

<b>ANNEXURE – 1 (LIST OF DRAWINGS &amp; DOCUMENTS)</b>	
<b>Project :</b>	<b>RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) 132kV SWITCHYARD</b>
<b>Customer :</b>	<b>NTPC Limited</b>
<b>Drawing/Doc No.</b>	<b>Drawing Title</b>
5602-003-H230-PVE-P-155	132 kV SINGLE LINE DIAGRAM
5602-003-H230-PVE-F-103	132 kV SWITCHYARD LAYOUT
5602-003-H230-PVE-F-106	132 kV EARTHMAT LAYOUT
5602-003-H230-PVE-F-109	CABLE TRENCH ROUTING LAYOUT
5602-003-H230-PVE-E-100	EQUIPMENT EARTHING PHILOSOPHY AND DETAILS
5602-906-H115-PVM-F-107	LAYOUT OF AUXILIARY BUILDING
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## ANNEXURE-2 - STANDARD SCOPE NOTE FOR E.T.C. WORKS

1	Individual item may vary up-to any extent and even may get deleted, however overall contract value may vary +/-30%. Variation will be valid up-to contract stage.
2	Unloading, handling and shifting of material within site, assembly, installation, pre-commissioning test and commissioning tests (as per BHEL / Customer FQP) are included in the scope. Scope includes loading / unloading of the material from truck/trailor within site with Hydra/crane e.t.c. complete in all respect. All T&P including hyrda / crane is in bidder's scope.
3	Bidder Supplied Material - Bidder (ETC contractor) to supply material of proven design and make, which have already been extensively used and tested (as applicable). Bidder to obtain approval from BHEL Engineer incharge / Customer prior to supply.
4	Following documents will be required for billing of supplied items:
	Lorry receipt (LR)
	Tax invoice
5	<p><b>Supply of Insulating mats:</b></p> <p>The scope covers supply and laying of insulating mats of "class A" conforming to IS: 15652-2006. These insulating mats shall be laid in front of all floor mounted AC and DC switchboards and control &amp; relay panels located in control room building/ Switchyard panel room / GIS LCC Panel e.t.c.</p> <p>The insulating mats shall be made of elastomer material free from any insertions leading to deterioration of insulating properties. It shall be resistant to acid, oil and low temperature.</p> <p>Upper surface of the insulating mats shall have small aberration (rough surface without edges) to avoid slippery effects while the lower surface shall be plain or could be finished slip resistant without affecting adversely the dielectric property of the mat.</p> <p>Insulating mat (wherever applicable) shall be of pastable type, to be fixed permanently on the front and rear side of the panels except for the chequered plate area which shall not be pasted as per requirement. The insulating mats shall generally be fixed and joints shall be welded as per recommendations in Annexure-A of IS: 15652.</p> <p>Width of insulating mats shall generally be of 1.5 meters or as per site requirements. Length shall be supplied as per site requirements. The insulating mats offered shall conform to IS: 15652-2006.</p>
6	<p><b>SUPPLY OF CABLE TAGS AND MARKERS</b></p> <p>Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule. The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS:280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.</p> <p>Location of cables laid directly underground shall be clearly indicated with cable route marker made of galvanised iron plate.</p> <p>Location of underground cable joints shall be indicated with cable route marker with an additional inscription "Cable joints".</p> <p>The cable route marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings as per relevant standard.</p> <p>Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry and at each end &amp; turning point in cable tray/trench runs.</p> <p>Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, where a number of cables enter together through a gland plate.</p>
7	All the drawings and documents enclosed as per note or refered elsewhere shall be followed for ETC work.
8	Minor Civil works such as modification of civil foundations, making foundations for JB/Panel/MK etc, making holes in the trenches/ wall/ ceiling of building, chipping work, grouting work, fixing of trench material will be in the scope of ETC contractor.
9	Any cutting of masonry / concrete work, which is necessary shall be done by the contractor at his own cost and shall be made good to match the original work.



10	All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grounding of anchor bolts, sills, inserts and fastening devices shall be carried out by the contractor including minor modification of civil works as may be required for erection.
11	Wall openings at suitable locations for ventilation fans shall be made by the bidder. Civil works such as grouting, filling up of crevices/ cut outs etc. during installation of equipment shall also be in bidder's scope. Any other damage caused to civil works during ETC work of the equipment/ system shall be made good to the original finish by the bidder at no extra cost to the BHEL.
12	Removal of gravel, if gravelling is already done, for connection of Equipment earthing strip to the existing mat (wherever earthing mat is already laid), and after completion of earthing , contractor should place the gravel to bring it in original shape.
13	Quoted rates are deemed to be inclusive of miscellaneous works viz erection of clamps and connectors.
14	All paint , welding electrodes & other consumable by contract supplies shall be part of ETC works. Paint /welding electrode make etc. is subject to BHEL/CUSTOMER approval.
15	All the phases are to be identified by painting the structures Red, Yellow and Blue by reflecting colour as per as built condition. Phase identification colour is to be provided around the top of the structure with colour band of 100 mm width at a height of approximately 2000mm from the finished ground level.
16	All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any load on it. All arc welding with large dia. conductors shall be done with low hydrogen content electrodes.
17	Equipment erection (say Isolator ) means complete erection, metallics, post insulator, connectors (expansion/rigid tubular for Al.Tube / single/double/quadruple conductor), connection to the next in line (if connected to overhead busbar or droppers) including PG clamps/Tee connectors etc. This will be clear from the enclosed electrical layout drawings.
18	Equipment and tower erection would include supply and erection of miscellaneous items , viz Phase colour discs , labels painting of equipments , phase colour painting , phase marking , bay identification board , danger plates , rubber mats , device number marking on the equipment, keyboard etc as per site requirements. Supply & Mounting of phase color discs & Danger plates shall be as per IS-2551; 1982 & IS 5; 1978.
19	Quantity of supply items are provisional and shall be notified during detailed engineering stage.
20	MS Welding - The M.S. flat/angle/channel shall be finally painted with two coats of Red oxide primer and two coats of Zinc riched enamel paint.
21	In cable tray / ladder if minor fabrication is required the same shall be applied with one coat of red lead primer, one coat of oil primer followed by two finishing coats of aluminium paint. Supporting steel shall be painted before laying of cables. The painting shall be done with one coat of red lead paint and two coats of approved bituminous aluminium paint
22	Testing instruments (duly calibrated) have to be arranged by ETC Contractor at it's own cost on returnable basis (List is only provided for information, if any other instrument not mentioned below but required for successful completion of ETC work shall be in ETC contractor scope)
i	DCRM (Dynamic Contact Resistance Measurement kit) OPERATIONAL ANALYZER
ii	CRM (Contact Resistance Measurement kit)
iii	Relay test kit
iv	Capacitance and Tan delta measurement Kit
v	Dew Point Measurement kit
vi	5kV/1kV Megger
vii	Primary current Injection Kit of suitable rating
viii	Secondary current/Voltage Injection kit
ix	1Ph Variac
x	Multimeters
xi	Clamp on meter
xii	Leakage Tester
xiii	Gas leak detector
23	General Tools and Tackles to be arranged by ETC Contractor on returnable basis. (based on general requirement for erection, testing and commissioning of GIS under scope): The following is the list of Items which may be extended further depending upon the site timely requirements



24	Necessary numbers of fire extinguisher
25	Proper test reports for the tests conducted at site shall be prepared by the contractor on the formats provided by BHEL/NTPC and the reports shall be presented for approval of BHEL and NTPC engineer in required no. of sets in hard copy.
26	It shall be the bidder responsibility to arrange for the charging clearance/approval from the CEA or the concerned agency well before the scheduled date of charging of equipment.
27	Arrangement of temporary/ adequate illumination for site work/watch and ward/security and safety of material at site shall be in scope of ETC contractor.
28	Annexure- B comprising Switchyard Installation notes, site testing & commissioning, cabling, earthing & lightning protection and erection conditions of contract shall be followed for ETC work.
29	Complete ETC package is under the scope of bidder. All Tools & Plant including oil filterating machine, cranes etc. required to complete the job shall be provided by bidder only.
30	Supervision of erection, Testing & commissioning of equipment shall be done by supplier. Necessary manpower support, tools, tackles etc shall be in the scope of ETC contractor.
31	For specification of Fire Proof Cable Penetration system refer Annexure-D.
32	For specification of Equipment Fixing Hardware refer Annexure-E.
33	Scope for spare items/ maintenance equipment shall include Loading/ Unloading, shifting to and from stores, proper storage and handing over to customer.
34	Erection Materials required for ETC work shall be supplied from Customer/ BHEL approved vendors.



RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) 132kV SWITCHYARD		
LIST OF MANDATORY SPARES/ MAINTENANCE EQUIPMENT FOR NTPC RAMMAM		
SL. NO.	DESCRIPTION	QUANTITY
<b>A</b>	<b>LIST OF MANDATORY SPARES</b>	
<b>I</b>	<b>132 kV ISOLATORS</b>	
1	One complete pole of Double break Isolator with 2 E/S along with operating mechanisms, etc. (without support structure)	1 No
2	One complete pole of HCB solator with 2 E/S along with operating mechanisms, etc. (without support structure)	1 No
2	Moving and fixed contacts	3 Nos each
3	Relay, power contactors, switch fuses for electrical control circuit (one no. of each type and rating)	1 Set
4	Support insulator stack for one pole of isolator	1 No
5	Rotary bearings for isolator	3 nos. of each type
6	Limit switch & aux. switch	3 nos. of each type
7	Terminal connectors	1 set (6 nos.)
<b>II</b>	<b>132 kV CIRCUIT BREAKER</b>	
1	One complete pole unit of the breaker with operating mechanism	1 Set
2	Closing coil	6 Nos
3	Tripping coil	6 Nos
4	Spare Motor for spring charged mechanism or Air compressor unit for pneumatic mechanism	2 Nos
5	Gas filling unit comprising of gas regulator and manometer with necessary coupling and hose for filling SF6 gas from cylinder to the breaker	1 Set
6	Spare SF6 cylinder (50Kg)	4 Nos
7	SF6 gas leakage detector	2 Nos
8	SF6 Dew Point Meter	1 No
<b>III</b>	<b>132 kV CTs and CVTs</b>	
1	Single Phase, CT complete in all respects. (Number of core as per the system requirement)	3 Nos.
2	Single Phase, 3 Winding, CVT complete in all respects	3 No.
<b>IV</b>	<b>132 kV LIGHTNING ARRESTER</b>	
1	Surge Arrestor complete with insulating base and surge monitor	3 No.
<b>V</b>	<b>132kV INSULATORS &amp; HARDWARE</b>	
1	String / Strain insulators with hardware (1 no. of each type)	1 Set
<b>VI</b>	<b>Bus post insulators</b>	3 Nos.
<b>VII</b>	<b>Clamps, spacers and connectors including equipment terminal connectors.</b>	10% of total qty. of each type
<b>VIII</b>	<b>SUBSTATION AUTOMATION SYSTEM AND PROTECTION SYSTEM FOR SWITCHYARD (FOR ST, LINE, BUS BAR PROTECTION):</b>	
1	Bay Control unit (complete with all components)	2 Nos
2	Numerical Relays comprising various bay protection units	1 No. of each type
3	Numerical Relays comprising GRP	1 No. of each type
4	Interface relays used in the system	10% of each type of total population (min 1 no.)
5	Cards/Modules of generator disturbance recorder, Line DR ( if stand alone)	1 No. of each type
6	Operator work station (OWS) along with software, monitor, mouse, keyboard, printer,etc.	1 No
7	Complete Network Controller / Server along with software	1 No
8	Complete Programming station along with software, monitor etc.	1 No
9	Hard Disks for OWS	1 No
10	Hard Disk for Network Controller / Server (if applicable)	1 No
11	Lamps / LEDs used in the system	10% of Total Quantity
12	Power supply modules used in the system	2 nos. of each type
13	LAN switches (If included in main package)	1 No. of each type
14	Media cleaning solution	2 bottles
15	Fuses	10% of each type and rating
16	Terminal Blocks	2 nos. of each type, make, model and rating
17	Interfacing pre-fab cables ,one of each type of cable with its connector for each type of peripheral	2 Sets




18	MCBs	50% of each type, make and model used in the system
19	Relays other than numerical relays	1 no. of each type
20	Gateways	1 no. of each type
21	Modem	1 no. of each type
22	LIU of OFC including necessary connectors	1 no. of each type
<b>IX</b>	<b>LV SWITCHGEAR</b> <i>NOTE: Quantity mentioned in percentage (%) is the % of total installed. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required].</i>	
1	Circuit breaker (triple pole)/ MCCB/Isolator/Switch	1 no. of each type and rating
2	Current transformer	1 no. of each type and rating
3	Potential Transformer	1 no. of each type and rating
4	TNC control switch for circuit breaker control	2 nos. of each type and rating
5	HRC fuses links	6 nos. of each type and rating
6	Ammeter selector switches	2 nos. of each type and rating
7	Local/Remote selector switches	2 nos. of each type and rating
8	Voltmeter selector switches	3 nos. of each type and rating
9	Shunt trip coil	2 nos. of each type and rating
10	Closing coil	2 nos. of each type and rating
11	Push button for trip circuit healthy test	2 nos. of each type and rating
12	KWh meter, 3 phase, 3 wire(Microprocessor based Trivector)	1 no. of each type and rating
13	Alarm bell	1 no. of each type and rating
14	Relays (including Anti pumping relay, Aux. relay, Lockout relays/times	2 nos. of each type and rating
15	Discrepancy control switch for C.B. control	2 nos. of each type and rating
16	ACB driving motor	2 nos. of each type and rating
17	ACB driving mechanism	2 nos. of each type and rating
<b>IX</b>	<b>BATTERY</b> <i>NOTE: Battery spares shall be provided for each set of battery being supplied i.e. for 48V DC Battery set.</i>	
1	Complete dry cell	8 Nos.
2	Intercell connector with hardware	10% or 5 Nos. whichever is more
3	Vent Plug	10% or 5 Nos. whichever is more
4	Acid level indicating float (for opaque containers only)	10% or 5 Nos. whichever is more
5	Stand Insulator	10% or 5 Nos. whichever is more
<b>X</b>	<b>BATTERY CHARGERS</b> <i>NOTE: Battery Charger spares shall be provided for 48V DC Battery Charger set.</i>	
1	Electronic Cards & relays	1 No. of each type & rating
2	Fuses	3 Nos. of each type & rating
3	SCR	3 Nos. of each type & rating
<b>XI</b>	<b>POWER AND CONTROL CABLES</b> <i>NOTES: a. Quantity mentioned in percentage (%) is the % of total installed. b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.</i>	
1	1.1 KV Grade power cables for each type and size.	10% of installed quantity
2	1.1 KV Grade control cables for each type and size.	10% of installed quantity



