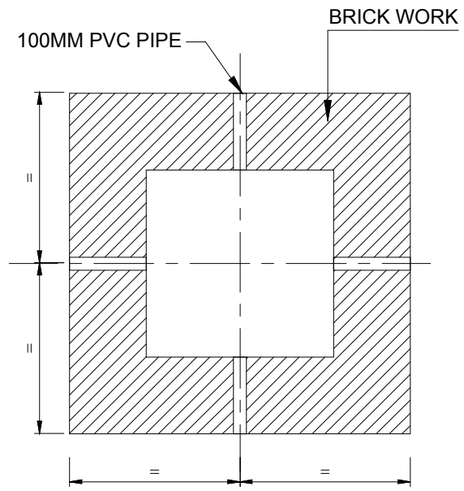


DETAIL-4



DETAIL-1

DETAIL-3



DETAIL-2

NOTES:

1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.
2. BRICK WORK SHALL BE DONE AFTER COMPACTING THE SOIL.
3. AFTER REMOVAL OF CAP, OWNER SHALL BE ABLE TO POUR WATER THROUGH THE FUNNEL WITH STEEL WIRE MESH.
4. COLOR CODING & PAINTING OF COVER SHALL BE AS PER OISD NORMS.
5. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
6. IN CASE OF PAVED AREA, TOP OF PIT SHALL BE FLUSHED WITH F.F.L., WHEREAS IN UNPAVED AREA, TOP OF PIT SHALL BE PROJECTED 100MM ABOVE F.G.L.
7. ALL EARTH PITS SHALL BE MARKED WITH EARTH PIT NUMBER FOR EASY IDENTIFICATION. IN ADDITION, METALLIC TAG IS ALSO TO BE FASTENED WITH THE EARTH ELECTRODE INSIDE THE PIT AS A PERMANENT INDENTIFICATION.
8. PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.

STANDARD IDENTIFICATION SYMBOL

STC
E01

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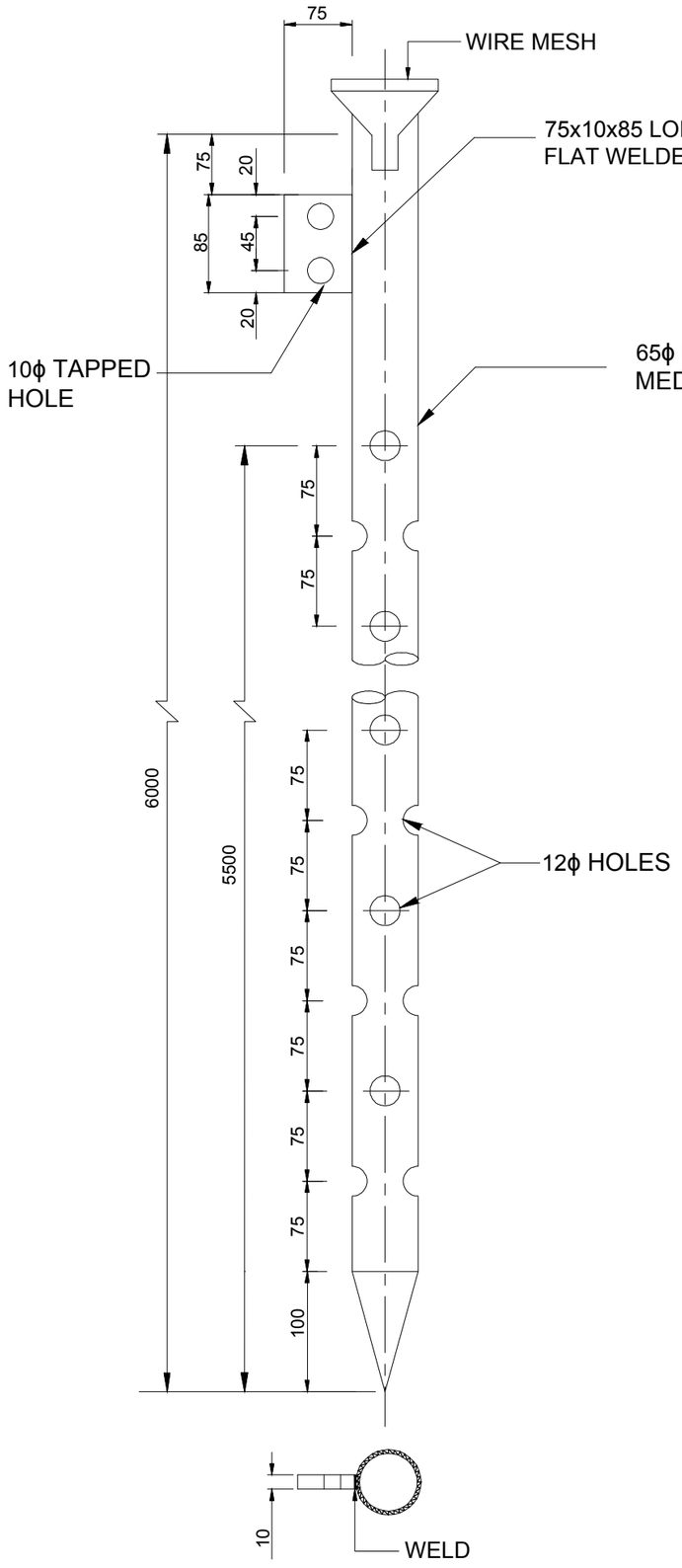
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TITLE: TYPICAL INSTALLATION OF EARTH PIT

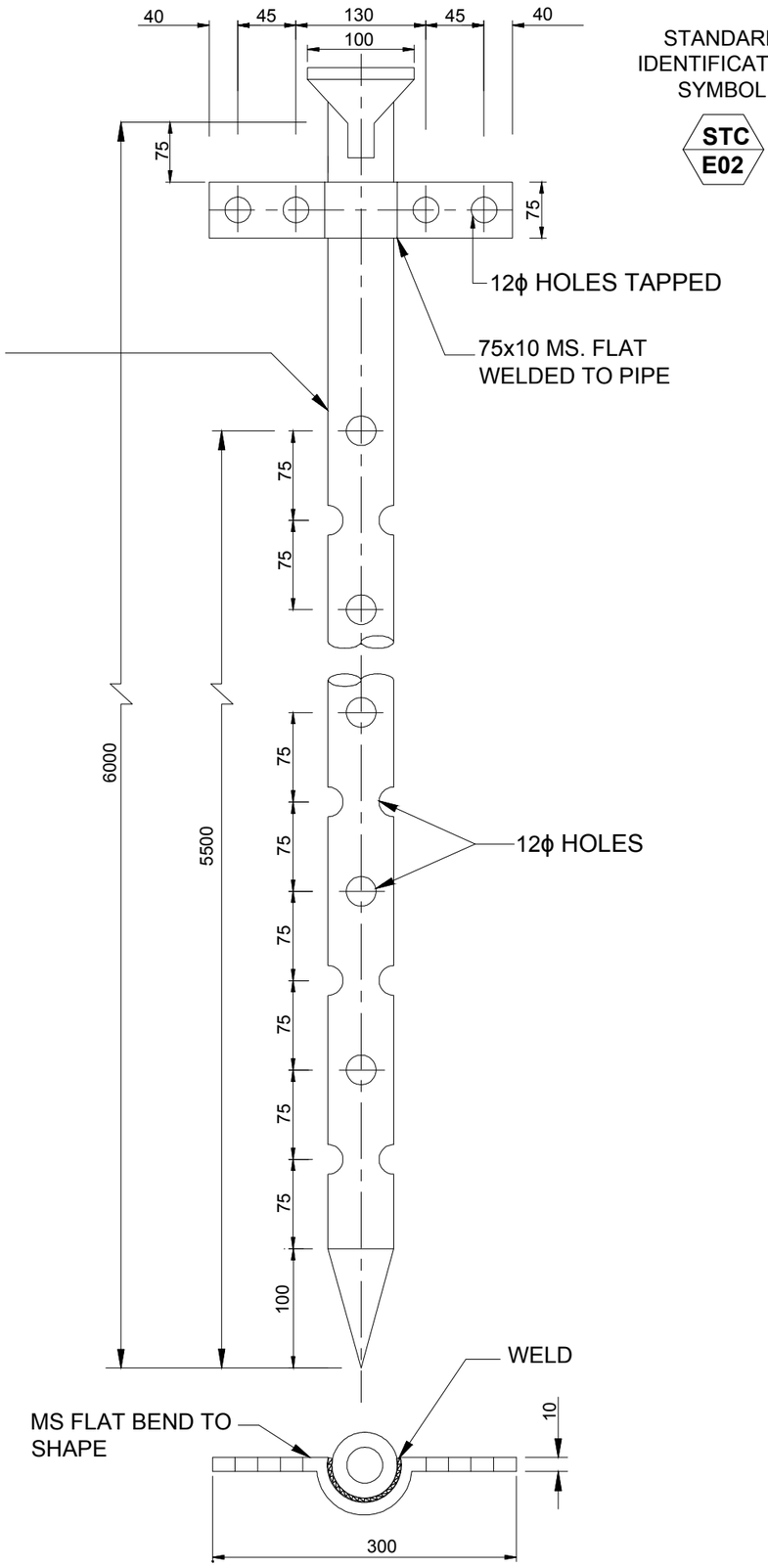
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-001-06.DWG

SHEET SIZE : A3



TYPE-1



TYPE-2

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION, IN CASE OF G.I.
3. GI COVER CAP SHALL BE PLACED OVER THE EARTH ELECTRODE AFTER REMOVING THE FUNNEL FROM THE TOP.
4. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
5. ALL SUITABLE HARDWARE LIKE BOLT, LOCK NUT, SPRING & PLAIN WASHER REQUIRED FOR CONNECTION SHALL BE SUPPLIED BY ELECTRICAL CONTRACTOR.
6. ELECTRICAL CONTRACTOR TO SUPPLY 25% OF THE TOTAL G.I. COVER CAP BEING SUPPLIED.
7. UNLESS STATED OTHERWISE ON PLAN DRG. ONLY TYPE-2 SHALL BE USED.

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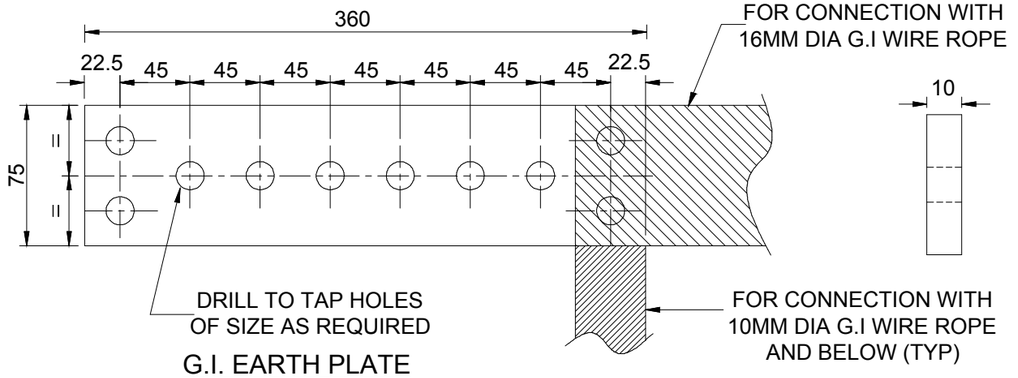
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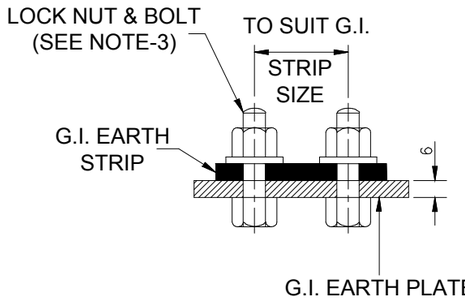
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G.I. EARTH PLATE



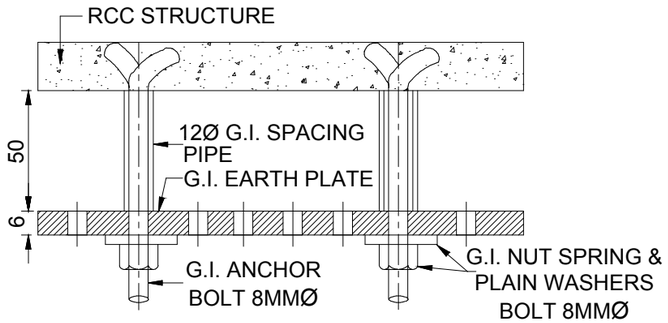
TYPICAL FIXING DETAIL OF G.I EARTH STRIP TO EARTH PLATE

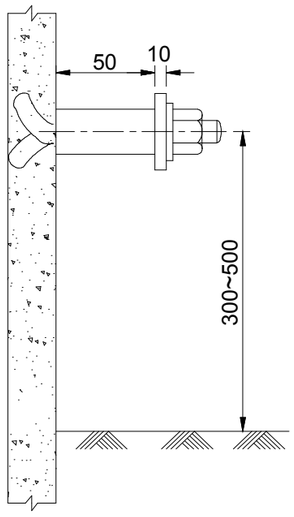
STANDARD IDENTIFICATION SYMBOL

STD
E03

NOTES:

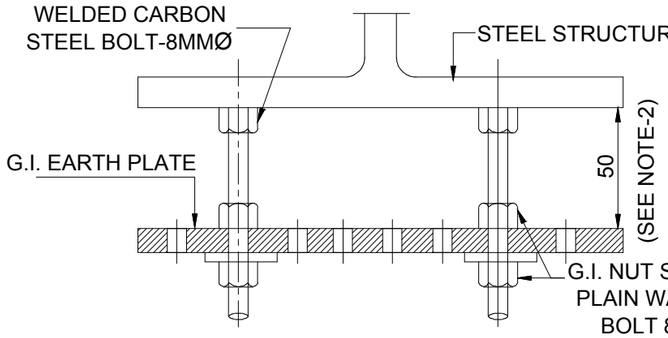
1. ALL DIMENSIONS ARE IN MM.
2. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED, LENGTH OF CARBON STEEL BOLT SHALL BE INCREASED FOR FIXING OF EARTH PLATE.
3. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH G.I BOLD, NUT, SPRING AND PLAIN WASHERS.
4. CONNECTION BETWEEN EARTH PLATE AND EARTHING STRIP SHALL BE MADE BY WELDING GENERALLY. HOWEVER BOLTING CAN BE USED IN SPECIFIC CASES.
5. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
6. ALL SUITABLE HARDWARE LIKE BOLT, LOCK NUT, SPRING & PLAIN WASHER REQUIRED FOR CONNECTION SHALL BE SUPPLIED BY ELECTRICAL CONTRACTOR.
7. ISMC 100 SHALL BE USED FOR NON FIREPROOF STRUCTURE AND ISMC 150 SHALL BE USED FOR FIREPROOF STRUCTURE.

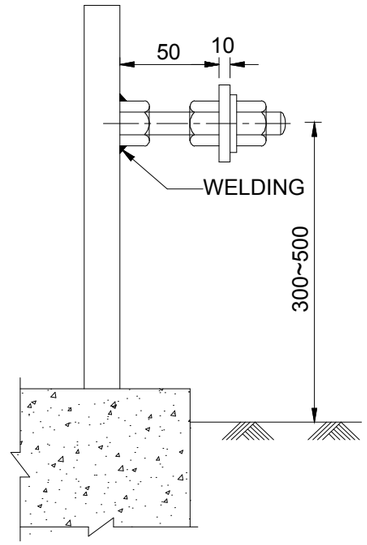




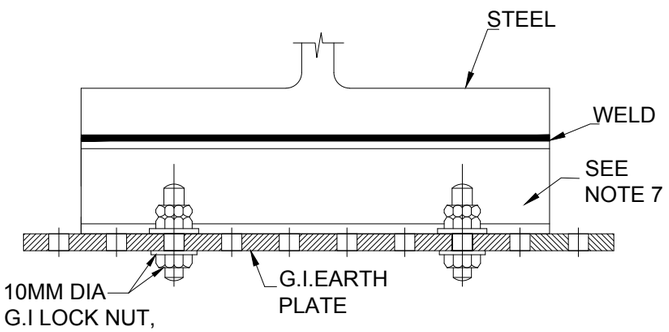
TYPICAL INSTALLATOIN OF EARTH PLATE ON R.C.C. STRUCTURES

OPTION-A

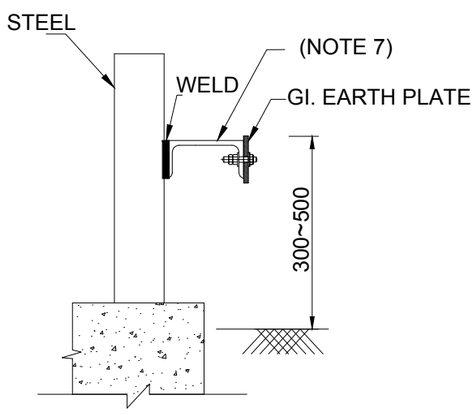




OPTION-B



FIXING ARRANGEMENT ON STEEL SURFACE



TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES

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TITLE: TYPICAL EARTH PLATE FIXING DETAILS

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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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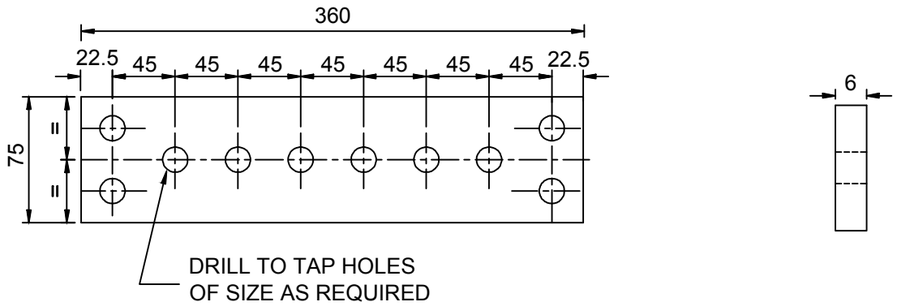
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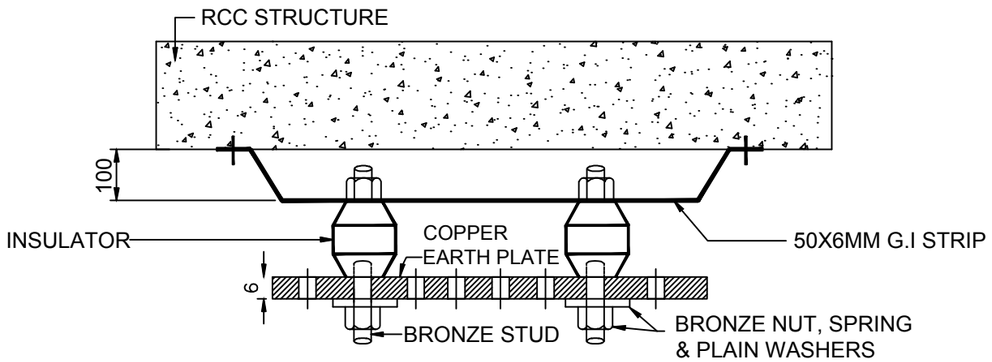
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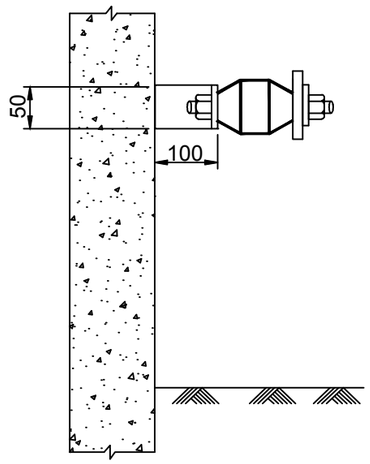
STANDARD IDENTIFICATION SYMBOL

STC
E04



COPPER EARTH PLATE





TYPICAL INSTALLATION OF INSULATED EARTH PLATE ON R.C.C STRUCTURES

NOTES:

1. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE BRONZ STUD, NUT, SPRING AND PLAIN WASHERS.

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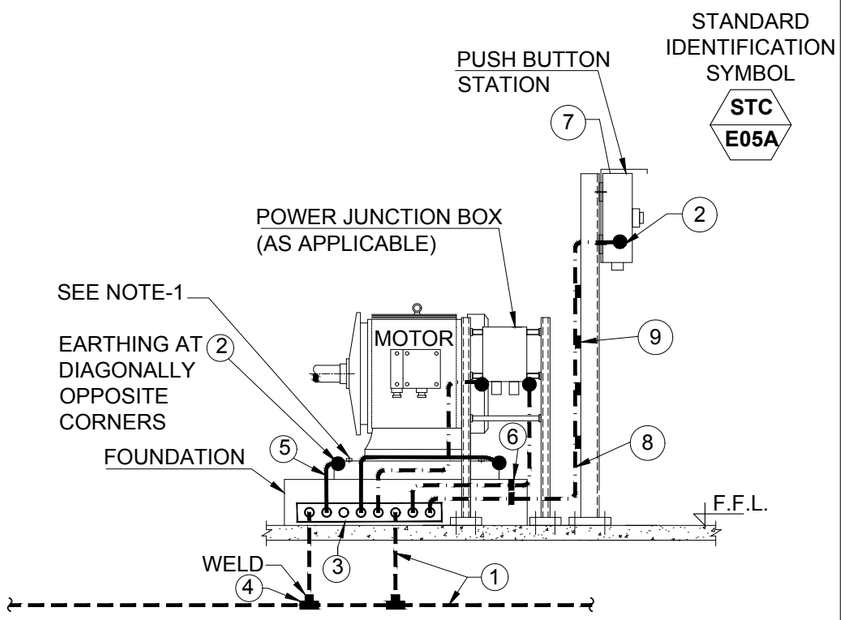
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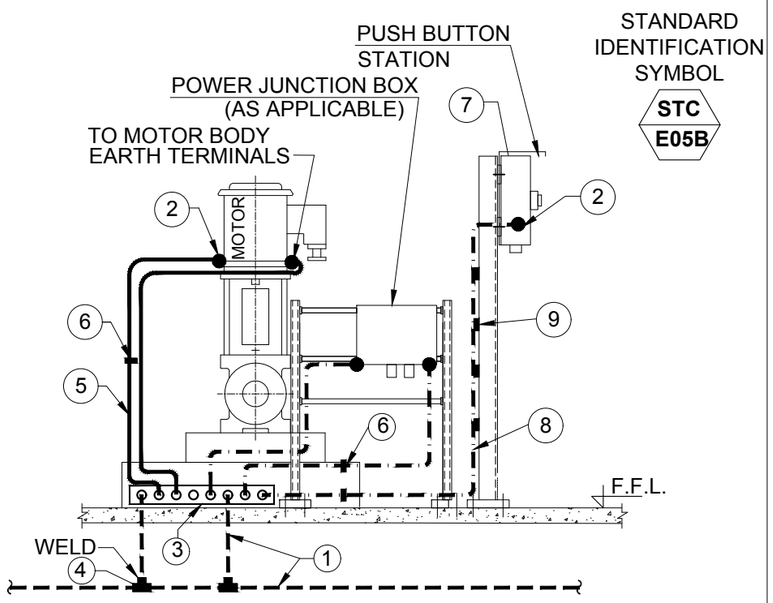
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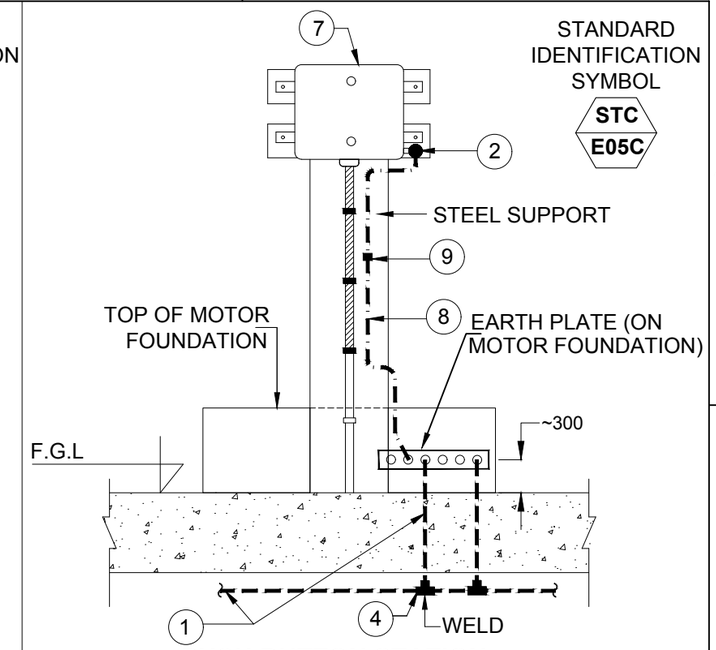
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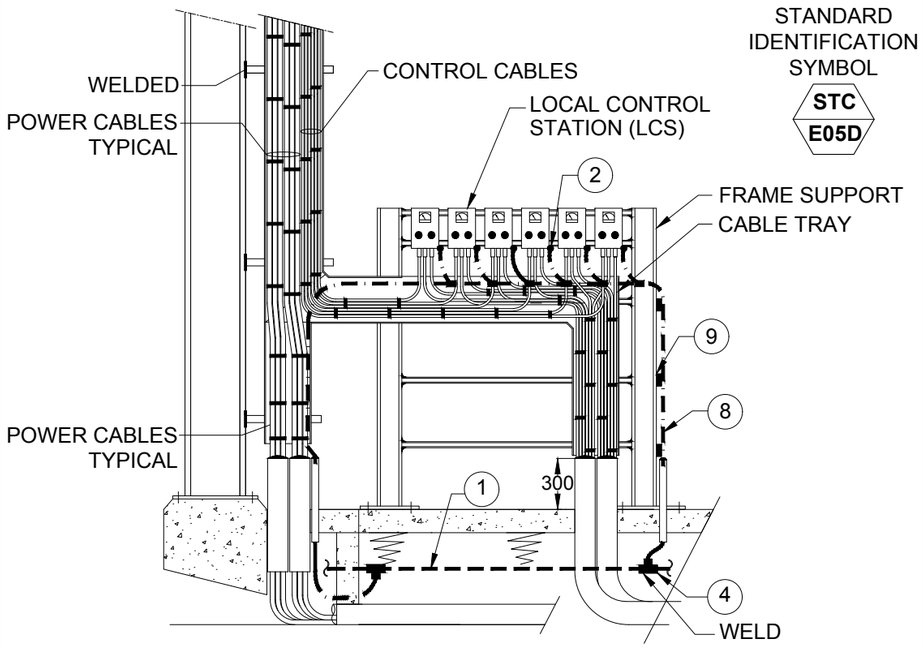
HORIZONTAL MOTOR AND LCS EARTHING CONNECTION WITH BURIED EARTH GRID



VERTICAL MOTOR AND LCS EARTHING CONNECTION WITH BURIED EARTH GRID



PUSH BUTTON STATION MOUNTED ON STEEL/CONCRETE SUPPORT



GROUP OF LCS ON STAND

ITEM	COMPONENT DESCRIPTION
1	MAIN EARTH GRID G.I. STRIP
2	LUG, G.I. NUT, BOLT & WASHER FOR CONNECTIONS OF EARTHING WIRE/STRIP
3	G.I. EARTH PLATE AS PER STANDARD
4	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE
5	G.I. WIRE AS PER MOTOR TYPE (SEE TABLE-1)
6	G.I CLAMP WITH FIXING SCREW (AT 400MM INTERVAL)
7	PUSH BUTTON STATION
8	8 SWG SOLID G.I. WIRE
9	G.I CLAMP WITH FIXING SCREW/BASE/SELF TAPING SCREW AT REGULAR INTERVAL OF 400MM

NOTES:

1. MOTOR FOUNDATION BOLT SHALL NOT BE USED FOR EARTHING.
2. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
3. PUMP HANDLING HYDROCARBON IF ITS BASE PLATE IS SEPARATE FROM MOTOR'S BASE PLATE SHALL BE EARTHED.
4. IN CASE OF HV MOTOR METALLIC SKID SHALL BE SEPARATELY EARTHED.
5. FOR INSTALLATION OF EARTH PLATE REFER STD E03 / E04

TABLE-1:

TYPE OF MOTOR	EARTHING CONDUCTOR SIZES
MOTOR UP TO 3.7 KW	8 SWG SOLID G.I. WIRE
MOTOR ABOVE 5.5KW UPTO 30KW	10 MM (3/8") DIA G.I WIRE ROPE
MOTOR ABOVE 30KW INCLUDING HV MOTORS	16 MM (5/8") DIA G.I WIRE ROPE/40 X 5 MM GI STRIP

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL EARTHING OF ELECTRIC MOTOR AND PUSH BUTTON STATION

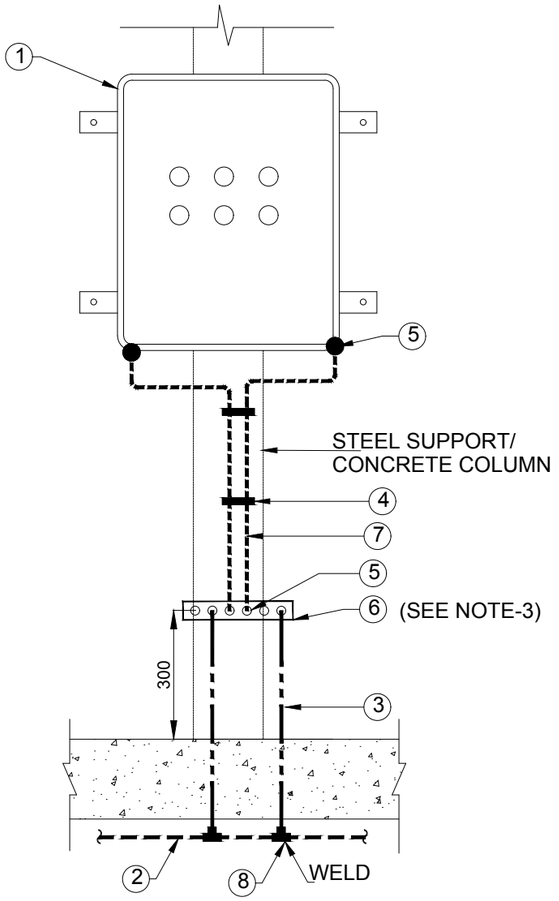
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SCALE	080557C001	000	STC	1691	001	10 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-001-10.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

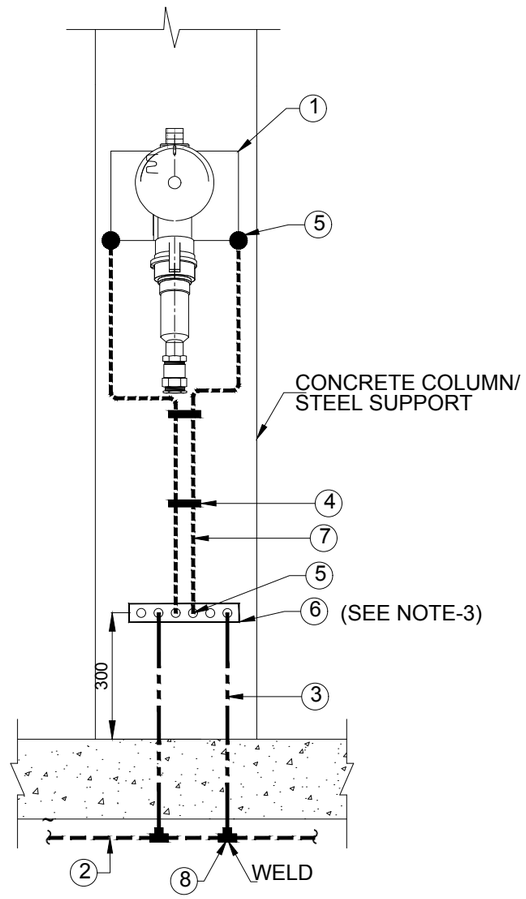
STD E06A



LOCAL PANEL / POWER JUNCTION BOX MOUNTED ON CONCRETE COLUMN/ STEEL SUPPORT

STANDARD IDENTIFICATION SYMBOL

STD E06B



WELDING RECEPTACLE MOUNTED ON STEEL SUPPORT/ CONCRETE COLUMN

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	LOCAL PANEL/JUNCTION BOX/WELDING RECEPTACLE	MTR.	AS REQUIRED.
2	MAIN EARTH GRID	MTR.	AS REQUIRED.
3	40x5 MM G.I. EARTH STRIP	MTR.	AS REQUIRED.
4	G.I CLAMP WITH FIXING SCREW	SET	AS REQUIRED.
5	LUG, GI NUT, BOLT & WASHER FOR CONNECTION OF CABLE	NO.	2
6	G.I. EARTH PLATE AS PER STANDARD	NO.	1
7	10 MM (3/8") DIA G.I WIRE ROPE	MTR.	AS REQUIRED.
8	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. ALL DIMENSION ARE IN MM.
2. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
3. FOR INSTALLATION OF EARTH PLATE REFER STD E03.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL INSTALLATION OF EARTH PIT

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	06 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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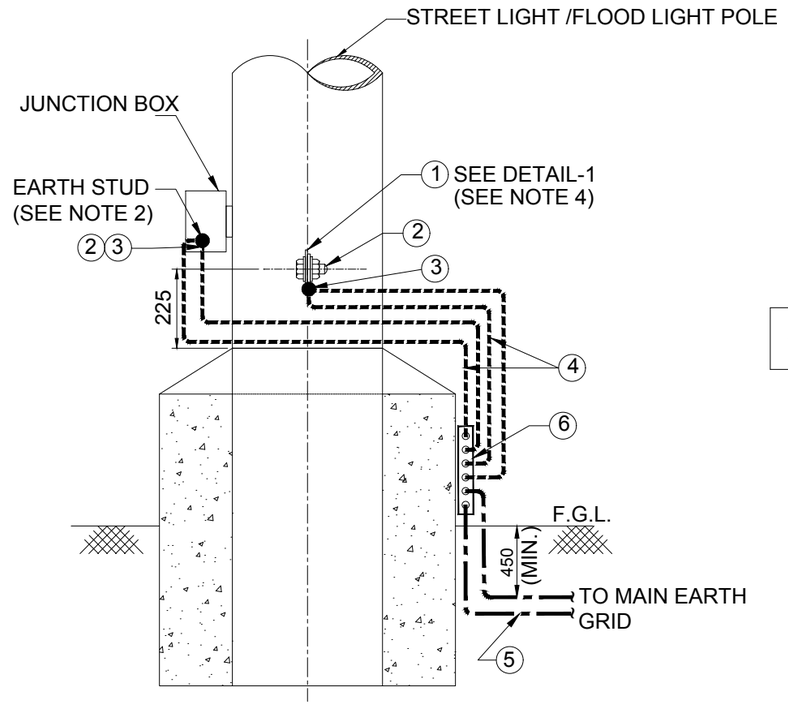
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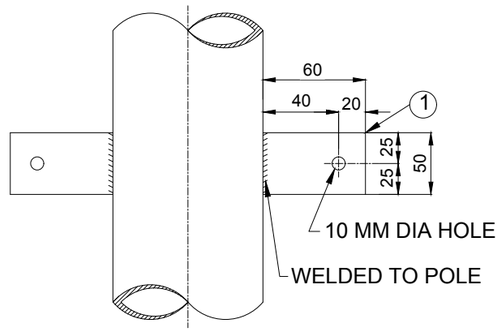
SHEET SIZE : A3

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STANDARD IDENTIFICATION SYMBOL

STC
E07





DETAIL-1

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION	NO.	AS REQUIRED.
2	LUG 10mmØ GLAVINISED M.S. BOLT NUT AND SPRING WASHER	SET	3
3	TERMINAL LUG CONNECTOR	NO.	2
4	10 MM (3/8") DIA G.I WIRE ROPE	MTR.	AS REQUIRED.
5	50x6 MM G.I. EARTH STRIP	MTR.	AS REQUIRED.
6	G.I. EARTH PLATE AS PER STANDARD	NO.	1

LIGHTING POLE

NOTES:

1. ALL DIMENSION ARE IN MM.
2. USE TWO EARTH WIRES IF VOLTAGE IN THE POLE JUNCTION BOX IS 415 VOLTS.
3. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
4. EACH STREET LIGHTING POLE SHALL BE EARTHED AT TWO POINTS BY CONNECTING TO THE PLANT EARTH GRID.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
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DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
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DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL EARTH CONNECTION FOR STREET LIGHT/FLOOD LIGHT POLE

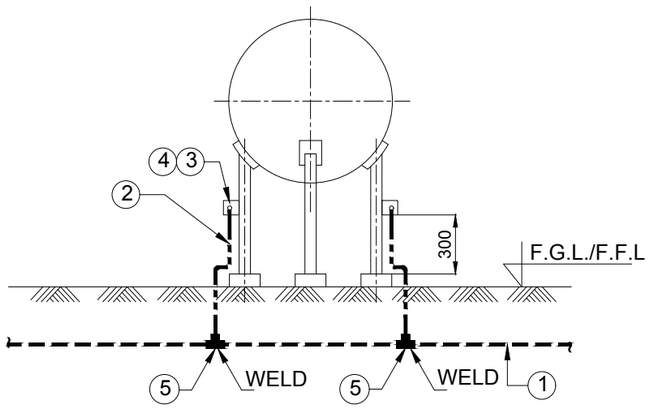
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	12 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-001-12.DWG

SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

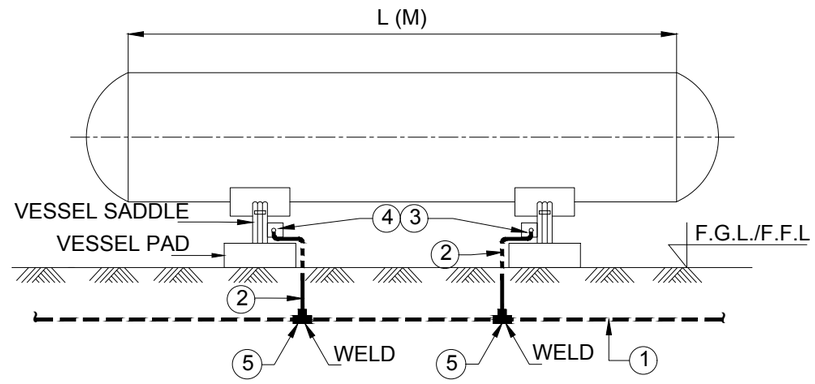
STC
E08A



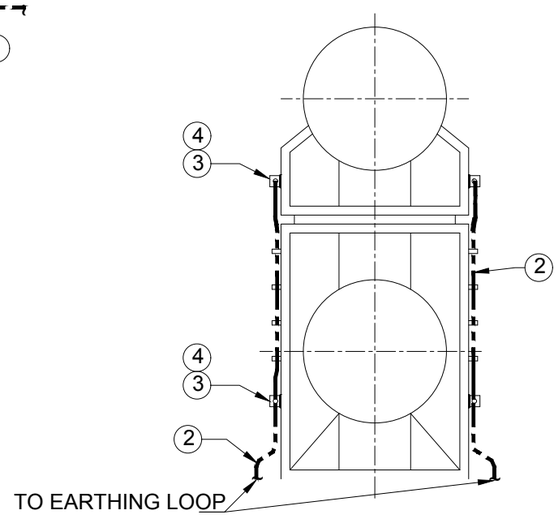
SPHERE EARTHING

STANDARD IDENTIFICATION SYMBOL

STC
E08B



HORIZONTAL VESSEL EARTHING



EARTHING FOR STACKED VESSELS

L IN METERS	NUMBER OF EARTHING CONNECTIONS
≤ 20 M	2
> 20 M	4

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 G.I. STRIP	MTR.	AS REQUIRED.
3	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION	NO.	2
4	10 MM DIA 25 LONG G.I.BOLT, NUT AND TWO SPRING WASHERS.	SET	2
5	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. TWO NOS. OF EARTHING LUGS WILL BE AVAILABLE ON LEG SUPPORTS (DIAMETRICALLY OPPOSITE) OF EQUIPMENT FOR PROVIDING EARTH CONNECTION.
2. ALL VESSELS, SPHERES AND COLUMNS SHALL HAVE TWO EARTH CONNECTIONS IN GENERAL.
3. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
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DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL EARTH CONNECTION FOR VESSEL & SPHERE

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	13 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

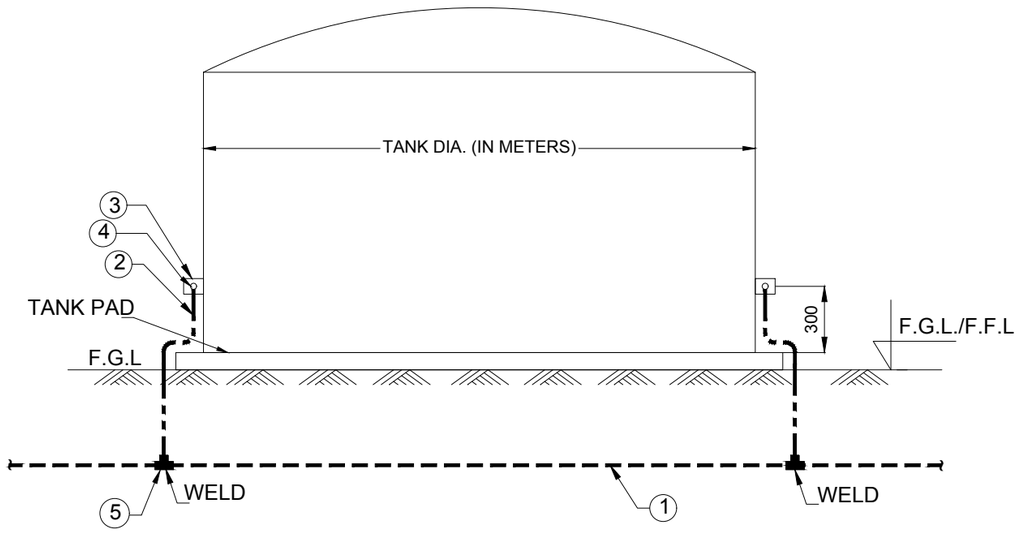
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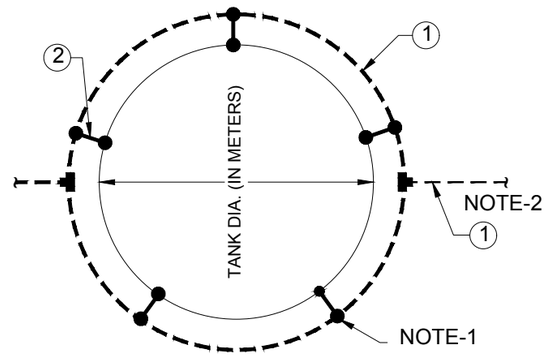
SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
E09



TANK EARTHING
(NTS)



PLAN
(NTS)

TABLE-A

TANK DIAMETER (IN METERS)	EARTHING CONNECTION
<5	1
<20	2 AT 180°
<30	3 AT 120°
>40	4 AT 90°
>50	5 AT 72°
>60	6 AT 60°
>70	7 AT 51.43°
>80	8 AT 45°
>90	9 AT 40°

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 MM G.I. EARTH STRIP	MTR.	AS REQUIRED.
3	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION	NO.	AS REQUIRED.
4	10MM DIA 25 LONG BOLT,NUT AND TWO SPRING WASHERS.	SET	AS REQUIRED.
5	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. NO. OF EARTHING CONNECTION SHALL BE AS PER TABLE-A
2. EARTH LOOP AROUND THE TANK SHALL BE CONNECTED AT LEAST TWO POINT WITH MAIN EARTH GRID.
3. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
4. ITEM 3 (G.I FLAT) NEEDS TO BE SUPPLIED ONLY IF SAME IS NOT ATTACHED WITH EQUIPMENT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: TYPICAL EARTH CONNECTION FOR TANK

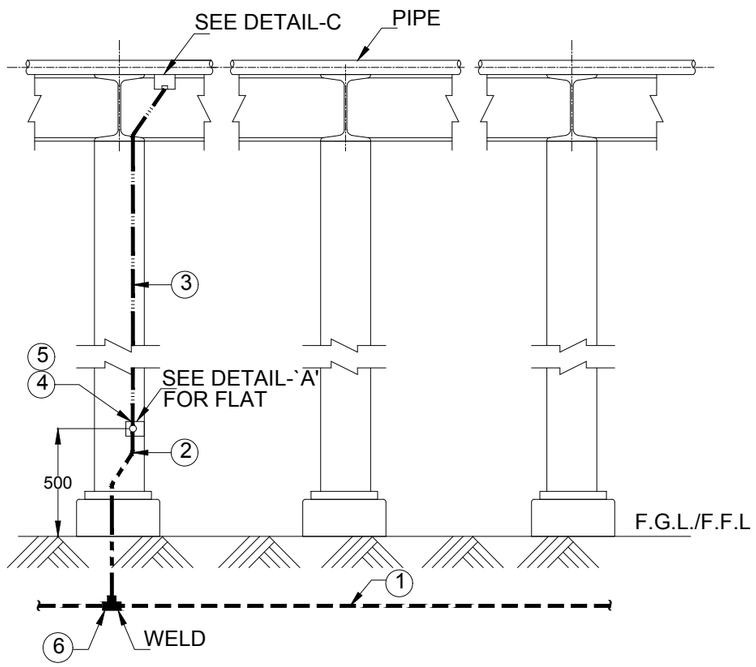
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SCALE	080557C001	000	STC	1691	001	14 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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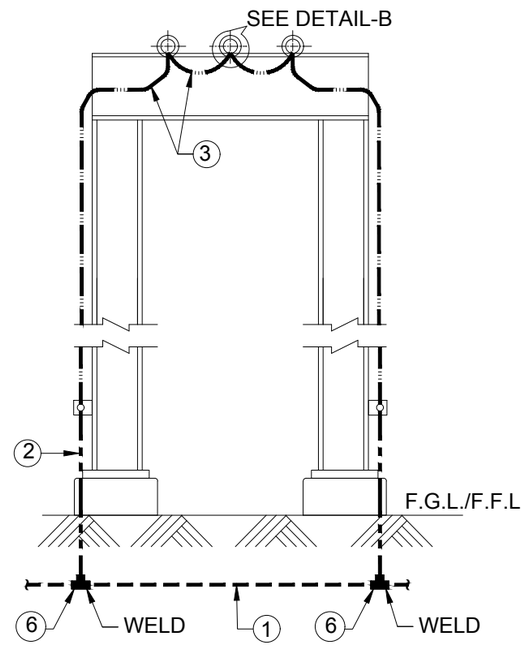
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PIPE RACK

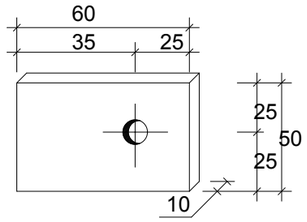


SIDE VIEW

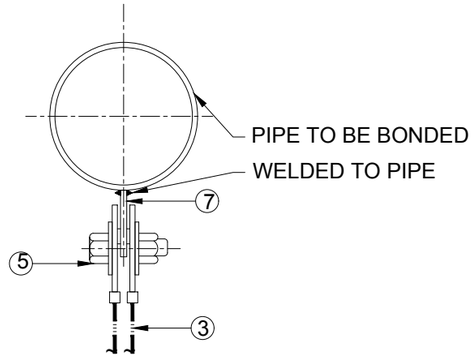
STANDARD IDENTIFICATION SYMBOL

STC
E10

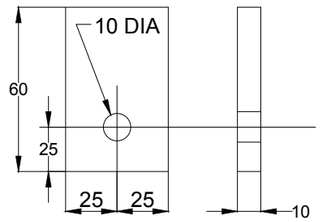
ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 MM GI EARTH STRIP	MTR.	AS REQUIRED.
3	25 Sq.MM INSULATED FLEXIBLE CU.CABLE	MTR.	AS REQUIRED.
4	GI FLAT, 50x10x(60+LENGTH OF FIRE PROOFING)	NO.	1
5	LUG 8 MM DIA. G.I. BOLT, NUT & WASHERS AND CRIMPED TYPE CABLE LUG FOR 25Sq.MM FLEXIBLE Cu CABLE	NO.	AS REQUIRED.
6	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.
7	50x10x60 MM GI FLAT FOR EARTH TERMINATION	-	AS REQUIRED.
8	CRIMPED TYPE CABLE LUG FOR 25 SQ.MM FLEXIBLE CU. CABLE.	NO.	AS REQUIRED.