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1.00.00	GENERAL			
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work or this contract to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.			
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such person shall function from the Site office of the Contractor during the pendency of Contract.			
2.00.00	REGULATION OF LOCAL AUTHORITIES AND STATUTES			
2.01.00	In addition to the local laws and regulations the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.			
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.			
3.00.00	WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING			
	The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:			
3.01.00	Qualification of Weld Procedures			
	All the welding procedures adopted by the Contractor shall be qualified in accordance with the latest applicable requirements of Section IX of ASME code before the work is begun. The Contractor shall submit to the Employer for review, copies of certificates qualifying welding procedures proposed to be used. Such certified welding procedures for welding of pressure parts and pipings submitted to the Employer shall clearly state the type of material, material thickness, the joint details, the pre-heat temperature maintained, the post weld heat treatment given and the welding current and the voltage used during qualifications of welding procedures.			
3.02.00	Welder's Qualification			
	Only welders, qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts. In addition to such statutory qualification requirements, the welders			
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3.03.00	<p>shall also perform a satisfactory pre-production qualification test to be conducted by the Contractor at site in consultation with and to the requirements of the Employer, prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.</p> <p>All the welders carrying out welding at site, shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding. All such badges shall be countersigned by the Employer.</p>			
	<p><b>Records</b></p> <p>All records of the welding procedures, the welder's qualification tests and the welders' performance details for the work performed under these specifications shall be maintained by the Contractor in a manner acceptable to the Employer. The certified copies of any or all the above documents shall be submitted to the Employer on request.</p>			
	<p><b>Marking</b></p> <p>On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.</p>			
	<p><b>HEAT TREATMENT</b></p>			
4.01.00	<p>Pre-heating, post-heating and post - weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local postweld stress relieving heat - treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations.</p>			
4.02.00	<p>After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (Clause 7.00.00 of this Part) etc.</p>			
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<b>5.00.00</b>	<b>WELD EDGE PREPARATION</b>  Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200 mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.			
<b>6.00.00</b>	<b>CLEANING AND SERVICING</b>			
6.01.00	The inside of all tubes, pipes, valves and fittings shall be free from dirt and loose scales before being erected. All the pipe lines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.			
6.02.00	All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and service prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.			
6.03.00	All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.			
<b>7.00.00</b>	<b>FIELD WELDING SCHEDULE</b>  The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field welding schedule to be issued by the Contractor shall contain the following: <ul style="list-style-type: none"> <li>a) Drawing No (s)</li> <li>b) Location of the weld</li> <li>c) Size of the weld (outside diameter and thickness)</li> <li>d) Type of joints</li> <li>e) Material specifications</li> <li>f) Size of fillet on backing ring, when the type of joint is with backing ring</li> <li>g) Electrode/ filler metal specifications</li> </ul>			
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	<ul style="list-style-type: none"> <li>h) Number of welds per unit</li> <li>i) Quantity of filler metal per weld</li> <li>j) Indication of required Non-destructive Examination (NDE) for each weld</li> <li>k) Pre-heat temperatures for welding</li> <li>l) Process of welding</li> <li>m) Post-welding heat treatment temperature ranges, duration, under clause 3.01.00 entitled 'Qualification of Weld Procedures' in this Part-D.</li> <li>n) Qualification details of weld procedures to be adopted as specified under clause 3.01.00 entitled 'Qualification of Weld Procedures' in this Part-D.</li> </ul>			
<b>8.00.00</b>	<p><b>SITE RUN MISCELLANEOUS PIPING</b></p> <p>Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of the site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipe between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.</p>			
<b>9.00.00</b>	<p><b>THERMAL EXPANSIONS</b></p> <p>All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.</p>			
<b>10.00.00</b>	<p><b>PIPING SUPPORTS</b></p>			
10.01.00	<p>Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly leveled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.</p>			
10.02.00	<p>The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any</p>			
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	<p>sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.</p> <p><b>11.00.00 CODE REQUIREMENTS</b></p> <p>The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules Codes, Indian Boiler Regulations, ASME codes and accepted good practice, the Employer Drawings and other applicable Indian recognized codes and laws and regulations of the Government of India.</p> <p><b>12.00.00 REMOVAL OF MATERIAL</b></p> <p>No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.</p> <p><b>13.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES</b></p> <p>The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.</p> <p><b>14.00.00 ACCESS TO SITE AND WORKS ON SITE</b></p> <p><b>14.01.00</b> Suitable access to site and possession of the Site shall be afforded to the Contractor by the Employer in reasonable time.</p> <p><b>14.02.00</b> In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.</p>			
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15.00.00	<b>CONTRACTOR'S SITE OFFICE ESTABLISHMENT</b>  The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.			
16.00.00	<b>CO-OPERATION WITH OTHER CONTRACTORS</b>			
16.01.00	The Contractor shall co-operate with all other Contractors or tradesmen of the Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the Works under the Contract. The Contractor shall also arrange to perform his work as to minimize, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his Works.  Employer shall give full access to visit the contractor's site at any time for inspection & surveillance checks.			
16.02.00	The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.			
17.00.00	<b>DISCIPLINE OF WORKMEN</b>  The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative of employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or incompetent or negligent or otherwise undesirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.			
18.00.00	<b>CONTRACTOR'S FIELD OPERATION</b>			
18.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the or the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.			
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18.02.00	<p>The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all person employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.</p>			
<b>19.00.00</b>	<b>PHOTOGRAPHS AND PROGRESS REPORT</b>			
19.01.00	<p>The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.</p>			
19.02.00	<p>The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.</p>			
19.03.00	<p>The Contractor shall submit the progress of work in video cassettes (2 copies) quarterly highlighting the progress and constraints at site.</p>			
<b>20.00.00</b>	<b>MAN-POWER REPORT</b>			
20.01.00	<p>The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.</p>			
20.02.00	<p>The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill-wise and the areas of employment of such labour.</p>			
<b>21.00.00</b>	<p><b>PROTECTION OF WORK</b></p> <p>The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or 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 or other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or 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 resolved as per the provisions of the Clause 16.00.00 above entitled "Co-operation with other Contractors." 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.</p>			
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<b>22.00.00</b>	<b>EMPLOYMENT OF LABOUR</b>			
22.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.			
22.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.			
22.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.			
22.04.00	Contractor's employees shall wear identification badges while on work at Site.			
22.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills.			
<b>23.00.00</b>	<b>FACILITIES TO BE PROVIDED BY THE EMPLOYER</b>			
23.01.00	<b>Communication:</b>			
	The employer will extend the telephone facilities, if available at site, for purpose of contract. The Contractor shall be charged at actuals for such facilities.			
23.02.00	<b>Cranes</b>			
23.02.01	One (1) number of EOT crane in the Power House and one (1) number of EOT Crane in Butterfly Valve House to be procured under this package shall be used by the Contractor for erection of the equipment. For equipments which cannot be handled by these cranes, the Contractor shall make his own arrangements.			
23.02.02	Contractors shall clearly bring out in his offer the proposed method of installation of hydro turbine generator equipments. This shall be supported by detailed write up drawings & other technical data.			
<b>24.00.00</b>	<b>FACILITIES TO BE PROVIDED BY THE CONTRACTOR</b>			
24.01.00	The Contractor shall make his own arrangements for suitable and adequate land /space & power supply for his office, storage area, pre-assembly and fabrication areas, labour and staff colony area, toilets etc. at a convenient place near the project area. Adequate and suitable security arrangements including lighting to be provided by the Contractor for the storage area & pre-assembly and fabrication areas shall be subject to approval of the Employer. The above arrangement shall be at no extra cost to the employer.			
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24.02.00	<p><b>Construction Power Supply</b></p> <p>The Contractor shall make his own arrangement for construction power. Contractor shall arrange DG sets of adequate capacity at his own cost to meet construction power supply requirement including lighting, dewatering etc.</p> <p>The Contractor shall submit to the Employer within thirty (30) days from the date of acceptance of the Notification of Award, his electrical power requirements and mobilization plan for the same. All wiring must comply with local regulations and will be subject to Employer inspection and approval before connection to supply.</p>			
24.03.00	<p><b>Power Supply and Illumination to be arranged by the Contractor</b></p>			
24.03.01	<p>The Contractor shall install, operate and maintain electrical distribution system which shall include transformers, circuit breakers, disconnection and safety switches, voltage regulators, lines, poles, pole hardware, conductors, meters and other equipments as required for power distribution throughout his site and temporary facilities.</p>			
24.03.02	<p>The Contractor shall ensure adequate illumination as required for his work area.</p>			
24.04.00	<p><b>Water</b></p> <p>Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite /colony.</p>			
24.05.00	<p><b>Contractor's site office Establishment</b></p> <p>The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.</p>			
24.06.00	<p><b>Tools, tackles and scaffoldings</b></p> <p>The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailor, etc. for the purpose of fabrication, erection and commissioning.</p>			
24.07.00	<p><b>First-aid</b></p>			
24.07.01	<p>The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.</p>			
24.08.00	<p><b>Cleanliness</b></p>			
24.08.01	<p>The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed</p>			
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24.08.02	<p>in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.</p> <p>Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.</p>			
25.00.00	<p><b>LINES AND GRADES</b></p> <p>All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.</p>			
26.00.00	<p><b>FIRE PROTECTION</b></p>			
26.01.00	<p>The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.</p>			
26.02.00	<p>Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.</p>			
26.03.00	<p>All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.</p>			
26.04.00	<p>The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.</p>			
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27.00.00	<b>SECURITY</b>  The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.			
28.00.00	<b>CONTRACTOR'S AREA LIMITS</b>  The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contractor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.			
29.00.00	<b>CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER</b>  In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.			
30.00.00	<b>PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS</b>			
30.01.00	<b>General</b>			
30.01.01	The pre-commissioning and commissioning activities including tests, checks and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.			
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30.01.02	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.			
30.01.03	The Contractor upon completion of erection of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.			
30.02.00	<b>Testing / Commissioning Schedule</b>  The Contractor shall submit to the Employer, his testing/ commissioning schedules for various equipments/ systems covered under the contract, for approval, at least 18 months before the actual commissioning of the equipment/ systems.  The testing/ commissioning schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of documents and commissioning checks to be submitted and their content details shall be agreed upon during preaward discussions.			
30.03.00	<b>Pre-Commissioning Activities</b>			
30.03.01	<b>General</b>  The Contractor shall draw up a detailed sequential & systematic list of checks/ tests and various activities/ procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.			
30.04.00	<b>Commissioning of Facilities</b>			
30.04.01	<b>General</b>  Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities.  Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is erected in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.			
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30.04.02	<p><b>Initial Operation</b></p> <p>Upon completion of system checking/tests as per 30.04.01 above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.</p>			
31.00.00	<p><b>MATERIALS HANDLING AND STORAGE</b></p>			
31.01.00	<p>All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.</p>			
31.02.00	<p>Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.</p>			
31.03.00	<p>The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.</p>			
31.04.00	<p>All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.</p>			
31.05.00	<p>All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energized. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.</p>			
31.06.00	<p>All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.</p>			
31.07.00	<p>The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.</p>			
31.08.00	<p>The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.</p>			
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31.09.00	All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.			
31.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.			
31.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.			
<b>32.00.00</b>	<b>CONSTRUCTION MANAGEMENT</b>			
32.01.00	The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.			
32.02.00	The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.			
32.03.00	<b>Time is the essence of the Contract</b> and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.			
32.04.00	The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co- ordination work between various Contractors as set out earlier.			
<b>33.00.00</b>	<b>FIELD OFFICE RECORDS</b>  The Contractor shall maintain at his Site Office up-to-date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such			
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	<p>changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.</p> <p><b>34.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE</b></p> <p>34.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.</p> <p>34.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.</p> <p>34.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under clause 34.02.00 above and credit the proceeds thereto to the account of the Contractor.</p> <p><b>35.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY</b></p> <p>35.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.</p> <p>35.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.</p>			
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<b>36.00.00</b>	<b>INSURANCE</b>			
36.01.00	In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.			
36.02.00	<p><b>Workmen's Compensation Insurance</b></p> <p>This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than:</p> <p>Workmen's Compensation : As per statutory Provisions</p> <p>Employee's liability. : As per statutory Provisions</p>			
36.03.00	<p><b>Comprehensive Automobile Insurance</b></p> <p>This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:</p> <p>Fatal Injury : Rs.100,000 each person</p> <p>: Rs.200,000 each occurrence</p> <p>Property Damage : Rs.100,000 each occurrence</p>			
36.04.00	<b>Comprehensive General Liability Insurance</b>			
36.04.01	The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).			
36.04.02	The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.			
36.05.00	The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.			
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37.00.00	<b>UNFAVOURABLE WORKING CONDITIONS</b>  The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.			
38.00.00	<b>PROTECTION OF MONUMENTS AND REFERENCE POINTS</b>  The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.			
39.00.00	<b>WORK &amp; SAFETY REGULATIONS</b>			
39.01.00	<b>General</b>  i) The contractor shall comply with all the equipments of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.  ii) The contractor shall follow the Employer's Safety Rules as issued from time to time with respect to safety in construction & erection.  iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to the Project Manager.  iv) The contractor shall submit the safety plan comprising of methods to implement the safety policy/rules, risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, supervision and responsibility to ensure safety at various levels, safety training to employees, review of safety and accident analysis, ensure health and safety procedures to prevent accidents to the Project Manager for approval as per the format of Safety Plan as annexure at Annexure-I.			
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	<p>v) The Contractors shall ensure proper safety of all the workmen, material, plant and equipment belonging to him or to the Employer or to others, working at the Site.</p> <p>vi) All equipments used in construction and erection by the contractor shall meet BIS/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the contractor in accordance with manufacture's operation manual. The contractor should also follow guidelines/rules of the employer in this regard.</p> <p>vii) The Contractor shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Project Manager shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.</p> <p>viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall use standard quality of material.</p> <p>ix) The contractor shall follow and comply with all the safety rules, standards, code of practice of the Employer and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer/obtain copy of the Employer's safety documents as stated above.</p> <p>x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.</p> <p>The medical examination of the works employed in hazardous areas shall be conducted as per Rule 223 of the Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to the Project Manager. The medical fitness certificate to be submitted to the Project Manager.</p> <p>xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen &amp; office bearers working at site.</p>			
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39.02.00	<p><b>Emergency Action Plan</b></p> <p>The Contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.</p>			
39.03.00	<p><b>Flood Monitoring (Hydro Projects)</b></p> <p>The contractor shall take necessary measures for monitoring of flood/water levels and develop a forewarning system to evacuate people to safer places well before the flood occurs. For this purpose he may maintain liaison with meteorological department and with the Employer. The contractor shall make suitable communication and transporting system to rescuer and workers to safer places. The contractor shall provide suitable shelters, food, drinking water and other requisite facilities till they are brought back to their colonies and normalcy is restored.</p>			
39.04.00	<p><b>Scaffolding</b></p> <p>The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold conform to the BIS / International standards.</p>			
39.05.00	<p><b>Opening</b></p> <p>The Contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.</p>			
39.06.00	<p><b>Fencing of Machinery</b></p> <p>The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.</p> <p>The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.</p>			
39.07.00	<p><b>Carrying of Excessive Weight by a Worker</b></p> <p>The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction workers.</p>			
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39.08.00	<p><b>Dangerous and Harmful Gases/Equipment</b></p> <p>The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.</p> <p>The contractor should not allow any worker to go into the confined space unless it is certified by the Project Manager to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.</p>			
39.09.00	<p><b>Overhead Protection</b></p> <p>The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.</p> <p>Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.</p>			
39.10.00	<p><b>Working at Heights</b></p> <p>All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.</p> <p>Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.</p> <p>Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.</p> <p>Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8mm diameter wire higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.</p> <p>The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.</p>			
39.11.00	<p><b>Handling of Hazardous Chemicals</b></p> <p>The Contractor will notify well in advance to the Project Manager of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Employer shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract</p>			
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39.12.00	<p>shall strictly adhere to and comply with such instructions. The Project Manager shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to be used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Employer and the Employer shall not entertain any claim of the Contractor towards additional safety provisions/conditions to be provided for/constructed.</p> <p>Further, any such decision of The Project Manager shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the site is forbidden by the Employer, the Contractor shall use alternative methods with the approval of the Employer without any cost implication to the Employer or extension or work schedule.</p> <p>Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Project Manager. In case any approvals are necessary from the Chief Inspection (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.</p> <p>The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.</p> <p>The Contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.</p> <p>As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.</p> <p><b>Eye Protection</b></p> <p>The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eye.</p>			
39.13.00	<p><b>Electrical Hazards</b></p> <p>The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts/rules.</p>			
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39.14.00	<p>The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs/RCCBs for al the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.</p> <p>The contractor should ensure use of single/double insulated hand tools or low voltage i.e. 110 volts hand tools.</p> <p>The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.</p>			
	<p><b>Vehicular Traffic</b></p> <p>The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act. 1988.</p>			
	<p><b>Lifting Appliances, Tools &amp; Tackles, Lifting Gear and Pressure Plant &amp; Equipment, etc.</b></p> <p>The contractor shall ensure all the lifting appliances, tools &amp; tackles including cranes, etc. lifting gear including fixed or movale and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting/hoisting equipment &amp; tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Project Manager or by the person authorised by him.</p>			
	<p><b>Excessive Noise, Vibration</b></p> <p>The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules- Noise Pollution (Regulation and Control) Rules, 2000.</p>			
	<p><b>Electrical Installations</b></p> <p>The contractor shall not interface or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Project Manager to handle such fuses, wiring or electrical equipment.</p> <p>Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the EMPLOYER, he shall</p> <ol style="list-style-type: none"> <li>Satisfy the Project Manager that the appliances is in good working condition;</li> <li>Inform the Project Manager of the maximum current rating, voltage and phases of the appliances;</li> </ol>			
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	<p>iii) Obtain permission of the Project Manager detailing the sockets to which the appliances may be connected.</p> <p>The Project Manager will not grant permission to connect until he is satisfied that:</p> <p>The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.</p> <p>Wherever armored/metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.</p> <p>iv) No repair work shall be carried out on any live equipment. The Project Manager must declare the equipment safe and a permit to work shall be issued by the Employer/contractor as the case may be to carry out any repair/maintenance work. While working on electric lines/equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / officers.</p> <p>v) The contractor shall employ necessary number of qualified, full time Electricians/Electrical Supervisors to maintain his temporary electrical installation.</p> <p>The installation is provided with suitable ELCBs and RCCBs wherever required.</p>			
39.18.00	<b>Safety Organisation</b>			
39.18.01	<p>The contractor employing more than 250 workmen whether temporary, causal, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the Employer's Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of the Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees/workmen of the sub contractor shall also be considered as the contractor's employees workmen for the above purpose.</p> <p>In case of contractor deploying less than 250 workmen he should designate one of his Engineer/supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engineer/supervisor should get at least 2 days safety training from any reputed organization or from the Employer before resuming the work. If already trained in past the declaration along with training certificate to be furnished to the Employer's safety officer.</p>			
39.18.02	<p>The name and address of such safety officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the contract.</p>			
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39.19.00	<b>Reporting of Accident and Investigation</b>  In case any accident occurs during the construction/erection or other associated activities undertaken by the contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Project Manager, the Employer's Safety Officer with a copy to the Employer's Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.			
39.20.00	<b>Right to Stop Work</b>			
39.20.01	The Project Manager shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order or stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the contractor.			
39.20.02	The Contractor shall not be entitled for any damages/compensation for stoppage of work, [Sub-Clause 39.20.01] due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.			
39.21.00	<b>Fire Protection</b>  The Contractor shall provide sufficient fire extinguishers at place/s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers/equipment.			
39.22.00	<b>Penalties</b>  (i) If the Contractor fails in providing safe working environment as per the Safety Rules of the Employer or continues the work even after being instructed to stop the work by the Project Manager as provided in Clause 39.20.01 above, the Contractor shall be penalized at the rate of Rs.25,000/- per day or part thereof till the instructions are complied with and so certified by the Project Manager. However, in case of accident, the provisions contained in Sub-Clause 39.22.00(ii) below shall also apply in addition to the penalties mentioned in this sub-clause.  (ii) If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or the Employer 's employees or any other person who are at the Site or adjacent thereto, the			
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	<p>Contractor shall be responsible for payment of penalty to the Employer as per the following schedule :</p> <p>(a) Fatel injury or accident causing death :</p> <p>Penalty @10% of contract value or Rs. 5,00,000/- per person, whichever is less.</p> <p>(b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees.</p> <p>Penalty @2.5% of contract value or 1,00,000/- per person whichever is less.</p> <p>Permanent disablement shall have the same meaning as indicated in the Workmen's Compensation Act 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act 1923 and rules framed there under or any other applicable laws as applicable from time to time.</p> <p>(iii) If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Project Manager/ Safety Officer of the Employer shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out the workplace immediately and shall not be allowed to work on that day. the Project Manager/Safety Officer of the Employer will also issue a notice in this regard to the contractor.</p> <p>iv) If two or more fatal accident occur at same site of the Employer under the contract of contractor during the period of contract and he has</p> <p>(1) not complied with keeping adequate PPEs in stock or</p> <p>(2) defaulted in providing PPEs to his workmen or</p> <p>(3) not followed statutory requirements/ the Employer's safety rules or</p> <p>(4) been issued warning notice by the Employer's head of the project on non observance of safety norms or</p> <p>(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents of the Employer for two years from the date of last accident.</p> <p>The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by the Employer. The contractor shall submit the accident data including fatal/non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be determined.</p>			
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39.23.00	<p><b>Award</b></p> <p>If the contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award "<b>ACCIDENT FREE SAFETY MERITORIOUS AWARD</b>" as per scheme of the Employer.</p>			
40.00.00	<p><b>FOREIGN PERSONNEL</b></p>			
40.01.00	<p>The Contractor shall submit to the Employer data on all personnel he proposes to bring into India for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.</p>			
40.02.00	<p>Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.</p>			
40.03.00	<p>No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.</p>			
40.04.00	<p>The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.</p>			
40.05.00	<p>The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India, the Employer and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.</p>			
40.06.00	<p>The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.</p>			
41.00.00	<p><b>NOT USED</b></p>			
42.00.00	<p><b>SHAFT ALIGNMENTS</b></p> <p>All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect accuracy as practicable. The equipment shall be free from</p>			
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43.00.00	<p>excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall not exceed forty (40) microns and shall conform to VDI 2056. All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.</p> <p><b>DOWELLING</b></p> <p>All the motors and other equipment shall be suitably dowelled after alignment of shafts with tapered machined dowels as per the direction of the Employer.</p>			
44.00.00	<p><b>CHECK OUT OF CONTROL SYSTEMS</b></p> <p>After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.</p>			
45.00.00	<p><b>COMMISSIONING SPARES</b></p>			
45.01.00	<p>It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares like indicating lights/lamps, diodes, fuses recorder charts, ink pads/pens etc. required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.</p>			
45.02.00	<p>These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of performance and functional guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.</p>			
46.00.00	<p><b>EQUIPMENT DELIVERY AND ERECTION</b></p>			
46.01.00	<p><b>General Requirements</b></p> <p>a) This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification.</p> <p>b) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, check-lists, documentation formats for all activities after</p>			
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46.02.00	<p>equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :</p> <ol style="list-style-type: none"> <li>1) Instructions for packing, shipping, receiving handling, ware-housing and storage.</li> <li>2) Instructions for location and installation of equipment furnished by this specification.</li> <li>3) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.</li> <li>4) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.</li> <li>5) Check lists and quality assurance hold points.</li> <li>6) Format for all related documentation.</li> </ol> <p>c) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.</p> <p>d) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engineering.</p>			
	<p><b>Crating</b></p> <ol style="list-style-type: none"> <li>a) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.</li> <li>b) Equipment shall be packed with suitable dessicants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.</li> <li>c) Dessicants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate dessicants shall be of a chemical nature to absorb moisture. In any case, the dessicant shall not be of a type that will absorb enough moisture to go into solution. Dessicants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough dessicant shall be used for the volumes enclosed in wrapping.</li> <li>d) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.</li> </ol>			
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	<p>e) All accessory items shall be shipped with the equipment. Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.</p> <p>f) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.</p> <p>g) An itemized list of contents shall be closed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number :</p> <p>a) Export case markings</p> <p>b) Case number</p> <p>c) Gross weight and net weight in Kilograms</p> <p>d) Dimensions in centimeters</p> <p>e) Complete description of material</p> <p>h) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.</p> <p>j) Electrical equipment, control and insulations shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.</p> <p>k) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.</p> <p>l) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.</p> <p>m) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.</p>			
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46.03.00	<p>n) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.</p> <p>p) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.</p> <p>q) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.</p> <p><b>Factory Assembly</b></p> <p>a) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismantled from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.</p> <p>b) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.</p> <p>A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.</p>			
46.04.00	<p><b>Equipment Installation</b></p> <p>a) General Requirements</p> <p>i) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.</p> <p>ii) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.</p> <p>iii) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.</p> <p>iv) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.</p>			
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	<p>b) <b>Installation Materials</b></p> <p>All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.</p> <p>c) <b>Regulatory Requirements</b></p> <p>All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.</p> <p>d) <b>Cleaning</b></p> <p>All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.</p> <p>e) <b>Equipment Assembly</b></p> <p>Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.</p> <p>f) <b>Equipment Setting</b></p> <p>Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.</p> <p>Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block/isolating cock comes within 1600 mm from operating floor level.</p> <p>All free standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Employer's plant arrangement drawings.</p> <p>g) <b>Free-Standing Equipment</b></p> <p>Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.</p>			
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	<p>h) <b>Non-free Standing Equipment</b></p> <p>i) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.</p> <p>ii) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.</p> <p>i) <b>Equipment Location</b></p> <p>i) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.</p> <p>ii) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.</p> <p>iii) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.</p> <p>iv) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.</p> <p>v) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.</p> <p>For location of C&amp;I related equipment/devices, please refer relevant Parts, Section-VI.</p> <p>j) <b>Installation of Field Mounted Instruments and Devices</b></p> <p>The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.</p> <p>(Also refer relevant Parts, Section VI).</p> <p>k) <b>Piping Connections</b></p> <p>i) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall,</p>			
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	<p>however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.</p> <p>ii) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.</p> <p>l) <b>Equipment Checkout</b></p> <p>1. All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.</p> <p>2. After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.</p> <p>m) <b>Defects</b></p> <p>i) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.</p> <p>ii) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.</p> <p>n) <b>Equipment Protection</b></p> <p>i) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.</p> <p>ii) The equipment shall be protected during storage as described herein.</p> <p>iii) Equipment shall be protected from weld spatter during construction.</p> <p>iv) <b>Protective Guards</b></p> <p>Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.</p> <p>v) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.</p> <p>vi) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and</p>			
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	constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.			
47.00.00	<b>WELDING - SPECIAL REQUIREMENTS</b>  If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.			
48.00.00	<b>DEVIATION DISPOSITIONING</b>  Any deviation to the contract and employer approved document shall be properly recorded in the format prescribed by the Employer. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.			
49.00.00	<b>Non-Destructive Testing (NDT)</b>  The Contractor shall record results of NDT, carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & corrected to the job shall be handed over to the employer. Sensitivity of all the rest equipment shall be compatible to the job & acceptance norms agreed.			
50.00.00	<b>TESTING EQUIPMENT &amp; FACILITIES</b>  Contractor shall provide the testing equipment and facilities necessary to carryout tests & inspections.			
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	<p style="text-align: right;"><b>ANNEXURE-I</b></p> <p style="text-align: center;"><b>Safety Plan</b></p> <ol style="list-style-type: none"> <li>01. Safety Policy of the Contractor to be enclosed</li> <li>02. When was the Safety Policy last reviewed</li> <li>03. Details of implementation procedure/methods to implement Safety Policy / Safety Rules.</li> <li>04. Name, Qualification, experience of Safety Officer</li> <li>05. Review of Accidents Analysis Method, Methods to ensure Safety and Health.</li> <li>06. Unit executive responsible to ensure safety at various levels in work area</li> <li>07. List of employees trained in safety employed before execution of the job. give the details of training</li> <li>08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees</li> <li>09. Details of checklist for different jobs/work and responsible person to ensure compliance (copy of checklist to be enclosed)</li> <li>10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed.</li> <li>11. Risk Assessment, Safety Audit</li> <li>12. Implementation of Recommendations of Audit/Inspections. Procedures for implementation and follow up</li> <li>13. Provision for treatment of injured persons at work site</li> <li>14. Review of overall safety by top management and periodicity</li> <li>15. System for Implementation of Statutory legislation</li> <li>16. Issue of PPEs to employees, Periodicity / stock on hand etc.</li> </ol> <p style="text-align: right;"><b>Signature</b></p> <p style="text-align: right;"><b>Head of the Organisation</b></p> <p style="text-align: right;"><b>with date &amp; stamp</b></p>			
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1.00.00	<b>CODES AND STANDARDS</b>			
1.01.00	The fire proof cable penetration (FPCP) sealing system shall conform to the requirement of latest edition including amendments of BS:476 Part-20 Fire tests on Building materials and structures.			
1.02.00	Fire penetration seal complying with any other international standards will also be considered if it ensures performance equivalent or superior to standard listed above.			
1.03.00	The Contractor shall clearly indicate the standards adopted and furnish a copy of the English version of the latest editions of standards alongwith the bid, and shall clearly bring out the salient features for comparison.			
2.00.00	<b>SYSTEM DESCRIPTION</b>			
2.01.00	The fire proof cable penetration sealing system shall be of the following types; i) Type - A Type A fire sealing system is either Silicone foam or equivalent foam system or using individual blocks for each cable along with suitable frame work rated for one hour. Type A is to be implemented at floor openings below C&I panels, control panels/Boards etc. in Control Room & Control Equipment Room. ii) Type-B Type B fire sealing system is any proven fire sealing system rated for one hour. This will comprise of rest of wall and floor crossings of cables/cable trays, opening below HT/LT Switchgears/board other than those covered under Type A.			
2.02.00	The penetration system, shall be installed immediately after the completion of cable termination in a particular switchboard/control panel/area after clearance from the Project Manager.			
3.00.00	<b>GENERAL INFORMATION</b>			
3.01.00	The cables shall generally be laid in cable trays/racks, conduits, ducts. The fire proof cable penetration system shall be designed in such a way that the existing supporting structure/cable is not disturbed.			
3.02.00	The penetration system shall be suitable for site condition at 40°C ambient temperature and relative humidity of 100%.			
3.03.00	The penetration system of each wall/floor crossing shall be adequately designed/sized such that 20% addition of cables is possible at any later date without disturbance/wastage of material in the penetration system.			
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3.04.00	<p>Contractor shall plan the schedule of supply of the materials in consultation with Project Manager and use the material within stipulated shelf life of material. After award of work, drawings for each penetration seal shall be prepared by the contractor after verifying the actual installation of cables at site and approval shall be taken from the Project Manager's representative before proceeding with the actual work. The requirement of fire sealing material shall be quantified accordingly.</p> <p>Fire sealing material to be supplied shall be based on the net area to be sealed, wastage, thickness, density and other parameters as per the type test report approved under this contract.</p>			
4.00.00	TECHNICAL REQUIREMENTS			
4.01.00	The fire proof cable penetration system shall fully comply with the requirements of BS:476 Part-20 and also to the requirements specified in this specification.			
4.02.00	The penetration system shall prevent spreading of fire in cable beyond the seal system in case of fire and shall have minimum 1 hour fire resistance rating.			
4.03.00	The penetration system shall be physically, chemically, thermally stable and shall be mechanically secure to the masonry/concrete/structural members. The system shall be mechanically robust and capable of giving satisfactory performance under vibrations encountered in power stations.			
4.04.00	The penetration system shall be capable of withstanding mechanical loads, foot traffic drop loads, vibrations, wind pressure, etc.			
4.05.00	The penetration system shall be completely gas and smoke tight.			
4.06.00	The penetration system shall retain integrity and perform satisfactorily even after remaining in water for long period.			
4.07.00	The materials used in FPCP sealing system shall be non-toxic and harmless to the working personnel.			
4.08.00	The penetration materials shall have no reaction with cable sheath/galvanising/painting of structural steel.			
4.09.00	The penetration materials shall have anti-rodent and anti-termite properties.			
4.10.00	The penetration materials shall have no shrinkage or cracking after the setting for the complete life of the power Plant.			
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4.11.00	Under normal load, short circuit and fire conditions, cables may be subjected to movement and vibration. The FPCP sealing system shall be designed to withstand and perform satisfactorily under these conditions.			
4.12.00	The penetration system shall not affect the current carrying capacity of cables passing through it.			
4.13.00	Asbestos shall not be used in the construction of fire penetration seal system.			
4.14.00	The penetration system shall have life expectancy of 40 years.			
4.15.00	The penetration system shall not emit any corrosive or toxic fumes or smoke on the unexposed face of the barrier.			
4.16.00	Any wastage of the compound during the process of mixing for preparing the FPCP sealing compound shall be to Contractor's account.			
4.17.00	For foam type of systems, only the foam shall form the penetration seal of specified rating, having the damming board removed after curing of the foam.			
5.00.00	PACKING AND STORAGE			
5.01.00	All materials and components of penetration system shall be supplied in packing to avoid contamination of materials due to dust/moisture and temperature during transit and storage. All packing shall be of durable quality and the date of expiry and the date of manufacture shall be printed on it.			
6.00.00	INSTALLATION			
6.01.00	The contractor shall take adequate care to ensure that cables are not damaged in any manner during penetration system installation.			
6.02.00	Wherever the floor/wall opening provided in the vicinity of penetration seals larger or smaller than that required for the cable fire penetration, these opening size can be reduced or increased in an approved manner by the contractor using the same materials as provided around the opening and of the same thickness. Generally the walls in the power station comprises of brickwork and the floors are made of RCC/steel work. The Contractor shall be paid for this work at the unit rates for the respective brickwork/ R.C.C.			
6.03.00	The work to be carried out under this specification shall be done under the supervision of Project Manager's representative.			
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6.04.00	All work shall be carried out in accordance with the agreed “field quality plan” and approved drawings. The “field quality plan” shall additionally specify the fire sealing material thickness, minimum cured density and other related parameters achieved in the approved type tests for the contract. The work shall be done to the satisfaction of the Project Manager and the same shall be subject to Project Manager’s approval for acceptance.			
6.05.00	The installation shall be carried out in a neat workmen like manner by the skilled, experienced and competent workmen.			
6.06.00	Installation work at site shall be properly coordinated with other services.			
6.07.00	All materials being supplied or consumed during installation by the Contractor in the process of installation shall be of the best quality and according to relevant standards. All materials shall be inspected and approved by the Project Manager before the same is used for installation work. Also regarding inspection of work, the engineer shall have the right to inspect at any stage during installation, testing and commissioning.			
6.08.00	The drilling and welding of building-steel or fixing supports etc. shall be carried out by contractor after taking prior approval of Project Manager.			