DETAIL-`A'



DETAIL-`B'



DETAIL-`C'

NOTES:-

1. UNLESS MENTIONED OTHERWISE ON DRAWING OR JOB SPECIFICATIONS, THE PIPE LINES SHALL BE BONDED AND EARTHED AT THE ENTRY AND EXIT POINTS OF BATTERY LIMIT.
2. EARTH CONTINUITY SHALL BE ENSURED ACROSS ALL THE FLANGES IN PROCESS UNITS AND OTHER HAZARDOUS AREAS. EQUIPMENT LOCATED REMOTE FROM MAIN EARTH NETWORK, MAY BE EARTHED BY MEANS OF INDIVIDUAL EARTH CONDUCTORS AND EARTH ELECTRODES.
3. STEEL PIPE RACKS IN THE PROCESS UNIT AND OFFSITE AREA SHALL BE EARTHED AT EVERY 25 METERS.
4. HOT DEEP GALVANISED G.I. FLAT AS PER DETAIL-C SHALL BE PROVIDED BY THE PIPING CONTRACTOR BEFORE HYDROTESTING OF LINE.
5. SUPPLY OF LUGS, BOLT, NUTS AND WASHERS ETC. AND MAKING CONNECTION SHALL BE DONE BY ELECTRICAL CONTRACTOR.
6. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL EARTHING/BONDING OF PIPES AND PIPE RACKS

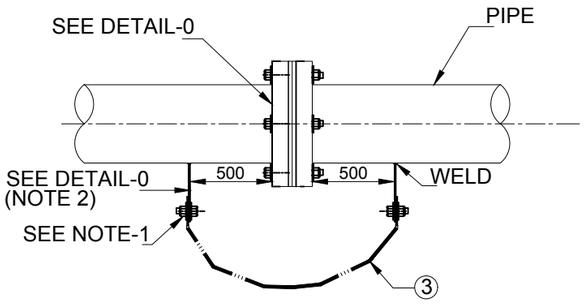
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	15 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1691-001-15.DWG

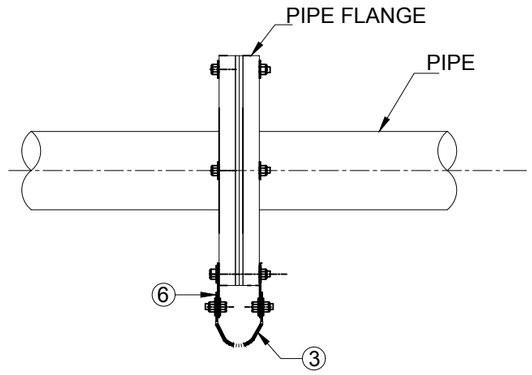
SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

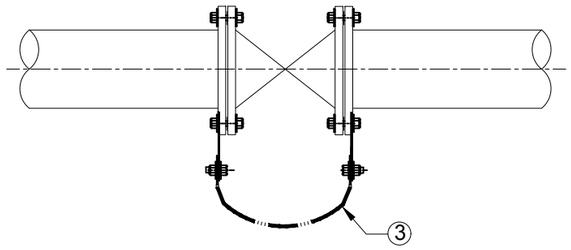
STC
E11



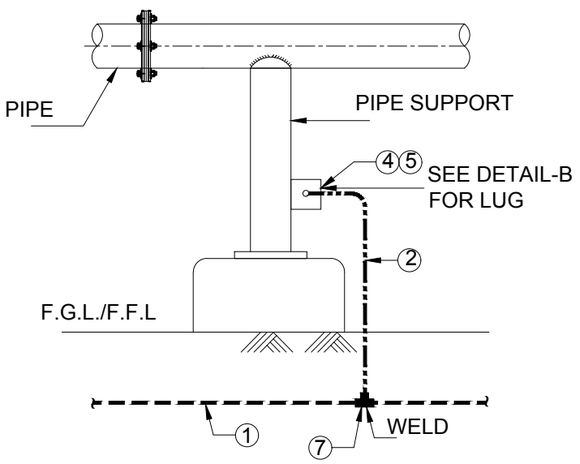
ARRANGEMENT-1



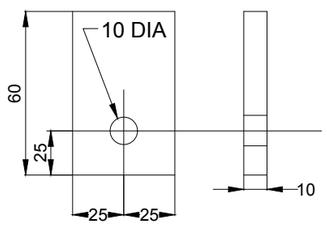
ARRANGEMENT-2
(APPLICABLE WHERE GLAVANISED M.S. FLAT ARE NOT AVAILABE AS PER ARRANGMENT-1)



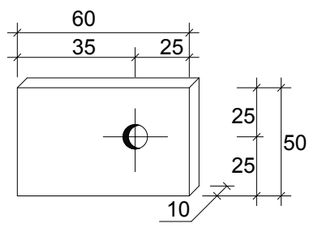
ARRANGEMENT-3
(APPLICABLE WHERE VALVES BETWEEN FLANGES)



ARRANGEMENT-4
(APPLICABLE WHEREVER PIPE SUPPORT ARE ON BOTH SIDE OF FLANGES/VALVES ETC.)



DETAIL-'A'



DETAIL-`B'

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 MM GI EARTH STRIP	MTR.	AS REQUIRED.
3	25 Sq.MM INSULATED FLEXIBLE CU.CABLE	MTR.	AS REQUIRED.
4	GI FLAT, 50x10x(60+LENGTH OF FIRE PROOFING)	NO.	1
5	LUG 8 MM DIA. G.I. BOLT, NUT & WASHERS	NO.	AS REQUIRED.
6	CRIMPED TYPE CABLE LUG FOR 25Sq.MM FLEXIBLE Cu CABLE	NO.	AS REQUIRED.
7	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. EARTH CONTINUITY SHALL BE ENSURED ACROSS ALL THE FLANGES IN PROCESS UNITS AND OTHER HAZARDOUS AREAS. EQUIPMENT LOCATED REMOTE FROM MAIN EARTH NETWORK, MAY BE EARTHED BY MEANS OF INDIVIDUAL EARTH CONDUCTORS AND EARTH ELECTRODES.
2. HOT DIP GALVANISED G.I. FLAT AS PER DETAIL-A SHALL BE PROVIDED BY THE PIPING CONTRACTOR BEFORE HYDROTESTING OF LINE.
3. SUPPLY OF ,LUGS , BOLT ,NUTS AND WASHERS ETC. AND MAKING CONNECTION SHALL BE DONE BY ELECTRICAL CONTRACTOR.
4. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
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- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
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TITLE
TYPICAL EARTH CONNECTION FOR PIPES

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	16 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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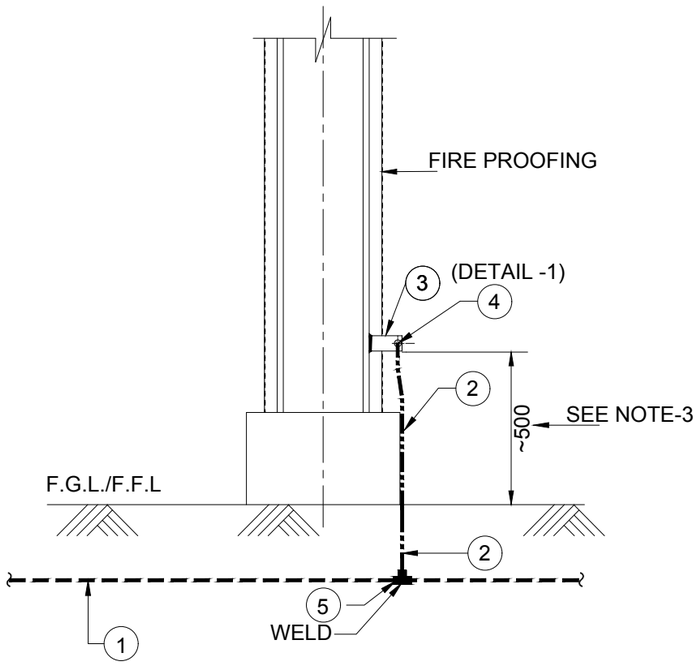
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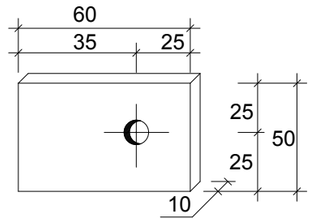
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STANDARD IDENTIFICATION SYMBOL

STC
E12



COLUMN EARTHING



LENGTH TO BE MAINTAINED
AFTER CLEARING FIRE PROOFING THICKNESS

DETAIL-1

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 MM GI EARTH STRIP	MTR.	AS REQUIRED.
3	GI FLAT, 50x10x(60+LENGTH OF FIRE PROOFING)	NO.	1
4	8 MM G.I. NUT, BOLT & SPRING WASHER	SET	AS REQUIRED.
5	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. STEEL PIPE RACKS IN THE PROCESS UNIT AND OFFSITE AREA SHALL BE EARTHED AT EVERY 25 METRES.
2. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
3. THE HEIGHT SHALL BE ADJUSTED AS PER SITE SUITABILITY IN CASE OF FIRE PROOFING.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL EARTH CONNECTION FOR STEEL/METALLIC COLUMN

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	17 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

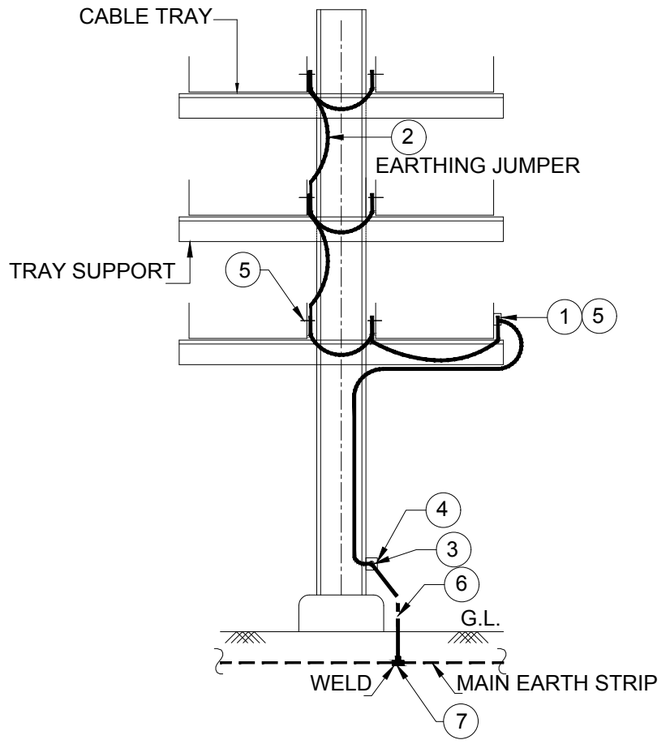
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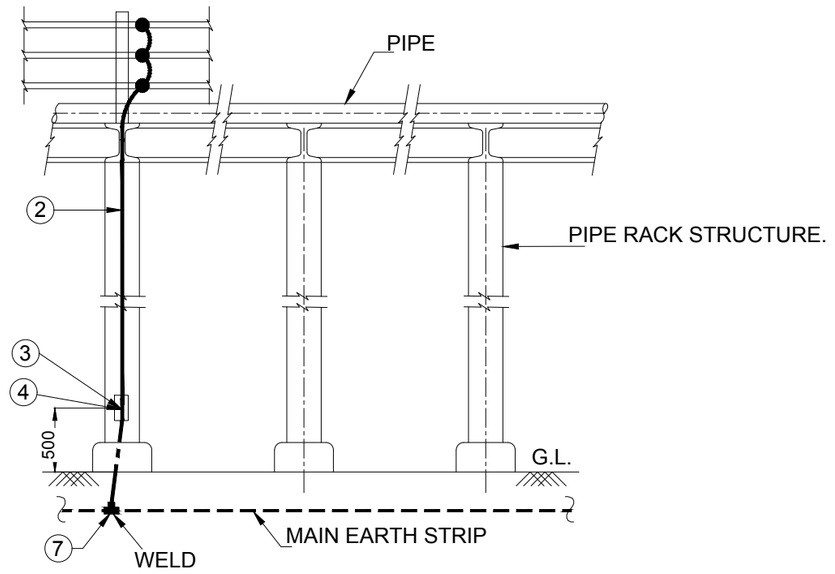
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STANDARD IDENTIFICATION SYMBOL

STC
E13



TYP. EARTH CONNECTION
(FOR CABLE TRAY)



SIDE VIEW

NOTES:

1. THE EARTHING CONDUCTOR SHALL RUN ALONG ONE OF THE CABLE TRAYS ALONG A CABLE ROUTE.
2. THE EARTHING CONDUCTOR SHALL BE SUITABLY CLEATED AND ELECTRICALLY BONDED TO ALL THE OTHER CABLE TRAYS ON THE SAME CABLE ROUTE AT A REGULAR INTERVAL OF 20 METER AND AT BOTH ENDS. THE EARTHING CONDUCTOR SHALL BE CONNECTED TO THE EARTH GRID AT EVERY 20m INTERVAL.
3. CABLE TRAY JOINTS FIXED WITH SPLICE PLATE BY NUT, BOLT & WASHERS, SHALL BE TIGHTENED TO FULL EXTENT TO ACHIEVE THE EARTH CONTINUITY BETWEEN CABLE TRAY JOINTS.
4. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

ITEM	COMPONENT DESCRIPTION
1	50x6 G.I. STRIP CONTINUOUS HORIZONTAL EARTH CONDUCTOR (ALONG CABLE TRAY)
2	16MM DIA G.I. WIRE ROPE
3	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION
4	8MM DIA 25 LONG BOLT,NUT AND TWO SPRING WASHERS.
5	LUG, 8MM DIA G.I. NUT BOLT & WASHER
6	50x6 MM GI EARTH STRIP
7	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE

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DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
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PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

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PMC: TechnipFMC

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TITLE: TYPICAL EARTHING OF CABLE TRAY

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	18 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

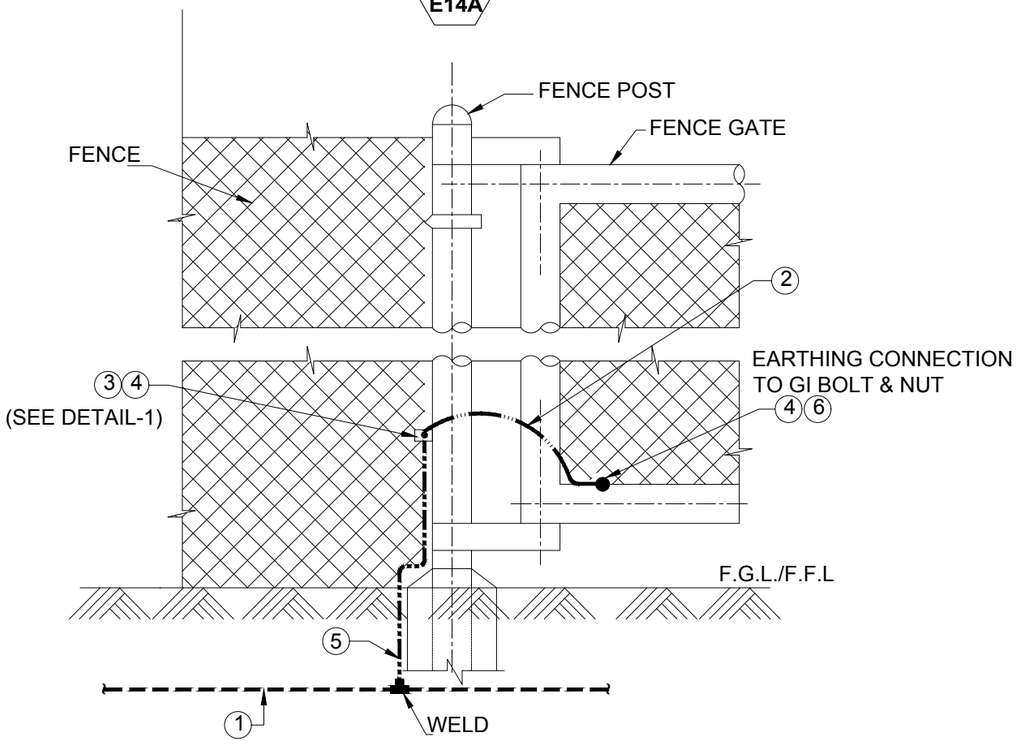
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STANDARD IDENTIFICATION SYMBOL

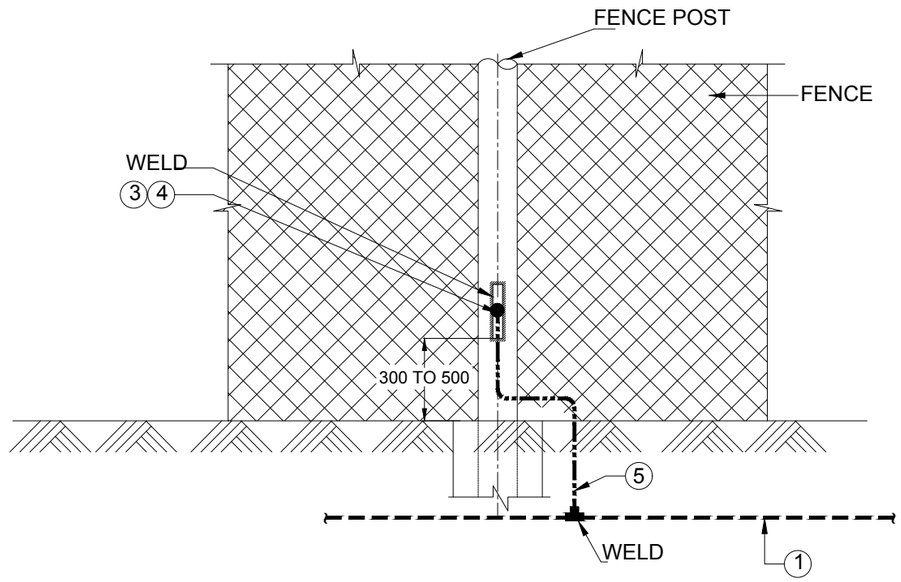
STC E14A



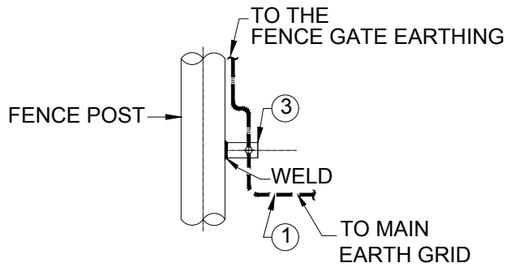
FENCE GATE

STANDARD IDENTIFICATION SYMBOL

STC E14B



FENCE POST



DETAIL-1

ITEM	COMPONENT DESCRIPTION
1	MAIN EARTH GRID
2	25 Sq.MM INSULATED FLEXIBLE CU.CABLE
3	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION
4	LUG, 25 Sq.MM INSULATED FLEXIBLE CU.CABLE
5	40x5 MM GI EARTH STRIP
6	8 MM DIA, G.I BOLT, NUT & WASHER

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DOCUMENT CATEGORY (USE " X " MARK)

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DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

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PMC: TechnipFMC

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TITLE: TYPICAL EARTHING/BONDING OF FENCE GATE

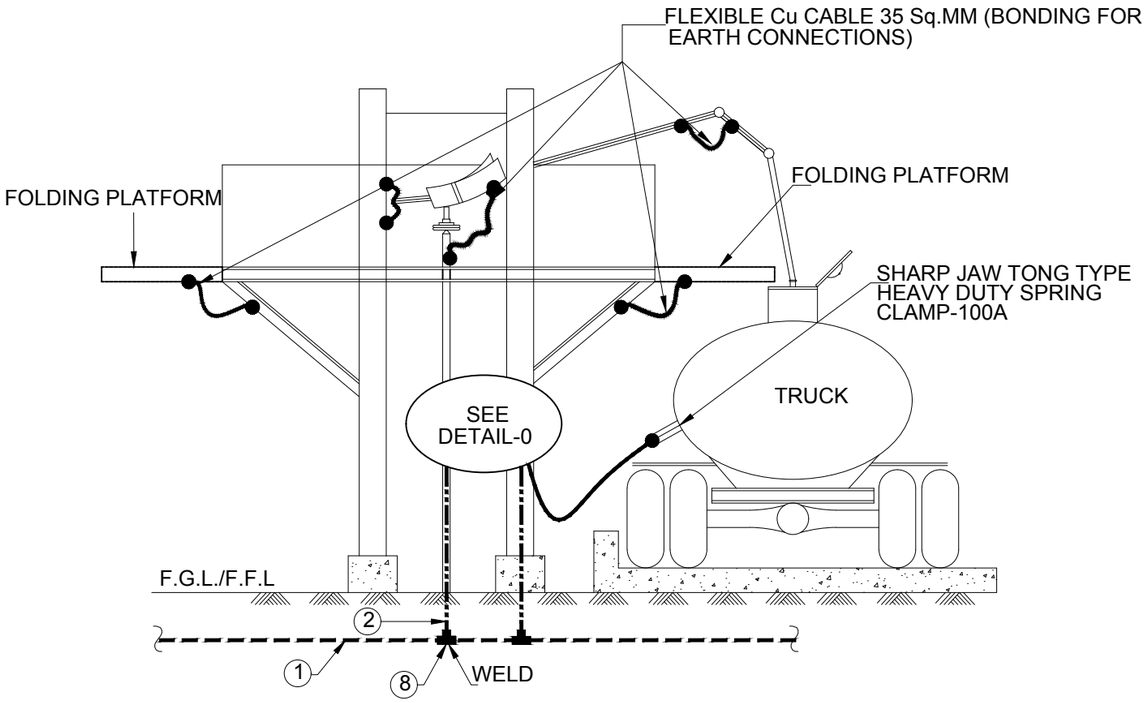
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	19 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

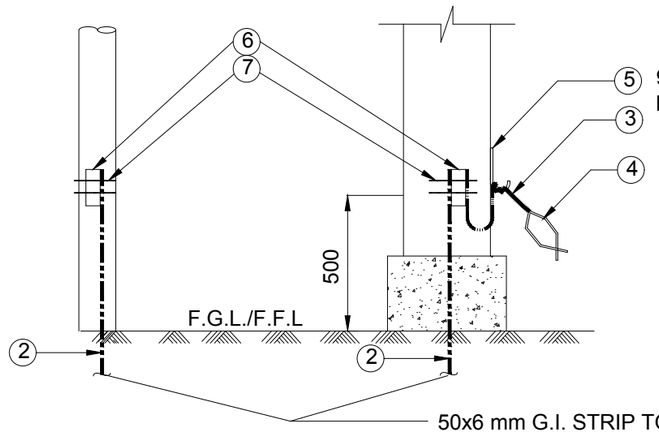
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SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
E15





DETAIL-A

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	40x5 G.I. STRIP	MTR.	AS REQUIRED.
3	25 Sq.MM INSULATED FLEXIBLE CU.CABLE	MTR.	AS REQUIRED.
4	SHARP JAW TONG TYPE HEAVY DUTY SPRING CLAMP-100A	NO.	1
5	9 DIA G.I. BAR	MTR.	AS REQUIRED.
6	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION	NO.	1
7	8MM DIA 25 LONG BOLT,NUT AND TWO SPRING WASHERS.	SET	2
8	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.

NOTES:

1. LOADING-ARM JOINTS SHALL BE BONDED BY 16 MM DIA G.I. WIRE ROPE.
2. IT SHOULD BE ENSURED THAT TRUCK IS EARTHED WITH SPRING CLAMP BEFORE FILLING.

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IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: TYPICAL EARTH CONNECTION FOR MOBILE LOAD & UNLOADING FACILITIES

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	20 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

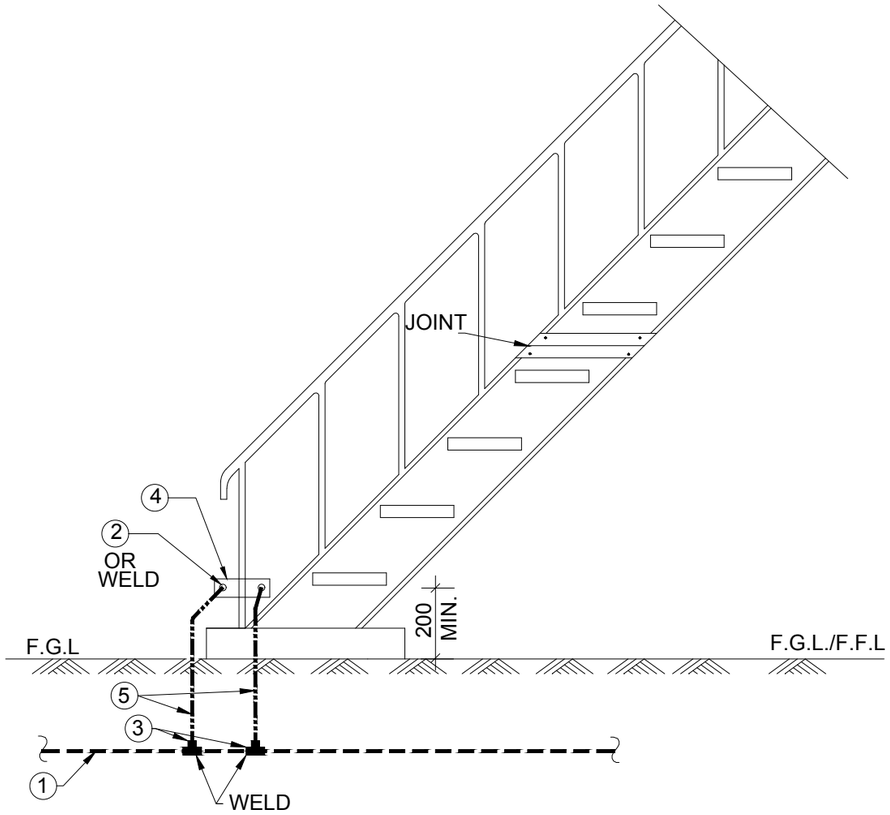
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SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
E16



STAIRWAY/LADDERS

ITEM	COMPONENT DESCRIPTION	UNIT	QUANTITY
1	MAIN EARTH GRID	MTR.	AS REQUIRED.
2	8MM DIA 25 LONG BOLT,NUT AND TWO SPRING WASHERS.	SET	AS REQUIRED.
3	TWO COATS OF BITUMEN IMPREGNATED HESSIAN TAPE	-	AS REQUIRED.
4	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION	NO.	AS REQUIRED.
5	40x5 G.I. STRIP	MTR.	AS REQUIRED.

NOTES:

1. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.
2. IN PLANT AREA, ALL STAIR CASES, RAILINGS, MONKEY LADDERS SHALL BE EARTHED ATLEAST AT TWO POINTS.

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IOCL PARADIP REFINERY, ODISHA , INDIA

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TITLE: TYPICAL EARTH CONNECTION FOR BONDING OF STAIRWAY/LADDERS

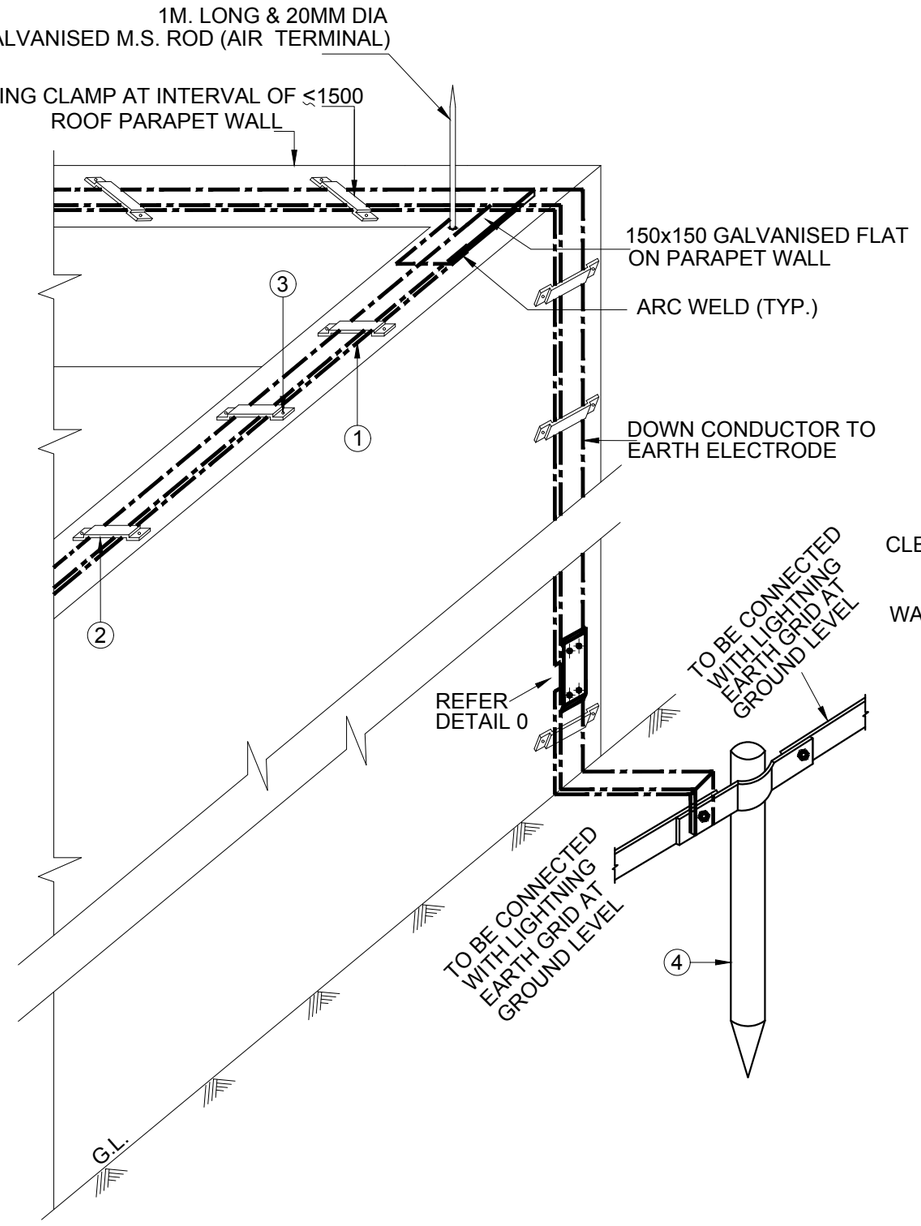
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

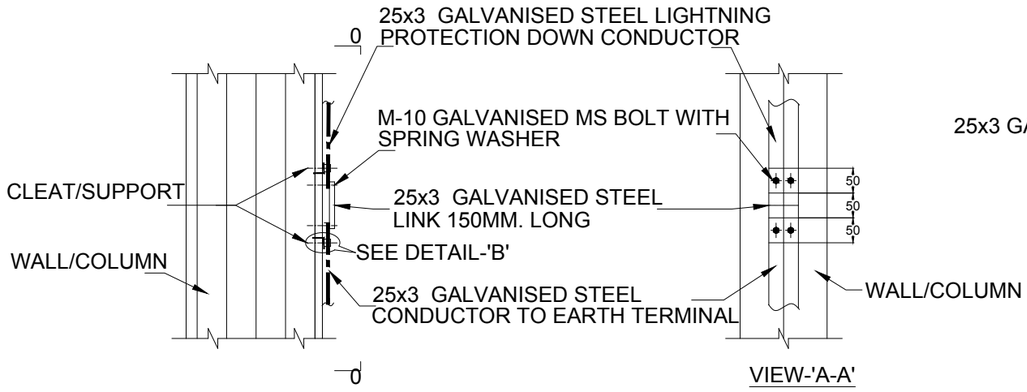
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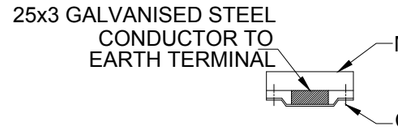
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DETAIL-A
TEST LINK POINT/CLEATING ARRANGEMENT



DETAIL-B
CLEATING ARRANGEMENT

STANDARD IDENTIFICATION SYMBOL

STC
E17

NOTES:

1. LAYOUT OF LIGHTNING PROTECTION OF RELEVANT BUILDING SHALL BE REFEREED.
2. ALL DAMAGE TO GALVANIZED SURFACES SHALL BE MADE GOOD WITH ZINC RICH PAINT.

ITEM	COMPONENT DESCRIPTION
1	25x3 MM G.I. STRIP
2	FIXING CLAMP
3	6 MM DIA G.I. ANCHOR BOLT WITH WASHER / G.I. FIXING SCREW WITH WASHER
4	EARTH ELECTRODE IN PIT AS PER STD.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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IOCL PARADIP REFINERY, ODISHA , INDIA

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TITLE: TYPICAL LIGHTNING PROTECTION OF BUILDING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	22 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

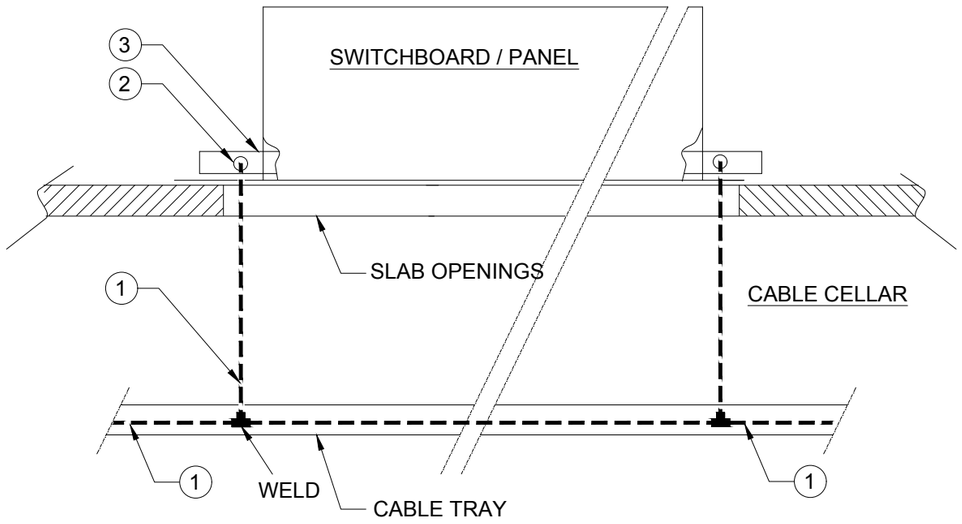
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STANDARD IDENTIFICATION SYMBOL

STC
E18



PANEL EARTHING IN SWITCHGEAR ROOM

NOTES :

1. HV SWITCHBOARDS AND MV MCC SHALL BE EARTHED WITH G.I. STRIP AT TWO (2) OPPOSITE POINTS OF THE SWITCHBOARD.
2. ALL THE ELECTRICAL PANELS OPERATING ABOVE 250 VOLTS SHALL BE EARTHED AT TWO POINTS.

ITEM	COMPONENT DESCRIPTION
1	MAIN EARTH GRID G.I. STRIP ALONG WITH CABLE TRAY
2	NUT & BOLT WITH WASHER FOR CONNECTING STRIP TO BUS BAR
3	EARTH BAR/STUD AVAILABLE IN SWITCHBOARDS/ PANEL

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA , INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
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TITLE
TYPICAL EARTHING OF SWITCHBOARD AND PANELS IN SUBSTATION

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	23 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

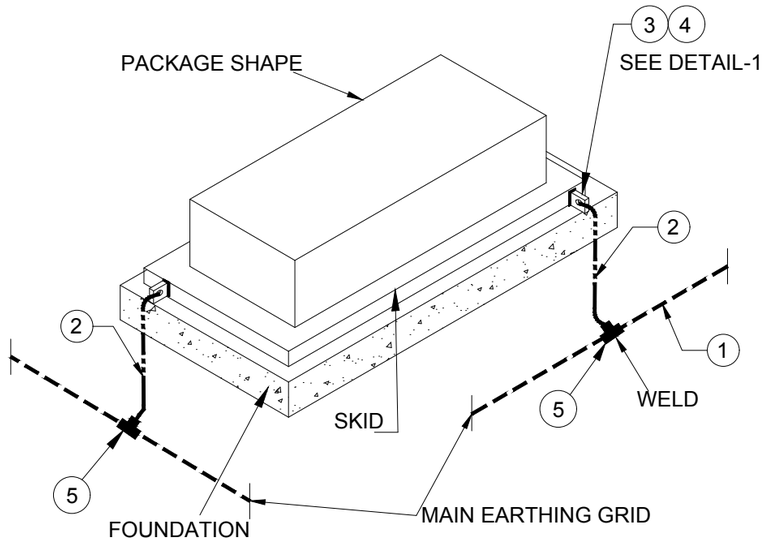
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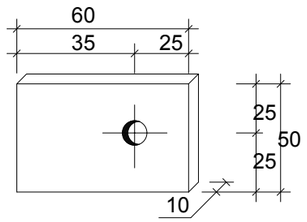
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STANDARD IDENTIFICATION SYMBOL

STC
E19



PACKAGE EARTHING



DETAIL-1

NOTES:

1. EARTHING CONNECTIONS OF SKIDS (PACKAGES) SHALL BE MADE AT 2 OPPOSITE POINTS OF THE SKID.
2. ALL ASSOCIATED METALLIC NON-CURRENT CARRYING EQUIPMENTS INSIDE THE PACKAGE SHALL BE BONDED.