6.09.00	Any work like chipping, breaking of existing structure like wall, floors, fabrications, any civil work etc. shall be done after taking prior approval of the Project Manager.			
6.10.00	The following jobs are also in the scope of contractor’s work and shall be carried out at no extra cost to the Employer: <div><div>a)</div><div>Reasonable amount of drilling, cutting and welding surface preparation to fix the fire stops.</div><div>b)</div><div>Supply of necessary cement, gravel, sand etc. required for grouting necessary supports.</div><div>c)</div><div>All supporting arrangement.</div></div>			
7.00.00	TESTS:			
7.01.00	Type tests as per the setup and procedures given in subsequent clauses for the Fire proof cable penetration sealing system shall be submitted: <div><div>a)</div><div>The accelerated ageing test</div><div>b)</div><div>Water absorption test</div></div>			
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<p>7.01.01</p> <p>7.01.02</p> <p>7.01.03</p> <p>7.01.04</p> <p>7.02.00</p> <p>8.00.00</p> <p>8.01.00</p> <p>8.02.00</p>	<p>c) Fire rating test</p> <p>d) Hose stream test</p> <p>e) Vibration test followed by fire rating test</p> <p>Tests a, b, c and d should have been carried out on same test sample subsequently one after the other without any touching up/repair/modifications in the same sequence and in accordance with the clause 9.00.00. The test sample shall be assembled as per clause 8.00.00.</p> <p>Test indicated in clause 7.01.00 (e) above should have been carried out on a separate sample and as per the procedure indicated under clause 9.05.00.</p> <p>Physical, chemical and mechanical properties of various components/ingredients used should have been also be tested as a part of type tests.</p> <p>Test reports shall contain the following information:</p> <ol style="list-style-type: none"> <li>Type of penetration material tested</li> <li>Details of various components/ingredients used alongwith their catalogue.</li> <li>Physical, chemical and mechanical properties of various components/ingredients used.</li> <li>Description of the various test assemblies tested.</li> <li>Details of method of conditioning.</li> <li>The observations as called for in BS:476 Part-20 and technical specification.</li> </ol> <p><b>ROUTINE &amp; ACCEPTANCE TESTS</b></p> <p>Routine and acceptance tests to be carried out on Type-A and Type-B cable fire sealing system shall be mutually agreed based on the type of fire sealing material offered before placement of award.</p> <p><b>TEST SPECIMEN ASSEMBLY</b></p> <p>The test specimen shall be assembled as per enclosed drawing and shall resemble typical floor crossing cable penetration system.</p> <p>The test specimen shall be designed to seal an opening of adequate size in a concrete slab of 200 mm thickness. Two lengths of 300/600 mm wide ladder type cable tray shall be assembled with required layer of XLPE/PVC insulated, PVC sheathed unarmoured cables in touching formation. Type and number of cables in the cable tray shall be as per enclosed drawing. Cables shall be adequately</p>			
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8.03.00	<p>clamped with tray at both the sides of the penetration as shown in the drawings. However, for penetration system with blocks which require staggered arrangement, cables can be clamped at an adequate distance from the penetration and the tray need not pass through the penetration seal.</p> <p>The opening in the test specimen then shall be sealed with fire proof cable penetration sealing materials.</p>			
9.00.00	<b>TEST PROCEDURES</b>			
9.01.00	<p><b>ACCELERATED AGEING TEST</b></p> <p>The test specimen assembled as per clause 8.01.00 with damming board removed shall be subjected to accelerated ageing test by storing in air furnace where the temperature of the inside air shall be maintained at 85 degree centigrade for 168 hours. The temperature controlled furnace should have 7 air changes per hour approx.</p>			
9.02.00	<b>WATER ABSORPTION TEST</b>			
9.02.01	<p>The test specimen shall be immersed in fresh clean water at a temperature of 20 deg. C <math>\pm</math> 2 deg C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hour soak period the specimen shall be removed from water and mopped up with a damp cloth.</p>			
9.03.00	<b>FIRE RATING TEST</b>			
9.03.01	<p>The test specimen after withstanding water absorption test shall be subjected to fire rating test as per BS: 476 part-20.</p>			
9.03.02	<p>Oil/Gas fired furnace shall be used for heating. The furnace shall have achieved standard time/temperature characteristics for fire tests as per BS:476 part-20.</p>			
9.03.03	<p>The pressure inside the furnace at the time of test shall be within 1.5 <math>\pm</math> 0.5 mm water gauge.</p>			
9.03.04	<p>Cables in the test specimen shall be anchored on the hot side to a structure independent of the barrier and its penetrations. This is to ensure that any differential movement between the penetration and the cable that could occur during a fire, is produced in the type tests and the reliability of the integrity of the penetration is checked.</p>			
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9.03.05	Cables shall be protruding between 1 to 2 metre, from the penetration face on the unexposed side and protruding into the furnace as far as it is practicable with a minimum length 750 mm. The ends of the cables shall be capped on the unexposed face to prevent gases and fumes to escape from the furnace during the fire.			
9.03.06	The test specimen shall be subjected to fire test with surface exposed to controlled fire in the furnace confirming to time/temperature characteristics specified in BS:476(20).			
9.03.07	During the test the temperature of both the faces of the fire stop i.e. one which is exposed to fire and other unexposed shall be measured by calibrated thermo couples after regular interval of 5 minutes.			
9.03.08	<p>Atleast 3 thermo couples shall be provided for temperature measurement of each face. The results at the end of the test shall be interpreted for failure criteria as under.</p> <div><div>1.</div><div>The system is deemed to have failed to maintain stability if there is a total collapse of the fire proof seal.</div></div> <div><div>2.</div><div>In case cracks are seen on the face of the fire stop or cracks through which the flame/ hot gas can pass the systems deemed to have failed to maintain integrity.</div><div>The development of crack is characterised by appearance of black soot on cotton wool held near the penetration on the unexposed surface at a distance of about 100mm.</div></div> <div><div>3.</div><div>Failure shall be deemed to have occurred when the mean temperature of the unexposed surface of the specimen assembly increases by more than 140<sup>0</sup>C above the initial temperature or if the temperature of the unexposed surface is increased at any point by more than 180<sup>0</sup>C above the initial temperature.</div><div>During the test the specimen shall meet all the three criteria simultaneously.</div></div>			
9.03.09	Temperature measurement on the unexposed side of penetration seal shall be measured by thermocouples at a distance of 25 mm from unexposed side of fire stop.			
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9.04.00	<b>HOSE STREAM TEST</b>			
9.04.01	A hose stream test shall be conducted on the test specimen immediately following a fire resistance test on that assembly. The specimen must first be removed from the furnace since the hose stream is to be applied to the exposed face. This must be done quickly since it is the intention of the test that the stream be applied to the specimen whilst it is hot.			
9.04.02	The hose stream shall be long range narrow angle, (20 <sup>0</sup> - 90 <sup>0</sup> set at 30 <sup>0</sup> included angle). High velocity water spray provided from a 28 mm hose discharging through an appropriate nozzle. The water pressure shall be 5 bar calculated at the base of the nozzle and the minimum flow rate shall be 4.7 litres/second. The stream shall be supplied perpendicularly to the exposed face of the test specimen with nozzle 3 m away from the exposed face.			
9.04.03	Application shall be for minimum of two and a half minutes per 9 sq.m. of the test specimen including the barrier.			
9.05.00	<b>VIBRATION TEST</b>			
9.05.01	The test assembly is to comprise a single ladder rack penetration in 1 m x 1m high normal section of fire barrier which is securely supported. The penetration seal shall be formed in the middle of the barrier around 1 m length of 600 mm ladder rack. The tray shall be fully loaded with cables in touching formation. The penetration assembly shall be formed symmetrically through the fire barrier as in service. The penetration sealant material shall then be allowed to cure for atleast as long as the time required for conditioning to constant mass. A vibration test shall then be conducted on the sample as set out below.			
9.05.02	The vibration shall be of 100 Hz frequency and of 0.5 mm amplitude (1.0 mm peak to peak) and this shall be applied to one rail of the ladder rack or the centre of a cross member secured to the two rails at 250 mm from the centre line of the penetration. This vibration shall be applied to the sample for the minimum period of 3 hrs. Immediately following this vibration test the barrier/ penetration assembly shall be successfully subjected to a fire test in accordance with clause no. 9.03.00.			
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<b>1.00.00</b>  1.01.00	<b>CODES AND STANDARDS</b>  All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS codes, standards, etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards/ codes as applicable.  IS: 513            Cold rolled low carbon steel sheets and strips  IS: 802            Code of practice for the use of Structural Steel in Overhead Transmission Line Towers  IS: 1079           Hot Rolled carbon steel sheet & strips  IS: 1239           Mild steel tubes, tubular and other wrought steel fittings  IS: 1255           Code of practice for installation and maintenance of power cables upto and including 33 KV rating  IS: 1367           Technical supply conditions for threaded Steel fasteners (Hot dip Part-13 galvanized coatings on threaded fasteners)  IS: 13947          Degree of protection provided by enclosures for low voltage switchgear and control gear  IS: 2309           Code of Practice for the protection of building and allied structures against lightning.  IS: 2629           Recommended practice for hot dip galvanizing of iron & steel  IS: 2633           Method for testing uniformity of coating on zinc coated articles  IS: 3043           Code of practice for Earthing  IS: 3063           Fasteners single coil rectangular section spring washers  IS: 6745           Methods for determination of mass of zinc coating on zinc coated iron & steel articles  IS: 8308           Compression type tubular in- line connectors for aluminium conductors of insulated cables  IS: 8309           Compression type tubular terminal ends for aluminium conductors of insulated cables  IS: 9537           Conduits for electrical installation  IS: 9595           Metal - arc welding of carbon and carbon manganese steels - recommendations.			
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1.02.00	<p>IS: 13573 Joints and terminations for polymeric cables for working voltages from 6.6kv upto and including 33kv performance requirements and type tests.</p> <p>IS: 2062 Structural Steel (Standard Quality)</p> <p>IS : 316 Code of practice for use of metal arc welding for general construction in mild steel.</p> <p>IS : 277 Galvanized sheet steel.</p> <p>IS : 808 Rolled Steel Beam, Channels and Angle section.</p> <p>IS : 800 Specification for use of structural steel in general building construction.</p> <p>BS: 476 Fire tests on building materials and structures</p> <p>IEEE: 80 IEEE guide for safety in AC substation grounding</p> <p>IEEE: 142 Grounding of Industrial &amp; commercial power systems</p> <p>DIN 46267 (Part-II) Non tension proof compression joints for Aluminium conductors.</p> <p>DIN 46329 Cable lugs for compression connections, ring type, for Aluminium conductors</p> <p>VDE 0278 Tests on cable terminations and straight through joints</p> <p>BS: 6121 Specification for mechanical Cable glands for elastomers and plastic insulated cables.</p> <p>Indian Electricity Act. Indian Electricity Rules.</p> <p>Equipment complying with other internationally accepted standards such as IEC, BS, DIN, VDE etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.</p>			
2.00.00	<b>EQUIPMENT DESCRIPTION</b>			
2.01.00	<b>Metallic Cable trays, Fittings, Accessories &amp; Support System</b>			
2.01.01	Cable trays shall be ladder/perforated type as specified complete with matching fittings (like brackets, elbows, bends, reducers, tees, crosses, etc.) accessories (like side coupler plates, etc. and hardware (like bolts, nuts, washers, G.I. strap, hook etc.) as required. Cable tray shall be ladder type for power & control cables and perforated for instrumentation cables.			
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2.01.02	Cable trays, fittings and accessories shall be fabricated out of rolled mild steel sheets free from flaws such as laminations, rolling marks, pitting etc. These (including hardware) shall be hot dip galvanized after fabrication as per relevant IS.			
2.01.03	Cable trays shall have standard width of 150 mm, 300 mm & 600 mm and standard lengths of 2.5 metre. Minimum thickness of mild steel sheets used for fabrication of cable trays and fittings shall be 2 mm. The thickness of side coupler plates shall be minimum 3 mm. Typical details of cable trays, fittings and accessories are shown in the enclosed drawings			
2.01.04	Cable troughs shall be required for branching out few cables from main cable route. These shall be U-shaped, fabricated of mild steel sheets of minimum thickness 2 mm and shall be hot dip galvanized after fabrication as per relevant IS. Troughs shall be standard width of 50 mm & 75 mm with depth of 25 mm			
2.02.00	Support System for Cable Trays			
2.02.01	Cable tray support system shall be pre-fabricated similar or equivalent to "Unistrut make".			
2.02.02	<p>Support system for cable trays shall essentially comprise of the two components i.e. main support channel and cantilever arms. The main support channel shall be of two types : (i) C1:- having provision of supporting cable trays on one side and (ii) C2:- having provision of supporting cable trays on both sides. The support system shall be the type described hereunder</p> <p>a. Cable supporting steel work for cable racks/cables shall comprise of various channel sections, cantilever arms, various brackets, clamps, floor plates, all hardwares such as lock washers, hexagon nuts, hexagon head bolt, support hooks, stud nuts, hexagon head screw, channel nut, channel nut with springs, fixing studs, etc.</p> <p>b. The system shall be designed such that it allows easy assembly at site by using bolting. All cable supporting steel work, hardwares fittings and accessories shall be prefabricated factory galvanised.</p> <p>c. The main support and cantilever arms shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hardware etc. to form various arrangements required to support the cable trays. Welding of the components shall not be allowed. However, welding of the bracket (to which the main support channel is bolted) to the overhead beams, structural steel, insert plates or reinforcement bars will be permitted. Any cutting or welding of the galvanised surface shall be brushed and red lead primer, oil primer &amp; aluminium paint shall be applied</p> <p>d. All steel components, accessories, fittings and hardware shall be hot dip galvanized after completing welding, cutting, drilling and other machining operation.</p> <p>e. The typical arrangement of flexible support system is shown in the enclosed drawings and described briefly below:</p>			
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	<p>The main support channel and cantilever arms shall be fabricated out of minimum 2.5mm thick rolled steel sheet conforming to IS.</p> <p>f. Cantilever arms as required shall be provided as shown in the enclosed drawings. The arm portion shall be suitable for assembling the complete arm assembly on to component constructed of standard channel section. The back plate shall allow sufficient clearance for fixing bolt to be tightened with tray in position.</p>			
2.02.03	<p>The size of structural steel members or thickness of sheet steel of main support channel and cantilever arms and other accessories as indicated above or in the enclosed drawings are indicative only. Nevertheless, the support system shall be designed by the bidder to fully meet the requirements of type tests as specified. In case the system fails in the tests, the components design modification shall be done by the Bidder without any additional cost to the Employer. The bidder shall submit the detailed typical drawings of the system offered by him along with the bid.</p>			
2.03.00	<b>Pipes, Fittings &amp; Accessories</b>			
2.03.01	<p>Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria</p>			
2.03.02	<p>GI Pipes shall be of medium duty as per IS: 1239</p>			
2.03.03	<p>Duct banks shall be provided with High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.</p>			
2.04.00	<b>Junction Boxes</b>			
2.04.01	<p>Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of 20mm diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets should be of powder coated MS. Type test reports for the following tests shall be furnished:-</p> <p>(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102</p> <p>(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.</p> <p>(c) Class of protection shall be IP 55.</p> <p>(d) HV test.</p>			
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2.04.02	Terminal blocks shall be 1100 volts grade, 10 Amps rated, made up of unbreakable polyamide 6.6 grade, complete with insulating barriers. Clip on type terminals, washers, nuts and identification strips. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be non ferrous. WAGO terminal of cage clamp with lugs shall also be acceptable. All terminal blocks shall be suitable for terminating on each side two (2) nos. stranded copper conductors of size upto 2.5 sq mm each.			
2.05.00	Terminations			
2.05.01	Terminations for 11 kV & 33 KV XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits shall be pre-moulded type, taped type or heat shrinkable type. Terminations shall be type tested as per IS: 13573. Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the aluminium solder-less crimping type cable lugs & ferrule as per DIN standard.			
2.05.02	Termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV system.			
2.05.03	Selection of cable drums for each run shall be so planned so as to avoid using straight through joints.			
2.06.00	Cable glands			
2.06.01	Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS: 6121 and be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating. Rubber components shall be of neoprene and of tested quality.			
2.07.00	Cable lugs/ferrules			
2.07.01	Cable lugs for power cables shall be Tinned Copper solder-less crimping type conforming to IS: 8309 suitable for aluminum compacted conductor cables. Cable lugs and ferrules for control cables shall be tinned copper conforming to IS: 8309. The cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipments.			
2.08.00	Trefoil clamps			
2.08.01	Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength when installed at 1 mt. intervals, to withstand the forces generated by the system short circuit current of 105 KA peak.			
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<b>2.09.00</b>	<b>Cable Clamps &amp; Straps</b>	<p data-bbox="207 252 305 277">2.09.01</p> <p data-bbox="389 252 1425 407">The cable clamps required to clamp multi-core cables on vertical run shall be made up of Aluminium strip of 25x3 mm size. For clamping the multi-core cables, self-locking, de-interlocking type nylon clamps/straps shall be used. The clamps/straps shall have sufficient strength and shall not get affected by direct exposure to sun rays and outdoor environment</p>		
<b>2.10.00</b>	<b>Galvanising</b>			
2.10.01	Galvanizing of steel components and accessories shall conform to IS: 2633 & IS: 4759. Additionally galvanizing shall be uniform, clean smooth, continuous and free from acid spots	<p data-bbox="207 609 305 634">2.10.02</p> <p data-bbox="389 609 1425 764">The amount of zinc deposit over threaded portion of bolts, nuts, screws and washers shall be as per IS: 1367. The removal of extra zinc on threaded portion of components shall be carefully done to ensure that the threads shall have the required zinc coating on them as specified. However nuts and bolts of size lesser than M12 can be electro galvanized / electro plated.</p>		
<b>2.11.00</b>	<b>Welding</b>			
2.11.01	The welding shall be carried out in accordance with IS: 9595. All welding procedures and welders qualification shall also be followed strictly in line with IS: 9595	<b>3.00.00</b>		
<b>3.01.00</b>	<b>Cable tray and Support System Installation</b>	<p data-bbox="207 1071 305 1096">3.01.01</p> <p data-bbox="389 1071 1425 1155">Cables shall run in cable trays mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures.</p>		
3.01.02	Horizontally running cable trays shall be clamped by bolting to cantilever arms at an interval of 2000 mm. Vertically running cable trays shall be bolted to main support channel by suitable bracket/clamps on both top and bottom side rails at an interval of 2000 mm. For vertical cable risers/shafts cable trays shall be supported at an interval of 1000mm. Fixing of cable trays to cantilever arms or main support channel by welding shall not be accepted. Cable tray installation shall generally be carried out as per the enclosed drawings.			
3.01.03	The cantilever arms shall be positioned on the main support channel with a minimum vertical spacing of 300 mm unless otherwise indicated in the relevant tray layout drawings.	<p data-bbox="207 1558 305 1583">3.01.04</p> <p data-bbox="389 1558 1425 1751">The contractor shall fix the brackets/ clamps/ insert plates using anchor fasteners. Minimum size of anchor fasteners shall be M 8 X 50 and material shall be stainless steel grade 316 or better. Anchor fastener shall be fixed as recommended by manufacturer and as approved by site engineer. For brick wall suitable anchor fasteners shall be used as per the recommendations of manufacturer. Make of anchor fasteners shall be subjected to QA approval.</p>		
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3.01.05	All cable way sections shall have identification, designations as per cable way layout drawings and painted/stenciled at each end of cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75 mm. For long lengths of trays, the identification shall be painted at every 10 meter. Risers shall additionally be painted / stenciled with identification numbers at every floor.												
3.01.06	In certain cases it may be necessary to site fabricate some of the portions of trays, supports and other non standard bends where the normal prefabricated trays, supports and accessories may not be suitable. In such cases the Contractor shall fabricate at site, suitable sections of trays, supports and accessories to make the installation complete for the specific purpose after obtaining employer's prior approval, which 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 aluminium paint.												
3.02.00	Conduits/Pipes/Ducts Installation												
3.02.01	The Contractor shall be fully responsible 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 water proof by the Contractor.												
3.02.02	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.												
3.02.03	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 coundits/pipes shall be sealed with Glasswool/Cement Mortar/Putty to prevent entrance of moisture and foreign material												
3.02.04	<p>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</p> <table><tr><th>Conduit/pipe size (dia)</th><th>Spacing</th></tr><tr><td>Up to 40 mm</td><td>1 M</td></tr><tr><td>50 mm</td><td>2.0 M</td></tr><tr><td>65-85 mm</td><td>2.5 M</td></tr><tr><td>100 mm</td><td>3.0 M</td></tr></table>			Conduit/pipe size (dia)	Spacing	Up to 40 mm	1 M	50 mm	2.0 M	65-85 mm	2.5 M	100 mm	3.0 M
Conduit/pipe size (dia)	Spacing												
Up to 40 mm	1 M												
50 mm	2.0 M												
65-85 mm	2.5 M												
100 mm	3.0 M												
3.02.05	For bending of conduits, bending machine shall be arranged at site by the contractor to facilitate cold bending. The bends formed shall be smooth.												
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3.03.00	<b>Junction Boxes Installation</b>			
3.03.01	Junction boxes shall be mounted at a height of 1200mm above floor level or as specified in the drawings or as decided by the employer and shall be adequately supported/mounted on masonry wall by means of anchor fasteners/ expandable bolts or shall be mounted on an angle, plate or other structural supports fixed to floor, wall, ceiling or equipment foundations as indicated in drawings/as directed by Project Manager.			
3.04.00	<b>Cable Installation (for cables upto &amp; including 33 KV grade)</b>			