ITEM	COMPONENT DESCRIPTION
1	MAIN EARTH GRID
2	40x5 G.I. STRIP
3	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION
4	LUG,8 MM DIA 25 LONG G.I.BOLT, NUT AND TWO SPRING WASHERS.
5	TWO COATS OF BITUMEN IMPREGNATED HESSAIN TAPE

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TITLE: TYPICAL EARTHING OF PACKAGE

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SCALE	080557C001	000	STC	1691	001	24 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

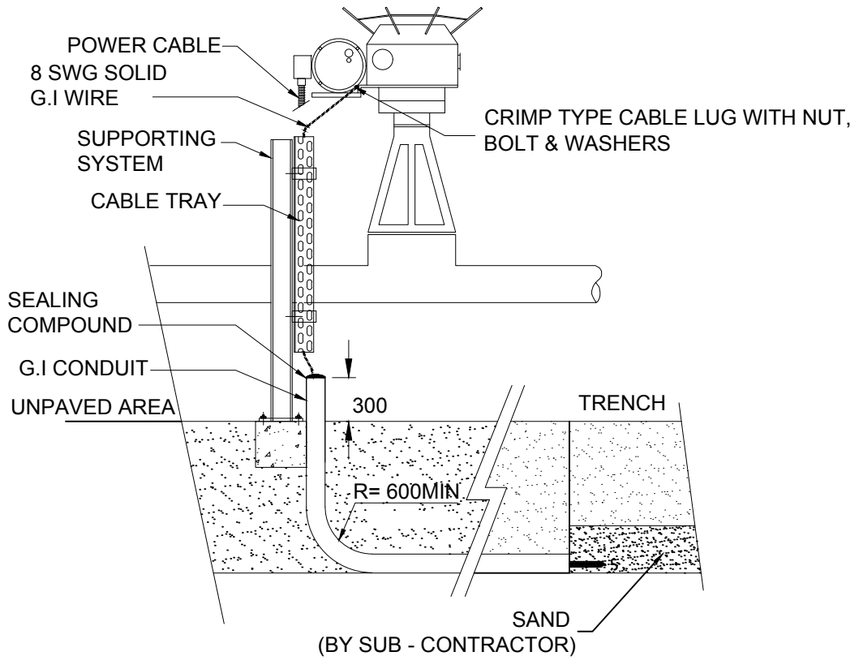
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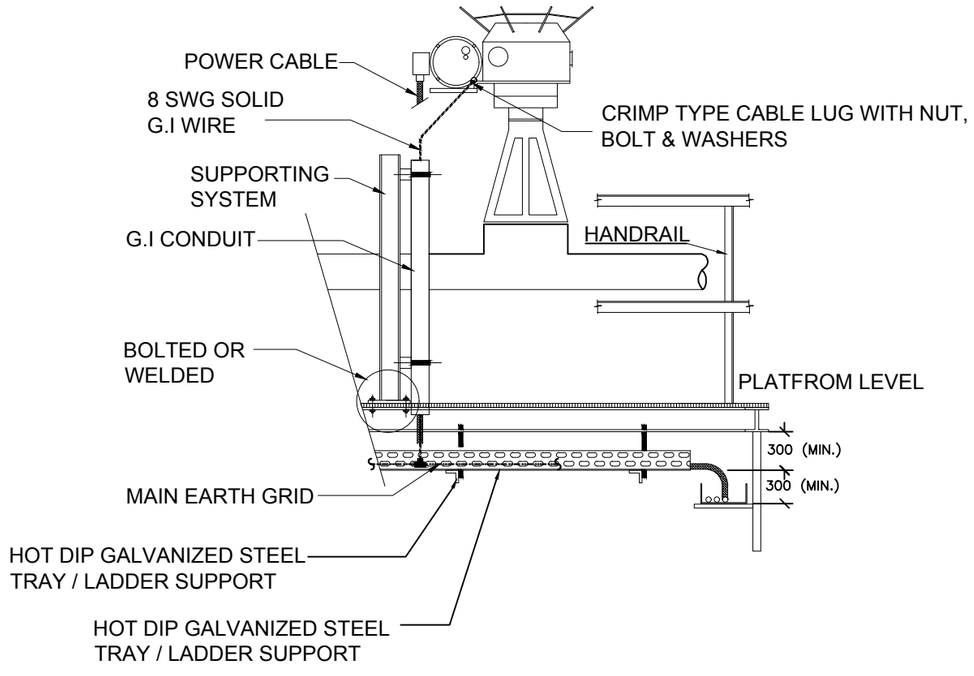
STC
E20A



AT GRADE ON UNPAVED AREA

STANDARD IDENTIFICATION SYMBOL

STC
E20B



MOTOR OPERATED VALVE (MOV) ON PLATFORM

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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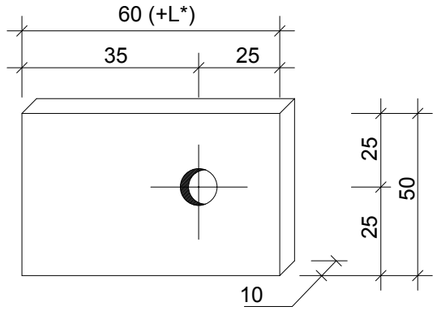
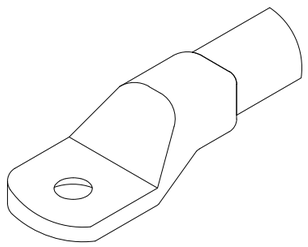
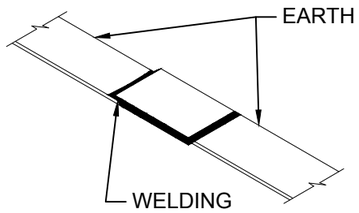
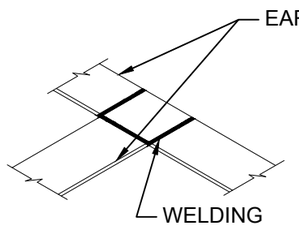
TITLE: TYPICAL EARTHING CONNECTIONS FOR MOV's

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1692	001	25 OF 30	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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CAD FILE NAME : 080557C-000-STC-1692-001-25.DWG

SHEET SIZE : A3

	50x10x60 MM LONG G.I. FLAT FOR EARTH TERMINATION (*) +L = PROVISION FOR INSULATION/FIRE PROFFING WHERE APPLICABLE	
	COMPRESSION LUG FOR G.I. WIRE ROPE	
	EARTH STRIP STRAIGHT JOINT	
	EARTH STRIP TAP JOINT	

STANDARD IDENTIFICATION SYMBOL

STC
E21

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PROJECT
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TITLE
EARTHING CONNECTIONS AND CONNECTORS DETAILS

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1691	001	26 OF 30	0
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SPARE

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CAD FILE NAME : 080557C-000-STC-1691-001-29.DWG

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TYPICAL LIGHTING INSTALLATION STANDARDS FOR CONSTRUCTION

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
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TITLE: COVER SHEET

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	01 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1693-001-01_0.DWG

SHEET SIZE : A3

PAGE	REVISION 0	1	2	STC No.	TITLE
01	X			-	COVER SHEET
02	X			-	INDEX SHEET
03	X			-	GENERAL NOTES
04	X			-	LEGEND
05	X			L01	STREET LIGHTING FIXTURE MOUNTED ON POLE
06	X			L02	LED FLOOD LIGHT FIXTURE MOUNTED ON POLE
07	X			L03	30m HIGH LIGHTING MAST
08	X			L04	LED LIGHT FIXTURE SUITABLE FOR GRADE MOUNTING
09	X			L05	LED LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTING
10	X			L06	JUNCTION BOX MOUNTING ARRANGEMENT
11	X			L07	LED LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTING
12	X			L08	LED FLOOD LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTED
13	X			L09	LED FLOOD LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTING ON STEEL / CONCRETE STRUCTURE
14	X			L10	HIGH / MEDIUM / LOW BAY LIGHT FIXTURES PENDANT MOUNTED
15	X			L11	AIRCRAFT WARNING LIGHTING
16	X			L12	CONVENIENCE SOCKET OUTLET MOUNTING ON CONCRETE / STEEL COLUMN
17	X			L13	LIGHTING FIXTURE MOUNTING IN CONCEALED CONDUIT SYSTEM
18	X			L14	LIGHTING FIXTURE RECESSED WITH FALSE CEILING (DECORATIVE FLUORESCENT)
19	X			L15	LIGHTING FIXTURE RECESSED WITH FALSE CEILING
20	X			L16	SPARE

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TITLE: INDEX SHEET

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GENERAL NOTES

A.BUILDING LIGHTING

UNLESS SPECIFIED OTHERWISE IN THE LAYOUT DRAWINGS, THE FOLLOWING NOTES SHALL BE APPLICABLE TO CARRY OUT LIGHTING INSTALLATIONS WITHIN BUILDING.

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOR BUILDING WITH FALSE CEILING, CONCEALED CONDUIT WIRING SHALL BE USED BELOW THE FALSE CEILING (INSIDE WALL) & SURFACE CONDUIT WIRING ABOVE FALSE CEILING.
3. IN CASE OF CONCEALED CONDUIT, CONTRACTOR SHALL CO-ORDINATE WITH OTHER AGENCY INVOLVED IN CIVIL WORK AND SHALL LAY THE CONDUIT ACCORDINGLY.
4. WIRING IN AREAS WITH FALSE CEILING SHALL BE DONE IN SURFACE CONDUIT (25mm DIA. G.I. CONDUIT) SUITABLE CLAMPED TO TRUE CEILING.
5. VERTICAL DROPS FROM THE CEILING FOR PANELS/SWITCHES/RECEPTACLES ETC. SHALL BE TAKEN IN 25MM DIA. PVC CONDUIT CONCEALED IN WALLS UP TO SWITCHBOARD PANELS.
6. FOR FLUSH MOUNTING OF MS BOXES FOR INSTALLATION OF SWITCHES FOR LIGHTING FIXTURE, FAN REGULATORS, 5/15 Amp. SOCKET, BOARD ETC. SHALL HAVE SWITCH, REGULATOR, SOCKET FIXING PLATE. ELECTRICAL CONTRACTORS SHALL PREPARE AND GET APPROVAL OF THE ARRANGEMENT DRAWING OF SUCH SWITCHES AND FAN REGULATORS HOUSED IN MS BOX.
7. MOUNTING HEIGHT OF LIGHTING EQUIPMENT SHALL BE AS UNDER :-

i)	TOP OF SWITCH BOX	1200 MM FROM FFL
ii)	5/15 Amp SOCKETS	300 MM (CL) FROM FFL (UNLESS OTHERWISE SPECIFIED)
iii)	15 Amp. INDUSTRIAL TYPE SOCKETS IN WORKSHOP, SHEDS, PROCESS AREA ETC.	1200 MM FROM FFL
iv)	LIGHTING / POWER PANELS	1800MM FROM FFL (TOP OF PANEL)
v)	LIGHTING FIXTURE - ALL TYPES, CEILING FANS ETC.	AS INDICATED IN PLAN DRAWINGS
vi)	EXHAUST FANS	ON CUT OUTS PROVIDED
vii)	3 PHASE MAIN DISTRIBUTION BOARD	AS INDICATED IN PLAN DRAWINGS

8. ALL G.I. PIPE SLEEVES SHALL BE OF MEDIUM GRADE.
9. WIRING FOR LIGHTING INSIDE THE BUILDING SHALL BE WITH MINIMUM 1.5 SQ.MM. CU CONDUCTOR, PVC INSULATED WIRE AND FOR SOCKET MINIMUM 2.5 SQ.MM.
10. THE ROUTING OF CABLES IN PLAN DRAWINGS ARE INDICATIVE AND MAY CHANGE AS PER SITE REQUIREMENT.
11. INDUSTRIAL TYPE PLUG SOCKET WITH 20A MCB OR RATING AS PER SLD / LIGHTING SCHEMATICS SHALL BE PROVIDED AT A HEIGHT OF 500MM FROM FFL FOR WINDOW AC UNITS.
12. CONDUIT SHALL BE OF MINIMUM 25MM DIA. MAXIMAM NUMBER OF WIRES PERMISSIBLE IN A CONDUIT SHALL BE SEVEN/NINE FOR WIRE SIZE OF 2.5 SQ.MM./1.5 SQ.MM. RESPECTIVELY.

B.PLAT LIGHTING

1. WIRING IN INDUSTRIAL / PROCESS BUILDINGS & PLANT SHALL BE DONE WITH CU CONDUCTOR, PVC INSULATED, ARMORED & PVC SHEATHED CABLE FOR LIGHTING.
2. IN PLANT LIGHTING SYSTEM, LIGHTING FIXTURES SHALL BE CONNECTED BETWEEN SINGLE PHASE, 230V SYSTEM.
3. WIRING FOR LIGHTING & POWER IN HAZARDOUS AREAS SUCH AS PROCESS UNITS SHALL BE DONE WITH MINIMUM 2.5 SQ.MM. CU CONDUCTOR, PVC, ARMORED CABLES SUITABLY SUPPORTED ALONG CABLE TRAYS, PIPE RACK, PLATFORM FLOORS, WALLS, COLUMNS ETC.
4. DOUBLE POLE MCB SHALL BE PROVIDED IN THE LIGHTING & POWER PANEL FOR ISOLATION OF EACH OUTGOING CIRCUIT.
5. FOR HAZARDOUS AREA, UNUSED ENTRY OF LIGHTING FIXTURE, CONTROL GEAR BOX AND JUNCTION BOX SHALL BE PLUGGED WITH NICKEL PLATED BRASS FLAME PROOF PLUG..
6. ALL FASTENERS, ANGLES, BASE PLATES, PIPES, AND FLATS SHALL BE OF G.I. MATERIAL.
7. THE FIXTURES / FITTINGS ON RCC COLUMNS, WALLS, CEILINGS SHALL BE INSTALLED WITH ANCHOR BOLTS. IN PLATFORMS ETC. PARTICULAR TYPE OF STEEL BRACKETS SHALL BE WELDED TO THE EXISTING STEEL MEMBERS AND LIGHTING FIXTURES SHALL BE MOUNTED ON THEM. WHEREVER REQUIRED SUITABLE BRACKETS SHALL BE FABRICATED AT SITE TO INSTALL LIGHTING, JUNCTION BOXS ETC. LIGHTING FIXTURES AND FITTING SHALL NOT BE WELDED DIRECTLY TO STEEL MEMBERS.
8. PAINTING OF ALL SUPPORTS SHALL BE AS PER PROJECT PAINTING SPECIFICATIONS.
9. ALL WELDINGS TO PLATFORM / HANDRAILS SHALL BE MINIMUM OF 6MM FILLET CONTINUOUS WELD TYPE.
10. ALL POLES FOR PLANT STREET AND FLOOD LIGHT FIXTURE SHALL BE DESIGNED TO WITHSTAND GUST WIND SPEED (3 SEC.) UNDER STROM / CYCLONIC CONDITION.
11. WIRING FOR LIGHTING AND CONVENIENCE OUTLETS IN OUTDOOR AREA SHALL BE CARRIED OUT WITH CU CONDUCTOR, PVC INSULATED, ARMORED & PVC SHEATHED CABLES.
12. PROPER SEALING SHALL BE ENSURED TO PREVENT INGRESS OF WATER INSIDE ELECTRICAL J.B/CGB/MARSHALLING BOX ETC.
13. ALL LIGHTING POLES AND ACCESSORIES SHALL BE HOT DIP GALVANIZED.
14. LIGHTING SHALL BE DONE IN ACCORDANCE WITH THE JOB SPECIFICATION FOR ELECTRICAL INSTALLATION. (DOC. NO. 080557C-000-JSD-1600-003)
15. UNDERGROUND LIGHTING CABLE (IN PAVED AREA) SHALL BE TAKEN IN SUITABLE SIZE OF G.I.PIPE SLEEVES BURIED AT SUITABLE DEPTH FROM FINISHED FLOOR LEVEL FOR MECHANICAL PROTECTION TO SUCH CABLES. GI PIPE SLEEVES SHALL BE EXTENDED TO MINIMUM 300MM ABOVE FINISHED FLOOR LEVEL.
16. LIGHTING FIXTURES MOUNTED ON PLATFORM, WALKWAY, STAIRS SHALL BE MOUNTED IN SUCH A WAY THAT RELAMPING CAN BE DONE WITHOUT USE OF LADDERS.
17. INSTALLATION OF SUPPORTS FOR LIGHT FIXTURES, SOCKETS, JUNCTION BOX ETC SHALL BE COMPLETED PRIOR TO FIREPROOFING ON STEEL BEAM / COLUMN WHEREVER APPLICABLE. FOR FIRE PROOFED STRUCTURES SUITABLE BRACKETS SHALL BE PROVIDED IN SUCH A WAY THAT FIXTURES LIES OUTSIDE FIRE PROOF COLUMN.

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TITLE: GENERAL NOTES

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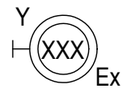
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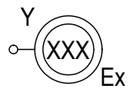
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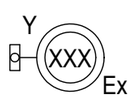
LED LIGHT FIXTURE SUITABLE FOR CEILING / PENDANT (STEEL/CONCRETE) MOUNTING



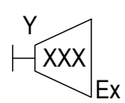
LED LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTED ON CONCRETE COLUMN / STEEL COLUMN / CONCRETE WALL



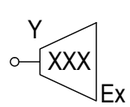
LED LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTING



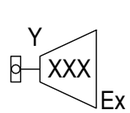
LED LIGHT FIXTURE SUITABLE FOR GRADE POLE MOUNTING



LED FLOOD LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTED ON CONCRETE COLUMN / STEEL COLUMN / CONCRETE WALL



LED FLOOD LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTING



LED FLOOD LIGHT FIXTURE SUITABLE FOR POLE MOUNTING



AVIATION LIGHTING FIXTURE



30M HIGH LIGHTING MAST

XXX -> LIGHT FIXTURE WATTAGE

Y -> E - EMERGENCY LIGHT FIXTURE
NORMAL LIGHT FIXTURE (NO LETTER MENTIONED)

Ex -> LIGHT FIXTURES SUITABLE FOR HAZARDOUS AREA
INDUSTRIAL TYPE LIGHT FIXTURE (NO LETTER MENTIONED)

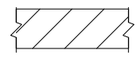


16A CONVENIENCE OUTLET



INTERMEDIATE LIGHTING JUNCTION BOX

Ex -> LIGHTING JBs SUITABLE FOR HAZARDOUS AREA



EVACUATION / ESCAPE ROUTE

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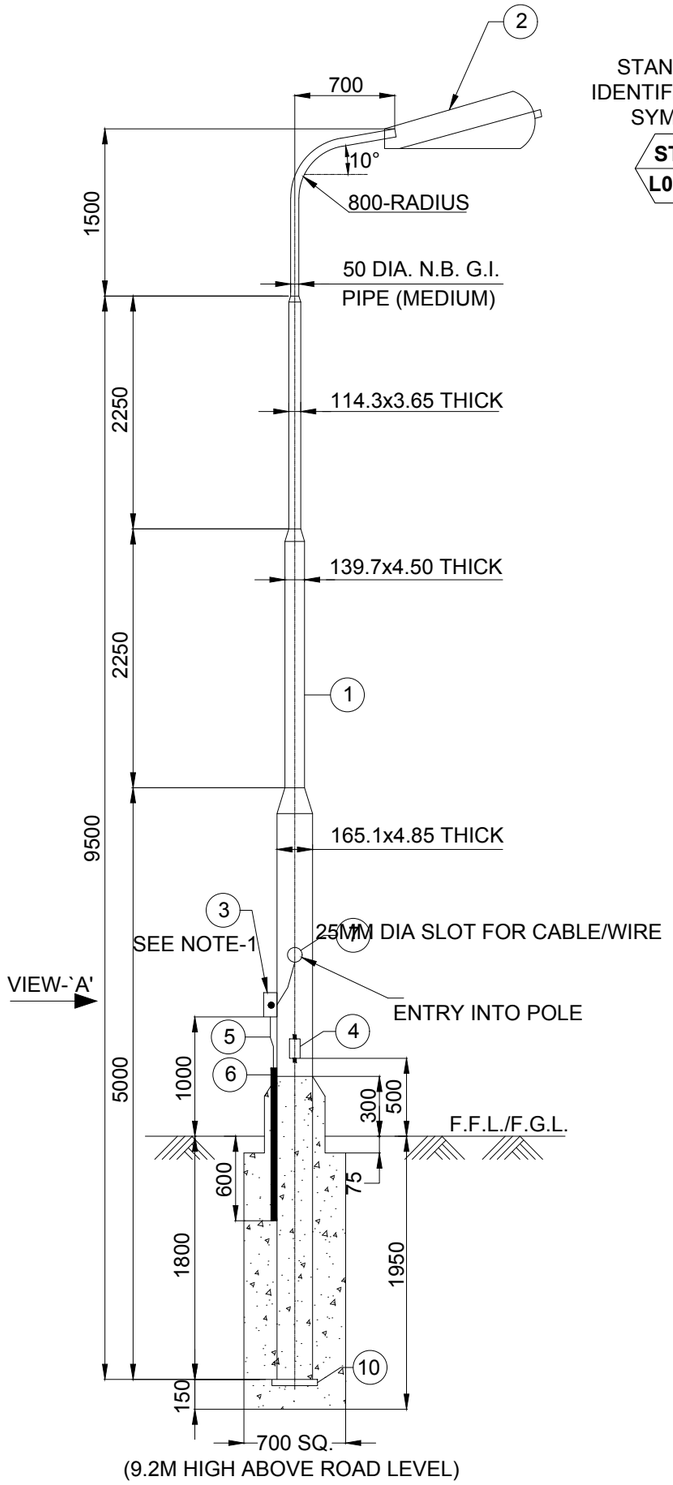
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DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	04 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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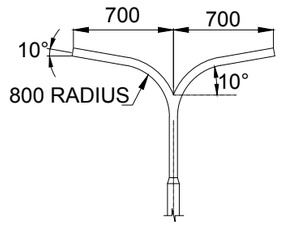
SHEET SIZE : A3



(9.2M HIGH ABOVE ROAD LEVEL)

STANDARD IDENTIFICATION SYMBOL

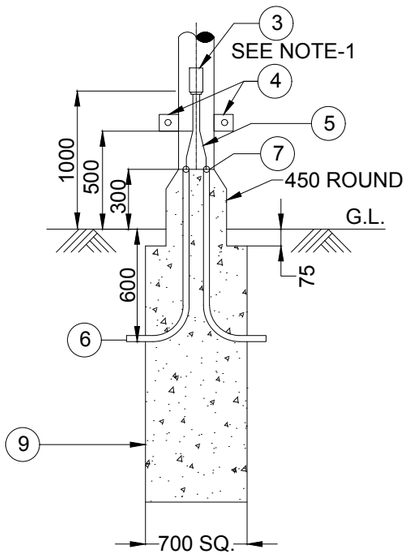
STC L01A



TYPE-2
ARRANGEMENT FOR TWO FIXTURES

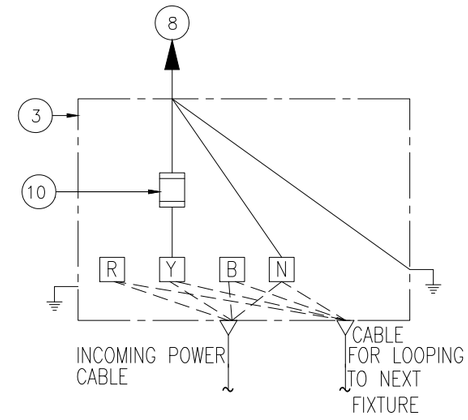
STANDARD IDENTIFICATION SYMBOL

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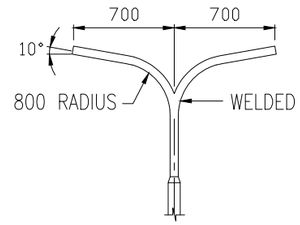


VIEW-`A'

LAMP POSITION	
ROAD WIDTH (M)	CUT-OFF ANGLE
6.0	5°
7.5	5°
9.0	9°
12.5	13°
19.0	13°



WIRING DIAGRAM FOR MARSHALLING BOX/JUNCTION BOX



TYPE-2
ARRANGEMENT FOR TWO FIXTURES

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	STEEL TUBULAR POLE AS PER IS:2713 (SEE NOTE 2)	Nos.	1
2	LIGHTING FIXTURE	Nos.	1
3	JUNCTION BOX WITH SUITABLE CABLE GLAND AS PER STD L06	Nos.	1
4	EARTH LUG (50x60x6MM) MS FLAT	Nos.	AS REQD.
5	ARMOURED CABLE	MTR.	AS REQD.
6	2 NO. 63 DIA NB G.I. PIPE SLEEVES	MTR.	AS REQD.
7	RUBBER BUSHING/SEALING COMPOUND	-	AS REQD.
8	2.5MM^2 Cu. CONDUCTOR, PVC INSULATED WIRE TO LIGHTING FIXTURE (FOR PHASES, NEUTRAL & EARTH)	MTR.	AS REQD.
9	CONCRETE FOUNDATION	-	AS REQD.
10	6A CARTRIDGE FUSE	SET	AS REQD.

NOTES:

1. FOR FIXING DETAIL OF JUNCTION BOX REFER (STD-L06).
2. THE LIGHTING POLES NEAR COOLING TOWERS / DM PLANT SHALL BE OF FRP MATERIAL.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)

- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: STREET LIGHTING FIXTURE MOUNTED ON POLE

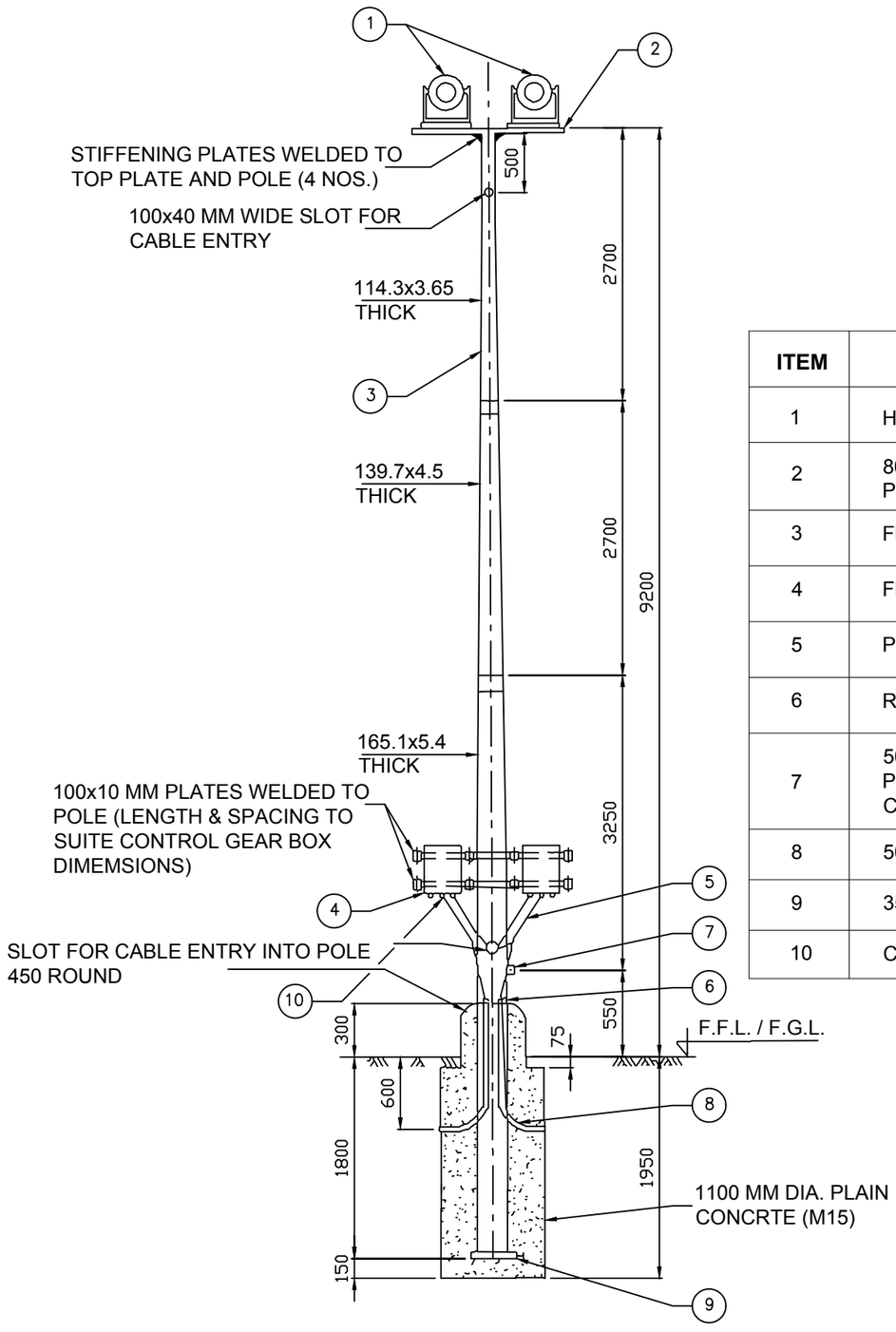
DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	05 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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STANDARD IDENTIFICATION SYMBOL

STC
L02

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	HAZARDOUS AREA FLOOD LIGHT FIXTURE	Nos.	2
2	800x400x10mm THK. M.S. PLATE WELDED TO POLE	Nos.	1
3	FLOOD LIGHTING POLE AS PER IS:2713	Nos.	1
4	FLAMEPROOF CONTROL GEAR BOX	Nos.	2
5	PVC ARMOURED CABLE	M	AS REQD
6	RUBBER BUSHING / SEALING COMPOUND	-	AS REQD
7	50MM WIDEx60MM LONGx6MM THICK M.S. PLATE WELDED TO POLE FOR EARTH CONNECTION	Nos.	1
8	50 DIA NB G.I. PIPE SLEEVE	M	AS REQD
9	350x350x10 MM M.S. PLATE WELDED TO POLE	Nos.	1
10	CABLE GLAND	Nos.	AS REQD

NOTES:

1. MINIMUM TWO AND MAXIMUM THREE NUMBER OF SLEEVES SHALL BE PROVIDED AS PER PLAN DRAWING.

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0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

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INDIAN OIL CORPORATION LTD.

PMC
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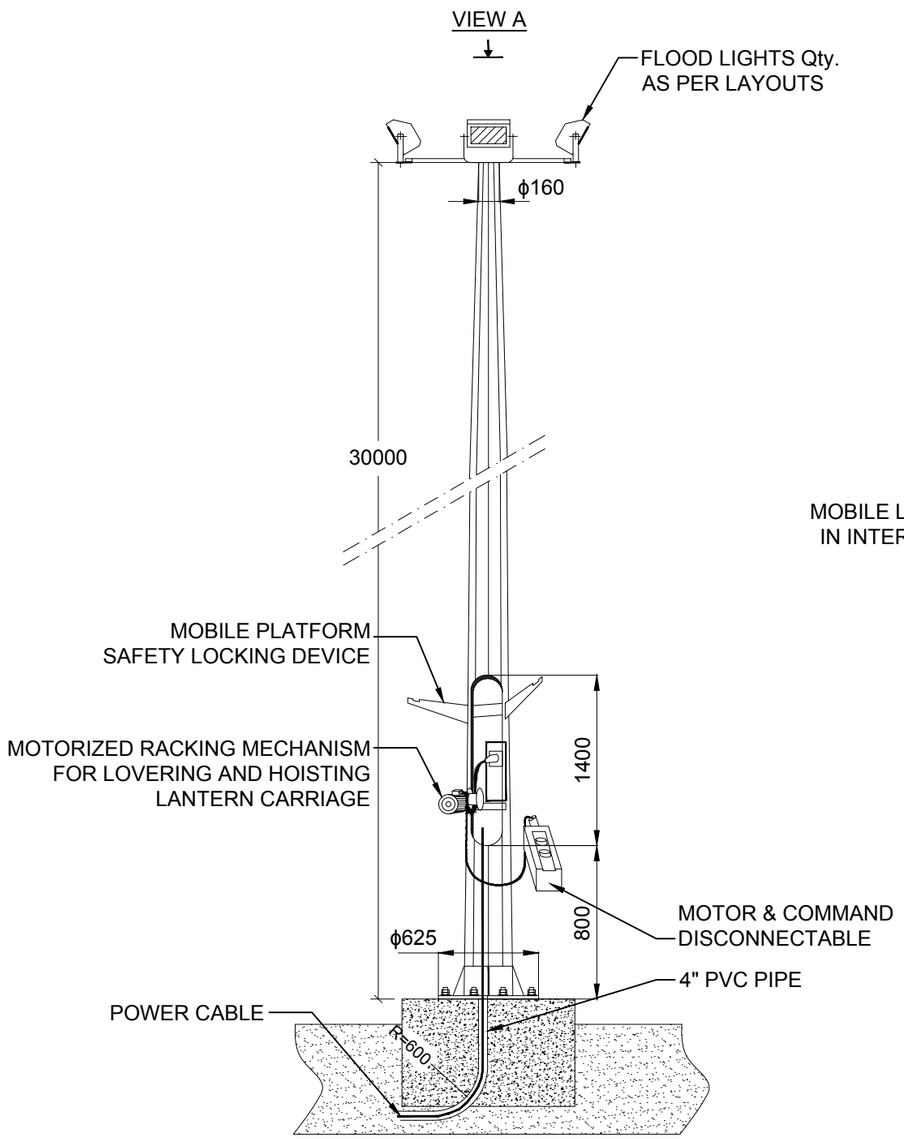
TITLE
LED FLOOD LIGHT FIXTURE MOUNTED ON POLE

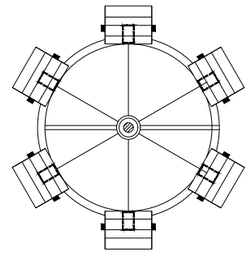
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NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

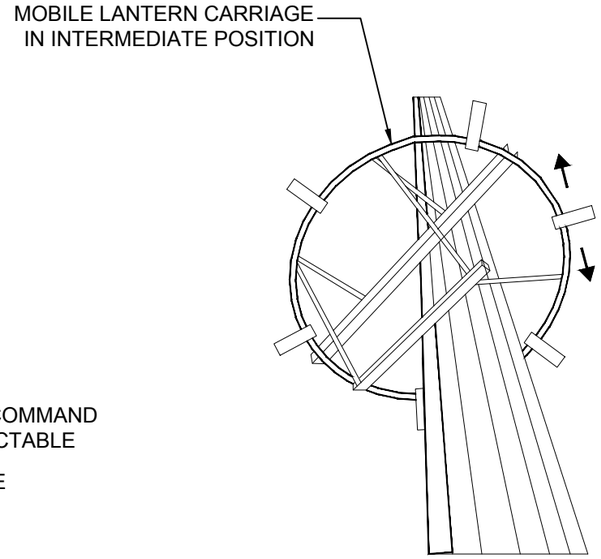
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STANDARD IDENTIFICATION SYMBOL

STC
L03

NOTES :
1. THE CABLE FROM MAIN JB TO EACH LIGHT FIXTURE SHALL BE IN THE SCOPE & LIGHTING MAST VENDOR.
2. LIGHTNING PROTECTION ROD SHALL BE PROVIDED IN THE LIGHTING MAST.

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0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
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DOCUMENT REVIEW STATUS (BY CLIENT)

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IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

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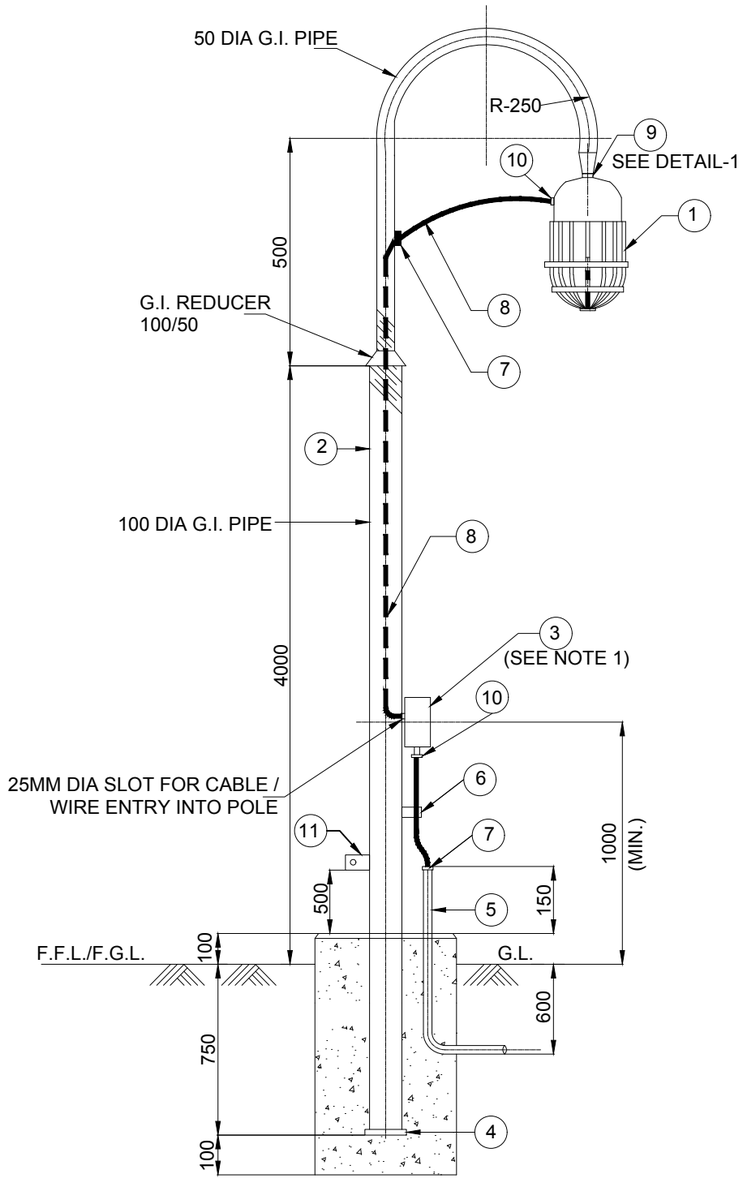
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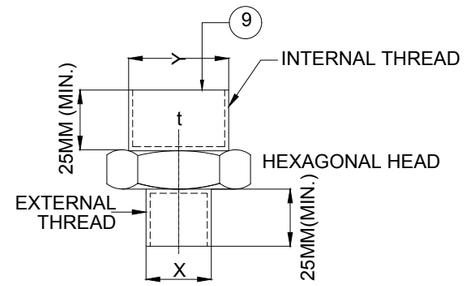
TITLE: 30m HIGH LIGHTING MAST

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	07 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1693-001-07_0.DWG

SHEET SIZE : A3





DETAIL-1

(ADAPTOR)

DESCRIPTION	DIMENSIONS	
	X	Y
FLOOR MOUNTED POLE	TO SUIT * 19 DIA.	TO SUIT 50 DIA.

* ALTERNATIVELY SIZE TO SUIT FIXTURE

STANDARD IDENTIFICATION SYMBOL

STC
L04

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	GROUND MOUNTED POLE (SEE NOTE 2)	Nos.	1
3	JUNCTION BOX WITH SUITABLE CABLE GLAND AS PER STD L08.	Nos.	1
4	200x200x8MM G.I. BASE PLATE	Nos.	1
5	2 NO. 63 DIA NB G.I. PIPE SLEEVES	MTS.	AS REQD
6	CABLE CLAMP	Nos.	AS REQD
7	RUBBER BUSHING/SEALING COMPOUND	Nos.	AS REQD
8	YWY CABLE IN HAZARDOUS AREA / PVC INSULATED WIRES IN SAFE AREA THROUGH PIPE TO FIXTURE.	MTS.	AS REQD
9	G.I. ADAPTOR OR REDUCER	Nos.	1
10	CABLE GLAND	Nos.	AS REQD
11	EARTH LUG (50x60x6MM) MS FLAT	Nos.	AS REQD

NOTES:

1. FOR FIXING DETAIL OF JUNCTION BOX REFER (STD-L06).
2. ALL G.I. PIPE SHALL BE MEDIUM GRADE.
3. POLE ASSEMBLY SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.

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IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
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TITLE
LED LIGHT FIXTURE SUITABLE FOR GRADE MOUNTING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	08 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

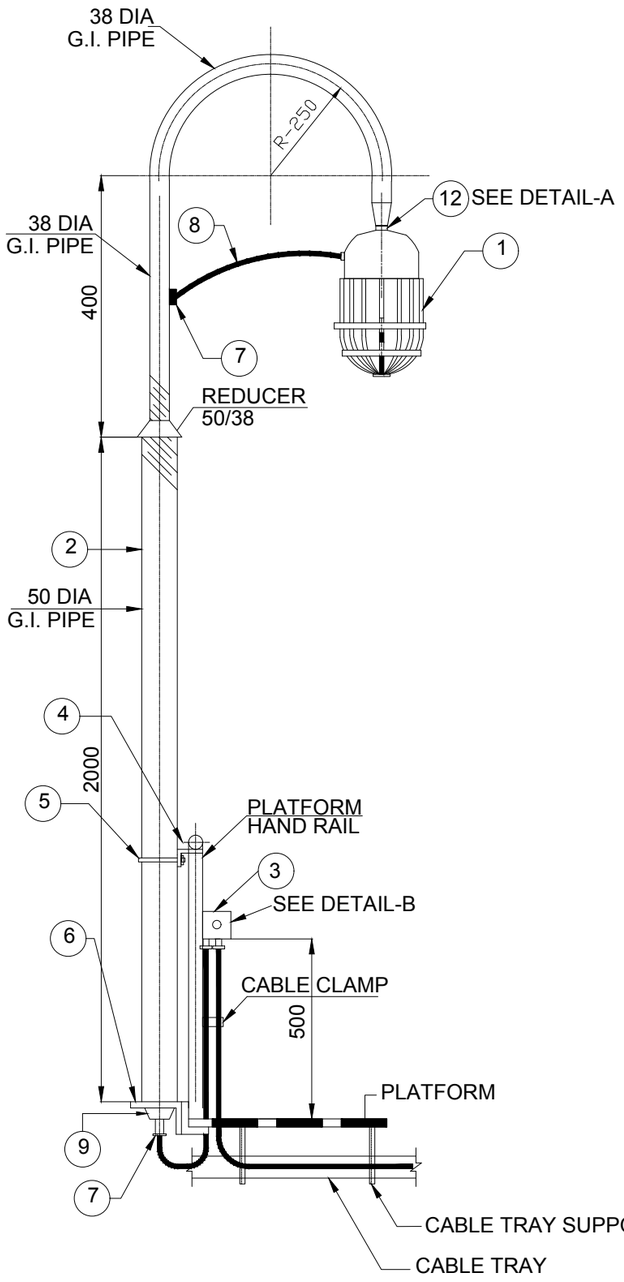
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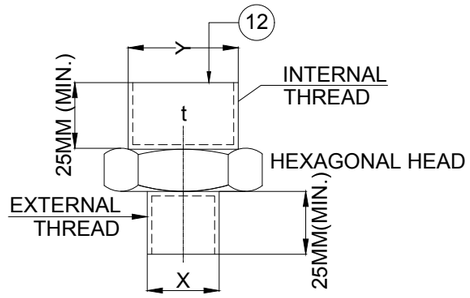
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SHEET SIZE : A3

STANDARD IDENTIFICATION SYMBOL

STC
L05

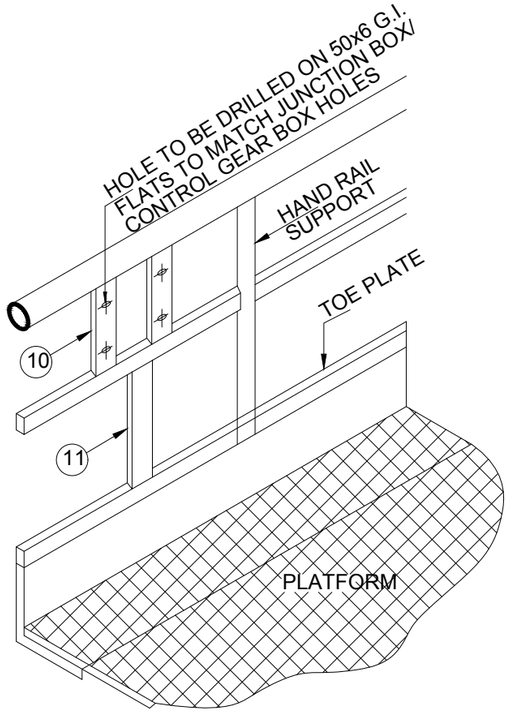




DESCRIPTION	DIMENSIONS	
	X	Y
FLOOR MOUNTED POLE	TO SUIT * 19 DIA.	TO SUIT 38 DIA.