3.04.01	Cable installation shall be carried out as per IS: 1255 and other applicable standards. 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, the drum shall 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.			
3.04.02	While laying cable, ground rollers shall be used at every 2 metre 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. If any particular cable is damaged, the same shall be repaired or changed to the satisfaction of Project Manager without any extra cost.			
3.04.03	Cables shall be laid on cable trays strictly in line with approved cable schedule. Where specific cable layouts are not shown on drawings, Contractor shall route these as directed by the Project Manager			
3.04.04	Power and control cables shall be laid on separate tiers. The laying of different voltage grade cables shall be on different tiers according to the voltage grade of the cables. In horizontal tray stacks, H.T. cables shall be laid on topmost tier and cables of subsequent lower voltage grades on lower tiers of trays. Single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil center lines and clamped at every two metre. All multi-core cables shall be laid in touching formation. Power and control cables shall be secured fixed to trays/support with self locking type nylon cable straps with de-interlocking facilities. For horizontal trays arrangements, multi-core power cables and control cables shall be secured at every five meter interval. For vertical tray arrangement, individual multi-core power cables and control cables shall be secured at every one meter by nylon cable strap. After completion of cable laying work in the particular vertical tray, all the control cables shall be bound to trays/supports by aluminium strips at every five meter interval and at every bend.			
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3.04.05	Bending radii for cables shall be as per manufacturer's recommendations and IS: 1255.			
3.04.06	Where cables cross roads/rail tracks, the cables shall be laid in hume pipe/ Heavy duty PVC pipes.			
3.04.07	Cable drum lengths shall be selected in such a way so that cable joints are avoided.			
3.04.08	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			
3.04.09	Wherever few cables are branching out from main trunk route troughs shall be used.			
3.04.10	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.			
3.04.11	Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and date on which laid, actual length and route, testing carried out, termination done alongwith the marked up copy of the cable schedule and interconnecting drawing where any modifications are made			
3.04.12	<p>Separation</p> <p>At least 300mm clearance shall be provided between:</p> <ul style="list-style-type: none"> <li>- HT power &amp; LT power cables,</li> <li>- LT power &amp; LT control/instrumentation cables,</li> </ul>			
3.04.13	<p><b>Segregation</b></p> <ol style="list-style-type: none"> <li>1) Segregation means physical isolation to prevent fire jumping.</li> <li>2) All cables associated with the unit shall be segregated from cables of other units.</li> <li>3) Interplant cables of station auxiliaries and unit critical drives shall be segregated in such a way that not more than half of the drives are lost in case of single incident of fire. Power and control cables for AC drives and corresponding emergency AC or DC drives shall be laid in segregated routes. Cable routes for one set of auxiliaries of same unit shall be segregated from the other set.</li> <li>4) In switchyard, control cables of each bay shall be laid on separate racks/trays.</li> </ol>			
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3.04.14	<p>Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:</p> <p>Minimum number of spare cores required to be left for interconnection in control cables shall be as follows:</p> <table><thead><tr><th>No. of cores in cable</th><th>No. of spare cores</th></tr></thead><tbody><tr><td>2C, 3C</td><td>NIL</td></tr><tr><td>5C</td><td>1</td></tr><tr><td>7C-10C</td><td>2</td></tr></tbody></table>				No. of cores in cable	No. of spare cores	2C, 3C	NIL	5C	1	7C-10C	2
No. of cores in cable	No. of spare cores											
2C, 3C	NIL											
5C	1											
7C-10C	2											
3.04.15	<p><b>Directly Buried Cables</b></p> <p>a) 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 and the enclosed drawings showing cabling details.</p> <p>b) 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.</p>											
3.04.16	<p>Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, and at every 20 meters in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, motor control centers, control and relay panels etc. where a number of cables enter together through a gland plate. Cable tag shall be of rectangular shape for power cables and control cables. Cable tag shall be of 2 mm thick aluminum with number punched on it and securely attached to the cable by not less than two turns of 20 SWG GI wire conforming to IS:280. Alternatively, the Contractor may also provide cable tags made of nylon, cable marking ties of 'TY-CAB' or equivalent type with cable number heat stamped on the cable tags</p>											
3.04.17	<p>While crossing the floors, un-armoured cables shall be protected in conduits up to a height of 500 mm from floor level if not laid in tray.</p>											
3.04.18	<p>11 KV Aerial bunched cables shall be installed on 9Mtr. Long poles (Type 540SP-32 or equiv) and 11Mtrs. long poles at road crossings (Type 540SP-55 or equiv) and made of ERW tubes, stepped tubular or swaged tubular type, as required, as per relevant IS &amp; REC standards.</p>											
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	<p>The poles shall be painted with two coats of red Oxide and Zinc chromate in Synthetic compound primer on the exposed outside surface and with Bituminous paint all along the inside of the pole and outside portion which shall be embedded in foundation, at manufacturing stage.</p> <p>The spacing between poles shall not be more than 30 Mtrs. and sag of cable shall not be more than one metre. The poles shall be designed and erected to withstand the following forces:</p> <ol style="list-style-type: none"> <li>Self weight of cables</li> <li>Forces and moments resulting due to action of wind, snow and eccentric placing of transformer</li> <li>Forces during stringing operations</li> <li>Forces/moments due to different spans and sags of cables Short circuit forces including snapping of cables.</li> </ol> <p><b>3.05.00 Cable Terminations &amp; Connections</b></p> <p>3.05.01 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.</p> <p>3.05.02 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.</p> <p>3.05.03 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 2mm thick aluminium sheets.</p> <p>3.05.04 Control cable cores 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.</p> <p>3.05.05 The panels where a larger number of cables are to be terminated and cable identification may be difficult, each core ferrule shall include the complete cable number as per the drawings. The ferrules shall be indelible interlocking type and shall fit tightly on cores. Spare cores shall have similar ferrules with a suffix letter 'S' alongwith cable numbers and coiled up after end sealing.</p> <p>3.05.06 All cable terminations shall be appropriately tightened to ensure secure and reliable connections.</p>			
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3.05.07	It is the responsibility of the Contractor to terminate the cables at motor terminals in correct phase sequence to ensure the proper direction of rotation. If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modifications, the same shall be carried out by the Contractor as directed by the Project Manager at no extra cost.			
3.05.08				
4.00.00	EARTHING SYSTEM			
4.01.00	Earthing system shall be in strict accordance with IS: 3043 and Indian Electricity Rules/Acts.			
4.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects			
4.03.00	The material of the earthing conductors shall be as follows:			
	1)	Conductors above ground level and in built up trenches.	-	Galvanized steel
	2)	Conductors buried in earth	-	Mild steel
	3)	Earth electrodes	-	Mild steel rod
4.04.00	The sizes of earthing conductors for various electrical equipments shall be as below:			
	Equipment	Earth conductor buried in earth		Earth conductor above ground level & in built-up trenches
	a) Main earth grid	40 mm dia. MS rod		65x8mm GS flat
	b) 33KV/11KV switchgear/ 415V equipment	---		65x8mm GS flat
	c) 415V MCC/Distribution boards/ Transformers			50x6mm GS flat
	d) LT Motors above 125 KW	---		50 x 6mm GS flat
	25 KW to 125 KW	---		25 x 6mm GS flat
	1KW to 25 KW	---		25 x 3mm GS flat
	Fractional Horse power motor	---		8 SWG GS wire (To be terminated with suitable lugs)
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4.05.00	<p>e) Control panel &amp; control desk --- 25 x 3 mm GS flat</p> <p>f) Push button station/ Junction Box --- 8 SWG GI wire (To be terminated with suitable lugs)</p> <p>g) Columns, structures, cable trays and bus ducts enclosures --- 50x6mm GS flat</p> <p>h) Crane, rails, rail tracks &amp; other non-current carrying metal parts --- 25x6mm GS flat</p> <p>Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system, each of 100% capacity. Crane rails, tracks, metal pipes and conduits shall also be effectively earthed at two points. Steel RCC columns, metallic stairs, and rails etc. of the building housing electrical equipment shall be connected to the nearby earthing grid conductor by one earthing ensured by bonding the different sections of hand rails and metallic stairs. Metallic sheaths/screens, and armour of multi-core cables shall be earthed at both ends. Metallic Sheaths and armour of single core cables shall be earthed at switchgear end only unless otherwise instructed by the Employer. Every alternate post of the switchyard fence shall be connected to earthing grid by one GS flat and gates by flexible lead to the earthed post. Railway tracks within the plant area shall be bonded across fish plates and connected to earthing grid at several locations. Portable tools, appliances and welding equipment shall be earthed by flexible insulated cable.</p>	
4.06.00	Each continuous laid lengths of cable tray shall be earthed at minimum two places by G.S. flats to earthing system, the distance between earthing points shall not exceed 30 metre. Wherever earth mat is not available Contractor shall do the necessary connections by driving an earth electrode in the ground. Where the trays are laid on the cable trestle, the same shall be earthed through strip along trestle leg at 30 mt (max) interval & structural footing of the trestle shall be earthed at an interval of 30 mt. (max.) with 3 mt. long 40 mm dia MS electrode.	
4.07.00	Neutral points of HT transformer shall be earthed through NG resistors if required. The Contractor shall connect the NGR earthing point/neutral point of LT transformer by two separate GI strips to two separate earth electrodes.	
4.08.00	Neutral connections and metallic conduits/pipes shall not be used for the equipment earthing. Lightning protection system down conductors shall not be connected to other earthing conductors above the ground level.	
4.09.00	Connections between earth leads and equipment shall normally be of bolted type. Contact surfaces shall be thoroughly cleaned before connections. Equipment bolted connections after being tested and checked shall be painted with anti corrosive paint/compound.	
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4.10.00	Suitable earth risers as approved by employer shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.			
4.11.00	Connections between equipment earthing leads and between main earthing conductors shall be of welded type. For rust protection the welds should be treated with red lead compound and afterwards thickly coated with bitumen compound. All welded connections shall be made by electric arc welding.			
4.12.00	Earthing conductors buried in ground shall be laid minimum 600 mm below ground level unless otherwise indicated in the drawing. Back filling material to be placed over buried conductors shall be free from stones and harmful mixtures. Back filling shall be placed in layers of 150 mm.			
4.13.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.			
4.14.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductor's crossings the road can be installed in pipes. Wherever earthing conductor crosses or runs at less than 300 mm distance along metallic structures such as gas, water, steam pipe lines, steel reinforcement in concrete, it shall be bonded to the same.			
4.15.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.			
4.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.			
4.17.00	Earth pit shall be constructed as per IS: 3043. Electrodes shall be embedded below permanent moisture level. Minimum spacing between electrodes shall be 600mm. Earth pits shall be treated with treated with Bentonite as per IS 3043.			
4.18.00	On completion of installation continuity of earth conductors and efficiency of all bonds and joints shall be checked. Earth resistance at earth terminations shall be measured in presence of Employer's representatives. All equipment required for testing shall be furnished by contractor.			
4.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and gates shall be connected to earthing grid by one lead.			
<b>5.00.00</b>	<b>LIGHTNING PROTECTION SYSTEM</b>			
5.01.01	Lightning protection system shall be in strict accordance with IS: 2309			
5.01.02	Lightning conductor shall be of 25x6mm GS strip when used above ground level and shall be connected through test link with earth electrode/earthing system			
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5.01.03	Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings			
<b>5.02.00</b>	<p><b>Down Conductors</b></p> <ol style="list-style-type: none"> <li>Down conductors shall be as short and straight as practicable and shall follow a direct path to earth electrode.</li> <li>Each down conductor shall be provided with a test link at 1000 mm above ground level for testing but it shall be inaccessible to interference. No connections other than the one direct to an earth electrode shall be made below a test point.</li> <li>All joints in the down conductors shall be welded type.</li> <li>Down conductors shall be cleated on outer side of building wall, at 750 mm interval or welded to outside building columns at 1000 mm interval.</li> <li>Lightning conductor on roof shall not be directly cleated on surface of roof. Supporting blocks of PCC/insulating compound shall be used for conductor fixing at an interval of 1500 mm.</li> <li>All metallic structures within a vicinity of two meters of the conductors shall be bonded to conductors of lightning protection system.</li> <li>Lightning conductors shall not pass through or run inside GI Conduits.</li> <li>Testing link shall be made of galvanized steel of size 25x 6mm.</li> </ol>			
<b>6.00.00</b>	<p><b>QUALITY ASSURANCE PROGRAMME</b></p> <p>Bidder shall furnish detailed Quality Assurance Program and Quality Plans for all materials and accessories to be supplied and installed under the scope of the specification as per General Technical Conditions of technical specification. The Quality Plans shall include all tests/ checks as per relevant National/International Standards and the requirements of this specification including tests listed in this section.</p>			
<b>7.00.00</b>	<b>TESTS</b>			
<b>7.01.00</b>	<p><b>Type tests on Cable Trays support system:</b></p> <p><b>Test 1: On main support channel type-C2 for cantilever arms fixed on one side only.</b></p> <p><b>a) Test 1A:</b> A 3.5 metre length of main support channel shall be fixed vertically at each end to a rigid structure as per the fixing arrangement as shown in the enclosed drawing. Eight (8) nos. 750 mm cantilever arms shall be fixed to the main channel and each arm shall be loaded over the</p>			
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	<p>outboard 600 mm with a uniform working load of 100 kg. Subsequently a point load of 100 kg shall be applied on arm 2. A uniform proof load on all the arms equal to twice the working load shall be then be applied. Deflections shall be measured at the points shown in the enclosed drawings and at the following load intervals:</p> <ul style="list-style-type: none"> <li>i) Working load</li> <li>ii) Working load + point load</li> <li>iii) Off load</li> <li>iv) Proof load + point load</li> <li>v) Off load</li> </ul> <p>The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.</p> <p><b>b) Test 1B: Test 1A shall be repeated with Eight Cantilever arms uniformly loaded and with the same point load on arm 2.</b></p> <p><b>Test 2:</b> On Main support channel type -C2 for cantilever arms fixed on both sides</p> <p><b>a)Test 2A:</b> A 3.5 m length of main support channel C2 for cantilever arms fixing on both sides shall be fixed at each end to rigid structure as per the fixing arrangement as shown in the enclosed drawing. Six (6), 750 mm cantilever arms shall be attached to each sides and each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall than be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.</p> <ul style="list-style-type: none"> <li>i) Working load</li> <li>ii) Working load + Point load</li> <li>iii) Off load</li> <li>iv) Proof load + Point load</li> <li>v) Off load</li> </ul> <p>The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.</p> <p><b>b) Test 2 B:</b>The test 2 A shall be repeated with the assembly but with an asymmetrical load on the C2 column and point load applied to arm 8. The 100 kg and 200 kg uniformly distributed loads shall be applied to the upper three arms on one side and the lower three arms on the opposite side.</p>			
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	<p><b>Test 3: Tests on Channel Fixed on Beam/Floor</b></p> <p><b>A length of main support channel section shall be fixed to steel structure/floor and have loads applied as shown in the drawing enclosed and as detailed below</b></p> <p><b>a) Test 3A :</b> A length of steel structure shall be rigidly supported. It should be fitted on a metre length of channel section using beam clamps welded/bolted. A point load of 1200 kg shall be applied to the centre point via two brackets. No distortion or pulling of the components shall take place.</p> <p><b>b) Test 3B :</b> With the components assembled as in Test 3A, two perpendicular point loads of 600 kg shall be simultaneously applied at positions 150 mm either side of the centre line, no distortion or pulling of the components shall take place.</p> <p><b>c) Test 3C :</b> With the components assembled as in Test 3A, a perpendicular point load shall be applied at a point 150 mm on one side of the centre line. The load shall be gradually increased to the maximum value that can be applied without causing distortion or pulling of the components. This value shall be recorded.</p> <p><b>Test 4 : Channel Insert Test</b></p> <p>A 2.5 m length of C1 channel fixed to the concrete wall/ steel structure as per actual site installation conditions. 6 nos. of 750 mm cantilever arms shall be attached to C1 channel as shown in enclosed drawing. Each arm uniformly loaded to a working load of 100 kg over the out board 600 mm. A point load of 100 kg shall then be applied to arm 2, followed by a uniform proof load of twice the working load on all the arms; deflection shall be measured at points shown in the enclosed drawings at the following load intervals.</p> <p>i) Working load ii) Working load + Point load iii) Off load iv) Proof load + Point load v) Off load</p> <p>The deflection measured at working loads shall not exceed 16mm. The permanent deflection after removing the combination of working load and point load shall not exceed 10 mm at the arm tips and 6 mm on the channel. No collapse of the structure shall occur with a combination of proof load and point load applied.</p>			
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	<p><b>Test 5: Channel nut slip characteristics (what ever applicable)</b></p> <p><b>Tests 5A1,5A2, 5A3 :</b> A length of channel C1 section 200mm long shall have fitted bracket with the two bolts fixing as shown in drawing enclosed.</p> <p>With loads applied at the position shown in drawing enclosed nut slip shall be determined with bolt torque of 30NM, 50 NM and 65 NM No fewer than three measurements shall be made for each torque setting.</p> <p>A minimum loading of 720 kg shall be obtained before nut slip with bolt torque of 65 NM.</p> <p><b>Tests 5B1,5B2, 5B3:</b> The length of channel C1 section 200 mm long shall have fitted bracket with the one bolt fixing as shown in drawing enclosed. With loads applied at the position shown in drawing, nut slip shall be determined with bolt torques of 30 NM, 50 NM and 65 NM. No fewer than three measurements shall be made for each torque setting.</p> <p>A minimum loading of 350 kg shall be obtained before nut slip with a bolt torque of 65 NM.</p> <p><b>Test 6 Weld Integrity Test</b></p> <p>After deflection test as per test 1A, 1B, 2, 3, 4 &amp; 5, weld integrity shall be checked by magnetic particle inspection to detect sub-surface cracks developed, if any.</p>			
7.02.00	Type Test on Cable termination kit as per IS:13573 for above 3.3 kV .			
7.03.00	<b>Routine/ Acceptance Tests</b>			
7.03.01	Routine Tests			
	<div>a) Routine tests as per specification and applicable standards shall be carried out on all equipments/items covered in the specification.</div> <div>b) Physical &amp; dimensional check on all equipments as per approved drawings/standards.</div> <div>c) HV/IR as applicable.</div> <div>d) Check/measurement of thickness of paint/zinc coating/nickel-chrome plating as per specification &amp; applicable standard.</div>			
7.03.02	<b>Acceptance Test</b>			
	<div>a) Galvanising Tests as per applicable standards</div> <div>b) Welding checks</div>			
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	<p>c) Deflection tests on cable trays:</p> <p>One piece each of 2.5m length of cable tray of 300mm &amp; above shall be taken as sample from each offered lot. It shall be supported at both end &amp; loaded with uniform load of 76 kg/meter along the length of cable tray. The maximum deflection at the mid-span of each size shall not exceed 7mm.</p> <p>d) Proof load tests on cable tray support system</p> <p>i) Tests on Main Support Channel shall be done if only C1 Channel are in scope of supply and cantilever arms shall be fitted on one side. This test shall be same as test 4 of type test.</p> <p>ii) Test on Main Support Channel shall be done with C2 channel and cantilever arms fitted on both sides, if C2 channels are in scope of supply. This test shall be same as test 2A of type test. Then test (i) above shall not be done.</p> <p>iii) Nut slip characteristic test (it shall support minimum load of 350kg before nut slips with a bolt torque of 65 NM). This test shall be same as test 5B3 of type test.</p> <p>The procedure for carrying out tests at “d” above shall be as per details given in Type Tests in specification thereafter Die-Penetration test shall be carried out to check weld integrity.</p> <p>e) The above acceptance tests shall be done only on one sample from each offered lot.</p>			
8.00.00	<b>COMMISSIONING</b>			
8.01.00	The Contractor shall carry out the following commissioning tests and checks after installation at site. In addition the Contractor shall carry out all other checks and tests as recommended by the Manufacturers.			
8.02.00	<p>Cables</p> <p>a) Check for physical damage</p> <p>b) Check for insulation resistance before and after termination/jointing.</p> <p>c) HT cables shall be pressure tested (test voltage as per IS:7098) before commissioning.</p> <p>d) Check of continuity of all cores of the cables.</p> <p>e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections etc., shall be carried out by the Contractor at no extra cost.</p>			
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8.03.00	f) Check for correct polarity and phasing of cable connections.  g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.  h) Check for provision of correct cable tags, core ferrules, and tightness of connections.			
	Cable trays / supports and accessories  1) Check for proper galvanizing/painting and identification number of the cable trays/supports and accessories. 2) Check for continuity of cable trays over the entire route. 3) Check that all sharp corners, burrs, and waste materials have been removed from the trays supports. 4) Check for earth continuity and earth connection of cable trays.			
	8.04.00 <b>Earthing and Lightning protection system</b>  1) Earth continuity checks.  2) Earth resistance of the complete system as well as sub-system.			
8.05.00	<b>GENERAL COMMISSIONING CHECKS (Application to all electrical equipments)</b> (a.) Check for name plate details according to specification. (b.) Check for physical damage, if an (c.) Check for tightness of all bolts, clamps & connecting terminals. (d.) Check for earth connection. (e.) Check for cleanliness of insulators & bushings. (f.) Check for lubrication of all moving parts. (g.) Check for provision of heater  Note: For Cabling, Earthing & Lightning Protection of Surface Pothead yard, please refer Sub Section E17 of the Technical Specification, Section-VI, Part-B.			
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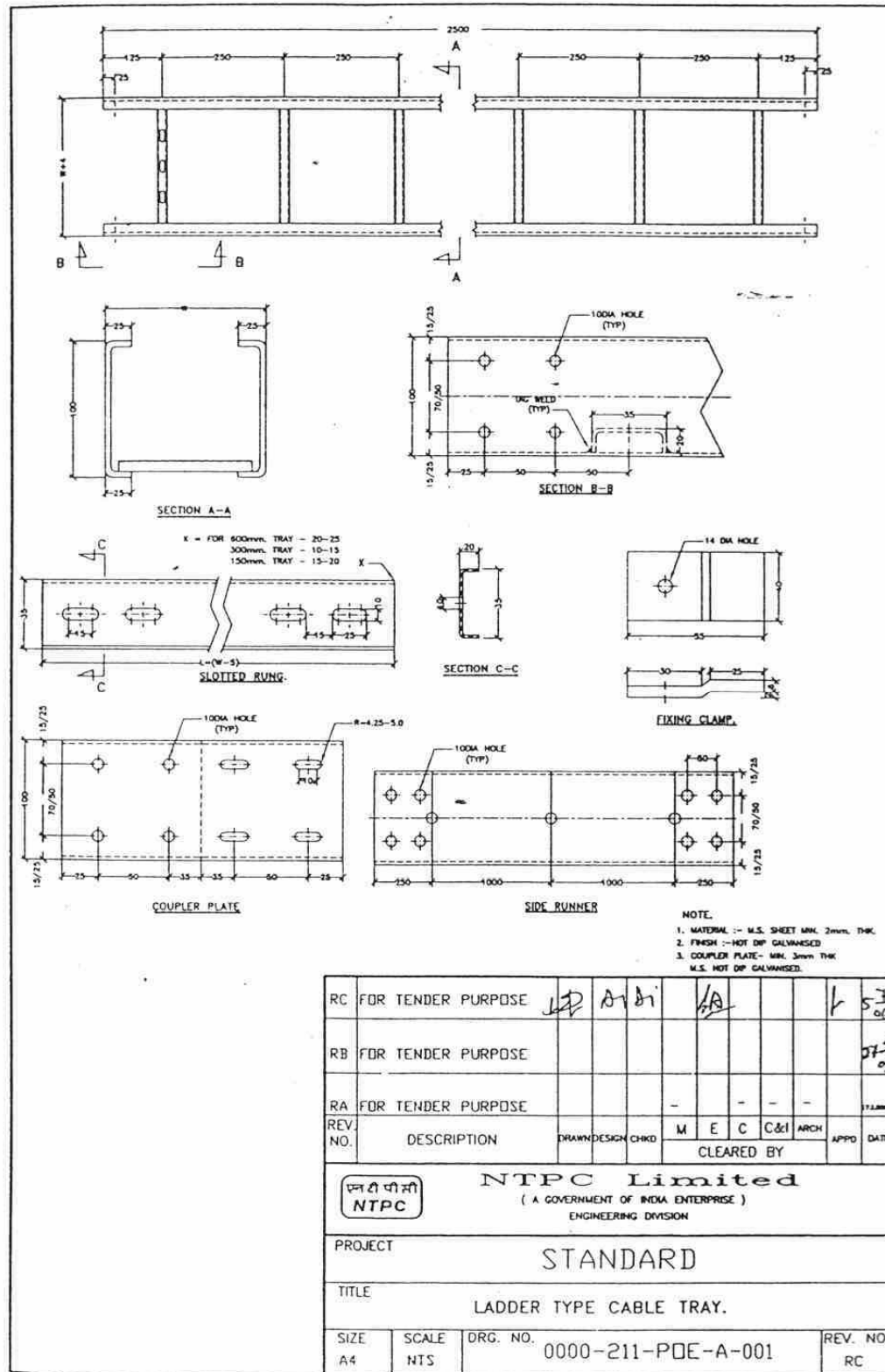