* ALTERNATIVELY SIZE TO SUIT FIXTURE

DETAIL-A
(ADAPTOR)



DETAIL-B

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	HANDRAIL MOUNTED POLE (SEE NOTE 1)	Nos.	1
3	JUNCTION BOX WITH SUITABLE CABLE GLAND.	Nos.	1
4	G.I. ANGLE 75x75x6-125MM LONG WELDED TO HANDRAIL	Nos.	AS REQD
5	GALVANISED U BOLT WITH NUT & WASHERS FOR SUPPORTING THE POLE	Nos.	AS REQD
6	100X75X6-100 MM LONG ANGLE WELDED TO THE PLATFORM FOR VERTICIAL SUPPORT OF THE POLE	Nos.	2
7	RUBBER BUSHING/SEALING COMPOUND	-	AS REQD
8	YWY CABLE IN HAZARDOUS AREA / PVC INSULATED WIRES IN SAFE AREA THROUGH PIPE TO FIXTURE.	MTS.	AS REQD
9	REDUCER 50/25 RESTING IN DRILLED HOLE OF ANGLE IRON PIECE	-	AS REQD
10	50X6 G.I. FLATS TO MATCH WITH JUNCTION BOX HOLES	MTS.	AS REQD
11	50X6 G.I. FLATS TO FOR CABLE SUPPORT	-	AS REQD
12	G.I. ADAPTOR OR REDUCER	-	1

NOTES:

1. THE LIGHTING POLES NEAR COOLING TOWERS / DM PLANT SHALL BE OF FRP MATERIAL.

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A	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

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- ☐ REVIEW
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DOCUMENT REVIEW STATUS (BY CLIENT)

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IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: LED LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	09 OF 20	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

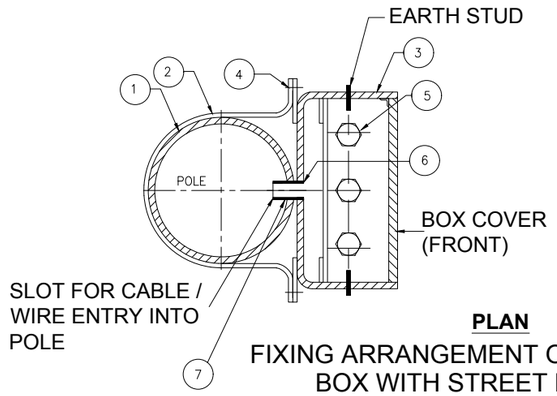
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STANDARD IDENTIFICATION SYMBOL

STC L06A



PLAN

FIXING ARRANGEMENT OF MARSHALLING BOX WITH STREET LIGHT POLE

STANDARD IDENTIFICATION SYMBOL

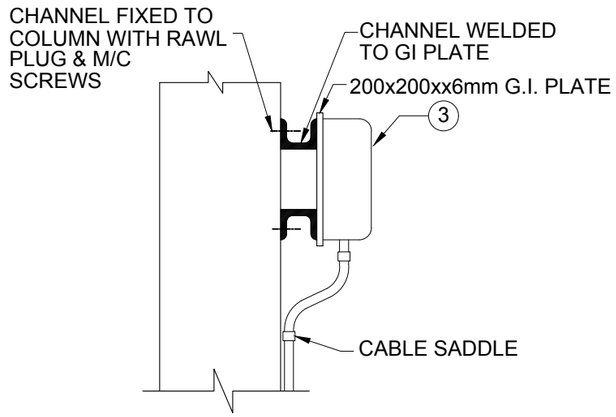
STC L06B

PLAN

FIXING ARRANGEMENT OF JUNCTION BOX / CONTROL GEAR BOX WITH FLOOD LIGHT POLE / GROUND MOUNTED POLE

STANDARD IDENTIFICATION SYMBOL

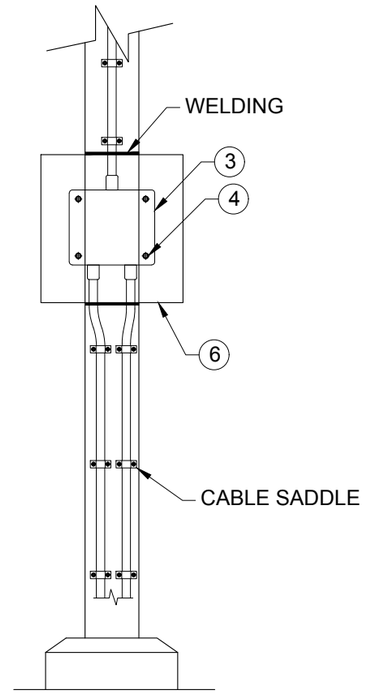
STC L06C



FIXING ARRANGEMENT OF JUNCTION BOX ON CONCRETE COLUMN

STANDARD IDENTIFICATION SYMBOL

STC L06D



FIXING ARRANGEMENT OF JUNCTION BOX ON STEEL COLUMN

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING POLE AS INDICATED IN DWG.	Nos.	1
2	25X3 G.I FLAT CLAMP BENT TO SUIT DIAMETER OF POLE .	Nos.	2
3	JUNCTION BOX / MARSHALLING BOX / CONTROL GEAR BOX	Nos.	1
4	G.I NUT, BOLT & WASHERS	SET	4
5	CABLE ENTRY IN GLAND PLATE AS INDICATED IN DWG.	Nos.	2/3
6	PVC BUSH	Nos.	1
7	25MM DIA, 25MM LONG HALF COUPLING	Nos.	1

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TITLE: JUNCTION BOX MOUNTING ARRANGEMENT

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	10 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

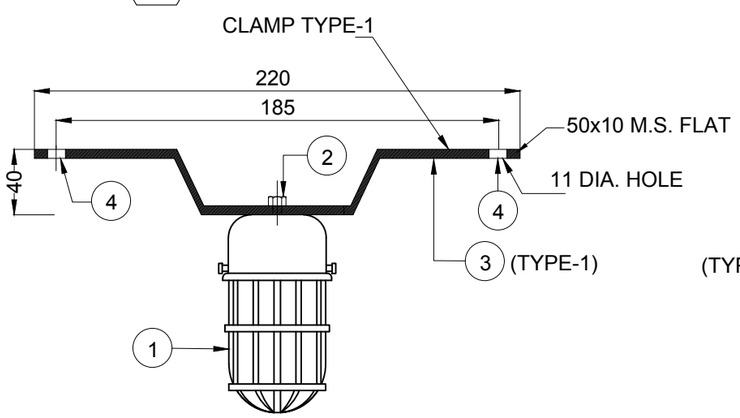
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SHEET SIZE : A3

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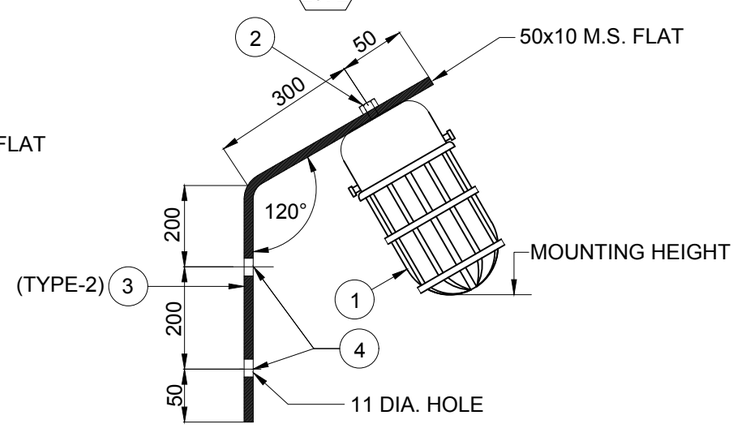
STC L07A



WELL GLASS LIGHTING FIXTURE-BRACKET
NOTE-2

STANDARD IDENTIFICATION SYMBOL

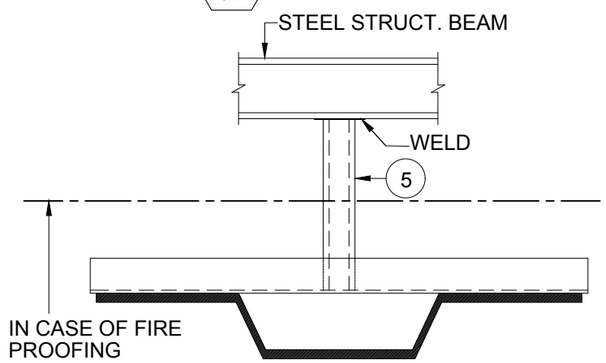
STC L07B



WELL GLASS LIGHTING FIXTURE-BRACKET
NOTE-2

STANDARD IDENTIFICATION SYMBOL

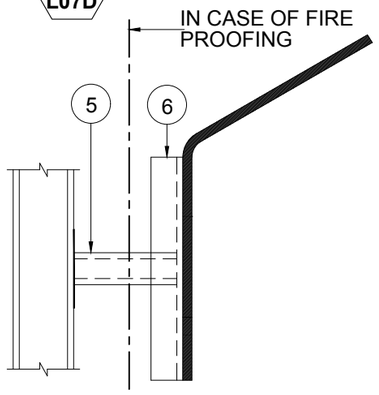
STC L07C



FOR STEEL BEAM

STANDARD IDENTIFICATION SYMBOL

STC L07D



FOR STEEL COLUMN

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	MOUNTING BOLT	Nos.	1
3	MOUNTING BRACKET (TYPE-1 OR TYPE-2)	MTR.	AS REQD
4	10Ø ANCHOR BOLT & ACCESSORIES	Nos.	AS REQD
5	ISMC-75 (LENGTH VARIATION BASED ON FIRE PROFFING)	MTR.	AS REQD
6	ANGLE 75X75X8	MTR.	AS REQD

NOTES:

1. SUPPORT ACCESSORIES VIZ. THE BRACKETS SHALL BE PAINTED WITH EPOXY BASED PAINT.
2. MOUNTING BRACKETS SHALL BE WELDED TO THE STEEL STRUCTURE OR TO BE FIXED BY ANCHOR FASTENER FOR CONCRETE SURFACE.
3. BRACKETS FOR LIGHTING FIXTURE, JUNCTION BOX & CABLE SUPPORT SHALL BE INSTALLED ON SUITABLE DEEP LEGGED ANGLE G.I. FRAME / DISTANCE BRACKET FOR FIRE PROOFING OF STEEL COLUMN, BEAM ETC.

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: LED LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	11 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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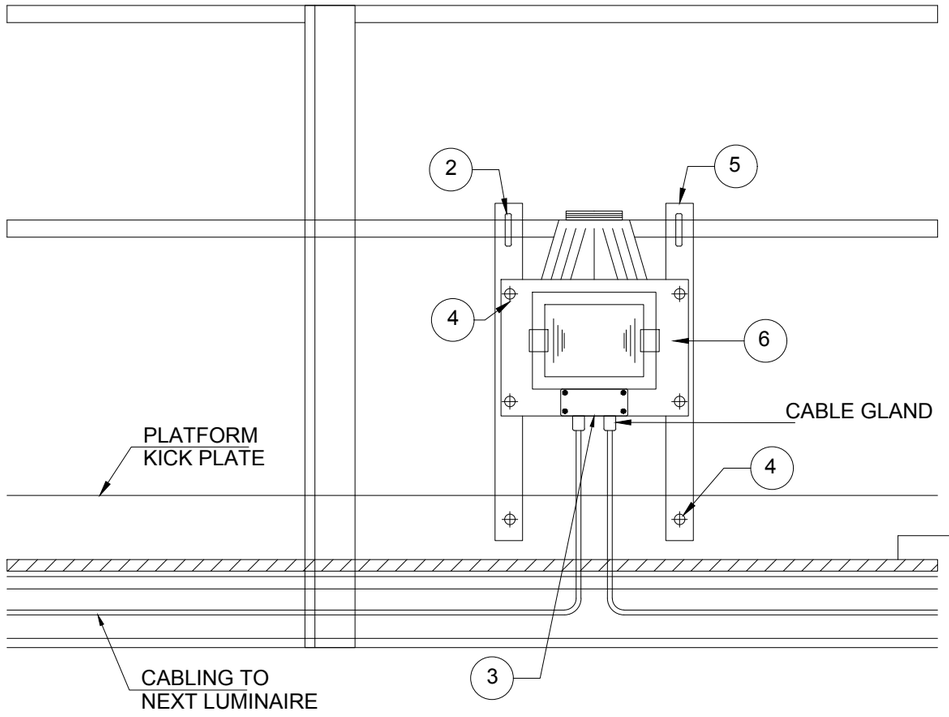
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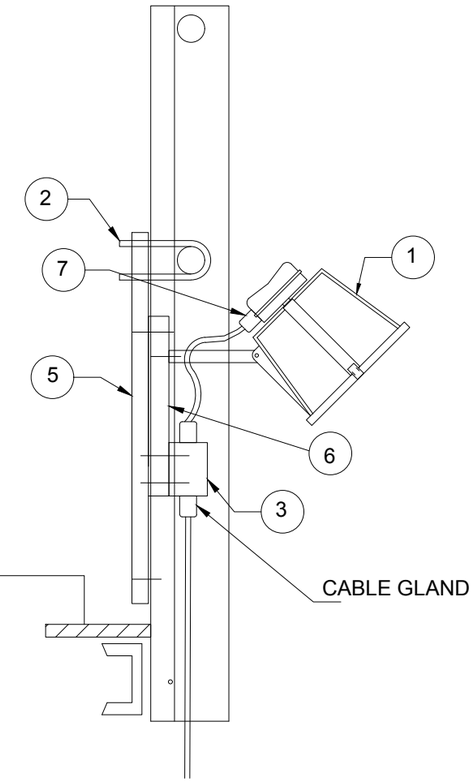
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STANDARD IDENTIFICATION SYMBOL

STC
L08



FLOOD LIGHT FIXTURE MOUNTED ON HANDRAIL



SIDE ELEVATION

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	U-BOLT ASSEMBLY TO SUIT HANDRAIL	Nos.	2
3	JUNCTION BOX WITH SUITABLE CABLE GLAND.	Nos.	1
4	M10x25MM BOLT, NUT & WASHER ASSEMBLY	Nos.	AS REQD
5	700x50x6 MILD STEEL BAR (LENGTH TO SUITABLE HANDRAIL STRUCTURE HEIGHT)	Nos.	2
6	600x600x6 MILD STEEL PLATE	Nos.	1
7	CABLE GLAND	Nos.	AS REQD

NOTES:

1. ALL STEEL ITEM SHALL BE HOT DIP GALVANIZED.

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IOCL PARADIP REFINERY, ODISHA, INDIA

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PMC: TechnipFMC

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TITLE: LED FLOOD LIGHT FIXTURE SUITABLE FOR HANDRAIL MOUNTED

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	12 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

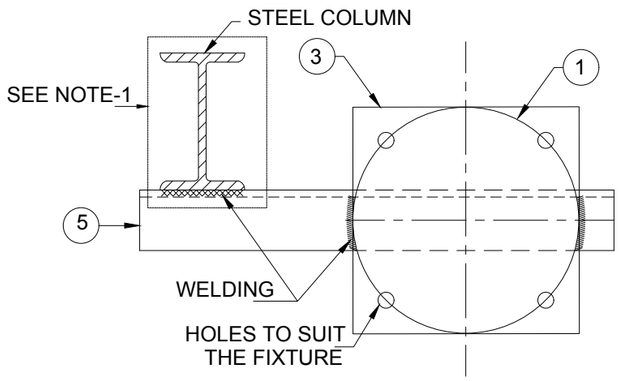
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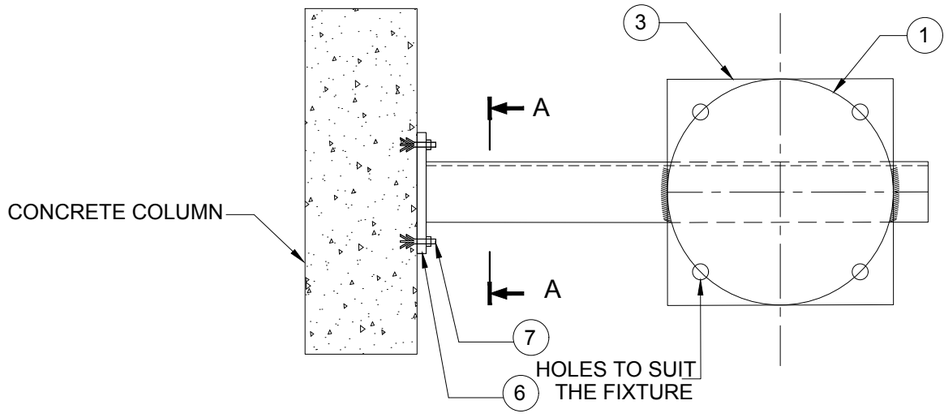
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STANDARD IDENTIFICATION SYMBOL

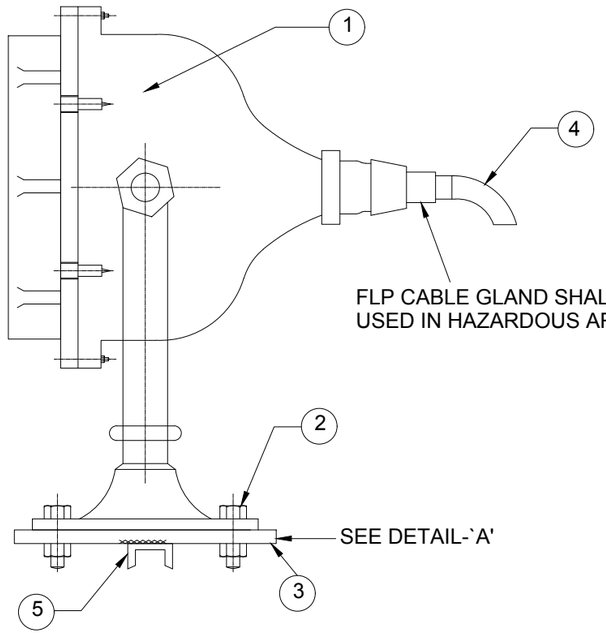
STC
L09

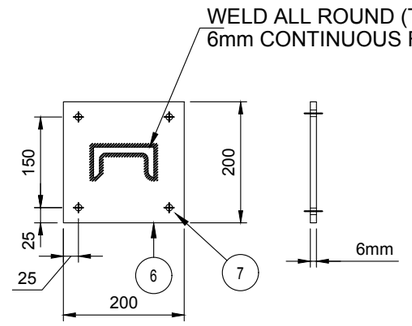


DETAIL-`A'
STEEL COLUMN MOUNTED



DETAIL-`B'
CONCRETE COLUMN MOUNTED





SECTION `A-A'

NOTES:

1. WHERE FIRE PROOFING COLUMNS / STRUCTURES ARE ENVISAGED, FIXTURE, JUNCTION BOX AND CABLE SHALL BE INSTALLED ON A SUITABLE DEEP LEGGED ANGLE IRON FRAME / DISTANCE BRACKET.

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	G.I. NUT, BOLT & WASHERS TO SUIT FIXING HOLE OF FIXTURE	Nos.	AS REQD.
3	6mm THK. G.I. BASE PLATE	Nos.	1
4	CABLE	MTR	AS REQD.
5	ISMC-100 (LENGTH AS REQUIRED)	Nos.	1
6	INSERT PLATE	Nos.	1
7	ANCHOR FASTENER	Nos.	AS REQD.

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IOCL PARADIP REFINERY, ODISHA, INDIA

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PMC: TechnipFMC

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TITLE: LED FLOOD LIGHT FIXTURE SUITABLE FOR BRACKET MOUNTING ON STEEL / CONCRETE STRUCTURE

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	13 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

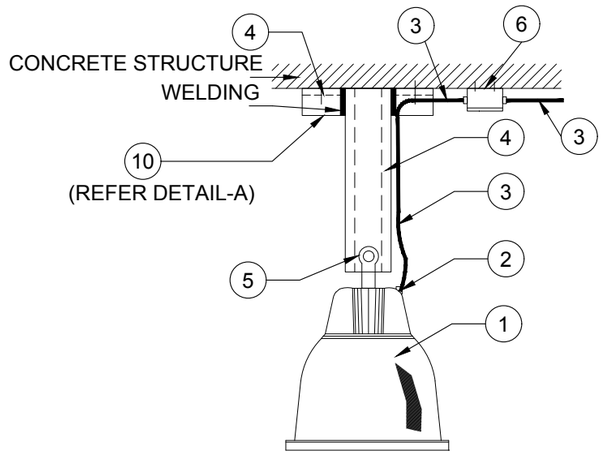
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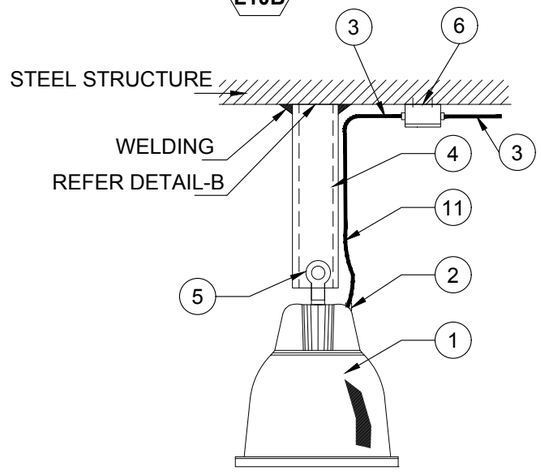
STC L10A



SUSPENSION OF HIGH/MEDIUM/LOW BAY LIGHTING FIXTURE ON CONCRETE STRUCTURE

STANDARD IDENTIFICATION SYMBOL

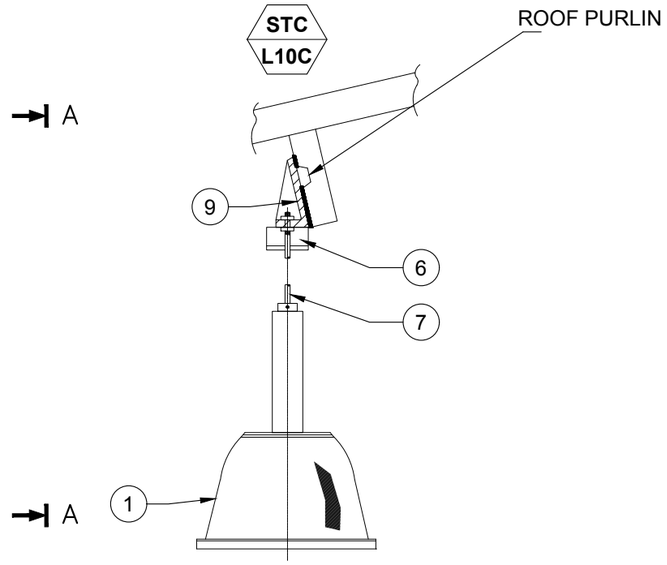
STC L10B



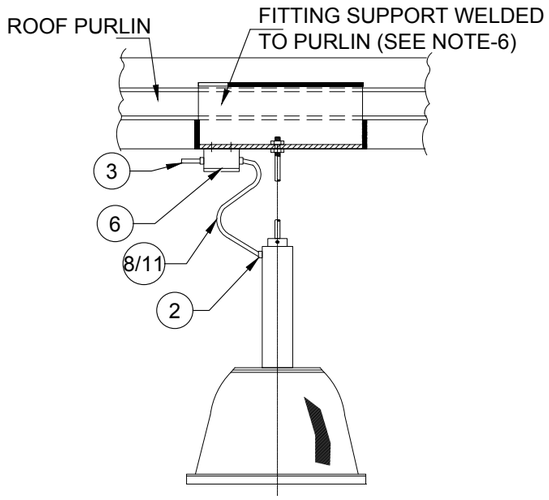
SUSPENSION OF HIGH/MEDIUM/LOW BAY LIGHTING FIXTURE ON STEEL STRUCTURE

STANDARD IDENTIFICATION SYMBOL

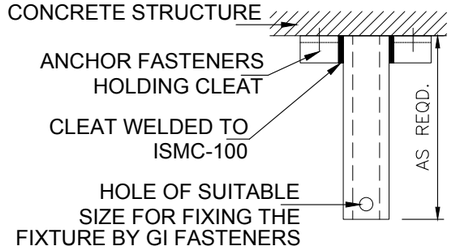
STC L10C



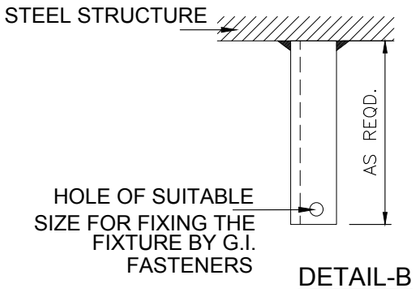
SUSPENSION OF LUMINAIRE FROM ROOF PURLIN



VIEW-AA



DETAIL-A



DETAIL-B

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	CABLE GLAND	Nos.	AS REQD.
3	CABLE	MTR.	AS REQD.
4	ISMC-100	MTR.	AS REQD.
5	EYE BOLT TO SUIT FIXTURE	Nos.	1
6	JUNCTION BOX WITH SUITABLE CABLE GLAND AS PER STD.	Nos.	1
7	25MM G.I. CONDUIT COMPLETE WITH LOCKNUT & WASHER ETC	MTR.	AS REQD.
8	FLEXIBLE CONDUIT	MTR.	AS REQD.
9	BRACKET FABRICATED FROM 6MM THICK M.S. PLATE	Nos.	1
10	ISMC-100	MTR.	AS REQD.
11	PVC WIRE	MTR.	AS REQD.

NOTES:

1. FOR MOUNTING HEIGHT OF LUMINAIRE SEE LAYOUT.
2. ALL STEEL ITEMS TO BE HOT DIP GALVANISED.
3. NO DRILLING OF UNDERSIDE OF PURLIN.
4. PURLIN TO BE PAINTED AFTER WELDING.
5. BRACKET TO BE HOT DIP GALVANISED.
6. BRACKET CAN BE BOLTED, IF WELDING NOT PRACTICABLE.

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PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

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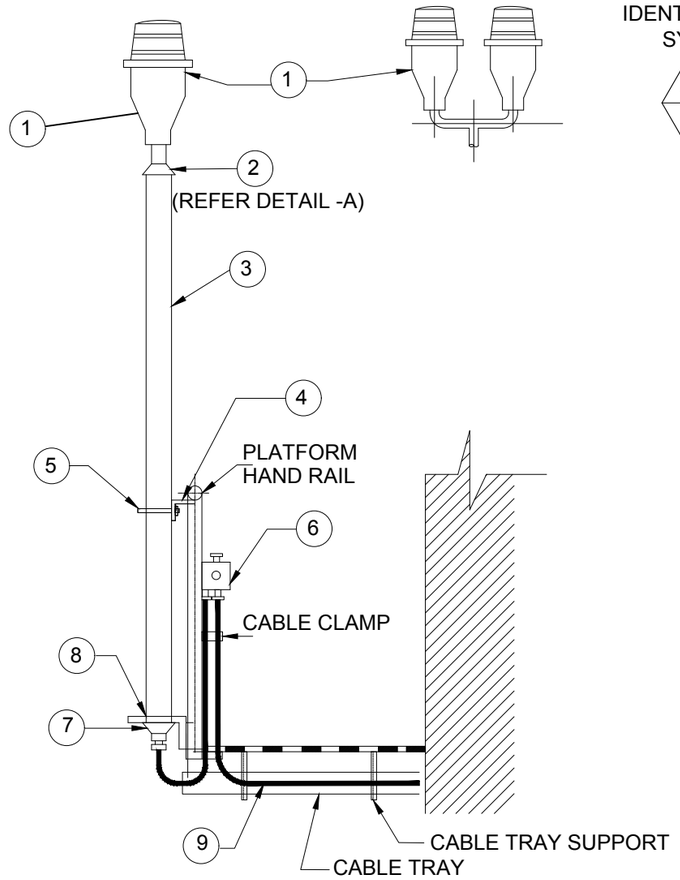
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TITLE: HIGH / MEDIUM / LOW BAY LIGHT FIXTURES PENDANT MOUNTED

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	14 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1693-001-14_0.DWG

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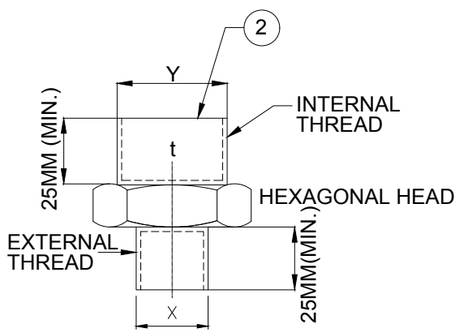


WARNING LIGHT MOUNTED ON PLATFORM

STANDARD IDENTIFICATION SYMBOL

STC
L11

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE WITH DOUBLE AVIATION LIGHT	Nos.	1
2	GI ADAPTOR OR REDUCER	Nos.	1
3	GI CONDUIT, 50Ø G.I. PIPE MEDIUM	MTR.	2
4	GI ANGLE 75x75x6-125 LONG WELDED TO HANDRAIL	SET	AS REQD
5	GI U-BOLT WITH NUT & WASHER	SET	1
6	JUNCTION BOX WITH SUITABLE CABLE GLAND	Nos.	1
7	REDUCER 50/25 RESTING IN DRILLED HOLE OF IRON PIECE	SET	AS REQD
8	100X75X6-100 MM LONG ANGLE WELDED TO THE PLATFORM FOR VERTICIAL SUPPORT OF THE POLE	Nos.	2
9	CABLE	MTR.	AS REQD



DESCRIPTION	DIMENSIONS	
	X	Y
FLOOR MOUNTED POLE	TO SUIT 19MM DIA.	TO SUIT 50MM DIA.

* ALTERNATIVELY SIZE TO SUIT FIXTURE

DETAIL-A
(ADAPTOR)

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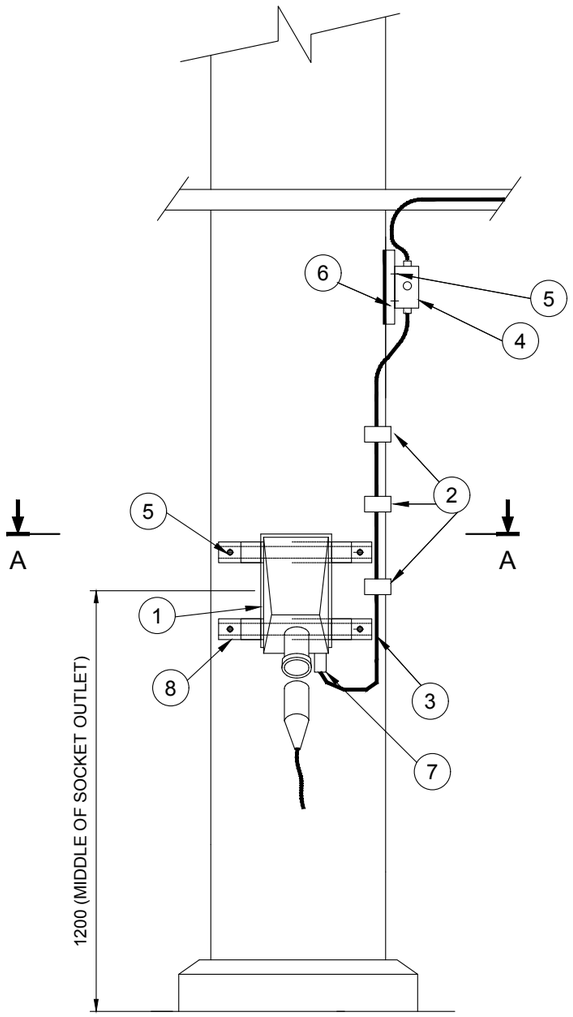
TITLE: AIRCRAFT WARNING LIGHTING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	15 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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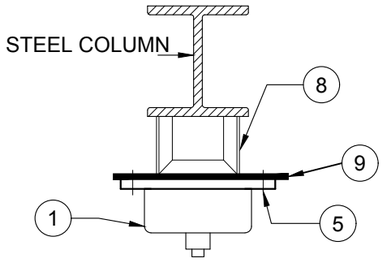
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STEEL/CONCRETE COLUMN

STANDARD IDENTIFICATION SYMBOL

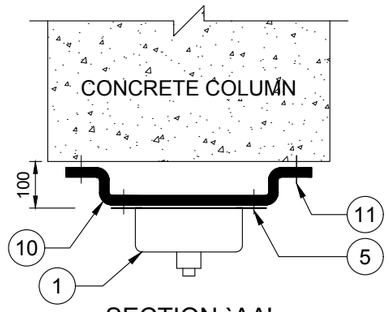
STC L12A



SECTION `AA'
(FOR STEEL COLUMN)

STANDARD IDENTIFICATION SYMBOL

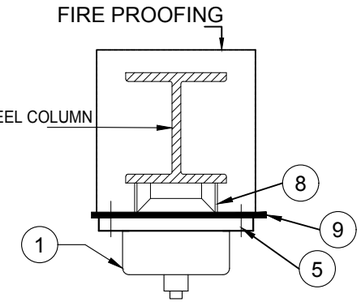
STC L12B



SECTION `AA'
(FOR CONCRETE COLUMN)

STANDARD IDENTIFICATION SYMBOL

STC L12C



SECTION `AA'
(FOR STEEL COLUMN WITH FIRE PROOFING)

NOTES:

1. DISTANCE BETWEEN 75/100 x 10mm M.S. FLAT & HOLES ON THESE FLAT SHALL BE SUCH THAT TO MATCH THE FIXING HOLES OF SOCKET OUTLET.
2. WHERE STEEL STRUCTURE ARE ENCOUNTERED, SOCKET OUTLET SHALL BE MOUNTED ON SUITABLE ANGLE FRAME WELDED TO STEEL STRUCTURE.
3. WHERE FIRE PROOFING OF COLUMNS/STRUCTURES ARE ENCOUNTERED SOCKET OUTLET CABLE SHALL BE INSTALLED ON SUITABLE DEEP LEGGED ANGLE IRON MOUNTING FRAME/DISTANCE BRACKET.
4. ALL DIMENSION ARE IN MM.

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	16A 240V 3 PIN & EARTH SOCKET OUTLET	Nos.	1
2	G.I. CABLE SADDLE WITH FIXING FASTENER/ TO SUIT SITE CONDITION	Nos.	AS REQD.
3	ARMOURED CABLE	MTR.	AS REQD.
4	JUNCTION BOX WITH SUITABLE CABLE GLAND.	Nos.	1
5	G.I. NUT, BOLT & WASHER FOR FIXING MARSHALLING BOX/JUNCTION BOX/ SOCKET OUTLET	Nos.	4
6	200X200X6mm GI PLATE	-	-
7	CABLE GLAND	Nos.	1
8	FABRICATED BRACKET MADE OF ANGLE 75X75X8 WELDED TO THE STEEL COLUMN	MTR.	AS REQD.
9	75/100X10MM THK. MS FLAT (2 NOS.) (LENGTH AS REQ'D)	MTR.	AS REQD.
10	FABRICATED BRACKET MADE OF M.S. FLAT 75/100 x 10mm BENT TO SHAP	Nos.	2
11	10mm DIA. ANCHOR FASTNERS WITH ACCESSORIES	SET	4

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DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: CONVENIENCE SOCKET OUTLET MOUNTING ON CONCRETE / STEEL COLUMN

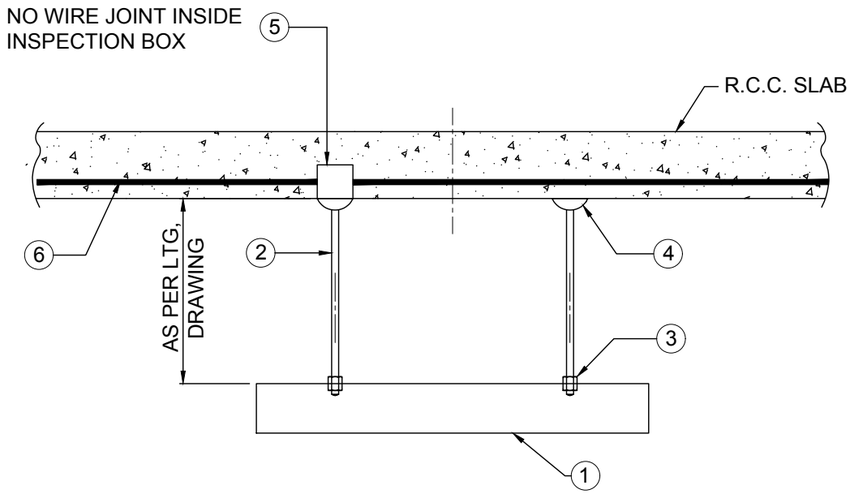
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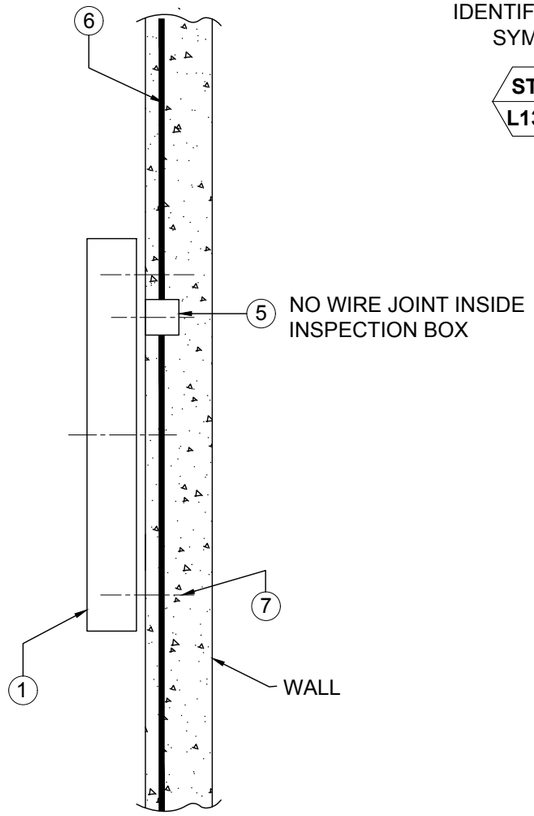
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SUSPENSION MOUNTING SIDE VIEW

STANDARD IDENTIFICATION SYMBOL

STC L13A



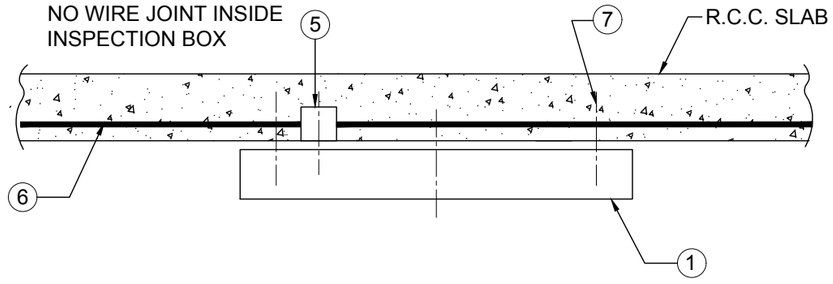
WALL MOUNTING PLAN VIEW

STANDARD IDENTIFICATION SYMBOL

STC L13C

STANDARD IDENTIFICATION SYMBOL

STC L13B



CEILING MOUNTING SIDE VIEW

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	19ø G.I. PIPE (PAINTED WHITE OR AS SPECIFIED) LENGTH AS INDICATED IN DWG	Nos.	1
3	G.I. LOCK NUT, BOLT & WASHERS	Nos.	AS REQD
4	SPRING LOADED BALL SOCKET ARRANGEMENT (CHROMIUM PLATED) FIXED WITH RAWL PLUG	Nos.	2
5	M.S. PULL / INSPECTION BOX WITH ANTI RUST COATING PAINT	Nos.	1
6	CONCEALED CONDUIT	MTR.	AS REQD
7	G.I. 8ø ANCHOR FASTENER WITH ACCESSORIES	Nos.	AS REQD

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PMC: TechnipFMC

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TITLE: LIGHTING FIXTURE MOUNTING IN CONCEALED CONDUIT SYSTEM

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	17 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

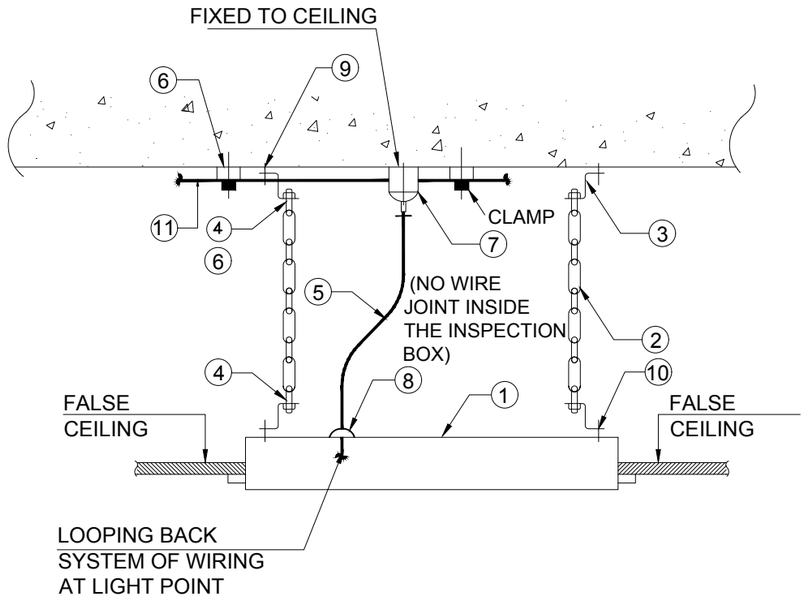
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STANDARD IDENTIFICATION SYMBOL

STC
L14



MOUNTING ARRANGEMENT WITH CHAIN SUPPORT

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	SUPPORTING CHAIN CHROMIUM PLATED (LENGTH AS REQUIRED)	Nos.	2
3	32x6 THK 110 LONG G.I. FLAT BEND TO SHAPE	MTR	4
4	EYE BOLT & NUT, CHROMIM PLATED	Nos.	4
5	WIRE IN 25ø FLEXIBLE CONDUIT	MTR.	AS REQD
6	M.S. SPACER SUPPORT FIXED WITH RAWL PLUG	MTR.	AS REQD
7	INSPECTION BOX (NO WIRE JOINT INSIDE THE INSPECTION BOX)	Nos.	1
8	RUBBER GROMMET	Nos.	1
9	G.I. 8ø ANCHOR FASTENER WITH ACCESSORIES	Nos.	2
10	G.I. NUT, BOLT & WASHERS	Nos.	2
11	CONDUIT	MTR.	AS REQD

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

CONFIDENTIAL, NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE: LIGHTING FIXTURE RECESSED WITH FALSE CEILING (DECORATIVE FLUORESCENT)

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	18 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

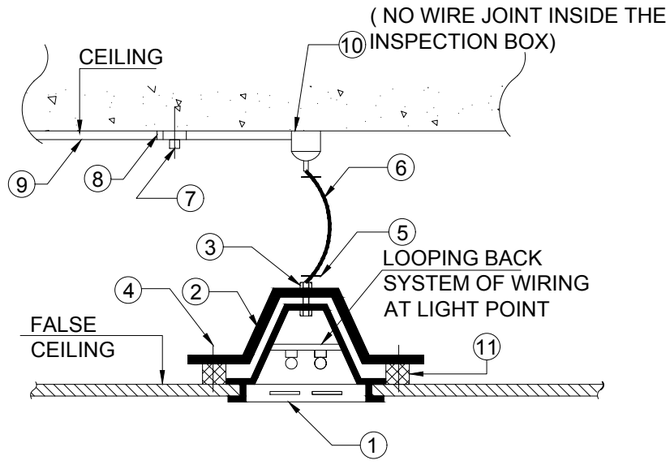
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STANDARD IDENTIFICATION SYMBOL

STC
L15



RECESS MTD. FIXTURE SUPPORTED ON WOODEN FRAME

ITEM	COMPONENT DESCRIPTION	UNIT	QTY
1	LIGHTING FIXTURE	Nos.	1
2	32x6 G.I. FLAT BENT TO SHAPE FOR FIXTURE SUPPORT HOLE AT BOTH END	Nos.	2
3	G.I. BOLT WITH FLYNUT TO MATCH THE FIXING HOLE OF LIGHTING FIXTURE	SET	2
4	STEEL SCREW (SIZE AS REQD.)	Nos.	4
5	RUBBER GROMMET	Nos.	1
6	WIRE IN 25ø FLEXIBLE CONDUIT	MTR	AS REQD
7	CLAMP	Nos.	AS REQD
8	M.S. SPACER SUPPORT FIXED WITH RAWL PLUG	Nos.	AS REQD
9	CONDUIT	Nos.	AS REQD
10	INSPECTION BOX FIXED TO CEILING	Nos.	1
11	WOODEN FRAME	Nos.	1

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☒ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: LIGHTING FIXTURE RECESSED WITH FALSE CEILING

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	19 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1693-001-19_0.DWG

SHEET SIZE : A3

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STANDARD IDENTIFICATION SYMBOL

STC
L16

SPARE

Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
0	29.05.2020	ISSUED FOR CONSTRUCTION	GP	CG	SV	JMC

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☒ INFORMATION	

PROJECT: STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER: INDIAN OIL CORPORATION LTD.

PMC: TechnipFMC

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TITLE: SPARE

DRAWING NO.						PAGE	REV.
SCALE	080557C001	000	STC	1693	001	20 OF 20	0
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

CAD FILE NAME : 080557C-000-STC-1693-001-20_0.DWG

SHEET SIZE : A3

MARK UP FOR SRR 811& MCR (SRR-815)

			Written By: Rathinakannan Chinnasamy 2020.06.11 18:39:36 +05'30'	Checked By: Shyamsundar Kanthalurajan 2020.06.11 18:45:44 +05'30'	Approved By: Sriram Sankaranarayanan 2020.06.11 21:58:01 +05'30'	Authorized By: Morischristopher Jesumarian 2020.06.12 00:15:16 +05'30'
C	11.06.2020	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
B	14.02.2020	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
A	12.12.2019	ISSUED FOR DESIGN	CRK	KRS	SS	JMC
REV.	**DATE**	**DESCRIPTION**	**PREPARED**	**CHECKED**	**APPROVED**	**AUTHORIZED**

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2. DEFINITIONS & ABBREVIATIONS 3
3. GENERAL NOTES 4
4. ANNEXURE 4

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1. INTRODUCTION:

INDIAN OIL CORPORATION LIMITED (IOCL) has awarded Fax of Acceptance (FOA) dated 29th August 2019 to M/s. Technip India Limited (TPIL) for Consultancy services (PMC/EPCM services) for overall project management, FEED Review / FEED, Detailed Engineering, Procurement & expediting services, Tendering & award, Construction Management & Supervision, Assistance in start-up, Commissioning & performance test runs for installation of a Standby SRU of 525 TPD capacity and execution of Additional tanks for Paradip Refinery, Odisha, India.

2. DEFINITIONS & ABBREVIATIONS

Abbreviation	Definition /Expanded form
IOCL/ CLIENT	Indian Oil Corporation Limited
PMC/ CONSULTANT	Technip India Limited
LICENSOR	Party selected by IOCL for process technology ownership for any UNIT
CONTRACTOR	Party whose services are obtained for performing the works specified as part of LSTK / packages.
EPCM	Engineering, Procurement & Construction Management Services.
LSTK	Lump Sum Turn Key portion of the work to be executed by CONTRACTOR
FEED	Front End Engineering Design
AUTHORISED REPRESENTATIVE	IOCL's/ CONSULTANT's representative authorized to act for and on behalf of them.
VENDOR	Any third party supplying the equipment/materials for setting up the Plant
PROJECT	Indicates Standby SRU and Additional tanks Project, Paradip Refinery
UNIT	Indicates any particular portion of the project to be built which can be Process related or Utilities/Offsites related

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3. GENERAL NOTES

1. The space required for placing cabinets of SRU-3(88) and WHB & INCINERATOR of TGTU-2 inside the Rack room of SRR -811 is marked in the attached annexure-1.

2. The space required for placing cabinets of SRU-3(88) and WHB & INCINERATOR of TGTU-2 inside the Rack room of SRR -815 Main Control Room MCR is marked in the attached annexure-2.

3. The required space for placing workstation/server for SRU-3(88) and WHB & INCINERATOR of TGTU-2 inside the SRR -815 Main Control Room(MCR) is marked in the attached annexure-3.

4. The required space for placing new consoles of SRU-3(88) and WHB & INCINERATOR of TGTU-2 inside the Operator control room of SRR -815 (MCR) - is marked in the attached annexure-4.

5. The space required for placing CPC workstation of SRU-3(88) and WHB & INCINERATOR of TGTU-2 inside the Engineering room of SRR -811 is marked in the attached annexure-1.

6. The attached markup is preliminary space reservation for placing cabinets of SRU-3(88) and WHB & INCINERATOR of TGTU-2

7. Contractor to further develop/update the layout indicating the cabinet details in consultation with IOCL and system vendor during detailed engineering.

8. Contractor shall validate the reserved spaces during the site visit in consultation with system vendor and IOCL during detailed engineering

4. ANNEXURE

1. D10T618-005-RR-811-CAB PLACEMENT- Mark Up
2. D10T618-005-RR-815-CAB PLACEMENT- Mark Up
3. D10T618-005-RR-815-CR- Mark Up
4. D10T618005-01-ER-815- Mark up
5. D10T618005-01-ER-811- Mark up

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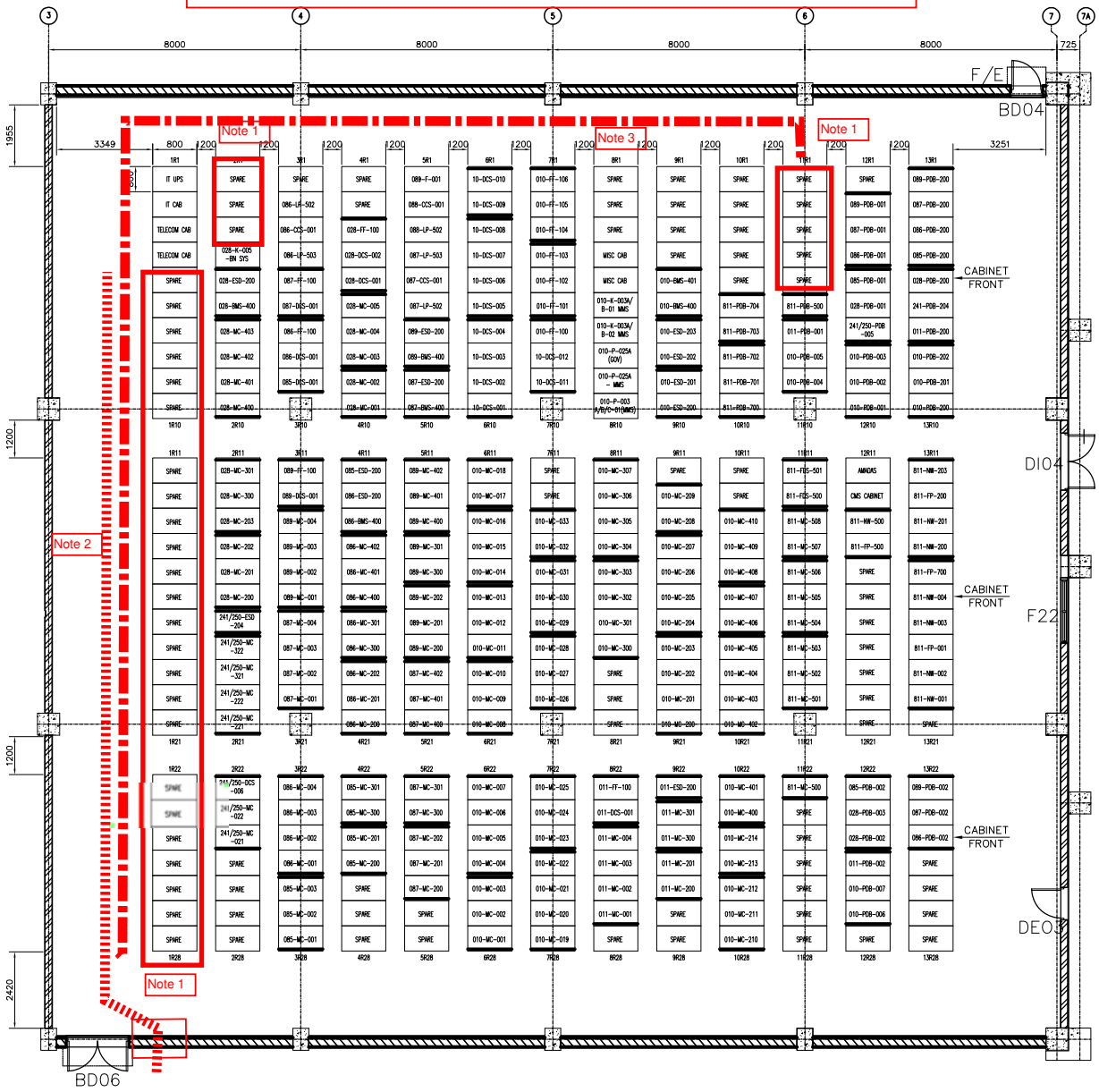
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ANNEXURE 1 TO 080557C-088-DW-1523-001

LEGENDS:

: SIDE PANEL



Notes

1.PMC Markup identifying the space for placing the cabinets of SRU-3(88) and WHB & INCINERATOR of TGTU-2(90)

2. Tentative routing of instrument trays for the cable from SRU 3 & TGTU 2

3.Tentative routing of Power trays from PDB board to marshalling and system cabinets.

4.Proposed tray routing are guidance purpose only and the same shall be revalidated/ modified by LSTK contractor according to actual requirement based on pre bid site visit and during detailed engineering.

5. All the cabinets for DCS, ESD,FDAS , PDB , subsystem shall be free standing type .

REV	DESCRIPTION	DRAWN	APPRV	DATE
0	ORIGINAL ISSUE	RBB	PB	02/07/13

PROJECT: ICS FOR IOCL 15MMTPA PARADIP REFINERY
PROJECT NO: D10T618

SCALE: NTS | ORN NO.: D10T618
CAD FILE: 01

Honeywell
HONEYWELL AUTOMATION INDIA LTD.

CLIENT NAME : INDIAN OIL CORPORATION LTD. (IOCL)
mPMC : FOSTER WHEELER ENERGY LTD.
END-USER : INDIAN OIL CORPORATION LTD. (IOCL)
EPCm : FOSTER WHEELER ENERGY LTD.

TITLE: ENGINEERING DOCUMENTATION
RACK ROOM (RR-811)
CABINET PLACEMENT DETAILS

DOC. NO: D10T618-005-RR-811-CAB PLACEMENT | REV. 0
SHT: 01 OF: 01 | DATE: 02/07/2013

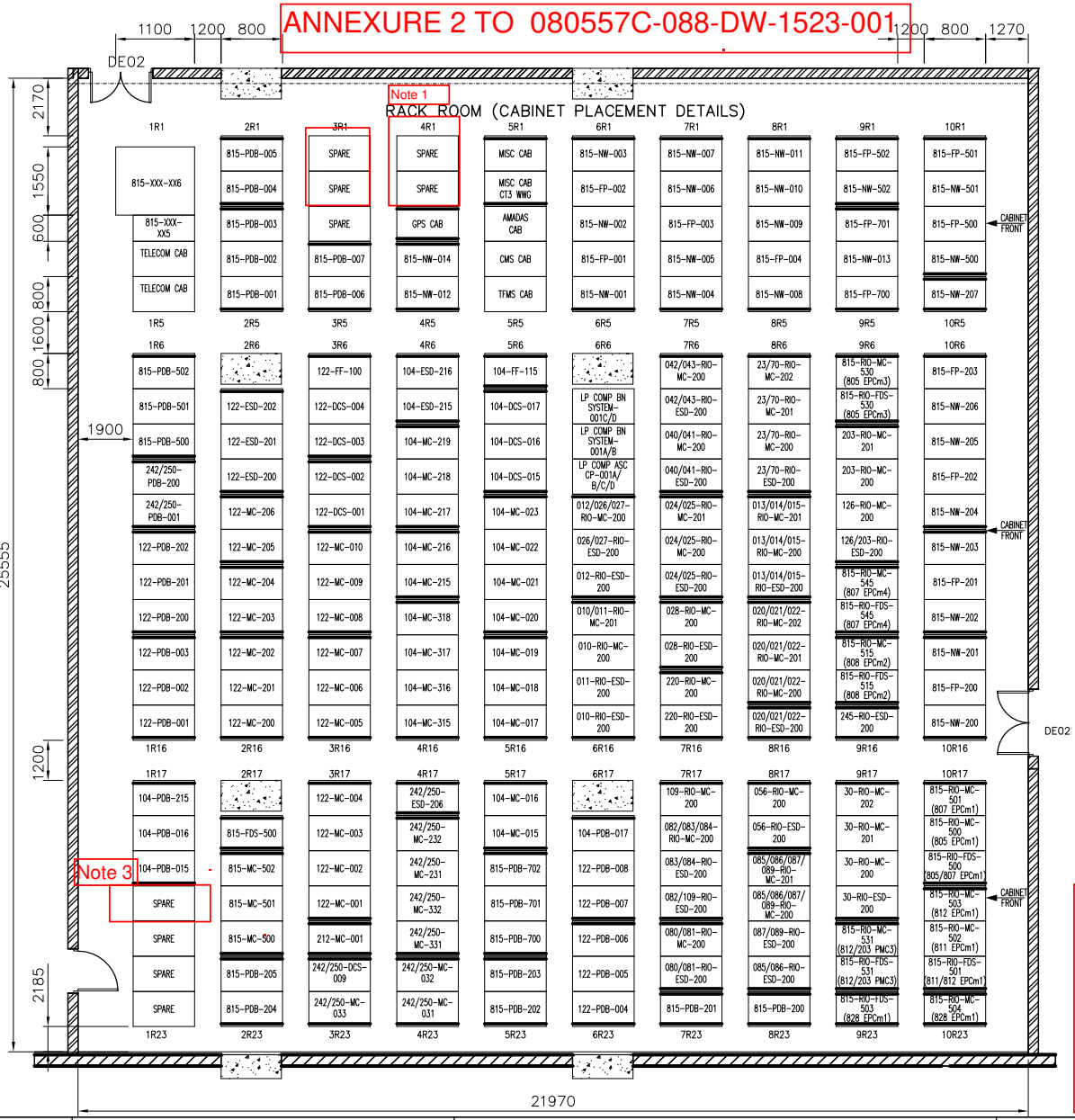
INP-003532

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ANNEXURE 2 TO 080557C-088-DW-1523-001

LEGENDS:

: SIDE PANEL



Note

1.PMC Markup identifying the space for placing the below cabinets of SRU-3(88) and WHB & INCINERATOR of TGTU-2(90)

a.RIO cabinet 2 nos

b.Network Cabinet 1 no

c.PDB cabinet 1 No

2.All the cabinets for DCS, ESD,FDAS , PDB , subsystem like AMADAS shall be free standing type .

3. PMC Markup identifying the space for placing AMADAS cabinet.

REV	DESCRIPTION	DRAWN	APPRV	DATE
0	ORIGINAL ISSUE	RBB	DP	27/06/13

PROJECT: ICS FOR IOCL 15MMTPA PARADIP REFINERY
PROJECT NO: D10T618

SCALE: NTS | ORN NO.: D10T618

CAD FILE: 01

Honeywell

HONEYWELL AUTOMATION INDIA LTD.

CLIENT NAME : INDIAN OIL CORPORATION LTD. (IOCL)
mPMC : FOSTER WHEELER ENERGY LTD.
END-USER : INDIAN OIL CORPORATION LTD. (IOCL)
EPCm : FOSTER WHEELER ENERGY LTD.

TITLE: ENGINEERING DOCUMENTATION
RACK ROOM (MCR-815)
CABINET PLACEMENT DETAILS

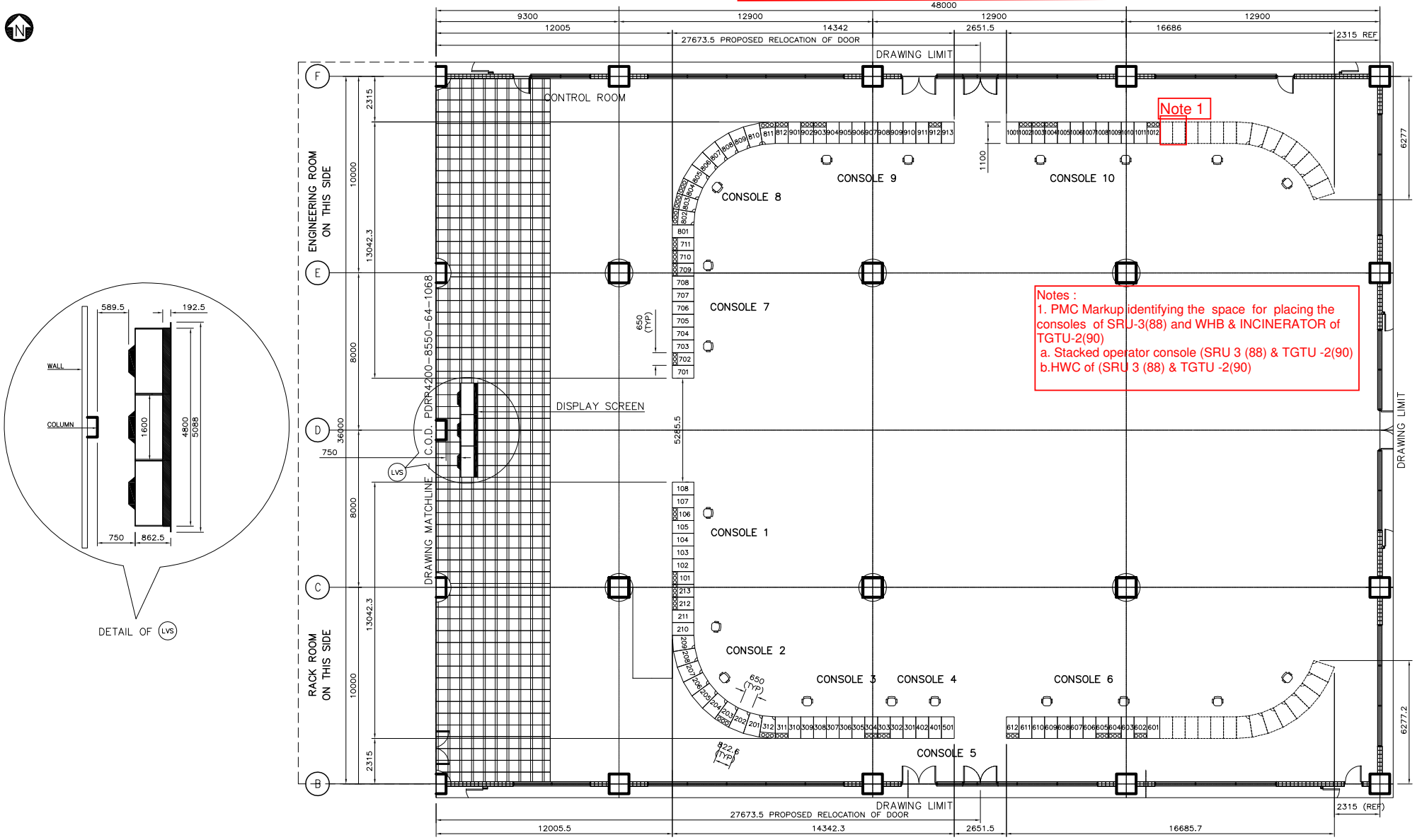
DOC. NO: D10T618-005-RR-815-CAB PLACEMENT | REV. 0

SHT: 01 OF: 01 | DATE: 27/06/2013

INP-003532

ANNEXURE 3 TO 080557C-088-DW-1523-001

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DRAWING REFERENCE : PDRP0275-8330-47-815-1401_REV_S4

REV	DESCRIPTION	DRAWN	APPRV	DATE
0	ORIGINAL ISSUE	RBB	DP	25/07/12
1	REVISED ISSUE	RBB	PB	09/07/13

PROJECT: ICS FOR IOCL 15MMTPA PARADIP REFINERY
PROJECT NO: D10T618

SCALE: NTS | ORN NO.: D10T618
CAD FILE: 005-01-CR-815

Honeywell
HONEYWELL AUTOMATION INDIA LTD.

CLIENT NAME : INDIAN OIL CORPORATION LTD. (IOCL)
mPMC : FOSTER WHEELER ENERGY LTD.
END-USER : INDIAN OIL CORPORATION LTD. (IOCL)
EPCm : FOSTER WHEELER ENERGY LTD.

TITLE: ENGINEERING DOCUMENTATION
CONSOLE ROOM LAYOUT
MCR 815

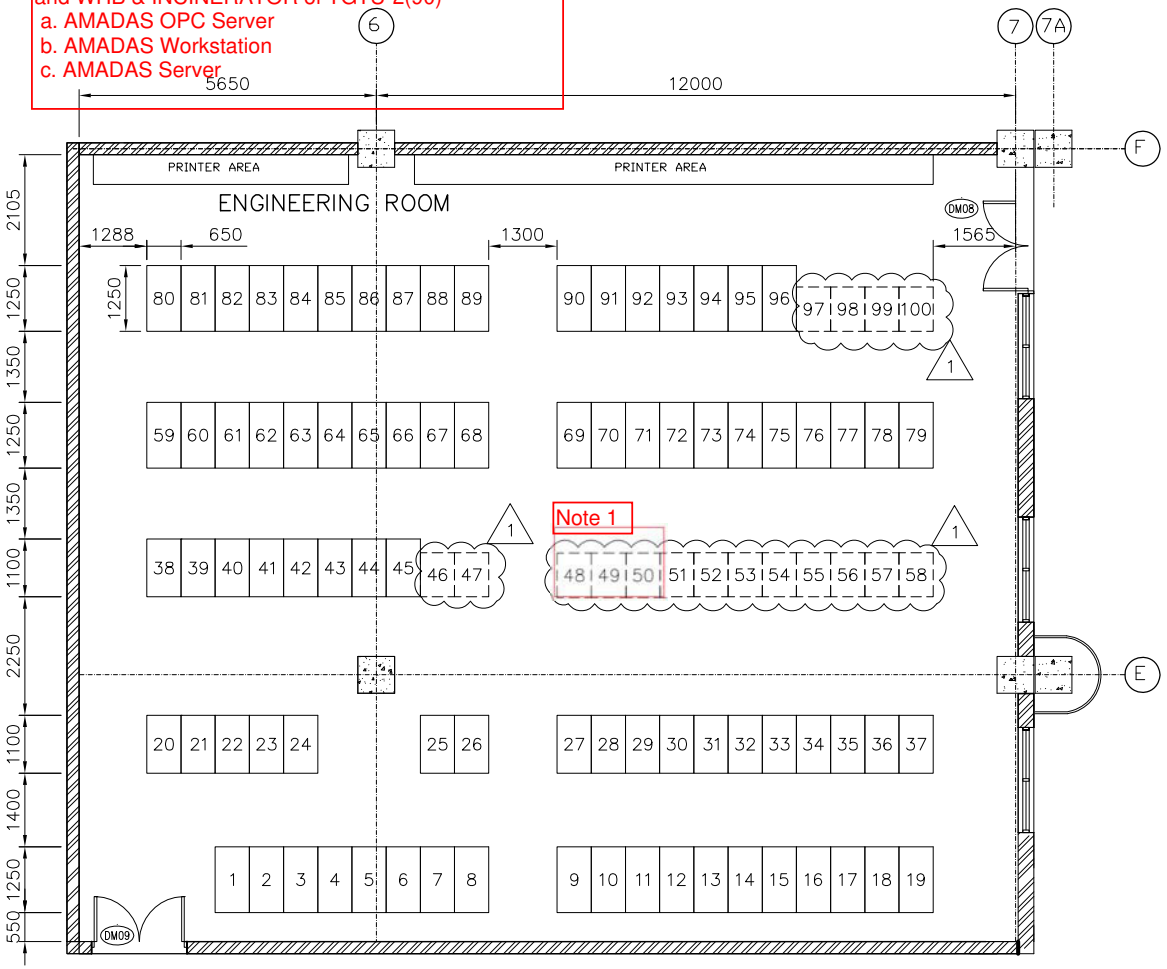
DOC. NO: D10T618-005-815-CR | REV. 1
SHT: 01 OF: 02 | DATE: 09/07/2013

INP-003532

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Note
1.PMC Markup identifying the space for placing the below engineering workstation & server of SRU-3(88) and WHB & INCINERATOR of TGTU-2(90)
a. AMADAS OPC Server
b. AMADAS Workstation
c. AMADAS Server

MCR 815 ENGINEERING ROOM



DESK LOC	SYSTEM	PC NAME	DESCRIPTION	EPCm	Unit	Unit Group
1	DCS	815-SRV-AMS	AMS Server	EPCm1	Common	Common
2	DCS	815-MCR-IAMS1	IAMS-1	EPCm1	Common	Common
3	DCS	815-MCR-IAMS2	IAMS-2	EPCm1	Common	Common
4	DCS	815-MCR-IAMS3	IAMS-3	EPCm1	Common	Common
5	DCS	815-MCR-IAMS4	IAMS-4	EPCm1	Common	Common
6	DCS	815-SRV-DCS13A	DCS SERVER-A (U104)	EPCm1	104	26
7	DCS	815-SRV-DCS13B	DCS SERVER-B (U104)	EPCm1	104	26
8	DCS	815-SRV-DCS17A	DCS SERVER-A (U122)	EPCm1	122	29,30,31
9	DCS	815-SRV-DCS17B	DCS SERVER-B (U122)	EPCm1	122	29,30,31
10	DCS	815BSRV-DCS01A	DCS EMB SERVER (PRIM)	EPCm1	Common	Common
11	DCS	815BSRV-DCS01B	DCS EMB SERVER (BKUP)	EPCm1	Common	Common
12	DCS	-	PIMS BUFFER-1 (PRIM)	EPCm1	Common	Common
13	DCS	-	PIMS BUFFER-1 (BKUP)	EPCm1	Common	Common
14	DCS	-	PIMS BUFFER-2 (PRIM)	EPCm1	Common	Common
15	DCS	-	PIMS BUFFER-2 (BKUP)	EPCm1	Common	Common
16	DCS	-	PIMS BUFFER-3 (PRIM)	EPCm1	Common	Common
17	DCS	-	PIMS BUFFER-3 (BKUP)	EPCm1	Common	Common
18	DCS	-	PIMS BUFFER-4 (PRIM)	EPCm1	Common	Common
19	DCS	-	PIMS BUFFER-4 (BKUP)	EPCm1	Common	Common
20	DCS	815-EWS-DCS001	DCS ENGG STATION (U104)	EPCm1	104	26
21	DCS	815-EWS-DCS002	DCS ENGG STATION (U122)	EPCm1	122	29,30,31
22	DCS	815-CLI-AMS	AMS Client	EPCm1	Common	Common
23	DCS	815BSCLI-DCS01	DCS EMB CLIENT	EPCm1	Common	Common
24	DCS	815BSCLI-DCS02	DCS EMB CLIENT	EPCm1	Common	Common
25	DCS	815BSCLI-DCS03	DCS EMB CLIENT	EPCm1	Common	Common
26	DCS	815BSCLI-DCS04	DCS EMB CLIENT	EPCm1	Common	Common
27	DCS	815BSCLI-DCS05	DCS EMB CLIENT	EPCm1	Common	Common
28	DCS	815BSCLI-DCS06	DCS EMB CLIENT	EPCm1	Common	Common
29	DCS	815BSCLI-DCS07	DCS EMB CLIENT	EPCm1	Common	Common
30	DCS	815-DCS-AVPATCH	AV/PATCH PC	EPCm1	Common	Common
31	ESD	815OES-ESD1405A	ESD EWS (U104 CT3+CT4) U104/122 SCADA PRIM	EPCm1	104	26
32	ESD	815OES-ESD1405B	ESD EWS (U122) U104/122 SCADA PRIM	EPCm1	122	29,30,31
33	ESD	815BSCLI-ESD002	ESD EMB CLIENT	EPCm1	Common	Common
34	ESD	815BSCLI-ESD003	ESD EMB CLIENT	EPCm1	Common	Common
35	ESD	815BSCLI-ESD004	ESD EMB CLIENT	EPCm1	Common	Common
36	ESD	815BSCLI-ESD005	ESD EMB CLIENT	EPCm1	Common	Common
37	ESD	815BSCLI-ESD006	ESD EMB CLIENT	EPCm1	Common	Common
38	ESD	815BSCLI-ESD007	ESD EMB CLIENT	EPCm1	Common	Common
39	ESD	815-ESD-AVPATCH	AV/PATCH PC	EPCm1	Common	Common
40	FDAS	815OWS-FDS500	FDAS OWS (EPCm1 RR-815 FDAS)	EPCm1	EPCm1-815	EPCm1-815
41	FDAS	815-FDS-AVPATCH	AV/PATCH PC	EPCm1	Common	Common
42	ANALYSER	3rd Party Supply	ANALYSER WORKSTATION	LSTK	Common	Common
43	AMADAS	3rd Party Supply	AMADAS WORKSTATION	LSTK	Common	Common
44	CMS	3rd Party Supply	CMS WORKSTATION	LSTK	Common	Common

DESK LOC	SYSTEM	PC NAME	DESCRIPTION	EPCm	Unit	Unit Group
45	TFMS	3rd Party Supply	TFMS Workstation ER	LSTK	Common	Common
46 - 58	SPARE	NA	SPARE SPACE FOR EWS / OWS	EPCm1	NA	NA
59	DCS	-	PIMS DOMAIN PC	EPCm1	Common	Common
60	DCS	-	PIMS SHADOW SERVER (PRIM)	EPCm1	Common	Common
61	DCS	-	PIMS SHADOW SERVER (BKUP)	EPCm1	Common	Common
62	DCS	-	PIMS SQL SERVER	EPCm1	Common	Common
63	DCS	-	PIMS WEB SERVER	EPCm1	Common	Common
64	DCS	MCR-DCS-ROOT	ROOT DOMAIN	EPCm1	Common	Common
65	DCS	COMMUNITY-A-ADC	DCS FTE COMMUNITY-A DOMAIN	EPCm1	Common	Common
66	DCS	COMMUNITY-B-ADC	DCS FTE COMMUNITY-B DOMAIN	EPCm1	Common	Common
67	DCS	COMMUNITY-C-ADC	DCS FTE COMMUNITY-C DOMAIN	EPCm1	Common	Common
68	DCS	COMMUNITY-D-ADC	DCS FTE COMMUNITY-D DOMAIN	EPCm1	Common	Common
69	DCS	COMMUNITY-E-ADC	DCS FTE COMMUNITY-E DOMAIN	EPCm1	Common	Common
70	DCS	COMMUNITY-F-ADC	DCS FTE COMMUNITY-F DOMAIN	EPCm1	Common	Common
71	DCS	COMMUNITY-G-ADC	DCS FTE COMMUNITY-G DOMAIN	EPCm1	Common	Common
72	DCS	815-SRV-INTBLDA	OPC SERVER - INTER BUILDING (PRIM)	EPCm1	Common	Common
73	DCS	815-SRV-INTBLDB	OPC SERVER - INTER BUILDING (BKUP)	EPCm1	Common	Common
74	DCS	815-SRV-BOO1A	OPC SERVER - BOO1 (PRIM)	EPCm1	Common	Common
75	DCS	815-SRV-BOO1B	OPC SERVER - BOO1 (BKUP)	EPCm1	Common	Common
76	DCS	815-SRV-AMADASA	OPC SERVER - AMADAS (PRIM)	EPCm1	Common	Common
77	DCS	815-SRV-AMADASB	OPC SERVER - AMADAS (BKUP)	EPCm1	Common	Common
78	DCS	815-SRV-CMSA	OPC SERVER - CMS (PRIM)	EPCm1	Common	Common
79	DCS	815-SRV-CMSB	OPC SERVER - CMS (BKUP)	EPCm1	Common	Common
80	DCS	815-SRV-WEB	WEB-SERVER	EPCm1	Common	Common
81	ESD	MCR-ESD-ROOT	ESD DOMAIN-A	EPCm1	Common	Common
82	ESD	MCR-ESD-ADC	ESD DOMAIN-B	EPCm1	Common	Common
83	ESD	815-BSRCL-ESDA	ESD EMB (PRIM)	EPCm1	Common	Common
84	ESD	815-BSRCL-ESDB	ESD EMB (BKUP cum CLIENT)	EPCm1	Common	Common
85	ESD	815-SOE-ESD001	ESD COMMON SOE	EPCm1	Common	Common
86	FDAS	MCR-FDS-ROOT	FDAS DOMAIN-A	EPCm1	Common	Common
87	FDAS	MCR-FDS-ADC	FDAS DOMAIN-B	EPCm1	Common	Common
88	FDAS	815OES-FDS500A	FDAS EWS (PRIM)	EPCm1	Common	Common
89	FDAS	815OES-FDS500B	FDAS EWS cum OWS (BKUP)	EPCm1	Common	Common
90	FDAS	815-SOE-FDS500	FDAS COMMON SOE	EPCm1	Common	Common
91	FDAS	815-OWS-FDS502	FDAS HMI	EPCm1	Common	Common
92	FDAS	815-OWS-FDS503	FDAS HMI	EPCm1	Common	Common
93	ANALYSER	3rd Party Supply	ANALYSER GC MAINT. TERMINAL	LSTK	Common	Common
94	AMADAS	3rd Party Supply	AMADAS SERVER	LSTK	Common	Common
95	CMS	3rd Party Supply	CMS SERVER 1	LSTK	Common	Common
96	CMS	3rd Party Supply	CMS SERVER 2	LSTK	Common	Common
97 - 100	SPARE	NA	SPARE SPACE FOR SERVER	EPCm1	NA	NA

REV	DESCRIPTION	DRAWN	APPRV	DATE
0	ORIGINAL ISSUE	RBB	DP	09/07/12
1	REVISED ISSUE	RBB	PB	16/07/13

PROJECT: ICS FOR IOCL 15MMTPA PARADIP REFINERY
PROJECT NO: D10T618

SCALE: NTS | ORN NO.: D10T618
CAD FILE: 005-01-ER-815

Honeywell
HONEYWELL AUTOMATION INDIA LTD.

CLIENT NAME : INDIAN OIL CORPORATION LTD. (IOCL)
mPMC : FOSTER WHEELER ENERGY LTD.
END-USER : INDIAN OIL CORPORATION LTD. (IOCL)
EPCm : FOSTER WHEELER ENERGY LTD.

TITLE: ENGINEERING DOCUMENTATION
ENGINEERING ROOM LAYOUT
MCR 815

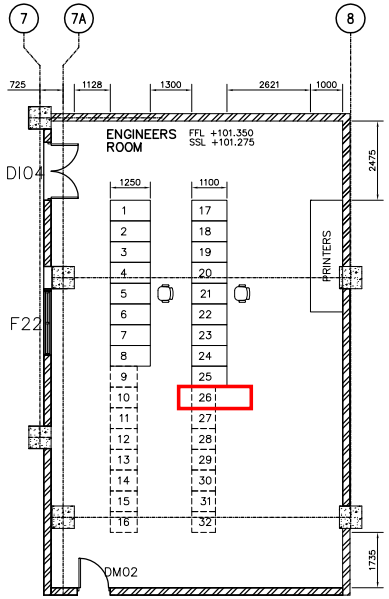
DOC. NO: D10T618-005-ER-815 | REV. 1
SHT: 01 OF: 01 | DATE: 16/07/2013

INP-003532

PROPRIETARY DATA ALL RIGHTS RESERVED.

ANNEXURE 5 TO 080557C-088-DW-1523-001

SRR 811 ENIGINEERING ROOM



1

DESK LOC	SYSTEM	PC NAME	DESCRIPTION	EPCm	Unit	Unit Group
1	DCS	811-SRV-DCS01A	DCS SERVER-A (U010)	EPCm1	10	1
2	DCS	811-SRV-DCS01B	DCS SERVER-B (U010)	EPCm1	10	1
3	DCS	811-SRV-DCS29A	DCS SERVER-A (U011)	EPCm1	11	2
4	DCS	811-SRV-DCS29B	DCS SERVER-B (U011)	EPCm1	11	2
5	DCS	811-SRV-DCS20A	DCS SERVER-A (U028)	EPCm1	28	10
6	DCS	811-SRV-DCS20B	DCS SERVER-B (U028)	EPCm1	28	10
7	DCS	811-SRV-DCS10A	DCS SERVER-A (U085/086/087/089)	EPCm1	85,86,87,89	19,20,21,22
8	DCS	811-SRV-DCS10B	DCS SERVER-B (U085/086/087/089)	EPCm1	85,86,87,89	19,20,21,22
9 - 16	SPARE	NA	SPARE SPACE FOR SERVER	EPCm1	NA	NA
17	DCS	811-EWS-DCS002	DCS ENGG STN (U010)	EPCm1	10	1
18	DCS	811-EWS-DCS001	DCS ENGG STN (U011)	EPCm1	11	2
19	DCS	811-EWS-DCS003	DCS ENGG STN (U028)	EPCm1	28	10
20	DCS	811-EWS-DCS004	DCS ENGG STN (U085/086/087/089)	EPCm1	85,86,87,89	19,20,21,22
21	ESD	811OES-ESD107A	ESD EWS (U010) SCADA PRIM	EPCm1	10	1
22	ESD	811OES-ESD108A	ESD EWS (U011) SCADA PRIM	EPCm1	11	2
23	ESD	811OES-ESD609A	ESD EWS (U028) SCADA PRIM	EPCm1	28	10
24	ESD	811OES-ESD1010A	ESD EWS (U085/086/087/089) SCADA PRIM	EPCm1	85,86,87,89	19,20,21,22
25	FDAS	811OWS-FDS500	FDAS OWS (EPCm1 SRR-811 FDAS)	EPCm1	EPCm1-811	EPCm1-811
26 - 32	SPARE	NA	SPARE SPACE FOR EWS / OWS	EPCm1	NA	NA

Notes

1.PMC Markup identifying the space for placing Pollution CPC workstation of SRU-3(88) and WHB & INCINERATOR of TGTU-2(90)

DRAWING REF. : 1) PDRP4240-0275-8330-47-811-2001_REV_S1

REV	DESCRIPTION	DRAWN	APPRV	DATE
0	ORIGINAL ISSUE	RBB	DP	07/08/12
1	REVISED ISSUE	RBB	PB	19/07/13

PROJECT: ICS FOR IOCL 15MMTPA PARADIP REFINERY
PROJECT NO: D10T618

SCALE: NTS | ORN NO.: D10T618
CAD FILE: 005-01-ER-811

Honeywell
HONEYWELL AUTOMATION INDIA LTD.

CLIENT NAME : INDIAN OIL CORPORATION LTD. (IOCL)
mPMC : FOSTER WHEELER ENERGY LTD.
END-USER : INDIAN OIL CORPORATION LTD. (IOCL)
EPCm : FOSTER WHEELER ENERGY LTD.

TITLE: ENGINEERING DOCUMENTATION
ENGINEERING ROOM LAYOUT
SRR 811

DOC. NO: D10T618-005-ER-811 | REV. 1
SHT: 01 OF: 01 | DATE: 19/07/2013

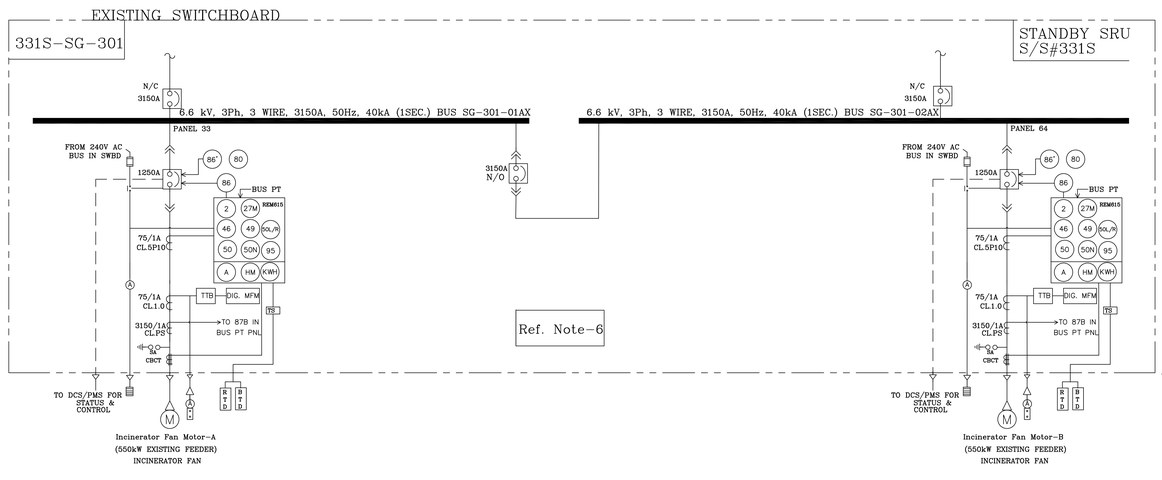
INP-003532

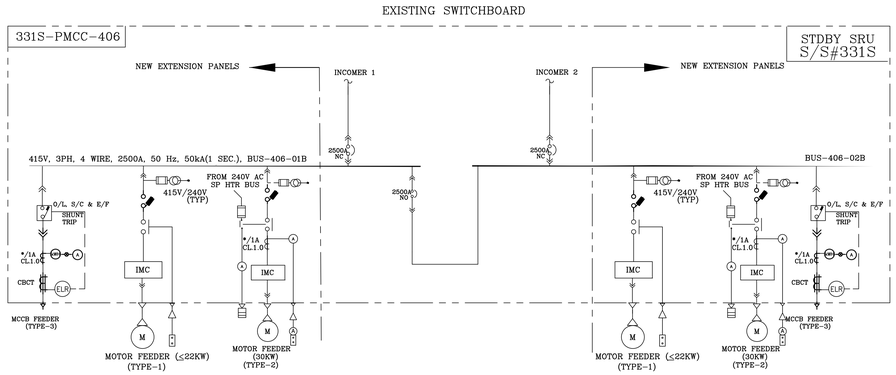
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

ESP-001-12A

DRG. NO. B366-088-16-50-0010 SH. 1 OF 1

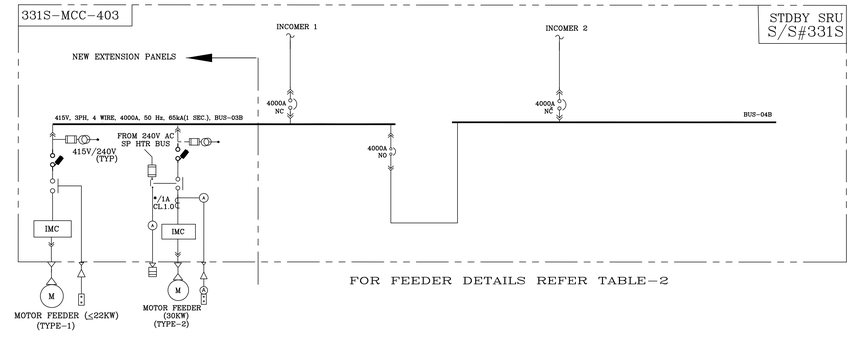




FOR FEEDER DETAILS REFER TABLE-1

TABLE-1

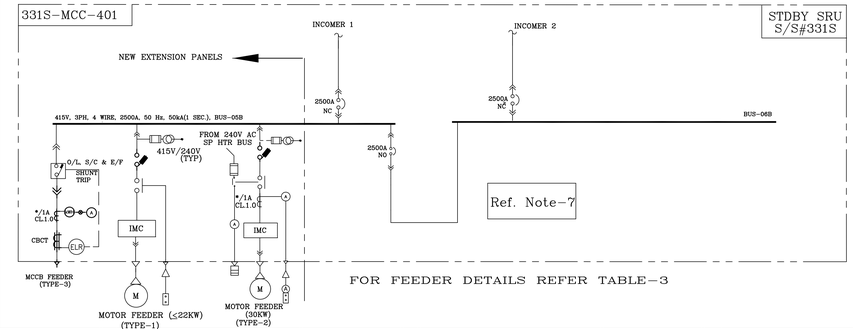
LEFT BUS (406-01B)				RIGHT BUS (406-02B)			
TAG NO.	RATING	TYPE	CT RATIO	TAG NO.	RATING	TYPE	CT RATIO
Dinerator Aux	5.5 kW	Type-1	-	Dinerator Aux	5.5 kW	Type-1	-
Dinerator Aux	11 kW	Type-1	-	Dinerator Aux	32A	Type-3	-
Dinerator Aux	32A	Type-3	-	088-P-001A	11 kW	Type-1	-
088-P-001B	11 kW	Type-1	-	088-P-002B	11 kW	Type-1	-
088-P-002A	11 kW	Type-1	-	088-P-004A	7.5 kW	Type-1	-
088-P-004B	7.5 kW	Type-1	-	088-P-005A	30 kW	Type-2	100/1
088-P-005B	30 kW	Type-2	100/1	088-A-002M	3.7 kW	Type-1	-
088-A-002M	5.5 kW	Type-1	-	088-A-002P	2.2 kW	Type-1	-
088-A-002P	5.5 kW	Type-1	-	88-AC-002 A	5.5 kW	Type-1	-
88-AC-002 A	5.5 kW	Type-1	-	HB	250A	Type-3	-



FOR FEEDER DETAILS REFER TABLE-2

TABLE-2

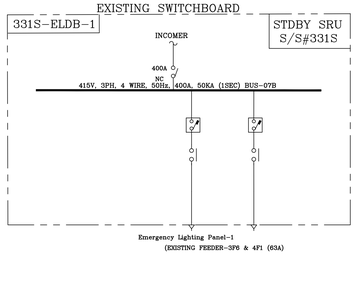
LEFT BUS (MCC-403-03B)				RIGHT BUS (MCC-403-04B)			
TAG NO.	RATING	TYPE	CT RATIO	TAG NO.	RATING	TYPE	CT RATIO
088-P-006A	30 kW	Type-2	100/1				
090-A-002M	5.5 kW	Type-1	-				
AS 090-AH-001	63A	Type-3	-				
090-A-002P	5.5 kW	Type-1	-				

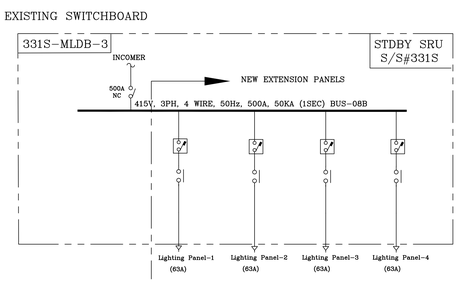


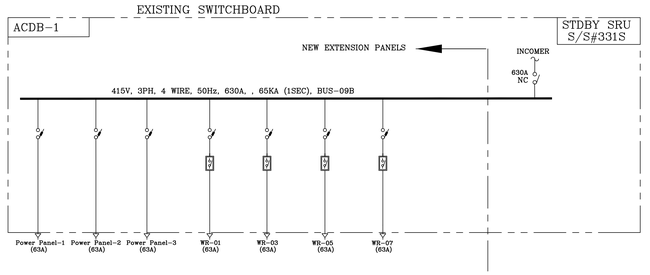
FOR FEEDER DETAILS REFER TABLE-3

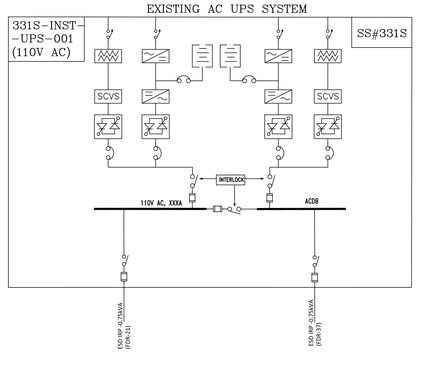
TABLE-3

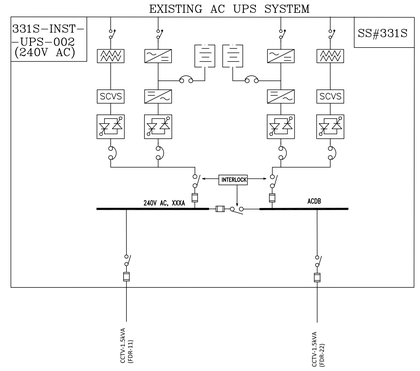
LEFT BUS (MCC-401-05B)				RIGHT BUS (MCC-401-06B)			
TAG NO.	RATING	TYPE	CT RATIO	TAG NO.	RATING	TYPE	CT RATIO
088-P-006B	30 kW	Type-2	100/1				
090-A-002M2	3.7 kW	Type-1	-				
090-A-002P2	2.2 kW	Type-1	-				
088-P-010A	11 kW	Type-1	-				
088-AC-001	22 kW	Type-1	-				
090-AP-02	32A	Type-3	-				
HB	250A	Type-3					
088-AP-01	32A	Type-3	-				

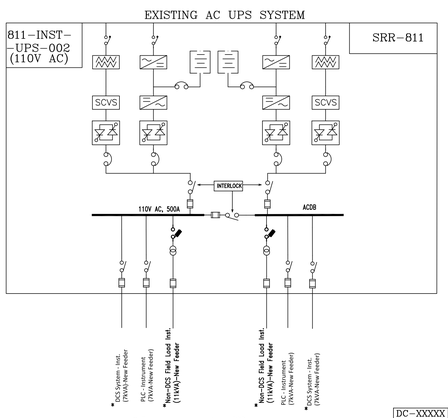




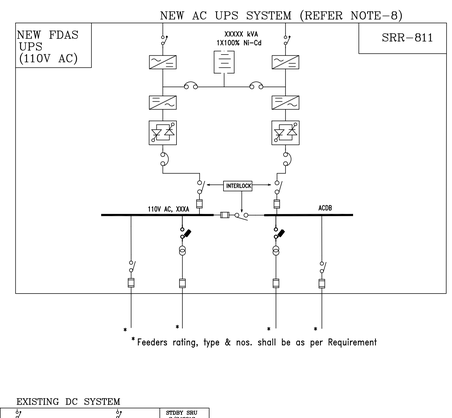




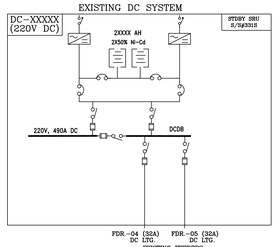




* Further distribution from PDB to consumer loads shall be done by Instrumentation



* Feeders rating, type & nos. shall be as per Requirement



REF. DWG. NO.	REFERENCE DRAWING TITLE
PDRP7145-8532-70-331-0001,REV S2	OVERALL SINGLE LINE DIAGRAM
080557C-088-JSD-1600-001, REV C	DESIGN BASIS

NOTES :-

1. THIS SINGLE LINE DIAGRAM IS INDICATIVE AND SHOWS THE POWER RECEIPT AND DISTRIBUTION PHILOSOPHY.
2. THE MOTOR RATINGS AND CORRENSPONDING CT RATIOS WHEREVER INDICATED ARE ESTIMATED. THE RATINGS SHALL BE REVISED AFTER ORDERING OF MOTORS.
3. THOUGH DISCRETE NEMA NUMBERS FOR RELAYS ARE SHOWN BUT ALL RELAYS IN HV SWBD, PCCs and MCCs (FOR INCOMER AND BUSCOUPLER) SHALL BE NUMERICAL COMMUNICABLE TYPE.
4. DCS/ ECS INTERFACE SHALL BE THROUGH EXISTING MARSHALLING PANELS.
5. SPACE HEATERS SHALL BE APPLICABLE TO MOTORS RATING ABOVE & EQUAL TO 30KW.
6. HV LOADS IN STANDBY SRU AREA SHALL BE CATERED FROM THE SPARE FEEDERS OF EXISTING HV SWITCHBOARD IN SS#331S. FOLLOWING MAJOR MODIFICATIONS SHALL BE CARRIED OUT IN EXISTING FEEDERS.
   -REPLACEMENT OF PQB RELAY WITH VAJH RELAY
   -ADDITION OF TRIPPING RELAY FOR PROCESS TRIP
   -WIRING MODIFICATION
   FOR DETAILS OF MODIFICATION TO BE CARRIED OUT REFER INSTRUCTIONS TO BIDDER DOCUMENT NO. B366-088-16-50-TR-0010
7. AS PER SITE CONDITIONS, SUFFICIENT SPACE FOR EXTENSION OF 331S-MCC-403 IS NOT AVAILABLE. ACCORDINGLY, 331S-MCC-401 HAS BEEN CONSIDERED FOR EXTENSION BY 3 PANELS ON LHS.
8. NEW UPS FOR FDAS SYSTEM SHALL BE FED FROM EXISTING 811-PDB-001 AND 811-PDB-003 LOCATED AT SRR-811. CLIENT TO CONFIRM SPARE FEEDERS

TYPICAL FEEDERS REFERENCE DETAIL					
TYPE - 1	415V MOTOR IMC FDR. (6W ≤ 22)	TYPE - 2	415V MOTOR IMC FDR. (30KW)	TYPE - 3	MCCB FEEDER (≤250A)

FEEDERS AVAILABILITY FOR PRESENT PROJECT SCOPE

SWITCHBOARD	TAG NO.	AVAILABILITY OF FEEDERS/EXTENSION PANELS
6.6kV SWITCHBOARD	3315-SG-301	EXISTING FEEDERS AVAILABLE
415V SWITCHBOARD	3315-PMCC-406	EXTENSION PANELS ENVISAGED (6 NOS.)
415V SWITCHBOARD	3315-MCC-403	EXTENSION PANELS ENVISAGED (1 NO.)
415V SWITCHBOARD	3315-MCC-401	EXTENSION PANELS ENVISAGED (3 NOS.)
415V SWITCHBOARD	3315-ELDB-1	EXISTING FEEDERS AVAILABLE
415V SWITCHBOARD	3315-MLDB-3	EXTENSION PANELS ENVISAGED (1 NO.)
415V SWITCHBOARD	ACDB-1	EXTENSION PANELS ENVISAGED (1 NO.)
UPS ACDB	3315-UPS-001	EXISTING FEEDERS AVAILABLE
UPS ACDB	3315-UPS-002	EXISTING FEEDERS AVAILABLE
	DCDB	EXISTING FEEDERS AVAILABLE
UPS ACDB	SRR-UPS-002	NEW FEEDERS TO BE ADDED

LEGEND

- HV CIRCUIT BREAKER
- AIR CIRCUIT BREAKER
- SWITCH FUSE UNIT
- ISOLATOR/SWITCH
- MINIATURE CIRCUIT BREAKER
- MOULDED CASE CIRCUIT BREAKER
- CONTACTOR
- DRAW OUT FEATURE
- FUSE
- POTENTIAL TRANSFORMER
- CURRENT TRANSFORMER
- CBCT
- THERMAL OVERLOAD RELAY
- CABLE GLAND TERMINATION
- BUS DUCT
- SELECTOR SWITCH
- BATTERY
- LOCAL P.B. STATION WITHOUT AMMETER
- LOCAL P.B. STATION WITH AMMETER
- SURGE ARRESTOR
- CHARGER
- SWITCH
- SPACE HEATER
- PUSHBUTTON-TR
- SEMICONDUCTING FUSES
- AMMETER
- VOLTMETER
- POWER FACTOR METER
- FREQUENCY METER
- LOCK OUT RELAY
- LOCK OUT RELAY FOR PROCESS TRIP
- INSTANTANEOUS E/F RELAY
- STANDBY E/F RELAY
- TIME DELAY RELAY
- UNDER VOLTAGE TRIP FOR MOTOR
- INSTANTANEOUS OVERCURRENT RELAY
- NEGATIVE PHASE SEQUENCE RELAY
- THERMAL OVERLOAD RELAY
- OVER VOLTAGE RELAY
- BUS DIFF. TRIP RELAY
- CONTROL SUPPLY SUPERVISION RELAY
- TRIP CIRCUIT SUPERVISION RELAY
- NUMERICAL RELAY
- LOCK ROTOR THERMAL WITHSTAND RELAY
- EARTH LEAKAGE CIRCUIT BREAKER
- DIGITAL MULTIFUNCTION METER
- TEMPERATURE SCANNER
- KILOWATT HOUR METER
- HOUR RUN METER
- INTELLIGENT MOTOR CONTROL (46, 49)
- TEST TERMINAL BLOCK

DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☒ REVIEW ☐ INFORMATION	

CLIENT	INDIAN OIL CORPORATION LIMITED PARADIP REFINERY PROJECT PARADIP, ORISSA
CONSULTANT	TECHNIP INDIA LIMITED
PROJECT	525 TPD STANDBY SRU PROJECT IOCL PARADIP REFINERY, ODISHA, INDIA

ENGINEERS INDIA LIMITED
NEW DELHI

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.				
CHD.				
APPD.				