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	Sl. No.	Drawing Name	Drawing No.	
	1	Ladder type Cable Tray	0000-211-POE-A-001	
	2	Perforated Type Cable Tray	0000-211-POE-A-002	
	3	C1 & C2 Channel, Cable Tray Support System	0000-211-POE-A-013	
	4	Typical Details of Cable Tray Support System	0000-211-POE-A-014	
	5	Typical Details of Cable Tray Support System	0000-211-POE-A-015	
	6	Cantilever Arms	0000-211-POE-A-016	
	7	Typical Details of Cable Tray Support System	0000-211-POE-A-017	
	8	Typical Details of Cable Tray Support System	0000-211-POE-A-018	
	9	Fixing of Channel in Trench Wall	0000-211-POE-A-019	
	10	Bracket Floor Plate Light Duty	0000-211-POE-A-020	
	11	Bracket Floor Plate Heavy Duty	0000-211-POE-A-021	
	12	Bracket C1 Channel Clamp Heavy Duty And Bracket C2 Channel	0000-211-POE-A-022	
	13	Bracket Right Angle & Bracket Right Angle Heavy Duty	0000-211-POE-A-023	
	14	Beam Clamp	0000-211-POE-A-024	
	15	Bracket C1 Channel Clamp	0000-211-POE-A-025	
	16	Bracket Beam Clamp	0000-211-POE-A-026	
	17	Typical Details of Structure for Testing	0000-211-POE-A-036	
	18	Typical Details of Structure for Testing	0000-211-POE-A-037	
	19	Typical Details of Structure for Testing	0000-211-POE-A-038	
	20	Typical Details of Structure for Testing	0000-211-POE-A-039	
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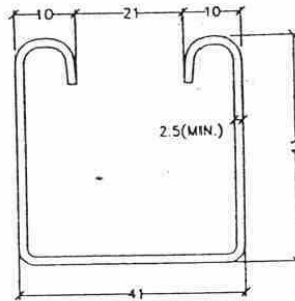