REV.	DATE	ALTERED BY	CHD/APPD	ZONE
A	18.05.2021	GCS	CHD/APPD AR/SV	ISSUED FOR REVIEW
0	24.05.2021		CHD/APPD	ISSUED FOR REVIEW/APPROVAL

DEPT. FEASD CODE 450 | UNTOL. DIMS. CR. -0.5/-F- | SCALE | WEIGHT (KG)

TITLE: SINGLE LINE DIAGRAM SUBSTATION-331S (STANDBY SRU)

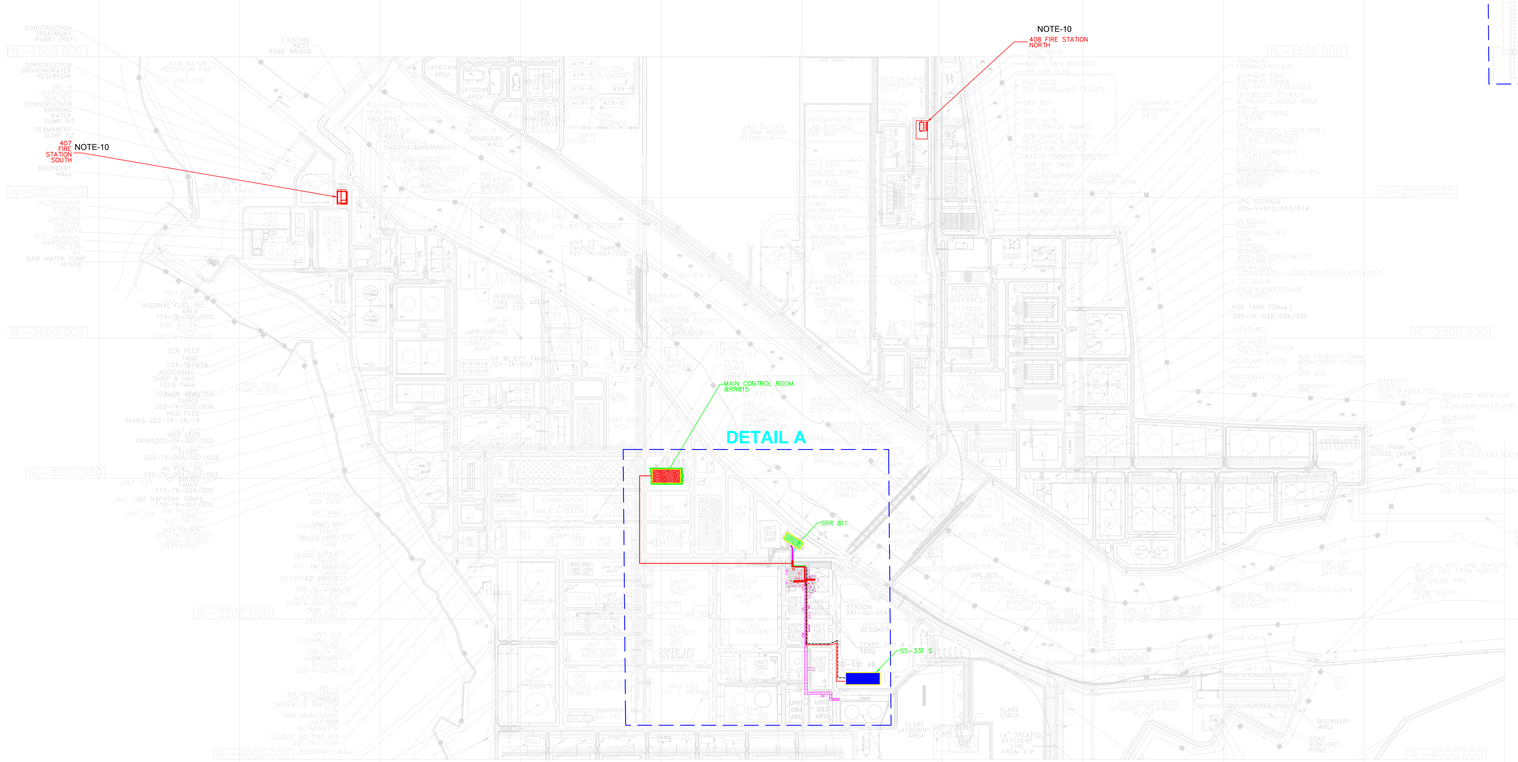
BHEL DRG NO. B366-088-16-50-00010 | REV. 0
CARD CODE | CUST DRG NO. 080557C-2689953-ELE-4410B-001_L
N.A. | SHT. No 1 | NO. OF SHT. 1

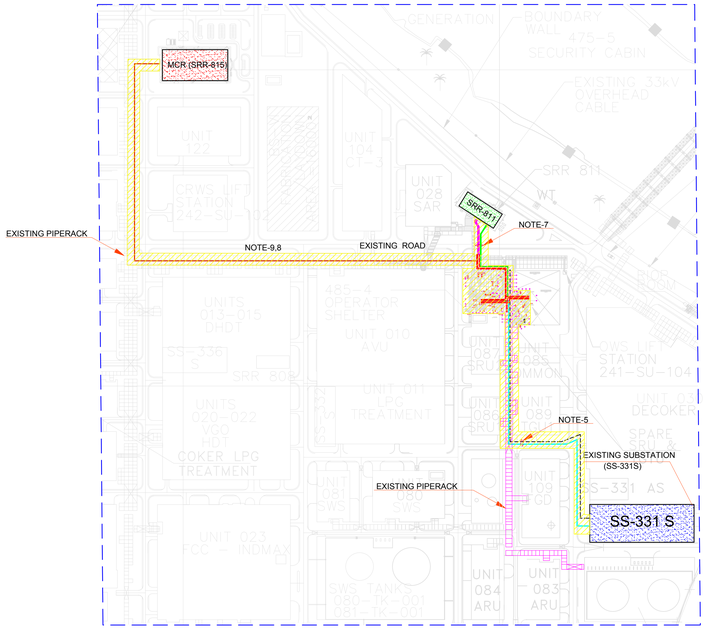
ITEM NO. | NO.OF ITEMS | REF. TO ASSY. DRG. | -N.A.- | -N.A.- | -N.A.-

INVENTORY NO | SIGN. AND DATE | REF. DRG. NO. | COMPUTER FILE NAME

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

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DETAIL A

REFERENCE DOCUMENTS/DRAWINGS:

DRAWING NO.	DESCRIPTION
080557C-088-DW-1500-001	CONCEPTUAL LAYOUT FOR INSTRUMENT MAIN CABLE WAY SRU 3 (UNIT - 088) AND WHB & INCINERATOR OF TGTU 2 (UNIT- 090)
PDRP4200-8230-03-600-0004-A12	OVERALL PLOT PLAN

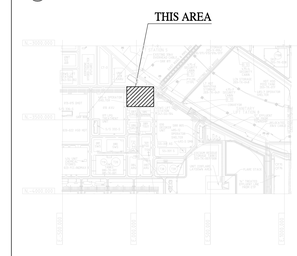
LEGENDS:

- NEW INSTRUMENT CABLE DUCT
- NEW INSTRUMENT CABLE TRENCH
- LSTK CONTRACTOR SCOPE
- NEW ELECTRICAL CABLE DUCT
- NEW ELECTRICAL CABLE TRENCH
- EXISTING INSTRUMENT CABLE TRENCH

NOTES:

1. THE CABLE TRENCH / TRAY LOCATIONS & SIZES SHOWN IN THIS DRAWING ARE INDICATIVE & FOR GUIDANCE PURPOSE ONLY AND THE SAME SHALL BE REVALIDATED / MODIFIED BY LSTK CONTRACTOR ACCORDING TO THE ACTUAL REQUIREMENT DURING DETAILED ENGINEERING.
2. FOR CABLE DUCT/TRAY SEGREGATION REFER TO INSTRUMENT INSTALLATION SPECIFICATION 080557C-000-JSS-1590-001.
3. ALL THE DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
4. ALL THE CABLE TRAYS AND DUCTS ARE FIRE PROOFED.
5. REFER THE "080557C-088-DW-1622-001" FOR TELECOM/ IRP CABLE ROUTING FROM SRU-3/WHB & INCINERATOR OF TGTU 2 TO EXISTING SUBSTATION SS-331-S.
6. INSTRUMENT CABLE TRENCH TO BE DESIGNED AS PER INSTRU. INSTALLATION SPECIFICATION – 080557C-000-JSS-1590-001
7. REFER THE "080557C-088-DW-1500-001" FOR INST. CABLE ROUTING DETAILS FROM SRU-3/WHB & INCINERATOR OF TGTU 2 TO EXISTING SRR-811.
8. CONTRACTOR TO VISIT & CHECK TO UTILIZE THE EXISTING TRENCH ON AGREEMENT WITH SITE IOCL DURING DETAILED ENGINEERING.
9. CONTRACTOR SHALL SUPPY & INSTALL FO CABLE IN REDUNDANT ROUTE WHICH IS REQUIRED BETWEEN SRR-811 & MCR TO INTERFACE / INTERGRATE CONTROL SYSTEM FOR UNIT-088 & UNIT-090 WITH CONTROL SYSTEM AT MCR. CONTRACTOR SHALL THE DESIGN THE TRENCH/DUCT ROUTING . CONTRACTOR SHALL SUPPLY& INSTALL REQUIRED CABLE TRAYS & ITS SUPPORT OR REQUIRED TRENCHING MATERIAL.
10. CONTRACTOR TO UPDATE MIMIC PANEL DISPLAY AND INTEGRATE/INTERFACE UNIT 88 & UNIT 90 FDAS TO NORTH FIRESTATION 408 & SOUTH FIRE STATIONS 407.

KEYPLAN:



Rev	Date DD-MM-YYYY	Description of Issue	Written by	Checked by	Approved by	Authorized by
A	05-12-2019	ISSUED FOR INFORMATION	JVK	CRK/KSR	SS	JMC

DOCUMENT CATEGORY (USE "X" MARK)
- ☐ APPROVAL
- ☐ REVIEW
- ☐ INFORMATION

DOCUMENT REVIEW STATUS (BY CLIENT)

PROJECT
STANDBY SRU & ADDITIONAL TANKS
IOCL PARADIP REFINERY, ODISHA, INDIA

OWNER
INDIAN OIL CORPORATION LTD.

PMC
TechnipFMC

CONFIDENTIAL. NOT TO DISCLOSE WITHOUT AUTHORISATION

TITLE
INSTRUMENT SCOPE TIE IN
SRU 3 (UNIT - 088) AND
WHB & INCINERATOR OF TGTU 2 (UNIT- 090)

DRAWING NO.						PAGE	REV.
SCALE	080557C	088	DW	1500	002	1 OF 1	A
NTS	PROJECT	UNIT	DOC. TYPE	MAT. CODE	SER. NO.		

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CAD FILE NAME : - 080557C-088-DW-1500-002.DWG

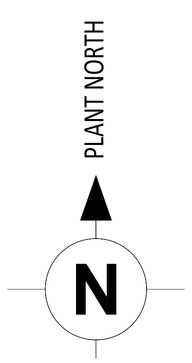
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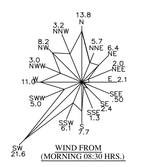
FIRST ANGLE PROJECTION

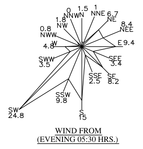
(ALL DIMENSIONS ARE IN mm)

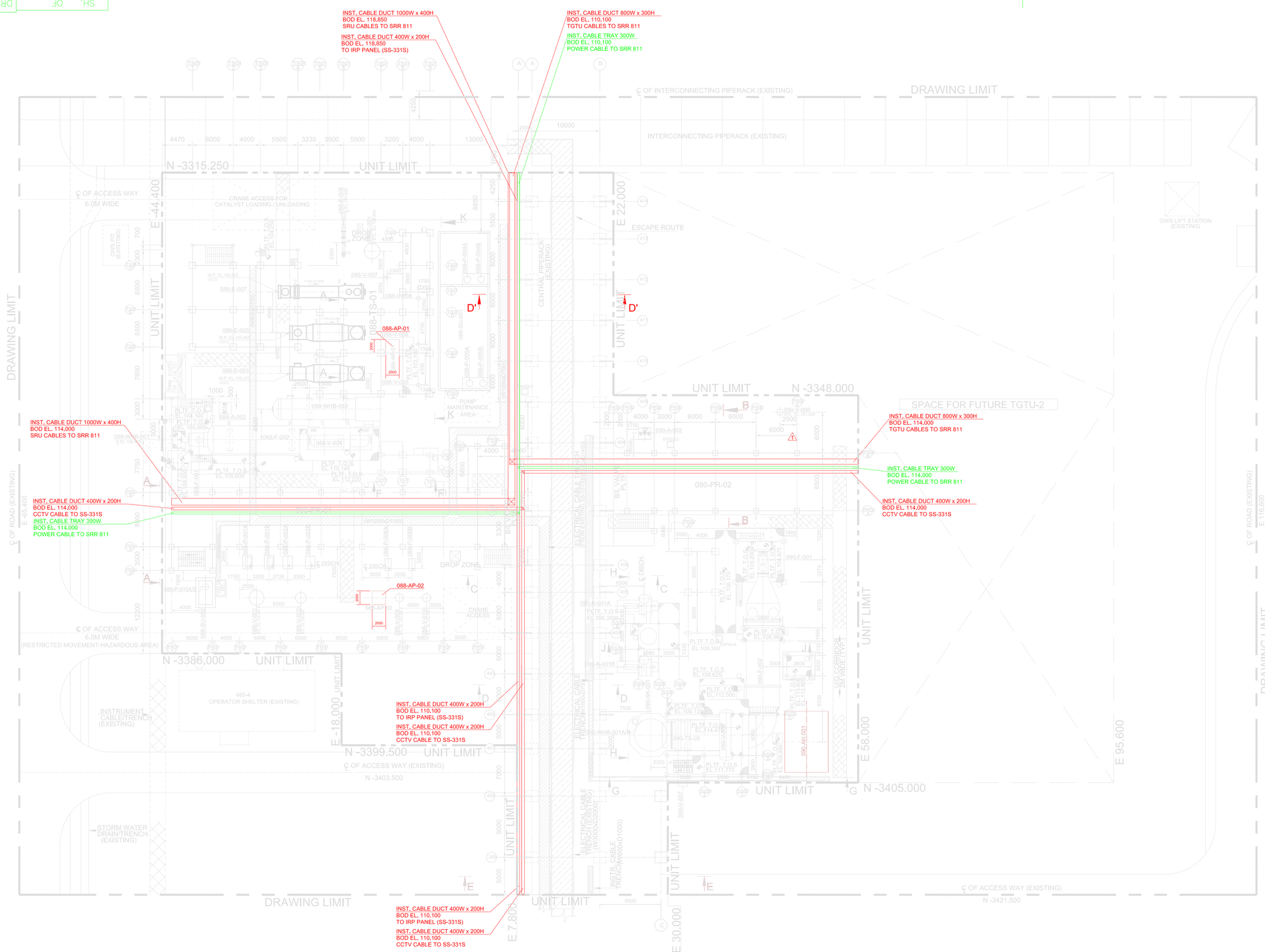
ESP-001-12A

PLANT NORTH









Analyser Shelter/Panel No.

S. No.	Analyser Shelter/Panel No.	Analyser Tag No.	Type of Analyser	Space Required	Remarks
1	090-AH-01 (Analyser Shelter)	> 090-AT-0310 :- SO2+O2 > 090-AT-0312 :- NOx > 090-AT-0311 :- O2 > 090-AT-0315 :- CO > 090-AT-0316 :- SPM >090-AT-0320 :- GC ⚠	CEMS, O2, SPM AND GAS CHROMATOGRAPH Analysers ⚠	As per layout	
2	088-AP-01 (Panel)	088-AT-0101	Tail Gas Analyser	2 Mtr X 2 Mtr	Panel to be located within 5 mtrs from the process sample take off. If this analyser panel has to be installed on elevated platform on TS-003 then 2 mtr X 2 mts space needs to be provided in TS for the panel installation.
3	088-AP-02 (Panel)	088-AT-0103	Conductivity Analyser	2 Mtr X 2 Mtr	
	⚠				

BHEL's Response: As per BHEL understanding, Overall Cable Layout, Doc. No. K366-999-16-50-01010 under Electrical drawings shall be referred for continuation. EIL may check again and confirm if continuation of cable routing will be covered in the Offsite general arrangement drawing area-01 (UG civil), referred in their reply.

REF. DWG. NO.	REFERENCE DRAWING TITLE
080557C-000-DW-0051-001	OVERALL SITE PLAN PLAN

NOTES :-

1. ALL CO-ORDINATES ARE IN METERS. ALL OTHER DIMENSIONS, DUCT/TRENCH SIZES AND ELEVATIONS ARE IN MM.
2. FOR INSTRUMENT DUCT FABRICATION DETAILS REFER STANDARD NO. 7-52-0254 (31 Sheets).
3. INSTRUMENT DUCT/TRAY SHALL BE SUPPORTED ON CONTINUOUS MEMBERS (BY STRUCTURE) RUNNING BELOW THE SAME INCLUDING VERTICAL DROPPING OF THE DUCT.
4. INSTRUMENT CABLE DUCT/ TRAY SHALL NOT BE ROUTED IN PARALLEL WITH ELECTRICAL CABLES. IF UNAVOIDABLE , TYPICAL GAP OF 1000 mm (w.r.t. HT CABLES) SHALL BE ENSURED.
5. BOTTOM OF INSTRUMENT CABLE DUCT (BOD) ELEVATION SHALL BE SAME AS PER THE SPACE GIVEN BY PIPING ON PIPE RACK / PIPE SLEEPERS.
6. NO STEAM/HOT LINES SHALL BE ROUTED NEAR INST. CABLE DUCT.
7. MINIMUM CLEARANCE REQUIRED FROM COLUMN FACE TO INST. DUCT EDGE IS 200mm TO FIX THE CLAMPS.
8. CABLE TRENCH FOR TELECOM SYSTEM (600W X1000D) FOR FURTHER ROUTING THE CABLES FROM 2 NOS. OF 400MM X 200MM DUCT TO SUBSTATION SS-331S SHALL BE REFERRED IN THE CIVIL AREA DRAWING.
9. STRUCTURAL SUPPORT AND SPACE WILL BE REQUIRED FOR FOLLOWING DUCT / TRAYS FROM ISBL TO OSBL FOR FURTHER INTERFACING WITH EXISTING SRR-811 : -
   (I) 1000MM W X 400 MM H DUCT
   (II) 400MM W X 200 MM H DUCT
   (III) 800MM W X 300 MM H DUCT
   (IV) 300MM W X 100 MM H TRAY
10. ⚠ OFFSITE GENERAL ARRANGEMENT DRAWING AREA-01 (DWG NO. B366-600-81-41-04001) SHALL BE REFERRED FOR INSTRUMENT DUCT / INSTRUMENT POWER CABLE TRAY INTERFACING FROM UNIT BATTERY LIMIT TO THE OFFSITE LOCATIONS (SRR-811/ SUBSTATION-SS331S)
11. ⚠ FOR PAGA ROUTING DETAILS, PA SYSTEM LAYOUT DETAILS (DRAWING NUMBER : B366-088-16-50-05010) SHALL BE REFERRED.

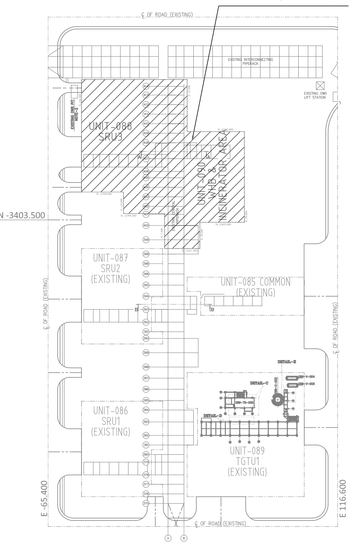
LEGEND :-

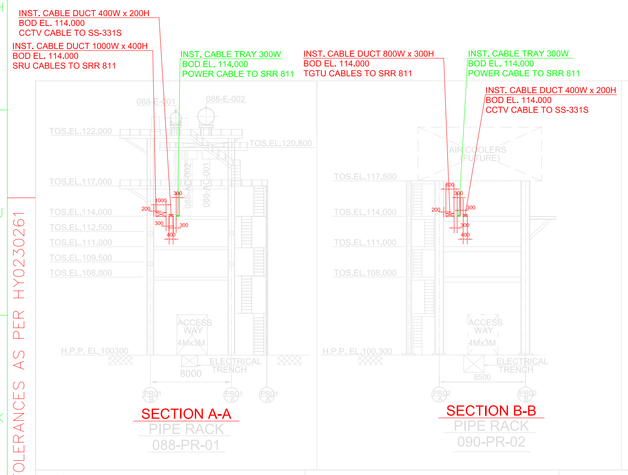
INSTRUMENT CABLE DUCT

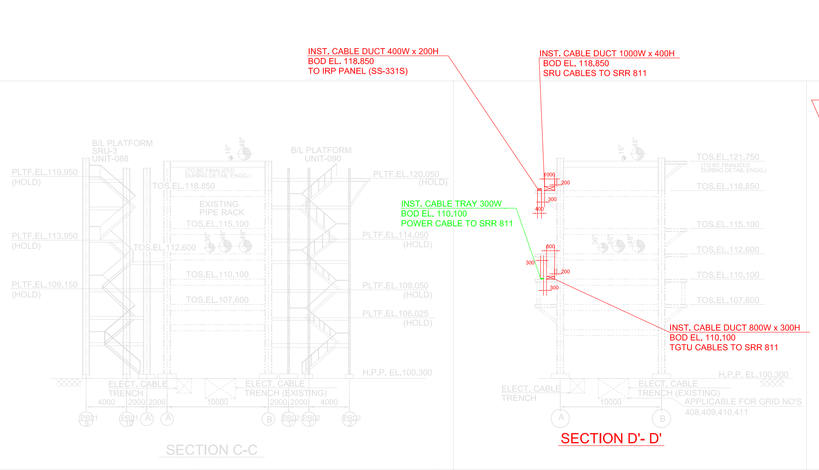
INSTRUMENT POWER CABLE TRAY FROM SRR-811

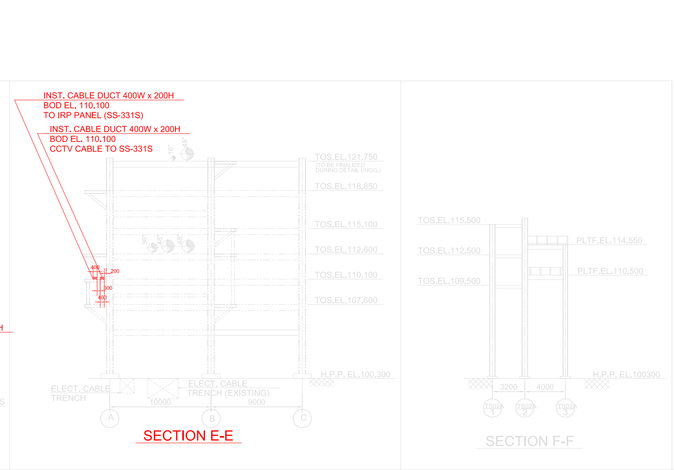
UNIT	DESCRIPTION	CAPACITY	LICENSOR
088	STANDBY SULPHUR RECOVERY UNIT (SRU)	525 TPD	BLACK & VEATCH
090	TAIL GAS INCINERATOR	–	

KEYPLAN









DOCUMENT CATEGORY (USE " X " MARK)	DOCUMENT REVIEW STATUS (BY CLIENT)
☐ APPROVAL ☐ REVIEW ☐ INFORMATION	

CLIENT: INDIAN OIL CORPORATION LIMITED, PARADIP REFINERY PROJECT, PARADIP, ORISSA

CONSULTANT: TECHNIP ENERGIES

PROJECT: 525 TPD STANDBY SRU PROJECT, IOCL PARADIP REFINERY, ODISHA, INDIA

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

ENGINEERS INDIA LIMITED NEW DELHI

	NAME	SIGN.	DATE
DRN.	MANOJ	MN	31.05.21
CHD.	VK	VK	31.05.21
APPD.	AR	AR	31.05.21

REV.	DATE	ALTERED	ZONE
A	25.03.21	CHD/APPD LSJ/GB	
		ISSUED FOR COMMENTS	

DEPT. INST. CODE: 450 | UNTOL. DIMS. OR +/-MAT'L: – | SCALE: 1:300 | WEIGHT (KG): – | REF. TO ASSY. DRG.: –N.A.– | ITEM NO.: –N.A.– | NO.OF ITEMS: –N.A.– | NO.OF VAR.:

TITLE: INSTRUMENT DUCT LAYOUT STAND BY SRU-3 & TAIL GAS INCINERATOR

BHEL DRG. NO.: B366-999-16-51-00801 | REV.: 1

CARD CODE: N.A. | CUST DRG NO. 080557C-36899053-NO-4A227-001

SHT. No 1 | NO. OF SHT. 1

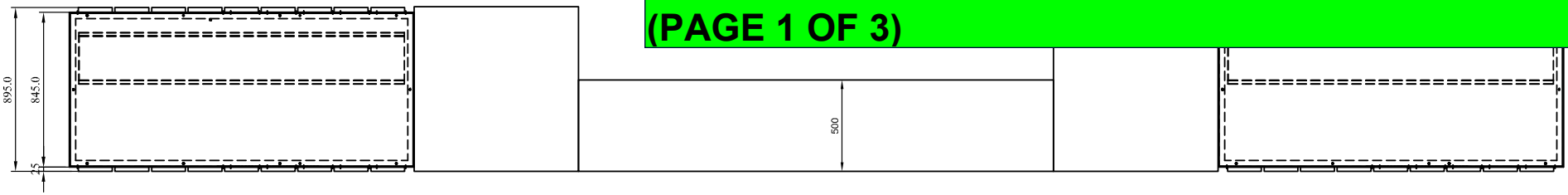
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GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY02300261

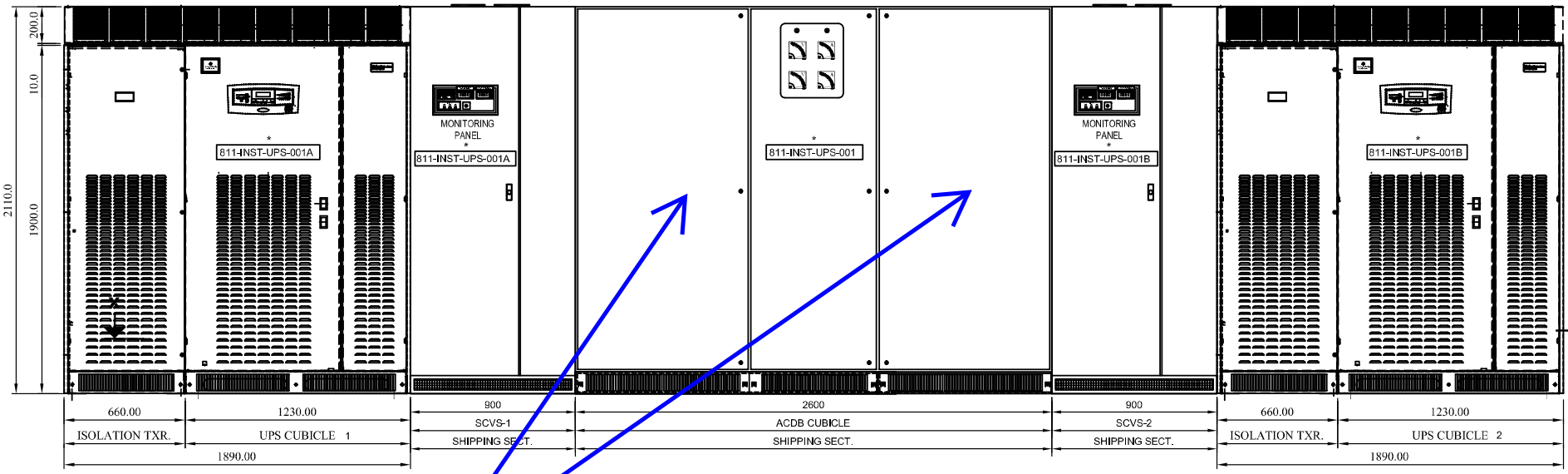
COMPUTER FILE NAME | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO.

ESP-001-12A

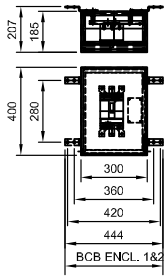
ANNEXURE-9 TO DOC. No. 080557C-088-JSS-1654-001 (PAGE 1 OF 3)



TOP VIEW



FRONT VIEW



NOTES:-

1) SYSTEM TO BE INSTALLED LEVEL AND SUPPORTED EVENLY ALONG ITS LENGTH.
2) ALL THE PANELS ARE PROVIDED WITH SIDE CUTOUTS. BEFORE PLACING T... REMOVE APPROPRIA... SIDE CUTOUTS.
3) ALL THE PANEL INT... ARE INTERNAL THR...
4) ALL THE GLAND PLA...
5) EACH CUBICLE IS A SEPERATE SHIPPING SECTION.
6) ENSURE 1000 mm CLEARANCE ON ALL SIDES OF SYSTEM.
7) CABLE ENTRY FROM BOTTOM.

...SIDE
...SHT 2 OF 2.
...TOP OF

THE FOLLOWING NEW OUTGOING MCCB FEEDERS SHALL BE ADDED AT BOTH EXISTING UPS DB - A & B OF 50 kVA UPS SYSTEM LOCATED AT EXISTING SRR-811 WITH NECESSARY MODIFICATIONS.

> 100A MCCB FEEDER : 1 No.

> 63A MCCB FEEDER : 2 Nos.

REV.	DESCRIPTION	INITIALS
01	* TAG NO.A...	

ALL DIMENSIONS IN mm.
TOLERANCE UNLESS OTHERWISE STATED. ± 0.5, HOLE ±0.2, ANGLES ±0.5
SCALE 1: 20

TITLE: LINEUP DIAGRAM
2 x 50kVA, 1PH, 110VAC
HIPULSE UPS SYSTEM WITH
SEPARATE BATTERY

DRAWING NO.	A1245 / SY / 006 -1
REV.	01
SHEET 1 OF 1	
APPD.	SHD
CHKD.	S.H.D.
DRAWN	SHIRISH
DRG.SIZE	A3

EMERSON Network Power

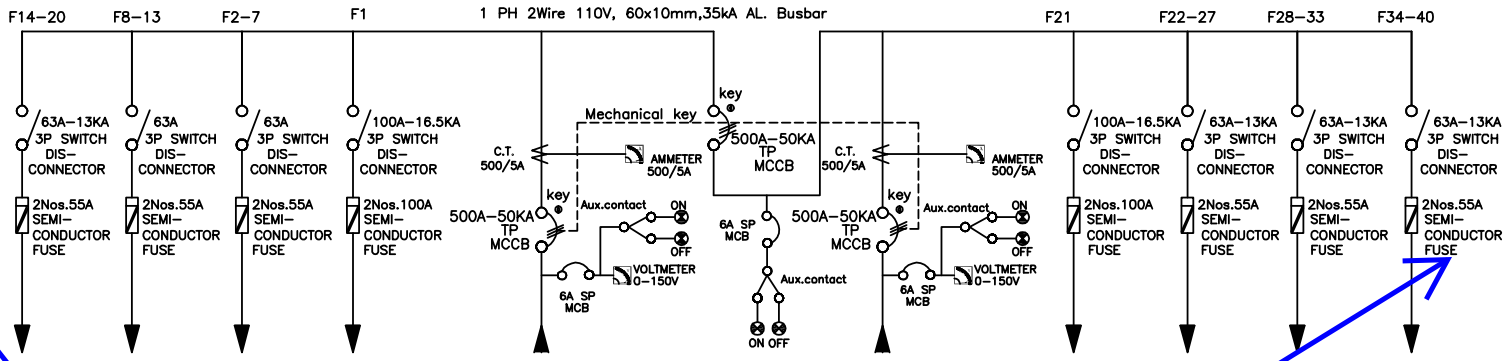
Emerson Network Power (India) Private Limited
Plot C-20, Road 19, Wagle Industrial Estate, Thane (W), Maharashtra

DATED :
PDF.No.

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ANNEXURE-9 TO DOC. No. 080557C-088-JSS-1654-001 (PAGE 2 OF 3)

690700500024



SERVICE DESCRIPTION	–	–	–	–	INCOMER–1	BUSCOUPLER	INCOMER–2	–	–	–	–
FEEDER RATING in KVA	5	5	5	10	50 KVA	50 KVA	50 KVA	10	5	5	5
MCCB/SWITCH RATING	63A–13KA	63A–13KA	63A–13KA	100A–16.5KA	500A–50KA	500A–50KA	500A–50KA	100A–16.5KA	63A–13KA	63A–13KA	63A–13KA
FUSE RATING	55A	55A	55A	100A				100A	55A	55A	55A
TERMINALs IN Sq.mm	35	35	35	50	60X10mm AL Strip	60X10mm AL Strip	60X10mm AL Strip	50	35	35	35
TERMINALs TYPE	STUD	STUD	STUD	STUD	–	–	–	STUD	STUD	STUD	STUD
TERMINALs/FERUAL Nos.	R14,N14,... ...R20,N20	R8,N8,.. ....R13,N13	R2,N2,,..... ....R7,N7	R1,N1,	–	–	–	R21,N21	R22,N22,... ...R27,N27	R28,N28... ...R33,N33	R34,N34,... ...R40,N40
MAXIMUM CABLE TERMINATED	2CX35 Sq.mm	2CX35 Sq.mm	2CX35 Sq.mm	2CX50 Sq.mm	SIZE '0000'	–	SIZE '0000'	2CX50 Sq.mm	2CX35 Sq.mm	2CX35 Sq.mm	2CX35 Sq.mm
TYPE OF CABLE	ALUMINIUM XLPE	ALUMINIUM XLPE	ALUMINIUM XLPE	ALUMINIUM XLPE	Nyvin/FRLSH Cable Copper	–	Nyvin/FRLSH Cable Copper	ALUMINIUM XLPE	ALUMINIUM XLPE	ALUMINIUM XLPE	ALUMINIUM XLPE
FEEDER QUANTITY	7Nos.	6Nos.	6Nos.	1Nos.	1No.	1No.	1No.	1Nos.	6Nos.	6Nos.	7Nos.

NOTES:–

CABLE FROM SCVS & ACDB WILL BE NYVIN CABLE IF ACDB IS A INTEGRAL PART OF LINEUP ELSE FRLS CABLE WILL BE SUPPLIED AS PER THE REQUIREMENT

THE FOLLOWING NEW OUTGOING MCCB FEEDERS SHALL BE ADDED AT EXISTING UPS DB - A & B OF 50 kVA UPS SYSTEM LOCATED AT EXISTING SRR-811 WITH NECESSARY MODIFICATIONS.

> 100A MCCB FEEDER : 1 No.

> 63A MCCB FEEDER : 2 Nos.

REV.	DESCRIPTION
01	DRAWING REVISED AS PER THE COMMEN
02	DRAWING REVISED AS PER THE COMMEN
03	DRAWING REVISED AS PER THE COMMEN
	CLINET– IOCL
	LOCATION:SRR–811

TITLE:

SLD FOR 50KVA 110VAC 1PHASE UPS ACDB PANEL

DRAWING NO.	REV.
A1245/ACDB-PCKT	03
SHEET 1 OF 1	
APPD. S.H.D.	
CHKD. J.S.S	
DRAWN ANAND	

Emerson Network Power (India) Private Limited
Plot C–20, Road 19, Wagle Industrial Estate, Thane (W), Maharashtra

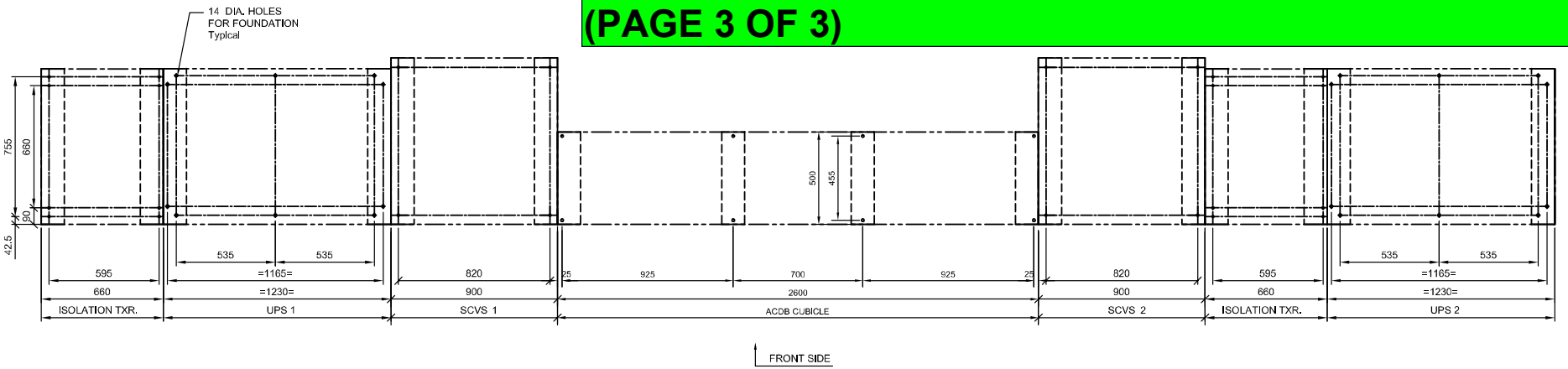
DRG.SIZE A3

DATED :

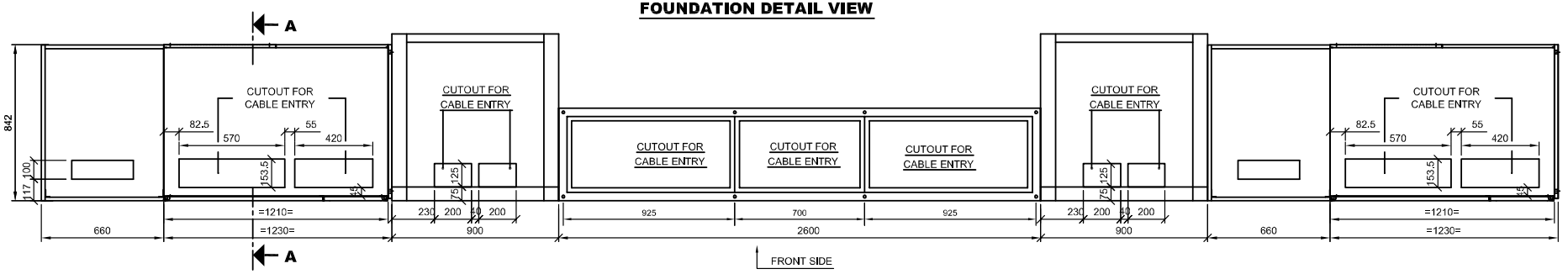
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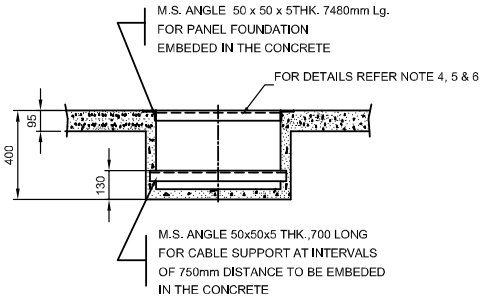
ANNEXURE-9 TO DOC. No. 080557C-088-JSS-1654-001 (PAGE 3 OF 3)



FOUNDATION DETAIL VIEW



SECT. XX CABLE ENTRY CUTOUT DETAILS



SECTION OF `A-A'

NOTES :-

1) TOLERANCE OF 50mm ON EITHER SIDE COVER TOTAL LENGTH SHALL BE KEPT.
2) FOUNDATION BOLT SHALL BE FIXED AFTER PANELS ARE PLACED IN POSITION.
3) MINIMUM HEIGHT OF THE ROOM REQUIRED - 2500mm
4) CABLE TRENCH DETAILS MODIFIED IN LINE WITH DISCUSSIONS ON 26.12.2010
5) THE TRENCH WILL BE OPEN TYPE. A CHANNEL SHALL BE WELDED AT SUITABLE LOCATIONS AS PER THE DRAWING DURING THE INSTALLATION OF UPS & ASSOCIATED PANELS.
6) THE ABOVE ACTIVITY IS NOT IN Ms. EMERSON'S SCOPE
7) BASE FRAME DETAILS ARE SHOWN IN PARTICULAR G.A. DIAGRAM

REV.	DESCRIPTION	INITIALS
01	DRAWING REVISED AS PER THE COMMENTS	

MATERIAL: N.A.

TRT. N.A.

ALL DIMENSIONS IN mm.

TOLERANCE UNLESS OTHERWISE STATED. ± 0.5, HOLE ±0.2, ANGLES ±0.5

SCALE 1: 20

TITLE: LINEUP DIAGRAM 50kVA, 1PH, 110VAC HIPULSE UPS SYSTEM WITH SEPARATE BATTERY

DRAWING NO.	REV.
A1245 / SY / 006-2	01
SHEET 1 OF 1	
APPD. SHD	
CHKD. S.H.D.	
DRAWN SHIRISH	

EMERSON Network Power

Emerson Network Power (India) Private Limited
Plot C-20, Road 19, Wagle Industrial Estate, Thane (W), Maharashtra

DRG.SIZE **A3**

DATED :

PDF.No.

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Erection BOM and Scope Details

PROJECT	**STANDYBY SULPHUR RECOVERY UNIT (SRU) AT IOCL PARADIP REFINERY**
CUSTOMER	**M/s IOCL PARADIP REFINERY, ODISHA, INDIA**
CONSULTANT	**M/s TECHNIP INDIA LIMITED, CHENNAI**

Rev. No.	Date	Details of Revision
02	19.06.2021	Generally revised as per discussion with projects team.
01	03.06.2021	Revised based on progress in engineering as on date and to include specific requirements for activities during Plant Shutdown period
00	20.03.2021	FIRST SUBMISSION

PROJECT ENGINEERING & SYSTEMS DIVISION BHEL, RAMACHANDRAPURAM, HYDERABAD- 502032.	PREPARED	CHECKED	APPROVED	DATE	DOC.NO.	REV.NO.
	Ch Mahesh	K Rangamani	Saroj Kumar	20.03.2021	**IOCL/SRU/EBOM**	**02**

ERECTION BILL OF MATERIAL: BOP-ELECTRICAL

Definitions:

i) **Erection Agency:** Contractor
ii) **Vendor/ Supplier/ Manufacturer:** Supplier of materials/ Equipment/ Systems
iii) **Customer: IOCL**
iv) **Consultant: IOCL consultant (Technip)**

I. **Intent:** This document elaborates the details of Balance of Plant items pertaining to Electrical scope, to be erected and commissioned by Erection agency for Standby SRU Project, IOCL-Paradip Refinery.

The document contains following Sections and Annexures:

Section-1: Erection BoM for Electrical activities to be carried out during shutdown period. Section-1 contains following Annexures:

Annexure-1: Consists of items that are to be erected, tested and commissioned by Erection agency. These items are supplied by BHEL.

Annexure-2: Consists of items that are to be **supplied**, erected, tested and commissioned by Erection agency.

Section-2: Erection BoM for Electrical activities to be carried out post-shutdown. Section-2 contains following Annexures:

Annexure-3: Consists of items that are to be erected, tested and commissioned by Erection agency. These items are supplied by, BHEL.

Annexure-4: Consists of items that are to be **supplied**, erected, tested and commissioned by Erection agency.

II. **General Notes for Erection and Commissioning Works (applicable for all Annexures):**

1) Erection Agency shall provide all the required services for installation, erection and commissioning of all the Equipment/ Packages/ Systems in BOP area for successful/ satisfactory operation of the Plant including Receipt, Unloading, Storage & Handling of Material, Erection & Installation, Commissioning, Calibration & Testing, and Final Painting etc.

2) Manufacturer/ Supplier supervision is envisaged for following packages:

- HT Switchgear
- LT Switchgear
- UPS System

- PA System
- Telephone System
- CCTV

3) Erection Agency shall arrange all the tools and facilities required for calibration, erection and testing required for Erection & Commissioning activities.

4) Obtaining statutory approvals from IBR, PESO, TAC, Electrical Inspector or any other Governing Agencies shall be in Erection Agency's scope.

5) All lubricants and other consumables (including initial/ first fills) for the equipment / packages / systems (including lube oil etc.) have to be procured directly by the Erection Agency. All the lubricants and consumables required for Commissioning, Testing for the operation period specified in customer's specification/ contract shall be in Erection Agency's scope.

6) Marked-up "As-Built" documents/ drawings have to be prepared and provided by the Erection Agency to PE&SD after Erection & Commissioning to enable submission of contractual "As-Built" documentation.

7) Erection Agency shall ensure that Storage and Handling of equipment/ packages is carried out as per the recommendations of OEMs.

8) The Erection/Commissioning work shall be carried out in accordance with the specifications/ drawings furnished during detailed engineering.

9) Some of the items/ parts of the equipment/packages will be supplied loose to site as per OEM's standard practices. These loose items have to be assembled at site by Erection Agency as per the guidelines provided.

10) All the necessary procedures and protocols shall be followed by Erection Agency during Erection & Commissioning, Testing, Handing Over, etc. of equipment as per the procedures finalized with Customer/ Consultant.

11) Only general erection guidelines have been indicated in this document. The Erection & Procedures and requirements specified in the Customer's Technical Specifications/ Contract Documents shall be followed by the Erection Agency while executing the project. The responsibility for adhering to Customer's Technical Specifications/ Contractual requirements shall be with Erection Agency.

12) Erection agency shall carry out the plant cabling works in line with customer/consultant's Technical specifications and approved "Notes & Details for Plant Cable Laying System".

13) Erection agency shall carry out the plant earthing and lightning protection works in line with customer/consultant's Technical specifications and approved "Notes & Details for Plant Earthing & Lightning Protection System".

14) Erection agency shall carry out the plant illumination works in line with customer approved "Notes & Details for Illumination System".

15) Actual quantities of the items, that are to be supplied by Erection Agency, shall be as per BHEL instructions.

Section-1

Erection BOM for Electrical Activities to be carried out during Shutdown

This section consists of following two Annexures:

Annexure-1:

Consists of items that are to be erected, tested and commissioned by Erection agency. These items are supplied by BHEL.

Annexure-2:

Consists of items that are to be **supplied**, erected, tested and commissioned by Erection agency.

Annexure-1 (under Section-1)

(Items that are to be erected, tested and commissioned by Erection agency. These items are supplied by BHEL.

Price bid ref. Sl. No.	Equipment/ Package Description	Unit of Qty.	Qty.	Dimension (Each) L x B x H (M)	Weight (Each) (kg)	Remarks
1.0	**HT SWITCHGEAR MODIFICATION**					
1.1.	Modification of 2 Panels in 6.6kV Switchgear	Nos.	2	--	100	1. No new panels are envisaged. Modification works to be carried out in 2 Panels as per contract. 2. These panels are to be interfaced with existing PMS system. Please refer Note-3 below.

Notes:

1. HT Switchgear vendor scope includes the following:
   - Supervisory services for erection and commissioning.
   - Installation of HT Switchgear components, testing of the panel and necessary internal wiring under the supervision of customer and BHEL.
2. Commissioning of HT Switchgear for successful/ satisfactory operation of the plant is in Erection Agency scope.
3. Interface of the HT panels is envisaged with PMS as per contract. Necessary support shall be provided by Erection Agency for completion of the job.
4. Required testing equipment shall be supplied/ arranged by Erection Agency during testing and commissioning.

Price bid ref. Sl. No.	Equipment/ Package Description	Unit of Qty.	Qty.	Dimension (Each) L x B x H (M)	Weight (Each) (kg)	Remarks
2.0	**LT SWITCHGEAR**					
2.1	**LT Switchgear Extension**					
2.1.1	Extension Panels in 331S-PMCC-406	Nos.	7	850 x 1000 x 2450 mm	400	7 Panels includes 1 Dummy Panel.
	Extension Panels in 331S-MCC-403	Nos.	1	850 x 1000 x 2450 mm	400	
	Extension Panels in 331S-MCC-401	Nos.	3	850 x 1000 x 2450 mm	400	
	Extension Panels in 331S-MLDB-3	Nos.	1	750 x 500 x 2450 mm	350	
	Extension Panels in 331S-ACDB-1	Nos.	1	750 x 500 x 2450 mm	350	
2.1.2	Extension Panels in 811-INST-UPS-002	Nos.	1	--	--	6 Feeders need to be added.
2.2	**LT Switchgear/ UPS DB Modification**					
2.2.1	Non DCS Field 110V UPS SUBDB(Wall Mounted) :1000 x 500 x 1000 mm	Nos.	2	--	--	Vacant Module needs to be modified to required rating feeder.
2.2.2	240V UPS PDB(Wall Mounted) for CCTV : 1000 x 500 x 1000 mm	Nos.	1			For CCTV
2.2.3	240V Non UPS DB/PDB (Wall Mounted) : 800 x 500 x 1000 mm	Nos.	2			
2.2.4	Addition of 63A/100A feeder in existing UPS	Nos.	8			
2.2.5	STP Serial Communication Cables within Conduits (Refer Note-3 below)	m	1100	--	80	1. Cable weight indicated in kg/km

						2. Quantity of this item is covered in section 1, D10 of price bid format

Notes:

1. LT Switchgear vendor scope is limited to following activities:
   - Modification of modules, installation of components and necessary internal wiring.
   - Supervisory services for installation, erection, testing and commissioning.
2. Installation and alignment of new panels, joining of new panels with existing panels, inter panel wiring and connections, erection, testing and commissioning of LT switchgear for successful/satisfactory operation of the plant is in Erection Agency scope.
3. Laying of STP serial communication cables in conduits between above Extension panels and existing Data Concentrator is in Erection Agency scope. However, services of OEM of Intelligent Motor Controllers (IMCs) are considered for hooking up of IMCs in new feeders in above Extension Panels with existing Data Concentrator, termination of communication cables, testing, commissioning, modification (if required) and necessary configuration of Existing Data Concentrator System.
4. Required testing equipment shall be supplied/ arranged by Erection Agency during testing and commissioning.

Price bid ref. Sl. No.	**Equipment/ Package Description**	**Unit of Qty.**	**Qty.**	**Dimension (Each) L x B x H (M)**	**Weight (Each) (kg)**	**Remarks**
4.0	**LT POWER CABLES**					
4.26	2C x 50 Cu XLPE	Meter	800	--	2475	Cable weight indicated in kg/km
4.2	1C x 120 Cu XLPE UNARM	Meter	500	--	1400	Cable weight indicated in kg/km
4.3	1C x 35 Cu XLPE UNARM	Meter	250	--	525	Cable weight indicated in kg/km
4.4	1C x 10 Cu XLPE UNARM	Meter	250	--	245	Cable weight indicated in kg/km
4.5	3.5C x 70 Cu XLPE	Meter	300	--	3110	Cable weight indicated in kg/km
4.27	2C x 16 Cu XLPE	Meter	800		1050	Cable weight indicated in kg/km
4.28	1C x70 Cu XLPE	Meter	800		1400	Cable weight indicated in kg/km
Price bid ref. Sl. No.	**Equipment/ Package Description**	**Unit of Qty.**	**Qty.**	**Dimension (Each) L x B x H (M)**	**Weight (Each) (kg)**	**Remarks**

7.0	**PRE-FABRICATED CABLE TRAYS AND ACCESSORIES (GI)**					
6.1	Ladder type cable tray, W=600mm	Sets	50	3.0 x 0.6 x 0.1	45	Each cable tray length 3 meter including coupler plate and nut bolts.
6.3	300mm(W) Perforated type cable tray	Sets	100	2.5 x 0.3 x 0.075	30	Each cable tray length 2.5 meter including coupler plate and nut bolts
6.4	150mm (W) Perforated type cable tray	Sets	200	2.5 x 0.15 x 0.05	20	Each cable tray length 2.5 meter including coupler plate and nut bolts

Notes:
1. Above cable trays are envisaged within SS-331S & SRR-811 only.

Price bid ref. Sl. No.	**Equipment/ Package Description**	**Unit of Qty.**	**Qty.**	**Dimension (Each) L x B x H (M)**	**Weight (Each) (kg)**	**Remarks**
7.0	**PLANT EARTHING AND PLANT LIGHTNING PROTECTION MATERIALS**					
7.3	50 x 6 mm GI Strip	Meter	150	--	2 kg/m	For HT & LT Panel Earthing
7.8	Providing Earthing pit as per drawing (Drg. No. 080557C001-000-STC-1691-001, sheet 6 of 30)) with charcoal & salt, GI pipes, GI earth electrodes, GI wire, GI strips, brick chamber with covers including associated earthwork etc. all complete (Earthing strips, electrodes and earth plate with funnel will be supplied by BHEL free of cost and all other items as per referred drawings shall be by bidder). Note: Only Earth Electrode (i.e. 65mm dia, 6000mm long-G.I Pipe	Nos.	10	--	--	

	Electrode,Earth Plate),G.I Strip shall be free issue by BHEL. All other items as per referred drawings shall be by bidder.					
B.18	Supply, installation and connection of Cu earth plates as per typical installation drawing no.080557C001-000-STC-1691-001,sheet 9 of 30, complete with anchor bolts, including nut, bolt, washer, insulator and all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in- Charge	Nos`	4		0.25 kg	Drawing no.080557C001-000-STC-1691-001, sheet 9 of 30
Price bid ref. Sl. No.	**Equipment/ Package Description**	**Unit of Qty.**	**Qty.**	**Dimension (Each) L x B x H (M)**	**Weight (Each) (kg)**	**Remarks**
14.0	**UPS SYSTEM ALONG WITH UPSDB FOR FDA SYSTEM**					
14.1	UPS System along with UPS DB/ UPS Battery Isolation Boxes	Set/ Nos	1/2	3000 x 750 x 2110 mm, 500 x 500 x 650 mm	200/ 60	
14.2	UPS Battery Bank	Set	1	4500 x 750 x 1750 mm	500	

Notes:

1. Erection agency has to arrange Discharge Resistor bank, if applicable, to carry out discharge test on Battery banks.

Annexure-2 (Under Section-1)

Items that are to be supplied erected, tested and commissioned by Erection agency.

Sl. No.	Equipment/ Package Description	Unit of Qty.	Qty.	Dimension (Each) L x B x H (M)	Weight (Each) (kg)	Remarks

1.0	**CABLE GLANDS PACKAGE**					
1.1	23.5-26 Weather proof cable gland (Suitable for 2Cx50 Sq.mm Cu Cable)	No.	30	NA	0.15	1. Glands shall be single compression nickel-plated brass type. 2. In price bid format, supply of these items is considered as a part of cabling work.
1.2	18.5-20 Weather proof cable gland (Suitable for 2Cx16 Sq.mm Cu Cable)	No.	15	NA	0.15	1. Glands shall be single compression nickel-plated brass type. 2. In price bid format, supply of these items is considered as a part of cabling work.
Sl. No.	**Equipment/ Package Description**	**Unit of Qty.**	**Qty.**	**Dimension (Each) L x B x H (M)**	**Weight (Each) (kg)**	**Remarks**
2.0	**CABLE LUGS PACKAGE**					In price bid format, supply of these items is considered as a part of cabling work.
2.1	70 SQ. MM Tinned Copper Lug	No.	20	--	0.15	
2.2	50 SQ. MM Tinned Copper Lug	No.	60	--	0.15	
2.3	35 SQ. MM Tinned Copper Lug	No.	20	--	0.15	
2.4	16 SQ. MM Tinned Copper Lug	No.	30	--	0.2	
2.5	10 SQ. MM Tinned Copper Lug	No.	30	--	0.15	
	UPS DB					
B 17, Sec 2	63A (6Nos)) and 100A (2 Nos) feeders in existing UPS Make of UPS DB : M/s Emerson Drawing No: A1245/SY/006-1	Set	1			8 Feeders need to be added. (Addition of 3 no. of 63A power feeder & 1 no. of 100A power feeder in each bus section ; Total number of bus section-2Nos.) Make of UPS DB : M/s Emerson Contractor to execute above job through M/s Emerson only Drawing No: A1245/SY/006-1

C	**Cut out Works for panel/ switchgear installation**					
C 1 Sec 2	"Cutting Reinforced concrete with mechanised tools like Core drilling machine etc. for cutting pockets, holes, cores in slab, beam, column or foundation as per direction of engineer in charge MSR item no 218"	CUDM	3000			As per panel dimensions
C 1 Sec 2	Supply, Fabrication, transportation, delivery at site and erection, installation and alignment of mild steel foundation bolt assembly conforming to IS:2062 and grade 1 of IS:432 in concrete along with nuts, lock nuts (as per IS:1363, 1364 and IS:3138), washers, anchor plates, stiffner plates, protective tape, pipe sleeves, templates etc. including welding, cutting, grinding, threading, drilling etc. all complete. (ISMC 100/150 Channels (0.5MT), ISA 75x75x6 mm Runner angles(0.5MT) (Mild steel), ISA 65x65x6 mm Runner angles (0.5MT) (Mild steel)) **Note: To be supplied, fabricated and erected during shutdown period**	MT	1.5			

Section-2

Erection BOM for Electrical Activities to be carried out Post-Shutdown

This section consists of following two Annexures:

Annexure-3:

Consists of items that are to be erected, tested and commissioned by Erection agency. These items are supplied by BHEL.

Annexure-4:

Consists of items that are to be **supplied**, erected, tested and commissioned by Erection agency.

Annexure-3 (Under Section-2)

Price bid ref. Sl. No.	Equipment/ Package Description	Unit of Qty	Qty.	Dimension (each) L x B x H (M)	Weight (each) kg	Remarks
3.0	**6.6kV HT XLPE ALUMINIUM CONDUCTOR ARMOURED CABLES**					
3.1	6.6kV (UE) 3C x 240 Al	Meter	1,600	--	6600	Cable weight indicated in kg/km
4.0	**LT POWER CABLES**					
4.4	1C x 10 Cu XLPE UNARM	Meter	1,500	--	245	Cable weight indicated in kg/km
4.3	1C x 35 Cu XLPE UNARM	Meter	1,500	--	525	Cable weight indicated in kg/km
4.2	1C x 120 Cu XLPE UNARM	Meter	750	--	1400	Cable weight indicated in kg/km
4.7	3.5C x 50 Al XLPE	Meter	3,000	--	1240	Cable weight indicated in kg/km
4.8	3.5C x 95 Al XLPE/ 3.5Cx70 Al XLPE	Meter	12,500	--	1900	Cable weight indicated in kg/km

4.9	3.5C x 120 Al XLPE	Meter	3,000	--	2400	Cable weight indicated in kg/km
4.10	3C x 2.5 Cu XLPE	Meter	20,000	--	460	Cable weight indicated in kg/km
4.11	3C x 4 Cu XLPE	Meter	4,000	--	530	Cable weight indicated in kg/km
4.12	3C x 6 Cu XLPE	Meter	4,000	--	680	Cable weight indicated in kg/km
4.13	3C x 10 Cu XLPE	Meter	2,000	--	865	Cable weight indicated in kg/km
4.14	3C x 16 Cu XLPE	Meter	5,500	--	1040	Cable weight indicated in kg/km
4.15	3C x 35 Al XLPE	Meter	2,000	--	900	Cable weight indicated in kg/km
4.16	3C x 50 Al XLPE	Meter	6500	--	1100	Cable weight indicated in kg/km
4.17	3C x 70 Al XLPE	Meter	7,000	--	1425	Cable weight indicated in kg/km
4.18	3C x 95 Al XLPE	Meter	2,000	--	1750	Cable weight indicated in kg/km
4.19	4C x 50 Cu XLPE	Meter	500	--	2510	Cable weight indicated in kg/km
4.20	4C x 25 Al XLPE	Meter	3,200	--	940	Cable weight indicated in kg/km
4.21	4C x 35 Al XLPE	Meter	3,500	--	1050	Cable weight indicated in kg/km
4.22	4C x 95 Al XLPE	Meter	2,000	--	2100	Cable weight indicated in kg/km
4.23	4C x 120 Al XLPE	Meter	1,800	--	2600	Cable weight indicated in kg/km
4.24	4C x 150 Al XLPE	Meter	1,800	--	3000	Cable weight indicated in kg/km
4.25	4C x 185 Al XLPE	Meter	6,000	--	3650	Cable weight indicated in kg/km
5.0	**HT CABLE TERMINATING KITS**					
5.1	6.6kV (UE) 3C x 240 Terminating Kit	No.	4	--	1	
*	**CABLE GLANDS PACKAGE**					
1	13-18 Gland	No.	600	--	400 (Total)	* In price bid format, E&C of these items is considered as a part of cabling work.
2	18.5-20 Gland	No.	150	--		
3	20.5-23 Gland	No.	100	--		
4	23.5-26 Gland	No.	50	--		
5	26.5-30 Gland	No.	175	--		
6	30.5-33 Gland	No.	75	--		

7	33.5-37 Gland	No.	75	--		
	37.5-41 Gland	No.	50	--		
**	**CABLE LUGS PACKAGE (Tinned Copper)**					
1	2.5 sq.mm Tinned Copper Lug	No.	20000	--	300 (Total)	1. Lugs for power cables shall be of compression type whereas lugs for control/ signal cables shall be of crimping type. Individual termination up to wire level shall be considered. ** In price bid format, E&C of these items is considered as a part of cabling work.
2	4 sq.mm Tinned Copper Lug	No.	500	--		
3	6 sq.mm Tinned Copper Lug	No.	700	--		
4	10 sq.mm Tinned Copper Lug	No.	800	--		
5	16 sq.mm Tinned Copper Lug	No.	600	--		
6	25 sq.mm Tinned Copper Lug	No.	1200	--		
7	35 sq.mm Tinned Copper Lug	No.	500	--		
8	50 sq.mm Tinned Copper Lug	No.	250	--		
9	70 sq.mm Tinned Copper Lug	No.	100	--		
10	95 sq.mm Tinned Copper Lug	No.	80	--		
11	120 sq.mm Tinned Copper Lug	No.	150	--		
12	150 sq.mm Tinned Copper Lug	No.	50	--		
13	180 sq.mm Tinned Copper Lug	No.	50	--		
14	240 sq.mm Tinned Copper Lug	No.	60	--		
Price bid ref. Sl. No.	**CONTROL CABLE (TWISTED PAIR OVERALL SHIELDED CABLE)**					
D 2, Section 1	8P x 2.5 sq.mm cable	Meter	14000	--	1600	Cable weight indicated in kg/km
D 2, Section 1	6P x 2.5 sq.mm cable	Meter	2000	--	1400	Cable weight indicated in kg/km

	Notes: **1. For Aluminium cable, Aluminium Lug shall be used. For Copper cable, Tinned copper lug shall be used. When Aluminium lug is connected to copper bus or when Copper cable lug is connected to Aluminium bus, Bimetallic strip shall be used between lug and bus. Bimetallic strips are supplied along with the above lugs.** 2. The glanding, termination and connection of cables shall be done strictly in accordance with the manufacturer's instruction, drawings and/or as directed by the Purchaser. 3. The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. 4. Control cable cores entering control panel/switchgear/MCC etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block. 5. The contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferruling shall be Cross-Ferruling. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type. 6. Spare cores shall also be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number. 7. Termination & Connection shall be carried out in such a manner as to avoid strain on the terminals. Cables shall be marked with cable numbers as per applicable drawing. 8. All cable entry points shall be properly sealed and made vermin and dustproof. Unused opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound.					
Price bid ref. Sl. No.	**PRE FABRICATED CABLE TRAYS AND ACCESSORIES (GI & FRP) AND CABLE DUCTS (GI & FRP)** **Cable Trays material mentioned at Sl. No 7.1 to 7.12 are of GI type and cable trays materials mentioned at Sl. No 7.13 to 7.18 are of FRP cable tray and Cable ducts mentioned against Sl. No. 7.19 to 7.20 are GI type Epoxy coated and Cable ducts mentioned against Sl. No. 7.21 to 7.26 are FRP cable Ducts.**					
6.1	Ladder type cable tray, W=600mm.	Sets	80	3.0 x 0.6 x 0.1	45	Each cable tray length 3 Mtr including coupler plate and Nut bolts.
	Horizontal Bends of 900mm bending radius for ladder type cable tray, W=600mm	Sets	8	--	35	Part of Cable Tray works
	Vertical UPs of 900mm bending radius for ladder type cable tray, W=600mm	Sets	8	--	25	Part of Cable Tray works

	Vertical downs of 900mm bending radius for ladder type cable tray, W=600mm	Sets	8	--	25	
6.2	Ladder type cable tray, W=300mm.	Sets	100	3.0 x 0.3 x 0.1	40	Each cable tray length 3 Mtr including coupler plate and Nut &bolts.
	Cover along with accessories for 300mm width ladder type cable tray	Sets	50	3.0 x 0.3 x 0.05	20	1. Each cable tray cover length 3 Mtr including clamp strips and Nut & bolts 2. Part of Cable Tray works
6.3	300mm(W) Perforated type cable tray	Sets	450	2.5 x 0.3 x 0.075	30	Each cable tray length 2.5 Mtr including coupler plate and Nut& bolts
	Cover for Perforated type Cable Tray, W=300mm	Sets	150	2.5 x 0.3 x 0.05	25	1. Each cable tray cover length 2.5 Mtr including clamp strips and Nut & bolts 2. Part of Cable Tray works
6.4	150mm (W) Perforated type cable tray.	Sets	300	2.5 x 0.15 x 0.05	20	Each cable tray length 2.5 Mtr including coupler plate and Nut &bolts
6.5	50mm(W) Perforated type cable tray	Sets	400	2.5 x 0.05 x 0.03	20	Each cable tray length 2.5 Mtr including coupler plate and Nut &bolts
	Cover for Perforated type Cable Tray, W=150mm	Sets	200	2.5 x 0.15 x 0.05	15	1. Each cable tray cover length 2.5 Mtr including clamp strips and Nut & bolts 2. Part of Cable Tray works
	Cover for Perforated type Cable Tray, W=50mm	Sets	300	2.5 x 0.05 x 0.03	7.5	1. Each cable tray cover length 2.5 Mtr including clamp strips and Nut & bolts 2. Part of Cable Tray works
6.6	300mm(W) Perforated FRP Cable	Sets	400	3 x 0.3 x 0.075	100	Each cable tray length 3 Mtr

	Tray & Cps					including coupler plate and Nut &bolts.
6.7	150mm(W) Perforated FRP Cable Tray & Cps	Sets	600	3 x 0.15 x 0.05	40	Each cable tray length 3 Mtr including coupler plate and Nut &bolts.
6.8	50mm(W) Perforated FRP Cable Tray & Cps	Sets	400	3 x 0.05 x 0.04	30	Each cable tray length 3 Mtr including coupler plate and Nut &bolts.
6.9	Cover For 300mm(W) Perforated FRP C.T	Sets	500	--	50	Each cable tray cover length 3 Mtr including clamp strips and Nut&bolts
6.10	Cover For 150mm(W) Perforated FRP C.T	Sets	600	--	15	Each cable tray cover length 3 Mtr including clamp strips and Nut&bolts
6.11	Cover For 50mm(W) Perforated FRP C.T	Sets	500	--	15	Each cable tray cover length 3 Mtr including clamp strips and Nut&bolts
6.12	1000 MM WIDTH, 400 MM Height & 5 mm Thick,2500mm length GI Cable duct with cover , Jointing plates and other accessories	Sets	230	2.5 x 1.0 x 0.4	50	Cable ducts are bolted type and to be assembled at site.
6.13	800 MM WIDTH, 300 MM Height & 5 mm Thick,2500mm length GI Cable duct with cover , Jointing plates and other accessories	Sets	280	2.5 x 0.8 x 0.4	40	Cable ducts are bolted type and to be assembled at site.
6.14	400 MM WIDTH, 200 MM Height & 5 mm Thick,2500mm length FRP Cable duct with cover , Jointing plates and other accessories	Sets	1100	2.5 x 0.4 x 0.2	30	Cable ducts are bolted type and to be assembled at site.
6.15	800 MM WIDTH, 200 MM Height & 5 mm Thick,2500mm length FRP Cable duct with cover , Jointing plates	Sets	110	2.5 x 0.8 x 0.3	100	Cable ducts are bolted type and to be assembled at site.

	and other accessories					
6.16	1000 MM WIDTH, 200 MM Height & 5 mm Thick,2500mm length FRP Cable duct with cover , Jointing plates and other accessories	Sets	210	2.5 x 0.1 x 0.2	80	Cable ducts are bolted type and to be assembled at site.
	1000MM width Horizontal Duct Elbow	Sets	10	--	30	1. Cable ducts are bolted type and to be assembled at site. 2. Part of cable tray
	800MM width Horizontal Duct Elbow	Sets	20	--	30	1. Cable ducts are bolted type and to be assembled at site. 2. Part of cable tray
	400MM width Horizontal Duct Elbow	Sets	25	--	20	1. Cable ducts are bolted type and to be assembled at site. 2. Part of cable tray

Notes for Cable Trays:

i) Erection agency shall consider supply of Red Oxide Zinc Chromate Primer for site painting of all Structural Steels (required for cable Tray Supports) in the Erection contractor's scope. Final painting shall be done with two coats of approved bituminous aluminium paint & same to be considered in erection contractor scope.

ii) Cable Trays shall be numbered as per layout drawing before laying of cables. Cabling Shall be done as per Cable Laying Notes & Details.

iii) All cables shall be provided with minimum of 2 mm thick,20mm wide and of enough length Stain less steel as cable identification tags indicating cable designation in accordance with the cable schedule. The cable tags shall be provided at the ends, every 30mtrs and when the cable changes its direction/elevation. The tags shall be of stainless steel with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG GI wire.

iv) The cable trays shall be supported in general at a span of 1.5mtrs horizontally and at a distance of 1mtr vertically.

v) Cable Tray covers shall be provided for the top most & bottom most cable trays and outermost trays of vertical droppers in outdoor area.

vi) For buried cable, the marker shall project at least 150mm above ground and shall be spaced at an interval of 30 mtrs and at every change of direction.

vii) All the cables shall be clamped to the cable trays/support structure with the help of clamps. All power cables shall be clamped individually and control cables shall be clamped in groups of 3 or 4 cables. Clamps for multicore cables shall be fabricated out of 25x3 mm aluminium/G.I flats. Single core power cables shall be laid in trefoil formation and suitably clamped with 25mm wide 8 SWG aluminium strips.

ix) All Sharp edges and Burr shall be removed.

x) Cables to be strapped to tray at interval not greater than 300mm.

xi) Cable ducts supplied for the project are of G.I & FRP type. Cable ducts shall be laid on the main pipe rack hard chrome plated nuts and bolts. Accessories such as nuts and bolts for cable ducts is contractor/vendor scope only.

xii) Fire proof shall be done on cable ducts and FRP cable trays using flexible ceramic fibre blanket system (in compliance to OISD STD 164).

7.0	**PLANT EARTHING AND PLANT LIGHTNING PROTECTION MATERIALS**					
7.1	50x10mm GI Strip Below ground	m	100	--	--	For risers
7.2	75 x 10 mm GI Strip Below ground	m	100	--	--	For risers
7.3	50 x 6 mm GI Strip	m	1500	--	2 kg/m	For earthing of LVSwgr/MCC/ Motor above 90kW including HT Motors/MLDB/Lighting trafo/ Flood Light masts/T.G. pedestal/Masts/Stack/MV cable Boxes/Pipe & cable racks
7.4	35 x 6mm GI Strips	m	800	--	2 kg/m	For earthing of Lighting DB/Structure,Columns/Storage Tanks/Stair Case/loading racks/Heat Exchangers/Vessels
7.5	25 x 3mm GI Strips	m	500	--	0.2 kg/m	Down and roof conductors Lighting fixtures/Single phase Receptacles/ Power & Lighting conduits
7.6	8SWG GI wire ,solid	m	3000	--	1 kg/m	For earthing of Motors up to 3.7KW, All push button stations, small equipments and instrument, Hand Rails/ Junction Boxes/Limit Switches
	5/8'' Dia GI Wire rope	m	150	--	--	1. For earthing of Three Phase Receptacles, Welding Outlets ,Lighting Transformer Neutral , Lighting Transformer, MLDB 2. Part of equipment earthing
	3/8'' Dia GI Wire rope	m	150	--	--	1. For earthing of Motors from

						5.5KW to 30KW & Welding Receptacles, Lighting, Power & Instrument Panels/street lighting poles , Lighting Fixtures, Single Phase Receptacles, Power & Lighting Conduits. 2. Part of equipment earthing
7.8	Providing Earthing pit as per drawing (Drg. No. 080557C001-000-STC-1691-001, sheet 6 of 30)) with charcoal & salt, GI pipes, GI earth electrodes, GI wire, GI strips, brick chamber with covers including associated earthwork etc. all complete (Earthing strips, electrodes and earth plate with funnel will be supplied by BHEL free of cost and all other items as per referred drawings shall be by bidder). Note: Only Earth Electrode (i.e. 65mm dia, 6000mm long-G.I Pipe Electrode,Earth Plate),G.I Strip shall be free issue by BHEL. All other items as per referred drawings shall be by bidder.	Nos.	5	--	--	For Treated earth pits for Machine Neutral Earthing & Untreated earth Pits for Machine Body Earthing. Material (charcoal & salt etc.) required for treated earth shall be supplied by erection agency
7.9	Vertical Air Termination Rod for lightning protection.	Nos.	5	1.2 x 0.3	25	Above ground installation
7.10	40x5 mm GI Strip	Meter	500		2Kg/Mtr	Motors/MLDB/Lighting. trafo/ Flood Light masts/T.G. pedestal/Masts/Stack/MV cable Boxes/Pipe & cable racks

	Notes: Erection agency/Site shall carry out the plant earthing & lightning protection works in line with customer/consultant's technical specifications i.e. "Notes and Details for Plant Earthing & Lightning Protection System".					
8.0	**PLANT ILLUMINATION PACKAGE**					
8.1	Twin cluster LED obstruction light	Nos	15	--	1	
8.2	Industrial DC LED Well Glass fixture (35-45W approx) suitable for DC Supply	Nos	25	--	3.5	
8.3	Flame proof DC LED Well Glass fixture (35-45W approx) suitable for DC Supply	Nos	50	--	4	
8.4	LED Well Glass fixture (45W Approx, 230VAC)	Nos	200	--	3.5	
8.5	Flame proof LED Well Glass fixture (45WApprox, 230VAC)	Nos	500	--	4	
8.6	LED Flood lighting Fixture (100W approx)	Nos	2	--	4	
8.7	Flameproof LED Flood lighting Fixture (100W approx)	Nos	4	--	7.5	
8.8	LED Flood lighting Fixture (200W approx)	Nos	2	--	10	
8.8	LED Flame proof Flood lighting Fixture (200W approx)	Nos	10	--	12	
8.9	11meter Steel tubular pole	Nos	4	--	180	
8.10	2 meter 50NB GI pole for Platform lighting	Nos	575	--	12	
	Cable clamps	Nos	50000	--	.05	Part of Illumination cabling
8.11	4 way 200x150x100mm rectangular sheet steel weather proof JB (IP55)	Nos	220	--	2	
8.12	Flame proof Cast light alloy JB	Nos	560	--	3	

	(200x150x100mm)					
8.13	Industrial metal clad type 1Ph, 20A Socket with 20A interlocked rotary switch & Plug	Nos	15	--	1.5	
8.14	Flameproof 1ph, 20A Socket with interlocked rotary switch & Plug	Nos	35	--	3	
8.15	Industrial metal clad type 3Ph, 63A (5pin) receptacle with interlocked rotary switch & Plug, weather proof (IP55) outdoor type	Nos	5	--	3	
8.16	Flameproof 3ph, 63A (5pin) Receptacle (Indoor type) with interlocked rotary switch & Plug	Nos	15	--	5	
8.17	Flameproof 3-Pph, 250A (5-pin) Receptacle (Outdoor type) with interlocked rotary switch & Plug	Nos	1	--	7	
8.18	Weatherproof 3-Ph, 250A (5-pin) Receptacle (Outdoor type) with interlocked rotary switch & Plug	Nos	1	--	2	
8.19	24V socket module with FLP Hand lamp	Nos	4	--	10	
8.20	18 way AC Outdoor Lighting Panel	Nos	2	1000 x 200 x 1000 mm	110	
8.21	12 way AC Outdoor Lighting Panel	Nos	2	1000 x 200 x 1000 mm	100	
8.22	6 way DC Outdoor Lighting Panel	Nos	2	1000 x 200 x 1000 mm	80	
8.23	FLP 12 way AC Lighting/Power Panel	Nos	10	800 x 200 x 800 mm	90	
8.24	Flameproof 6 way DC Lighting Panel	Nos	3	700 x 200 x 700 mm	60	
8.25	415V AC Wall Mounted DB	Nos	1	650 x 200 x 750 mm	50	
8.26	230V AC UPS Wall Mounted DB	Nos	2	500 x 200 x 500 mm	50	
8.27	110V AC UPS Wall Mounted DB	Nos	1	500 x 200 x 500 mm	50	

	Notes: 1) Fixtures, Accessories of lighting panel/JB like cable glands, gland plate etc. will be supplied to site in loose parts as per standard packing and practice of OEM. Assembly and erection of the fixtures shall be carried out by Erection Agency. 2) In case of non-integral fixtures, control gear box shall be separately mounted (which also acts as JB for looping in and looping out). However, in case the fixtures are of integral type, separate JB shall be considered for loop in and loop out. 3) Erection of all illumination items (including cutting/ threading/welding etc. of conduit/pipe/ISMC/ISA/Metsec etc.) shall be carried out at site by Erection Agency as per the installation requirements. 4) All the required erection consumables (like rawl plugs, screws, check nuts, nuts & bolts, locking wire, insulation tape, sealing compound/plugs, washers etc.) which are not covered in above list but required for successful completion of the work shall be in the scope of Erection Agency. 5) Pipes & accessories of poles will be supplied in loose condition. Assembling and Erection of these poles shall be carried out by Erection Agency. 6) All the necessary civil works including foundations etc. as well as structural works required for installation of these poles shall be in Erection Agency's scope. 7) Erection agency to ensure the completion of foundations for lighting poles before commencement of paving work in related areas.					
9.0	**CCTV SYSTEM**					
9.1	CCTV Cameras (Weatherproof)	Nos.	3	--	5	Network Switches, Media Converters, LIUs, Adaptors, along with Patch Cords etc. are part of CCTV Cabinet. Refer Notes below for further details reg. CCTV System.
9.2	CCTV Cameras (Ex-Proof)	Nos.	6	--	7	
9.3	CCTV Rack/Cabinet	Nos.	1	0.6 x 0.6 x 1.5	200	
9.4	Network Switches	Nos.	1	--	Part of CCTV Cabinet	
9.5	Media Converters, LIUs, Adaptors, along with Patch Cords etc.	Lot	1	--		
9.6	Junction Boxes (Weatherproof)	Nos.	3	--	50	
9.7	Junction Boxes (Ex-proof)	Nos.	6	--	100	
D 9, Sec 1	FO Cable and HDPE Duct	m	6000	--		
4.10	Power Cable (3C X 2.5 sq.mm)	m	1000	--		
D 10, Sec 1	Cat-6 Cable	m	100	--		
9.8	Poles	Nos.	3	--	150	

	Erection Agency may note the following: 1. Existing CCTV system is in SS-331-S to which new field telecom equipment like CCTV cameras associated with new SRU & TGTU-2 shall be interfaced. Additional hardware if any required in existing system shall be provided to interface and integrate new CCTV System equipment of new SRU & TGTU-2 with existing one. All required hardware and software modification/ upgradation in existing CCTV system at **SS-331S & Main Control Room** for interfacing and integration of new cameras inside the battery limit shall be done by CCTV System Vendor of SRU & TGTU-2 package. Required support shall be extended to CCTV Vendor by Erection Agency to complete the system in all respects. 2. Supply of Cables mentioned above is by BHEL/ CCTV System vendor. Laying, glanding, ferruling, identification, termination/ splicing of all type of cables required between CCTV cabinet and existing CCTV network, CCTV Cabinet and PDB and for integration of CCTV cameras inside the battery limit with existing CCTV system are in the scope of Erection Agency. 3. Supply of mounting poles shall be done by BHEL/ CCTV System vendor. Erection and installation of mounting poles including civil works and provision of permanent water connection near the cameras and hook up with CCTV cameras for cameras inside the battery limit is by Erection Agency. 4. Engage OEM of CCTV system at site, liaison with existing CCTV System OEM, perform adequacy check and augmentation of CCTV system, modification/ upgradation of hardware & software of existing CCTV system, interface and integration, testing and commissioning of augmented CCTV system with CCTV cameras inside the battery limit shall be in CCTV System Vendor of SRU & TGTU-2 package. Testing & Commissioning of CCTV System by CCTV System vendor.					
10.0	**PLANT COMMUNICATION SYSTEM (PA SYSTEM & TELEPHONE)**					
10.1	**PA SYSTEM**					
10.1.1	Modification of Existing PA System Cabinet for connection New Field Call Stations (UK0 Adapters, Power Supply Modules etc.)	Lot	1	--	--	Refer Notes below for further details regarding PA System.
10.1.2	Flame proof Field call station with flameproof loudspeakers 25W (Ex FCS + FLP loudspeaker)	Nos.	15	0.6 x 0.5 x 0.5	50	
10.1.3	Flashing Beacon lamps (Ex- proof type)	Nos.	8	--	2	
10.1.4	Acoustic hood	Nos.	15			
10.1.5	PA System Junction boxes, Flame	Nos.	2	0.4 x 0.37 x 0.165	20	

	proof type				
	Erection material like cable glands(weatherproof & Ex-proof), lugs, ferrules, etc. for indoor & outdoor installation of PA System (for Complete system as offered as well as free issued items)	Lot	1	--	100
10.1.6	50 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Non-Jelly filled)	m	1500	--	15 kg/m
10.1.7	5 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Non-Jelly filled)	m	2000	--	10 kg/m
10.1.8	2 pair x 1.5 sq.mm Dia, Armoured Communication cable (Non-Jelly filled)	150	meters	--	5 kg/m

Erection Agency may note the following:

1. Existing PA System is located in SS-331-S to which new field telecom equipment like FCS, Beacons associated to new SRU & TGTU-2 shall be interfaced. Additional hardware if any required in existing system shall be provided to interface & integrate new PA System equipment of new SRU & TGTU-2 with existing one. The new FCS along with required hardware is to be connected with existing PA/GA system and augmentation/modification/up gradation in the existing PA/GA system is in the scope of PA System vendor of SRU & TGTU-2.
2. Supply of Cables mentioned above is by PA System vendor. Laying, glanding, ferruling, identification, termination/ splicing of all type of cables required between new FCS at field and PA System cabinet is in the scope of Erection Agency.
3. Engage OEM of PA system at site, liaison with existing PA System OEM, perform adequacy check and augmentation of PA system, modification/ upgradation of hardware & software of existing PA system, interface and integration, testing and commissioning of augmented PA system with new FCS inside the battery limit shall be in the scope of PA System vendor of SRU & TGTU-2.
4. Testing & Commissioning of PA System is in the scope of PA System vendor of SRU & TGTU-2.