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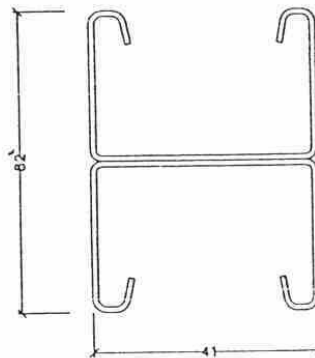
## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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SINGLE CHANNEL-TYPE C1



DOUBLE CHANNEL-TYPE C2

TWO LENGTHS OF C1 WELDED BACK TO BACK

## NOTES

- 1) ALL DIMENSIONS ARE IN mm.

RB	FOR TENDER PURPOSE	12/11/11	12							15/06	
RA	FOR TENDER PURPOSE									17/06/11	
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO DATE	
					CLEARED BY						
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		C1 & C2 CHANNEL, CABLE TRAY SUPPORT SYSTEM									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-013							REV. NO. RB		

TRAY1A-211-013

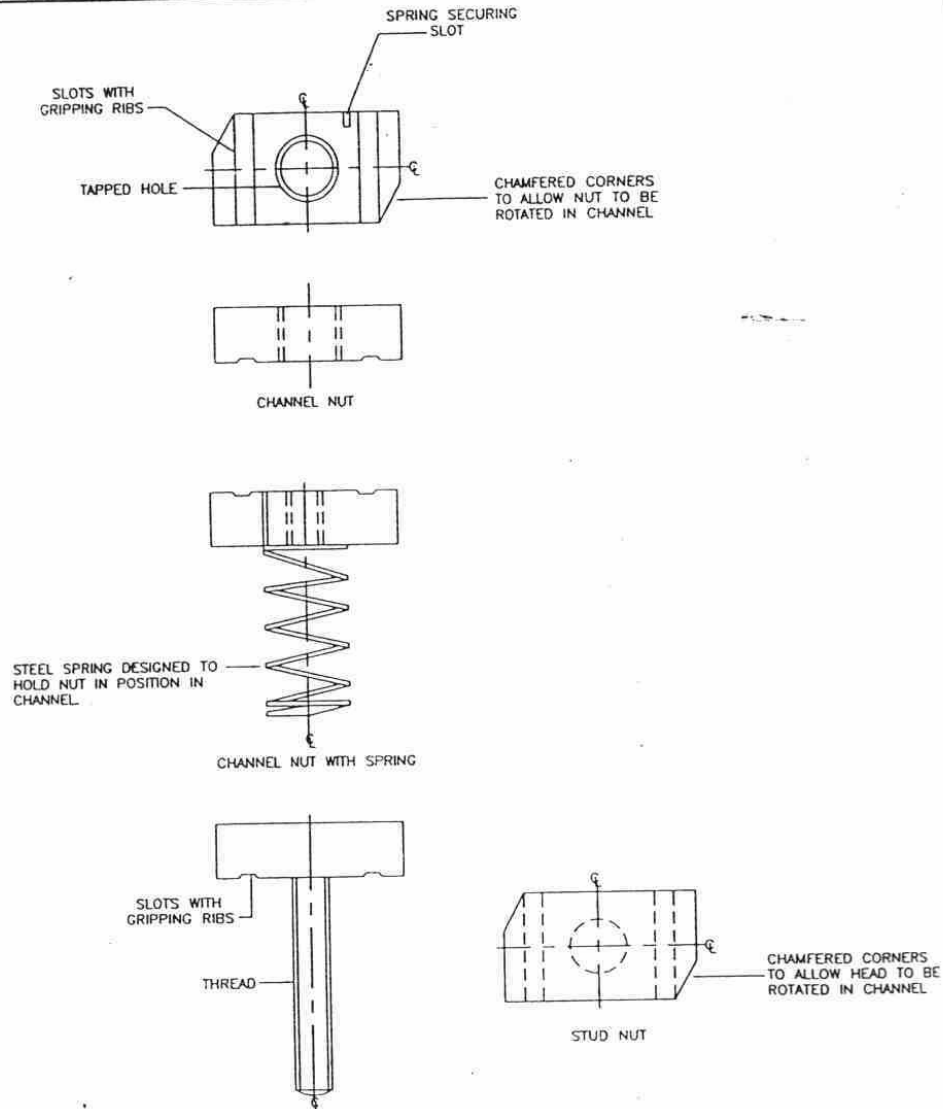


CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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TYPICAL DETAILS OF FIXING ACCESSORIES

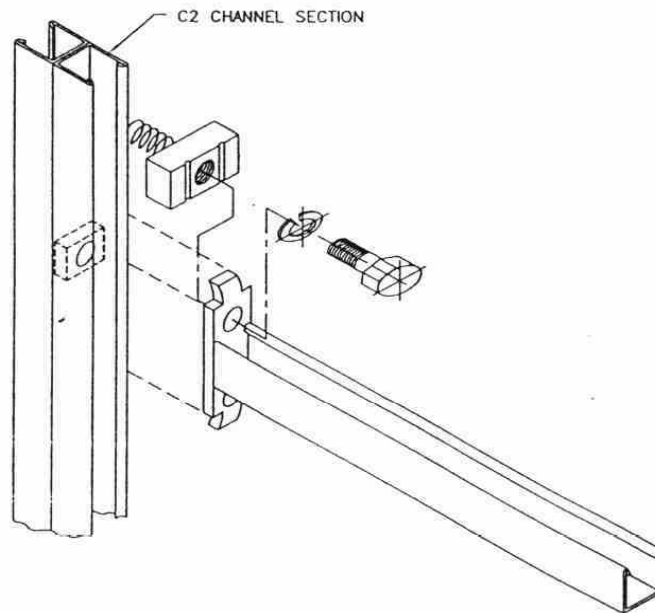
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<p style="text-align: center;"> <b>NTPC Limited</b>          ( A GOVERNMENT OF INDIA ENTERPRISE )          ENGINEERING DIVISION       </p>															
PROJECT STANDARD															
TITLE TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM															
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-014										REV. NO. RB			



CLAUSE NO.

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RB	FOR TENDER PURPOSE ONLY										
RA	FOR TENDER PURPOSE ONLY										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPO	DATE
					CLEARED BY						
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		TYPICAL DETAIL OF CABLE TRAY SUPPORT SYSTEM									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-015								REV. NO. RB	

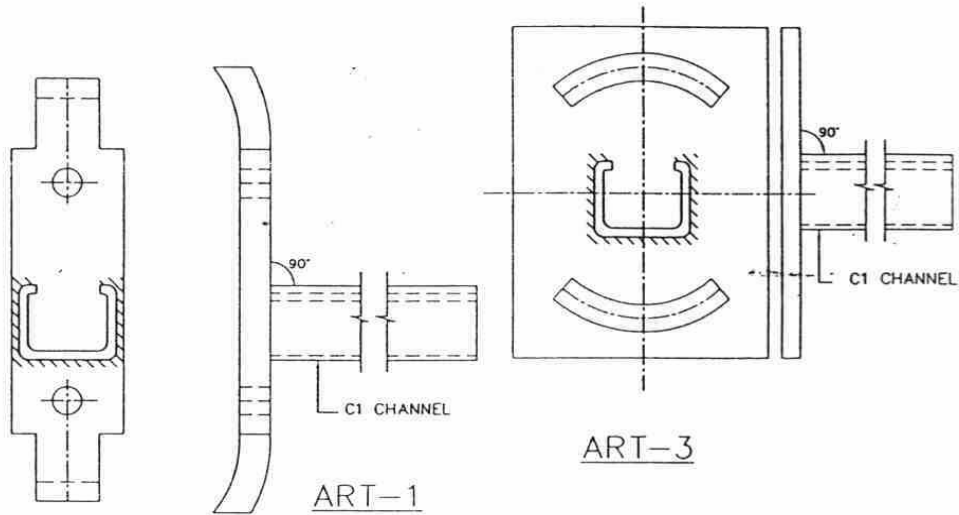
DWT FILE NAME: STAGE-III-POE-A-015



CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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हाइड्रो  
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## NOTES

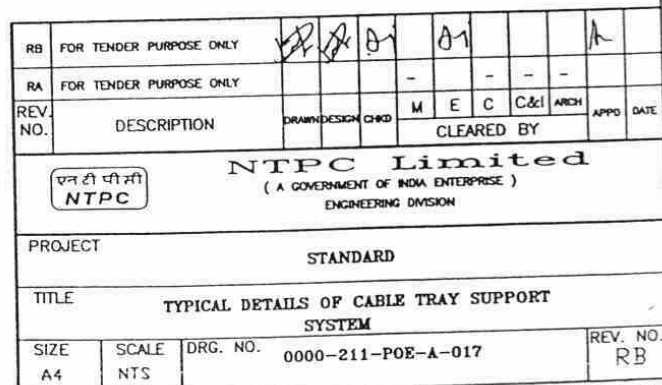
1. MATERIAL MILD STEEL
2. MATERIAL HOT DIP GALVANISED

ART-2

RB	FOR TENDER PURPOSE ONLY									
RA	FOR TENDER PURPOSE ONLY									
REV. NO.	DESCRIPTION	DRW	DESIGN	CHD	M	E	C	C&I	ARCH	APPD DATE
		Cleared By								
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION								
PROJECT		STANDARD								
TITLE		CANTILEVER ARMS								
SIZE	SCALE	DRG. NO.	0000-211-POE-A-016						REV. NO.	RB
A4	NTS									

CAD FILE NAME : STAND-211-016.DWG



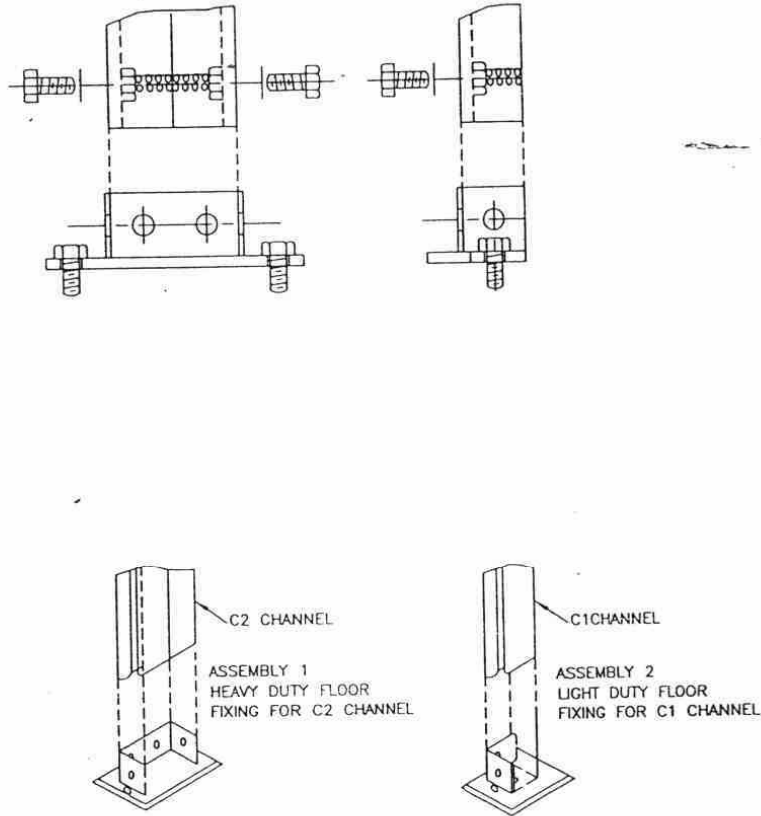




CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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FLOOR FIXING FOR CHANNEL VERTICAL SUPPORTS

RB	FOR TENDER PURPOSE ONLY									
RA	FOR TENDER PURPOSE ONLY									
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECKED	M	E	C	C&I	ARCH	APPRO. DATE
					CLEARED BY					
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION								
PROJECT		STANDARD								
TITLE		TYPICAL DETAILS OF CABLE TRAY SUPPORT SYSTEM								
SIZE	SCALE	DRG. NO.	0000-211-POE-A-018						REV. NO.	RB
A4	NTS									

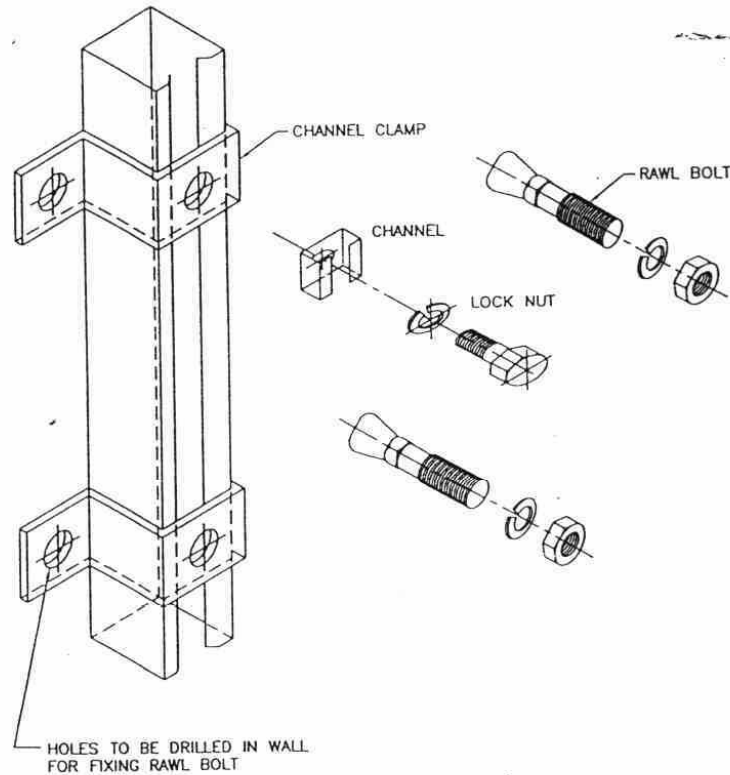
CAD FILE NAME : STAGE-2-DRG-D




CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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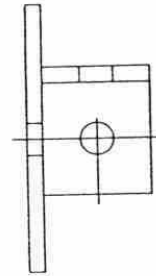
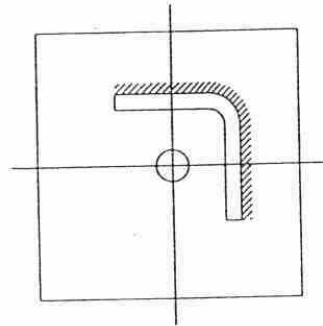
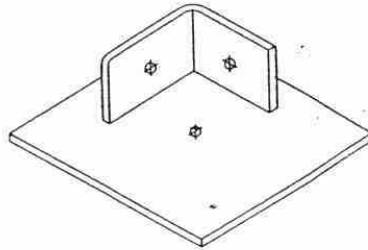


RB	FOR TENDER PURPOSE ONLY									
RA	FOR TENDER PURPOSE ONLY									
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHD	M	E	C	C&I	ARCH	APPO DATE
		CLEARED BY								
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION								
PROJECT		STANDARD								
TITLE		FIXING OF CHANNEL IN TRENCH WALL								
SIZE	SCALE	DRG. NO.							REV. NO.	
A4	NTS	0000-211-POE-A-019							RB	

CAD FILE NAME : STAND-211-019.DWG



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## NOTES

- 1) MATERIAL : MILD STEEL  
2) FINISH : HOT DIP GALVANISED.

RB	FOR TENDER PURPOSE																		57 06
RA	FOR TENDER PURPOSE																		17-11-2008
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECKED	M	E	C	C&I	ARCH	APPRO	DATE								
CLEARED BY																			
<div style="border: 1px solid black; padding: 5px; display: inline-block;">एन टी पी सी NTPC</div>		<p style="text-align: center;"><b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION</p>																	
PROJECT		STANDARD																	
TITLE		BRACKET FLOOR PLATE LIGHT DUTY.																	
SIZE A4	SCALE NTS	DRG. NO.		0000-211-PDE-A-020													REV. NO RB		

TRAY1A-211-020



## CABLING, EARTHING & LIGHTNING PROTECTION (E12)

2) FINISH : HOT DIP GALVANISED.