10.2	**TELEPHONE SYSTEM**

10.2.1	Modification of Existing Telephone System Exchange (24 Analog media module, Line Cards etc.)	Lot	1	--	--	• 24 Analog media module, Line Cards etc. • **Refer Notes below for further details**
10.2.2	Ex-proof Telephone Equipment	Nos.	3	--	50	
10.2.3	Weather proof Telephone, Wall mounting	Nos.	3		3	
10.2.4	Flashing Beacon lamps (Ex- proof type)	Nos.	2	--	2	
10.2.5	Acoustic Hood/Canopy (FRP) suitable for Weather proof & Ex-proof Telephones mounted in outdoor environment	Nos.	4	--	10	
10.2.6	Telephone System Junction boxes, Wp-proof type	Nos.	2	0.4 x 0.37 x 0.165	5	
	Erection material like cable glands(weatherproof & Ex-proof), lugs, ferrules, etc. for indoor & outdoor installation of PA System (for Complete system as offered as well as free issued items)	Lot	1	--	100	
10.2.7	10 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Jelly filled)	m	1500	--	15 kg/m	
10.2.8	2 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Jelly filled)	m	500	--	10 kg/m	
10.2.9	Main distribution for connection of Telephone sets to Main Telephone System Exchange	1			25	

Erection Agency may note the following:

1. The new Telephone equipment along with required hardware is to be connected with existing Telephone system and augmentation/ modification/ upgradation in the existing Telephone system is in the scope of Telephone system vendor of SRU & TGTU-2.
2. Required software and hardware modification/ upgradation in existing AVAYA telephone system/ network in SS-331-S for addition of new telephones shall be done by Telephone System vendor. All necessary power distribution (including UPS power) for new Telephones & associated additional hardware shall be in scope of Telephone system vendor of SRU & TGTU-2.
3. Supply of Cables mentioned above is by PE&SD/ Telephone System vendor. Laying, glanding, ferruling, identification, termination/ splicing of all type of cables required between new Telephones and Telephone System cabinet is in the scope of Erection Agency.
4. Engage OEM of Telephone system at site, liaison with existing telephone system OEM, perform adequacy check and augmentation of Telephone system, modification/ upgradation of hardware & software of existing telephone system, interface and integration, testing and commissioning of augmented telephone system with new telephones inside the battery limit shall be in the scope of Telephone system vendor of SRU & TGTU-2.
5. Testing & Commissioning of Telephone System is in the scope of Telephone system vendor of SRU & TGTU-2.

	STRUCTURAL STEEL					
B 5, Section 1	Structural steel (MS angle iron- 50x50x6, 75x75x6 mm for panel base frame & its site fabrication, STR STL 6MM (1500x5000X6), ISMC MS CHANNEL (100x50), ISA 65x65x6 mm Runner angles (Mild steel), ISA 50x50x6 mm Runner angles (Mild steel)	Lot Lot Lot	1 1 1	-- -- --	50MT	Painting shall be in erection agency scope and same shall be carried out as per contract standards.
	Notes: Structural steel is for cable tray supports in the cellar/ trenches/ vertical raceways, cross channels in floor cut outs for supporting panels, for the field mounted JBs/ PB Stations etc.					
11.0	**CONVENTIONAL FIRE PROOF SEALING MATERIALS**					
11.1	Fire Break Coatings for HT/ LT Power Cables	sq.m	150	--	--	Spray type liquid on cables
11.2	Fire proof materials required for	sq.m	80	--	--	Mortar seal

	sealing of cable entry through conduits/trenches & through panels					
11.3	Ceramic Fibre Mattress GI cable Ducts	sq.m	2250	--	--	Please refer G.I Cable duct BOQ item Sl. No. 7.19 & 7.20
11.4	Ceramic Fibre Mattress for below mentioned FRP cable trays & ducts	sq.m	2000	--	--	P Please refer G.I Cable duct BOQ item Sl. No. 7.21,7.22 & 7.23
12.0	**ELECTRICAL INSULATING MATS**					
12.1	Insulating Mat for voltage Grade upto 3.3kV (Class-A, Category-III)	Nos.	5	10 x 1 x 0.002	5	
13.0	**LCS (LOCAL CONTROL STATION) PACKAGE**					
13.1	Local Control Station (LCS)	Nos.	30	400 x 200 x 400	25	

Annexure-4 (Under Section-2)

(Items that are to be supplied erected, tested and commissioned by Erection agency.)

Erection and Commissioning Consumables: The consumables required for Electrical Equipment/ Items shall be included in Erection Agency's scope (The consumables shall be of Industrial Grade and suitable for use in refineries). The following are typical erection consumables that are envisaged in this project:

Price bid ref. Sl. No.	Equipment/ Package Description	Unit of Qty	Qty.	Dimension (each) L x B x H (M)	Weight (each) kg	Remarks
B 1, Sec 2	6 mm thick chequered plate for covering cutouts in Switchgear room	sq.m	50	--	--	Refer Switchgear Room Layout. Support structure for complete chequered plates shall be erected by Erection agency.

B 2, Sec 2	Cable Tags Aluminium Strips	Lot	1	2mm thick, 75mm long, 15mm width	--	At entry, exit and at every 30 M of cable run length
	Cable Markers	Lot	1			1. At every 3 m of cable length 2. Part of cabling
	Clamps for multicore cables – Aluminium Flats	Lot	1	--	--	
	Erection Hardware like Nuts, Bolts, Washers etc.	Sets	1	--	--	
B 3, B 4, B 5, B 6, B 7, B 8 Sec 2	Safety Items including the following: Danger boards, Do not switch on boards, Man on work boards Display charts First aid boxes near LT & HT panels Shock hazard charts Safety hand gloves Exit Signs	Sets	1	--	--	
	3mm dia Nylon Cord (Required for tying cables to trays, at every 5 m)	Lot	1	--	--	Supply of this item is Part of cabling E&C
B 9 Sec 2	GI Conduits of 50 mm diameter, medium duty, min 75 microns galvanizing thickness	m	200	--	--	As per Cable Tray/ Trench Layouts. Along with accessories like bends, couplers.
B 10 Sec 2	GI Conduits of 100 mm diameter, medium duty, min 75 microns galvanizing thickness	m	300	--	--	As per Cable Tray/ Trench Layouts. Along with accessories like bends, couplers.
B 11 Sec 2	GI Conduits of 150 mm diameter, medium duty, min 75 microns galvanizing thickness	m	50	--	--	As per Cable Tray/ Trench Layouts. Along with accessories like bends, couplers.
B 12 Sec 2	RCC Hume Pipes (150 NB as per IS: 458) for cables at Road Crossings - Satndard length 2.5 m	Nos.	20	--	--	As per Cable Tray/ Trench Layouts.

B 13 Sec 2	RCC Hume Pipes (200 NB as per IS: 458) for cables at Road Crossings - Satndard length 2.5 m	Nos.	5	--	--	As per Cable Tray/Trench Layouts.
B 14 Sec 2	PVC Conduits Class-3 of 300 mm diameter	m	10	--	--	As per Cable Tray/ Trench Layouts.
B 15 Sec 2	PVC Conduits Class-3 of 200 mm diameter	m	100	--	--	As per Cable Tray/ Trench Layouts.
B 16 Sec 2	PVC Conduits Class-3 of 150 mm diameter	m	50	--	--	As per Cable Tray/ Trench Layouts.
B 17 Sec 2	PVC Conduits Class-3 of 100 mm diameter	m	50	--	--	As per Cable Tray/ Trench Layouts.
	Framed Single Line Diagram	Nos.	1	--	--	To be arranged at site
B 19 Sec 2	GI earth plates as per typical installation drawing no.080557C001-000-STC-1681-001,Sheet 8 of 30, complete with anchor bolts, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge. Note: Complete material except 10mm GI wire/8mm G.I wire i.e earthing wire/Strip of equipment shall be supplied by bidder.	Nos.	25			

ATTENTION:

Notes regarding Erection of Cables, Cable Trays and Accessories:

a) The termination and connection of cables shall be carried out strictly in accordance with the manufacturer's instruction, drawings and / or directed by the Purchaser. The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. Cables shall be checked for insulation resistance before and after jointing. All erection consumables shall be in Erection Agency's scope. Termination & Connection shall be carried out in such a manner as to avoid strain on the terminals. Cables shall be marked with cable numbers as per applicable drawing.

b) Cable Glands and Lugs are being supplied along with corresponding equipment like Motors, LT Switchgear, Junction Boxes, Push Button Stations, and Transformers etc. However, one lot of Glands and Lugs are being supplied to take care of shortages/mismatches at site.

c) Control cable cores entering panel/switchgear/MCC etc. shall be neatly bunched and served with PVC perforated tape to keep in position at the terminal block.

d) Ferrules shall be installed on all control cable cores in all junction boxes and at all terminations. The ferruling shall be Cross-Ferruling. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type. Spare cores shall also be similarly ferruled, crimped with lug and aped on the ends. Spare cores shall be ferruled with individual cable number.

e) "Structural Steels for support" materials are supplied to make supports for cable trays (in the buried RCC trenches, Overhead tray arrangement on pipe racks and Cable Tray arrangement in Cellars & other arrangements as applicable for the project. These are also required for making of frames for PB stations, junction boxes as per the project requirements. Drilling of holes in ISA 65 x 65 x 6 for bolting of cable trays shall be done by Erection Agency. The holes in the Cable Trays shall be provided by the Cable Tray vendor, however in case of requirement of any additional holes to be drilled for Cable Trays for the purpose of Cable Tray Erection, same shall be done by the Erection Agency. Erection Agency shall ensure that all steel structure used for electrical installation shall be painted with one coat of Red Oxide Zinc Chromate Primer of approved shade for indoor installations. Final painting shall be done with two coats of approved bituminous aluminium paint & same to be considered in erection contractor scope. Supply of Red Oxide Zinc Chromate Primer for site painting of all Structural Steels (required for cable Tray Supports) shall be in the Erection contractor's scope. Erection Agency shall ensure that after welding and drilling (if any) of the steels bracket, above mentioned paint of approved shade shall be applied. Site shall carry out the structural steel works in line with customer/consultant's technical specifications "Notes & Details for Plant cable Laying System".

Annexure – I (Rev.01)

PRE QUALIFYING REQUIREMENTS

JOB	**"Electrical and C&I work" for IOCL Paradip-Standby SRU (525TPD) Train project, Odisha.**
Tender/Enquiry Ref No:	T0AUX00043

BIDDER SHALL SUBMIT BELOW PRE-QUALIFICATION REQUIREMENTS FORMAT, DULY FILLED-IN, SPECIFYING RESPECTIVE ANNEXURE NUMBER AGAINST EACH CRITERIA AND FURNISH RELEVANT DOCUMENT IN THE RESPECTIVE ANNEXURES IN THEIR OFFER.

SL NO	PRE-QUALIFICATION REQUIREMENTS	Bidders claim in respect of fulfilling the PQR Criteria	
		Name and Description of qualifying requirements	Page no of supporting document
A	Submission of Integrity Pact duly signed, if offer value is Rs 2 Cr [excluding taxes and duties] or more, if applicable. (Note: To be submitted by Prime Bidder & Consortium/Technical Tie up partner jointly in case Consortium bidding is permitted, otherwise by the sole bidder)		Applicable
B	Technical Criteria: Bidders must have achieved the following criteria (PQR), during last 7 years. B1.1 Successfully completed one similar work of value not less than Rs**. 157.00 Lakhs** OR B1.2. Successfully completed Two similar works each of value not less than **Rs. 98.25 Lakhs** OR B1.3. Successfully completed Three similar works each of value not less than **Rs.78.50 Lakhs**		
C 1	Financial Criteria Turnover: Bidders must have achieved an average annual financial turnover (Audited) of **Rs. 59.0** Lacs or more over last three completed Financial Years (FY) i.e. 2017-18,2018-19 & 2019-20.	T/O value: FY 2017-18: Rs. _____ Lacs FY 2018-19: Rs. _____ Lacs FY 2019-20: Rs. _____ Lacs	

2	Net worth: Net worth of the Bidder based on the latest Audited Accounts as furnished for 'C1' above should be positive. Net worth = Paid up share capital* + Reserves. (*Share Capital OR Partnership Capital OR Proprietor Capital as the case may be)		
3	Cash Profit: Bidder must have earned cash profit in any one of the three Financial Years as applicable in the last three years defined in 'C1 above based on latest Audited Accounts. NET cash profit=(PAT + Non cash expenditure viz depreciation)		
D	Capacity Evaluation of Bidder: Concurrent Commitments of the bidder shall not be greater than or equal to double the average financial turnover of last three completed Financial years i.e. for FY's 2017-18, 2018-19 & 2019-20.		
E	Approval of Customer: Note: Name of L-1 Bidder along with the credentials may be sent to end customer (IOCL Paradip) for approval as per customer requirement if sought by them.		Applicable
F	Price Bid opening. Note: Price Bids of only those bidders shall be opened through Reverse auction, who stand qualified after compliance of criteria A to E		By BHEL
	1. Explanatory Notes for the PQR (unless otherwise specified in the PQR): 2. Bidder to submit Audited Balance Sheet and Profit and Loss Account for the respective years as indicated against C-1 above along with all annexures. 3. Audited financial statement have to be submitted for all the three years as indicated against C-1 above. If financial statements are not required to be audited statutorily, then instead of audited financial statements, financial statements are required to be certified by chartered accountant. 4. Incase audited Financial statements have not been submitted any of three years as indicated against C-1 above, then the applicable audited statements submitted by bidders against the requisite three years, will be averaged for three years i.e. total divided by three. 5. However audited financial statement for FY 2019-20 is necessarily required to be submitted for determining net worth. 6. The bidder can be a company under Companies Act, 1956 or Partnership firm or Proprietor firm. Bidder to submit the document for same. 7. Time period for achievement of the 'Technical' criteria of PQR (as in 'B' above) will be the last 7 years ending on the 'latest date' of Bid submission. If the Qualifying work is executed in the last seven years period, as specified above, even if it has been started earlier, the same will also be considered meeting the qualifying requirements.		

8. 'Successfully completed'/'Executed' means the bidder should have achieved the criteria specified in the Technical criteria of PQR (as in 'B'' above) even if the Contract has not been completed or closed. The bidders will be required to submit successful completion of work completed (completion of entire work with closing of contract or part successful completion certificate upto a minimum level specified in the criteria B above).

9. For PQR 'B' value of work is to be updated as per the PVC formula of GCC with Indices for "All India Avg. Consumer Price Index for Industrial Workers" with base month as date of execution and indexed up to two months prior to the bid opening month. This condition will be applicable only for the completed jobs and not for the jobs in progress as on date of technical bid opening.

10. 'Similar Work' means any Electrical/ C&I / Electrical and C&I works in Hydrocarbon sector (Refineries/ Petrochemical Plant/ Onshore Oil or Gas Processing Facility/ Offshore Oil or Gas Processing Facility/ LNG facility/ Fertilizer Plant/ Chemical Plant /Metallurgy (Ferrous) Plant/Power plant (excluding solar/wind)".

11. Bidders are required to declare the current commitments in the attached format, Form F 09. For the purpose of determining Concurrent commitments.

12. Bidder to submit completion certificate and its Work order for documentary evidence as indicated against criteria B above. Duly certified Payment invoice from the customer organization can be accepted as completion certificate.

Annexure-II

CHECK LIST

NOTE: - Tenderers are required to fill in the following details and no column should be left blank

1	Name and Address of the Tenderer	
2	Details about type of the Firm/Company	
3a	Details of Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Fax No:
3b	Details of alternate Contact person for this Tender	Name : Mr/Ms Designation: Telephone No: Mobile No: Fax No
4a	EMD DETAILS	DD No: Date : Bank : Amount:
4b	Tender Fee Details.	DD No: Date : Bank : Amount:

		APPLICABILITY	BIDDER REPLY
5	Whether the format for compliance with PRE QUALIFICATION REQUIREMENTS (ANNEXURE-1) is understood and filled with proper supporting documents referenced in the specified format	Applicable	YES / NO
6	Whether Audited profit and Loss Account for the last three years submitted along with latest IT return & Cash Flow statement.	Applicable	YES/NO
7	Whether Copy of PAN Card submitted	Applicable	YES/NO
8	Whether all pages of the Tender documents including annexures, appendices etc are read understood and signed	Applicable	YES/NO
9	Integrity Pact	Applicable	YES/NO
10	Declaration by Authorised Signatory	Applicable	YES/NO
11	Whether No Deviation Certificate submitted	Applicable	YES/NO
12	Whether Declaration confirming knowledge about Site Conditions submitted	Applicable	YES/NO
13	Whether Declaration for relation in BHEL submitted	Applicable	YES/NO
14	Whether Non Disclosure Certificate submitted	Applicable	YES/NO
15	Whether Bank Account Details for E-Payment submitted	Applicable	YES/NO
16	Capacity Evaluation of Bidder for current Tender	Not Applicable	Not Applicable
17	Tie Ups/Consortium Agreement are submitted as per format	Not Applicable	Not Applicable
18	Whether Analysis of Unit rates submitted	Applicable	Applicable
19	Whether Acceptance to “Reverse Auction” submitted	Not Applicable	YES/NO
20	Whether GSTIN No.& certificate submitted	Applicable	YES/NO

NOTE: STRIKE OFF ‘YES’ OR ‘NO’, AS APPLICABLE

DATE:

AUTHORISED SIGNATORY
(With Name, Designation and Company seal)

ANNEXURE - III

Certificate by Chartered Accountant on letter head

This is to Certify that M/S . . . . . ,
(hereinafter referred to as 'company') having its registered office at ..... is registered under MSMED Act 2006, (Entrepreneur Memorandum No (Part—II) ..... dtd: ..... ,
Category: ..... (Micro/Small)). (Copy enclosed).

Further verified from the Books of Accounts that the investment of the company as per the latest audited financial year …….. as per MSMED Act 2006 is as follows:

1. For Manufacturing Enterprises: Investment in plant and machinery (i.e. original cost excluding land and building and the items specified by the Ministry of Small Scale Industries vide its notification No. S.O.1722(E) dated October 5, 2006:
   Rs ..... Lacs

2. For Service Enterprises: Investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service rendered or as may be notified under the MSMED Act, 2006:
   Rs ..... Lacs

(Strike off which is not applicable)

The above investment of Rs . . . . . Lacs is within permissible limit of Rs ..... Lacs for ..... Micro / Small (Strike off which is not applicable)

Category under MSMED Act 2006.

Or

The company has been graduated from its original category (Micro/Small) (Strike off which is not applicable) and the date of graduation of such enterprise from its original category is …..…… (dd/mm/yyyy) which is within the period of 3 years from the date of graduation of such enterprise from its original category as notified vide S.O. No. 3322(E) dated 01.11.2013 published in the ga zette notification dated 04.11.2013 by Ministry of MSME.

Date:

Signature)

Name -

Membership number -

Seal of Chartered Accountant

Annexure-IV

Reverse Auction Process Compliance Form

(**The bidders are required to print this on their company's letterhead and sign, stamp before RA)**

To
- M/s. {Service provider
- Postal address}

Sub: Agreement to the Process related Terms and Conditions

Dear Sir,

This has reference to the Terms & Conditions for the Reverse Auction mentioned in the RFQ document for {Items} against BHEL enquiry/ RFQ no.{……} dt. {…….} This letter is to confirm that:

1) The undersigned is authorized official/ representative of the company to participate in RA and to sign the related documents.
2) We have studied the Reverse Auction guidelines (as available on www.bhel.com), and the Business rules governing the Reverse Auction as mentioned in your letter and confirm our agreement to them.
3) We also confirm that we have taken the training on the auction tool and have understood the functionality of the same thoroughly.
4) We also confirm that, in case we become L1 bidder, we will FAX/ email the price confirmation & break up of our quoted price as per Annexure - 6 within two working days (of BHEL) after completion of RA event, besides sending the same by registered post/ courier both to M/s. BHEL and M/s. {Service provider.}

We, hereby confirm that we will honor the Bids placed by us during the auction process.

With regards

Signature with company seal

Name:
Company / Organization:
Designation within Company / Organization:
Address of Company / Organization:

Sign this document and FAX/ email it to M/s {Service provider} at {……} prior to start of the Event.

Annexure-V

Authorization of representative who will participate in the on line Reverse Auction Process;

1.	NAME & DESIGNATION OF OFFICIAL	
2.	POSTAL ADDRESS (COMPLETE)	
3.	TELEPHONE NOS (LAND LINE & MOBILE BOTH)	
4.	FAX NO	
5.	E-MAIL ADDRESS	
6.	NAME OF PLACE/ STATE/ COUNTRY, WHEREFROM S/HE WILL PARTICIPATE IN THE REVERSE AUCTION	

Revised Summary of Price Estimate Rev.1 dated:20.07.2021

Project Name: IOCL Paradip-Standby SRU (525TPD) Train project, Odisha

Works & Services Name for work: Installation, testing and commissioning of "Electrical, Control & Instrumentation" Works

Abstract of sheet

Sl No	Description	UOM	Qty	Rate in Rs.	Amount In Rs.	Weightage %	Remark
A	B	C	D	E	F	G	H
1	C&I Works and Services	Set	1			37.0187304%	Refer Section-1 for BOQ
2	Electrical Works and Services	Set	1			62.9812696%	Refer Section-2 for BOQ
	Total (Weightage Excluding Taxes)					100.0000000%	
	Total Amount Excluding GST.			**Bidders not to quote or write anything here. Bidder has to quote the total price in BHEL NIC portal https://eprocurebhel.co.in**			

Note:

1	Bidders should quote only the Total Amount both in figures & words in the specified place. They should not fill/quote/write anything in col. (E) & (F) of Abstract sheet as well as section - 1 to 2 . These rates & amount will be derived from the Total amount quoted and weightage factor assigned against respective items indicated in col. G. (Bidder to quote the total price in BHEL NIC portal https://eprocurebhel.co.in)
2	Evaluation Shall be based on total amount quoted by bidder.

Sectioon-1: Control and Instrumentation works.						
Sl No	**Item Description**	**UOM**	**Qty**	**Rate in (Rs.)**	**Amount in (Rs.)**	**Weightage %**
A	**Installation, Testing and commssioning of following items: Instruments**					
1	Mass flow meter	Nos	2			0.0338432%
2	RADAR Level Transmitter	Nos	15			0.4625309%
3	SMART transmitters (PT, DPT, FT, LT, TT)	Nos	169			1.4059198%
4	Pressure Gauges/ Differential Pressure gauges	Nos	107			0.6883421%
6	Level Gauges	Nos	22			0.3822786%
7	Temperature Gauges with Thermowell	Nos	51			0.3963367%
8	Temperature Elements (Thermo Couple, RTD, Multipoint thermocoples) with thermowell	Nos	91			0.6487559%
10	FRP Canopies	Nos	500			10.0478234%
11	Remote Indicators	Nos	2			0.0206276%
12	Junction Boxes (WP & ExP)	Nos	180			1.9821668%
13	EWLI (HYDRASTEP TYPE)	Nos	2			0.3632954%
14	FLAME SCANNER ASSEMBLY	Nos	8			0.2184262%
15	Flame Ionization Rods, Pilot Ignitors	Nos	2			0.1032115%
16	Pneumatic actuators- Regulating type for Incinerator Fans	Nos	2			0.1513435%
17	Vibration Transmitters for Condensate pump and blowdown fans	Nos	9			0.2775186%
B	**Fabrication, Installation, painting of support and hookup material**					
1	Pipes: Size 21.3x3.7, 4.5, 5.5, 7.1,, Qty to be in meters, Material shall be informed by engg.	Meter	2000			5.2427779%
2	Pre-fab hook-ups for PT: SS	Nos	45			0.4955417%
3	Pre-fab hook-ups for FT: SS	Nos	35			0.3854213%
4	2" pipe for transmitter and JB mounting & Support set up	Meter	300			1.4302092%
5	Structural steel (MS angle iron- 50x50x6, 75x75x6 mm for panel base frame & its site fabrication, STR STL 6MM (1500x5000X6), ISMC MS CHANNEL (100x50)	MT	50			12.7481112%
6	MCT Block : 6+6 x10 : 466x1311	Nos	3			0.3228155%
7	MCT Block : 6+6 x1 : 466x141	Nos	2			0.0538026%
8	MCT Block : 6+6 x2 : 466x271	Nos	1			0.0403528%
C	**Installation, testing, commissioing of the following items: Packages**					
1	Process Gas anaylsers & Gas Chromatograph					
1.a	Tail Gas Analyser (Field mounted cabinet)	Nos	1			0.3865228%
1.b	Conductivity analyser (Field mounted cabinet)	Nos	1			0.3865228%
1.c	Gas chroamatograph (Shall be installed in HPVP analyser shelter)	Nos	1			0.5797843%
2	STACK Analysers					
2.a	SOX, NOX, CO Analysers	Nos	1			0.7034810%
2.b	O2 Analyser	Nos	2			0.2855031%
2.c	Smoke Density Analyser	Nos	1			0.1901260%
3	DCS + PLC SYSTEMs consisting of (located at SRR-811 & MCR-815)					
3.a	DCS PLC Panels at SRR 811	Nos	26			3.5966153%
3.b	DCS PLC Panels, RIO, HWC at MCR 815	Nos	8			1.1066509%
3.c	BMS local panel and Pilot detector panel	Nos	4			0.5533254%
3.d	Operating Station and furniture/ CDSU PC for Stack Analyzers	Nos	2			0.1661223%
3.e	IRP Cabinets	Nos	4			0.5533254%

Sl No	Item Description	UOM	Qty	Rate in (Rs.)	Amount in (Rs.)	Weightage %
D	**Laying, dressing, tagging, terminations with ferruling, testing, commissioing of the following items: Instrumentation CABLEs**					
1	12P x 1.5 mm2/ 8T x 1.5 mm2	Meter	47000			11.2538139%
2	12P x 2.5 mm2/ 8P x 2.5 mm2/ 6P x 2.5 mm2	Meter	19600			5.8663498%
4	1P x 1.5 mm2/ 1P x 2.5 mm2/ 1T x 2.5 mm2 / 2P x 20 AWG	Meter	58000			9.3227393%
8	Field bus cables	Meter	30000			5.6652863%
9	FO cable	Meter	21000			4.8018537%
10	UTP/LAN Cables	Meter	8100			1.0274394%
11	Interpanel Cabling (2Cx2.5, 3Cx2.5, 4Cx2.5)	Meter	4000			0.5545882%
12	HDPE conduit	Meter	21000			15.0984978%
	Total (Weightage Excluding Taxes)					**100.0000000%**

Sectioon-2: Electrical works.						
Sl No	**Item Description**	**UOM**	**Qty**	**Rate (In Rs.)**	**Amount (In Rs.)**	**Weightage %**
A	**Installation, Testing and commssioning of following items: Instruments**					
1	**HT SWITCHGEAR MODIFICATION**					
1.1.	Modification of 2 Panels in 6.6kV Switchgear	Nos.	2			0.1414635%
2	**LT SWITCHGEAR**					
2.1	**LT Switchgear Extension**					
2.1.1	Installation, Testing and commissioning of Extension Panels in 331S-PMCC-406/ 331S-MCC-403/ 331S-MCC-401/ 331S-MLDB-3/ 331S-ACDB-1 (single panel width: 800mm)	Nos.	13			9.1973896%
2.1.2	Extension Panels in 811-INST-UPS-002	Nos.	1			0.0589576%
2.2	**LT Switchgear/ UPS DB Modification**					
2.2.1	Non DCS Field 110V UPS SUBDB(Wall Mounted) :1000 x 500 x 1000 mm	Nos.	2			0.0372834%
2.2.2	240V UPS PDB(Wall Mounted) for CCTV : 1000 x 500 x 1000 mm		1			0.0186417%
2.2.3	240V Non UPS DB/PDB (Wall Mounted) : 800 x 500 x 1000 mm		2			0.0372834%
2.2.4	Addition of 63A/100A feeder in existing UPS		6			
3	**6.6kV HT XLPE ALUMINIUM CONDUCTOR ARMOURED CABLES**					
3.1	6.6kV (UE) 3C x 240 Al	Meter	1600			1.0561373%
4	**LT POWER CABLES: Laying, dressing, tagging, terminations, testing, commissioing of the following items**					
4.1	2C x 95 Cu XLPE	Meter	0			
4.2	1C x 120 Cu XLPE UNARM	Meter	1250			0.3085858%
4.3	1C x 35 Cu XLPE UNARM	Meter	1750			0.3290583%
4.4	1C x 10 Cu XLPE UNARM	Meter	1750			0.1200329%
4.5	3.5C x 70 Cu XLPE	Meter	300			0.0779694%
4.7	3.5C x 50 Al XLPE	Meter	3000			0.6795864%
4.8	3.5C x 95 Al XLPE/3.5Cx70 Al XLPE	Meter	12500			3.4597635%
4.9	3.5C x 120 Al XLPE	Meter	3000			1.0275381%
4.10	3C x 2.5 Cu XLPE	Meter	20000			1.8837399%
4.11	3C x 4 Cu XLPE	Meter	4000			0.4252681%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
4.12	3C x 6 Cu XLPE	Meter	4000			0.5058617%
4.13	3C x 10 Cu XLPE	Meter	2000			0.2635156%
4.14	3C x 16 Cu XLPE	Meter	5500			0.9035787%
4.15	3C x 35 Al XLPE	Meter	2000			0.4746196%
4.16	3C x 50 Al XLPE	Meter	6500			1.2944359%
4.17	3C x 70 Al XLPE	Meter	7000			1.6534893%
4.18	3C x 95 Al XLPE	Meter	2000			0.5533165%
4.19	4C x 50 Cu XLPE	Meter	500			0.1058155%
4.20	4C x 25 Al XLPE	Meter	3200			0.4469100%
4.21	4C x 35 Al XLPE	Meter	3500			0.6223572%
4.22	4C x 95 Al XLPE	Meter	2000			0.6828144%
4.23	4C x 120 Al XLPE	Meter	1800			0.7114932%
4.24	4C x 150 Al XLPE	Meter	1800			0.7253874%
4.25	4C x 185 Al XLPE	Meter	6000			2.8188080%
4.26	2C x 50 Cu XLPE	Meter	800			0.1812230%
4.27	2C x 16 Cu XLPE	Meter	800			0.1314296%
4.28	1C x70 Cu XLPE	Meter	800			0.1812230%
5	**HT CABLE TERMINATING KITS**					
5.1	6.6kV (UE) 3C x 240 Terminating Kit	No.	4			0.1201789%
6	**PRE FABRICATED CABLE TRAYS AND ACCESSORIES (GI & FRP) AND CABLE DUCTS (GI & FRP)**					
6.1	Ladder type cable tray, W=600mm.	Meter	462			0.3220511%
6.2	Ladder type cable tray, W=300mm.	Meter	300			0.1496019%
6.3	300mm(W) Perforated type cable tray	Meter	1375			1.0388807%
6.4	150mm (W) Perforated type cable tray.	Meter	1250			0.8100315%
6.5	50mm(W) Perforated type cable tray	Meter	1000			0.5048295%
6.6	300mm(W) Perforated FRP Cable Tray & Cps	Meter	1200			0.9066595%
6.7	150mm(W) Perforated FRP Cable Tray & Cps	Meter	1800			1.1664453%
6.8	50mm(W) Perforated FRP Cable Tray & Cps	Meter	1200			0.6057954%
6.9	Cover For 300mm(W) Perforated FRP C.T	Meter	1500			1.1333244%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
6.10	Cover For 150mm(W) Perforated FRP C.T	Meter	1800			1.1664453%
6.11	Cover For 50mm(W) Perforated FRP C.T	Meter	1500			0.7572443%
6.12	1000 MM WIDTH, 400 MM Height & 5 mm Thick, 2500mm length GI Cable duct with cover , Jointing plates and other accessories	Meter	575			0.7117638%
6.13	800 MM WIDTH, 300 MM Height & 5 mm Thick, 2500mm length GI Cable duct with cover , Jointing plates and other accessories	Meter	700			0.7509624%
6.14	400 MM WIDTH, 200 MM Height & 5 mm Thick, 2500mm length FRP Cable duct with cover , Jointing plates and other accessories	Meter	2812.5			2.7624783%
6.15	800 MM WIDTH, 200 MM Height & 5 mm Thick, 2500mm length FRP Cable duct with cover , Jointing plates and other accessories	Meter	325			0.5830031%
6.16	1000 MM WIDTH, 200 MM Height & 5 mm Thick, 2500mm length FRP Cable duct with cover , Jointing plates and other accessories	Meter	550			1.2332758%
7	**PLANT EARTHING AND PLANT LIGHTNING PROTECTION MATERIALS**					
7.1	50x10mm GI Strip Below ground	Meter	100			0.0464117%
7.2	75 x 10 mm GI Strip Below ground	Meter	100			0.0654128%
7.3	50 x 6 mm GI Strip	Meter	1650			0.6792197%
7.4	35 x 6mm GI Strips	Meter	800			0.2861085%
7.5	25 x 3mm GI Strips	Meter	500			0.1444989%
7.6	8SWG GI wire ,solid	Meter	3000			0.2313604%
7.7	Copper Pipe Electrodes (65mm dia 3 m length)	Nos.	0			
7.8	Providing Earthing pit as per drawing (Drg. No. 080557C001-000-STC-1691-001, sheet 6 of 30)) with charcoal & salt, GI pipes, GI earth electrodes, GI wire, GI strips, brick chamber with covers including associated earthwork etc. all complete (Earthing strips, electrodes and earth plate with funnel will be supplied by BHEL free of cost and all other items as per referred drawings shall be by bidder). Note: Only Earth Electrode (i.e. 65mm dia, 6000mm long G.I Pipe Electrode,Earth Plate),G.I Strip shall be free issue by BHEL. All other items as per referred drawings shall be by bidder.	Nos.	15			0.9178300%
7.9	Vertical Air Termination Rod for lightning protection.	Nos.	5			0.0128116%
7.10	40 x 5mm GI Strips	Meter	500			0.1788178%
8	**PLANT ILLUMINATION PACKAGE**					
8.1	Twin cluster LED obstruction light	Nos	15			0.0761639%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
8.2	Industrial DC LED Well Glass fixture (35-45W approx) suitable for DC Supply	Nos	25			0.0985172%
8.3	Flame proof DC LED Well Glass fixture (35-45W approx) suitable for DC Supply	Nos	50			0.2538797%
8.4	LED Well Glass fixture (45W Approx, 230VAC)	Nos	200			0.7881372%
8.5	Flame proof LED Well Glass fixture (45WApprox, 230VAC)	Nos	500			2.5387971%
8.6	LED Flood lighting Fixture (100W approx)	Nos	2			0.0101552%
8.7	Flameproof LED Flood lighting Fixture (100W approx)	Nos	4			0.0213260%
8.8	LED Flood lighting Fixture (200W approx)	Nos	12			0.0639777%
8.9	11meter Steel tubular pole	Nos	4			0.1863963%
8.10	2 meter 50NB GI pole for Platform lighting	Nos	575			7.3413649%
8.11	4 way 200x150x100mm rectangular sheet steel weather proof JB (IP55)	Nos	220			0.7711978%
8.12	Flame proof Cast light alloy JB (200x150x100mm)	Nos	560			1.9630490%
8.13	Industrial metal clad type 1Ph, 20A Socket with 20A interlocked rotary switch & Plug	Nos	15			0.0274331%
8.14	Flameproof 1ph, 20A Socket with interlocked rotary switch & Plug	Nos	35			0.0882212%
8.15	Industrial metal clad type 3Ph, 63A (5pin) receptacle with interlocked rotary switch & Plug, weather proof (IP55) outdoor type	Nos	5			0.0244602%
8.16	Flameproof 3ph, 63A (5pin) Receptacle (Indoor type) with interlocked rotary switch & Plug	Nos	15			0.0799294%
8.17	Flameproof 3-Pph, 250A (5-pin) Receptacle (Outdoor type) with interlocked rotary switch & Plug	Nos	1			0.0089018%
8.18	Weatherproof 3-Ph, 250A (5-pin) Receptacle (Outdoor type) with interlocked rotary switch & Plug	Nos	1			0.0089018%
8.19	24V socket module with FLP Hand lamp	Nos	4			0.0195681%
8.20	18 way AC Outdoor Lighting Panel	Nos	2			0.0316642%
8.21	12 way AC Outdoor Lighting Panel	Nos	2			0.0289190%
8.22	6 way DC Outdoor Lighting Panel	Nos	2			0.0252418%
8.23	FLP 12 way AC Lighting/Power Panel	Nos	10			0.1445952%
8.24	Flameproof 6 way DC Lighting Panel	Nos	3			0.0378627%
8.25	415V AC Wall Mounted DB	Nos	1			0.0136932%
8.26	230V AC UPS Wall Mounted DB	Nos	2			0.0273863%
8.27	110V AC UPS Wall Mounted DB	Nos	1			0.0136932%
9	**CCTV SYSTEM**					
9.1	CCTV Cameras (Weatherproof)	Nos.	3			0.0413849%
9.2	CCTV Cameras (Ex-Proof)	Nos.	6			0.0993238%
9.3	CCTV Rack/Cabinet	Nos.	1			0.0381174%
9.4	Network Switches	Nos.	1			0.0052252%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
9.5	Media Converters, LIUs, Adaptors, along with Patch Cords etc.	Nos.	30			0.0947468%
9.6	Junction Boxes (Weatherproof)	Nos.	3			0.0151068%
9.7	Junction Boxes (Ex-proof)	Nos.	6			0.0333717%
9.8	Poles (each 10 Mtr length)	Nos.	3			0.1323765%
10	**PLANT COMMUNICATION SYSTEM (PA SYSTEM & TELEPHONE)**					
10.1	**PA SYSTEM**					
10.1.1	Modification of Existing PA System Cabinet for connection New Field Call Stations (UK0 Adapters-2, Power Supply Modules-1 etc.)	Lot	1			0.1181694%
10.1.2	Flame proof Field call station with flameproof loudspeakers 25W (Ex FCS + FLP loudspeaker)	Nos.	15			0.0755338%
10.1.3	Flashing Beacon lamps (Ex- proof type)	Nos.	8			0.0315255%
10.1.4	Acoustic hood	Nos.	15			0.0755338%
10.1.5	PA System Junction boxes, Flame proof type	Nos.	2			0.0100712%
10.1.6	50 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Non-Jelly filled)	m	1500			0.4690576%
10.1.7	5 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Non-Jelly filled)	m	2000			0.2458559%
10.1.8	2 pair x 1.5 sq.mm Dia, Armoured Communication cable (Non-Jelly filled)	m	150			0.0191194%
10.2	**TELEPHONE SYSTEM**					
10.2.1	Modification of Existing Telephone System Exchange (24 Analog media module, Line Cards etc.)	Lot	1			0.1181694%
10.2.2	Ex-proof Telephone Equipment	Nos.	3			0.0156757%
10.2.3	Weather proof Telephone, Wall mounting	Nos.	3			0.0156757%
10.2.4	Flashing Beacon lamps (Ex- proof type)	Nos.	2			0.0104505%
10.2.5	Acoustic Hood/Canopy (FRP) suitable for Weather proof & Ex-proof Telephones mounted in outdoor environment	Nos.	4			0.0636073%
10.2.6	Telephone System Junction boxes, Wp-proof type	Nos.	2			0.0100712%
10.2.7	10 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Jelly filled)	m	1500			0.2690349%
10.2.8	2 pair x 0.9 mm Dia, Twisted Pair, Overall Screen, Armoured Communication cable (Jelly filled)	m	500			0.0448606%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
10.2.9	Main distribution for connection of Telephone sets to Main Telephone System Exchange	Nos	1			0.1181694%
11	**CONVENTIONAL FIRE PROOF SEALING MATERIALS**					
11.1	Fire Break Coatings for HT/ LT Power Cables	sq.m	150			0.6715547%
11.2	Fire proof materials required for sealing of cable entry through conduits/trenches & through panels	sq.m	80			0.3581625%
11.3	Ceramic Fibre Mattress GI cable Ducts	sq.m	2250			10.0733198%
11.4	Ceramic Fibre Mattress for below mentioned FRP cable trays & ducts	sq.m	2000			8.9540621%
12	**ELECTRICAL INSULATING MATS**					
12.1	Insulating Mat for voltage Grade upto 3.3kV (Class-A, Category-III)	Sqm	50			0.0300963%
13	**LCS (LOCAL CONTROL STATION) PACKAGE**					0.0000000%
13.1	Local Control Station (LCS)/ Local Push Button station (LPBS)	Nos.	30			0.0972024%
14	**UPS SYSTEM ALONG WITH UPSDB FOR FDA SYSTEM**					
14.1	UPS System along with UPS DB (3KVA-5KVA) Battery isolation box	Set	1			0.1363596%
14.2	UPS Battery Bank	Set	1			0.3471752%
	Total sum for section-A					**85.9320208%**
B	**Supply, Installation, Testing and Commissioning of the following items:**					
1	6 mm thick chequered plate for covering cutouts in Switchgear room	KG	2335			1.3098179%
2	Cable Tags Aluminium Strips (75x25x2 mm)	Nos.	4500			0.2915287%
3	Safety Items including the following: a) Framed laminated shock treatment chart-5Nos, b) Danger boards-5Nos., b) Do not switch on boards-5Nos, d) Man on work boards-5Nos. e) Display charts-5Nos, f) Display board for artificial respiration system-1No., g) Exit Signs-2Nos.	Nos.	23			0.4102664%
4	First aid boxes near LT & HT panels- 3Nos.,	Nos.	3			0.0267441%
5	Self-contained portable hand lamp-complete with rechargeable battery-2Nos., portable battery operated emergency light-2Nos	Nos.	4			0.0136980%
7	Face shield-2 Nos	Nos.	2			0.0089078%
8	Safety hand gloves(HV and LV insulated)-2Nos.	Nos.	2			0.0192019%
9	GI Conduits of 50 mm diameter, medium duty, min 75 microns galvanizing thickness	m	200			0.5992535%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
10	GI Conduits of 100 mm diameter, medium duty, min 75 microns galvanizing thickness	m	300			1.9811807%
11	GI Conduits of 150 mm diameter, medium duty, min 75 microns galvanizing thickness	m	50			0.4298429%
12	RCC Hume Pipes (150 NB as per IS: 458) for cables at Road Crossings - Satndard length 2.5 m	Nos.	20			0.1174247%
13	RCC Hume Pipes (200 NB as per IS: 458) for cables at Road Crossings - Satndard length 2.5 m	Nos.	5			0.0386560%
14	PVC Conduits Class-3 of 300 mm diameter	m	10			0.0247799%
15	PVC Conduits Class-3 of 200 mm diameter	m	100			0.2449975%
16	PVC Conduits Class-3 of 150 mm diameter	m	50			0.1121738%
17	PVC Conduits Class-3 of 100 mm diameter	m	50			0.1052905%
18	63A (6Nos)) and 100A (2 Nos) feeders in existing UPS Make of UPS DB : M/s Emerson Drawing No: A1245/SY/006-1	Set	1			2.1296174%
19	Cu earth plates as per typical installation drawing no.080557C001- 000-STC-1691-001,sheet 9 of 30, complete with anchor bolts, including nut, bolt, washer, insulator and all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in- Charge	Nos.	4			0.0937751%
20	GI earth plates as per typical installation drawing no.080557C001-000-STC-1681-001,Sheet 8 of 30, complete with anchor bolts, including all labour and materials, as per approved drawings, specifications of this tender and directions of Engineer-in-Charge. Note: Complete material except 10mm GI wire/8mm G.I wire i.e earthing wire/Strip of equipment shall be supplied by bidder.	Nos.	25			0.1014277%
C	**Cut out Works for panel/ switchgear installation**					
1	Cutting Reinforced concrete with mechanised tools like Core drilling machine etc. for cutting pockets, holes, cores in slab, beam, column or foundation as per direction of engineer in charge MSR item no 218	CUDM	3000			4.9503328%

Sl No	Item Description	UOM	Qty	Rate (In Rs.)	Amount (In Rs.)	Weightage %
2	Supply, Fabrication, transportation, delivery at site and erection, installation and alignment of mild steel foundation bolt assembly conforming to IS:2062 and grade 1 of IS:432 in concrete along with nuts, lock nuts (as per IS:1363, 1364 and IS:3138), washers, anchor plates, stiffner plates, protective tape, pipe sleeves, templates etc. including welding, cutting, grinding, threading, drilling etc. all complete. (ISMC 100/150 Channels (0.5MT), ISA 75x75x6 mm Runner angles(0.5MT) (Mild steel), ISA 65x65x6 mm Runner angles (0.5MT) (Mild steel)) Note: To be supplied, fabricated and erected during shutdown period	MT	1.5			1.0590618%
	Total sum for section-B + C					**14.0679792%**
	Grand Total (A+B+C), Excluding Taxes					**100.00%**