[illegible]

TRAY1A-211-021

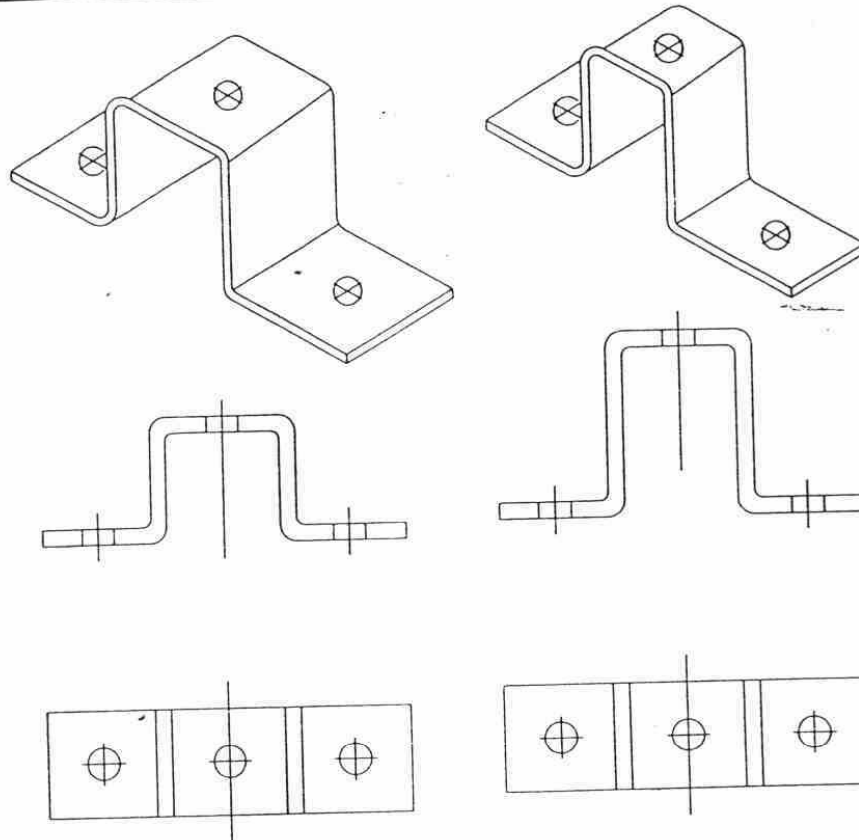


CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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BRACKET-C1 CHANNEL CLAMP HEAVY DUTY.

BRACKET-C2 CHANNEL CLAMP.

## NOTES

- 1) MATERIAL : MILD STEEL.
- 2) FINISH : HOT DIP GALVANISED.

RB	FOR TENDER PURPOSE	15/11/11		15/11/11		15/11/11		15/11/11		15/11/11	
RA	FOR TENDER PURPOSE										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
		CLEARED BY									
<p>एन टी पी सी NTPC</p>		<p><b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION</p>									
PROJECT		STANDARD									
TITLE		BRACKET C1 CHANNEL CLAMP HEAVY DUTY. AND BRACKET C2 CHANNEL.									
SIZE A4	SCALE NTS	DRG. NO. 0000-211-PDE-A-022								REV. NO. RB	

TRAYIA-211-022



## CABLING, EARTHING & LIGHTNING PROTECTION (E12)

The image contains two sets of technical drawings for brackets. The top set, labeled 'BRACKET RIGHT ANGLE', shows a 3D perspective view of a bracket with three bolt holes, a 2D side view, and a 2D front view. The bottom set, labeled 'BRACKET RIGHT ANGLE HEAVY DUTY', shows a 3D perspective view of a thicker bracket with two bolt holes, a 2D side view, and a 2D front view. The 3D views include hatching to indicate welded joints. The 2D views show the bolt hole patterns and dimensions.

BRACKET RIGHT ANGLE

BRACKET RIGHT ANGLE HEAVY DUTY

- 1) MATERIAL : MILD STEEL.
- 2) FINISH : HOT DIP GALVANISED.

[illegible]

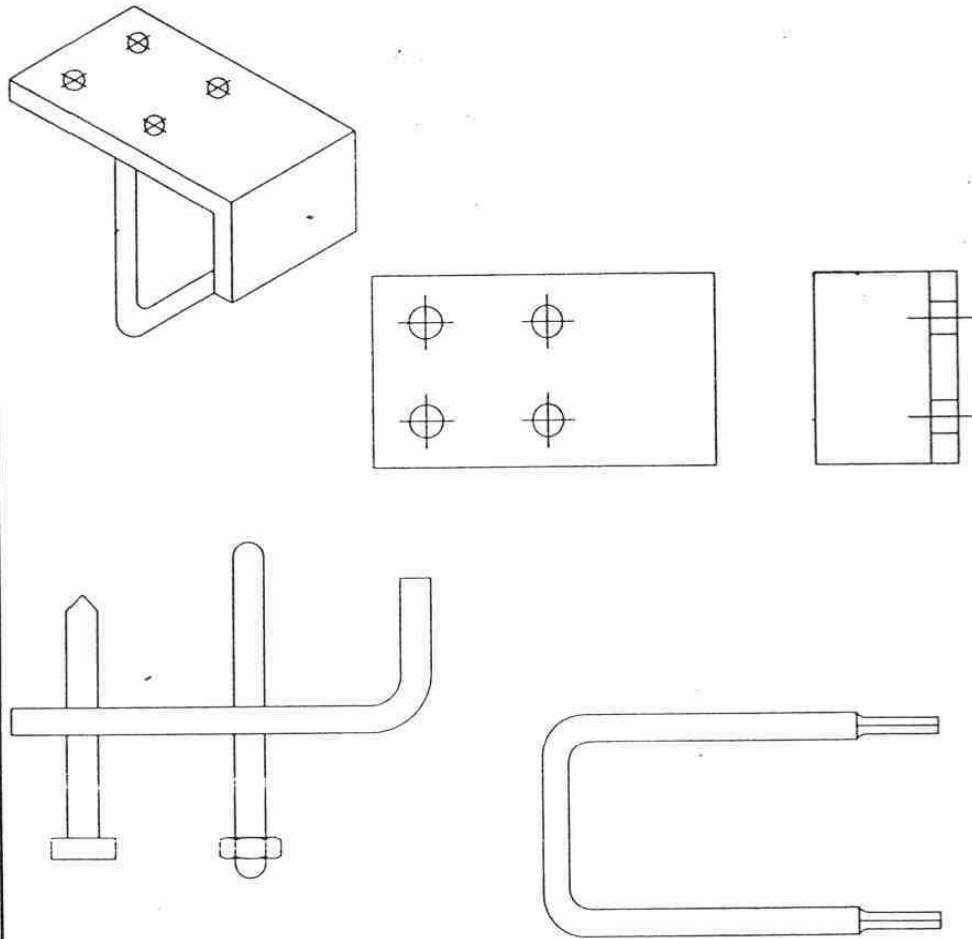


CLAUSE NO.


## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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**NOTES**

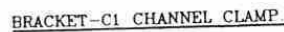
- 1) MATERIAL : MILD STEEL.
- 2) FINISH : HOT DIP GALVANISED.

RB	FOR TENDER PURPOSE	12/11/06	12/11/06							15/06	
RA	FOR TENDER PURPOSE										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE
					CLEARED BY						
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		BEAM CLAMP									
SIZE	SCALE	DRG. NO.							REV. NO.		
A4	NTS	0000-211-PDE-A-024							RB		

TRAY1A-211-024



## CABLING, EARTHING & LIGHTNING PROTECTION (E12)



1) MATERIAL : MILD STEEL  
2) FINISH : HOT DIP GALVANISED.

RB	FOR TENDER PURPOSE									157 06
RA	FOR TENDER PURPOSE				-	-	-	-		(P.L.M)
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECKED	M	E	C	C&I	ARCH	APPROV. DATE
CLEARED BY										

**NTPC Limited**  
 ( A GOVERNMENT OF INDIA ENTERPRISE )  
 ENGINEERING DIVISION

<b>एन टी सी NTPC</b>	
PROJECT	STANDARD
TITLE	BACKET C1 CHANNEL CLAMP.
SIZE A4	SCALE NTS
DRG. NO.	0000-211-PDE-A-025
REV. NO	RB

TRAY1A-211-025

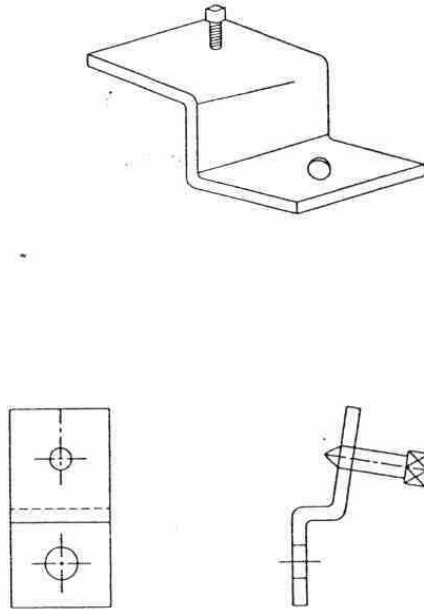


CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)


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## NOTES:

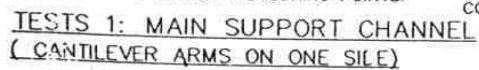
- 1) MATERIALS -MILD STEEL
- 2) FINISH-HOT DIP GALV.

RB	FOR TENDER PURPOSE	12/11/11	1A							15.7.11
RA	FOR TENDER PURPOSE									17.12.11
REV NO.	DESCRIPTION	DRAWN	DESIGN	CHKD	M	E	C	C&I	ARCH	APPRO DATE
					CLEARED BY					
		<b>NTPC Limited</b> ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION								
PROJECT		STANDARD								
TITLE		BRACKET BEAM CLAMP								
SIZE	SCALE	DRG. NO.							REV. NO.	
A4	NTS	0000-211-PDE-A-026							RB	

TRAYSUP2-211-026



## CABLING, EARTHING & LIGHTNING PROTECTION (E12)



ALL DIMENSIONS ARE IN MM  
(SCALE-NTS)

RA	FOR TENDER PURPOSE ONLY	1 2 3 4 5 6 7 8 9 10										
REV. NO.	DESCRIPTION	DRAWING	DESIGN	CHD	M	E	C	C&I	ARCH	APPRO	DATE	
		CLEARED BY										
<div><div>एन टी पी सी</div><div>NTPC</div></div>		<div>नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड</div> <div>National Thermal Power Corporation Ltd.</div> <div>( A GOVERNMENT OF INDIA ENTERPRISE )</div> <div>ENGINEERING DIVISION</div>										
PROJECT		STANDARD										
TITLE		TYPICAL DETAILS OF STRUCTURE FOR TESTING										
SIZE A4	SCALE NTS	DRG. NO. 0000-211-POE-A-036								REV. NO. RA		

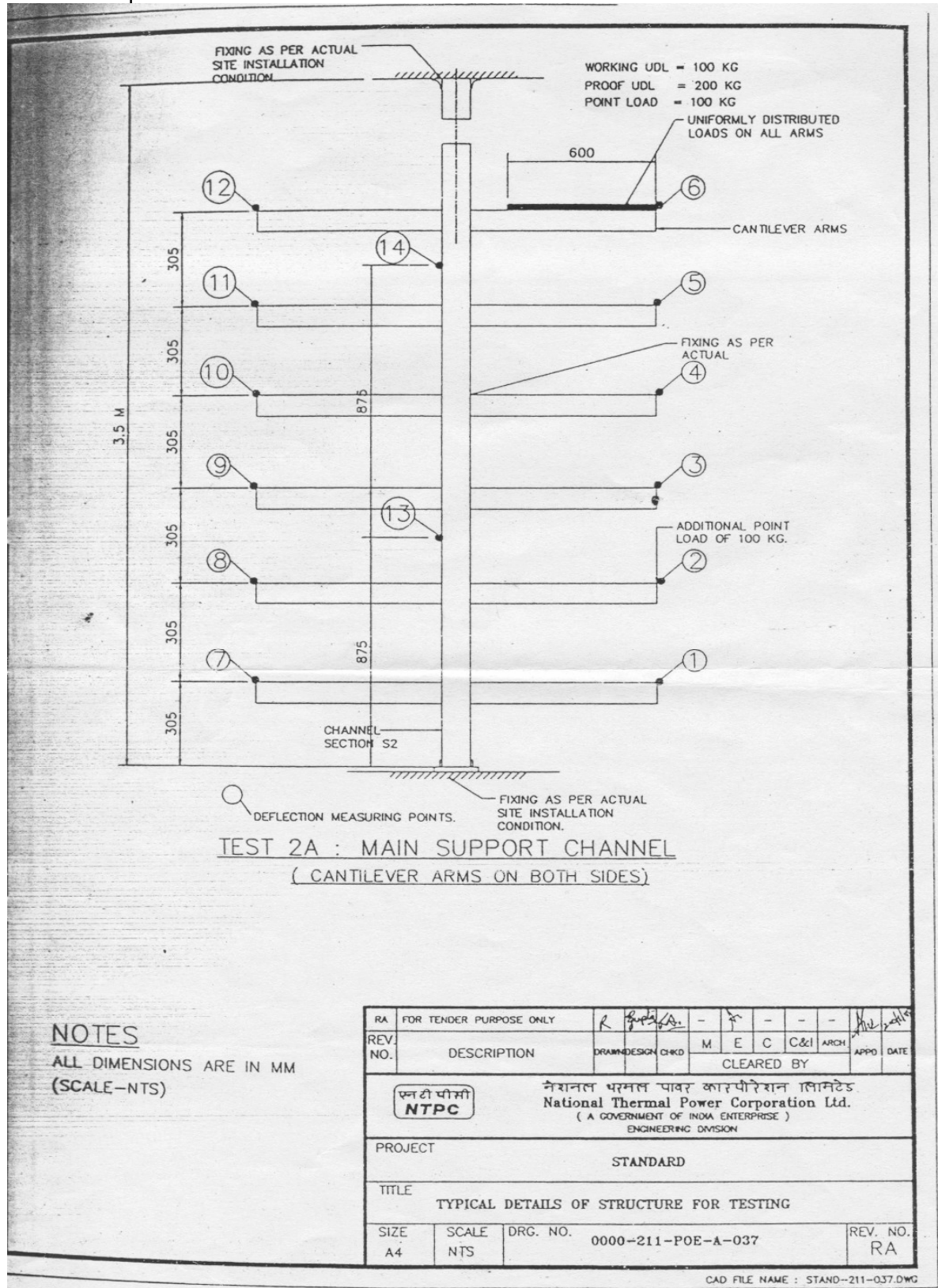
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CLAUSE NO.

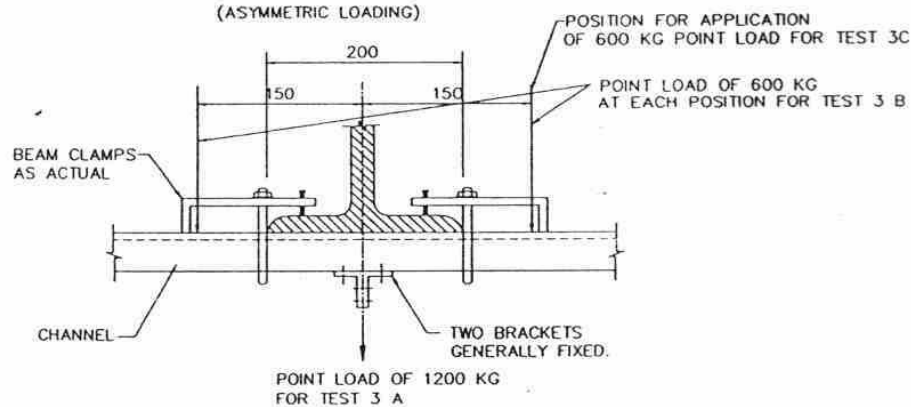
## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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


## CABLING, EARTHING & LIGHTNING PROTECTION (E12)



TEST 3A, 3B & 3C

1. FIXING SHALL BE AS PER ACTUAL SITE INSTALLATION CONDITION.
2. ALL DIMENSIONS ARE IN MM (SCALE-NTS)

RA	FOR TENDER PURPOSE ONLY	1	BP	SA	-	B	-	-	-	-	12/1/17
REV. NO.	DESCRIPTION	DRAWING DESIGN	CHKD	M	E	C	C&I	ARCH	APPD	DATE	
				CLEARED BY							
		नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड National Thermal Power Corporation Ltd. ( A GOVERNMENT OF INDIA ENTERPRISE ) ENGINEERING DIVISION									
PROJECT											
STANDARD											
TITLE											
TYPICAL DETAILS STRUCTURE FOR TESTING											
SIZE A4	SCALE NTS	DRG. NO.	0000-211-POE-A-038							REV. NO. RA	

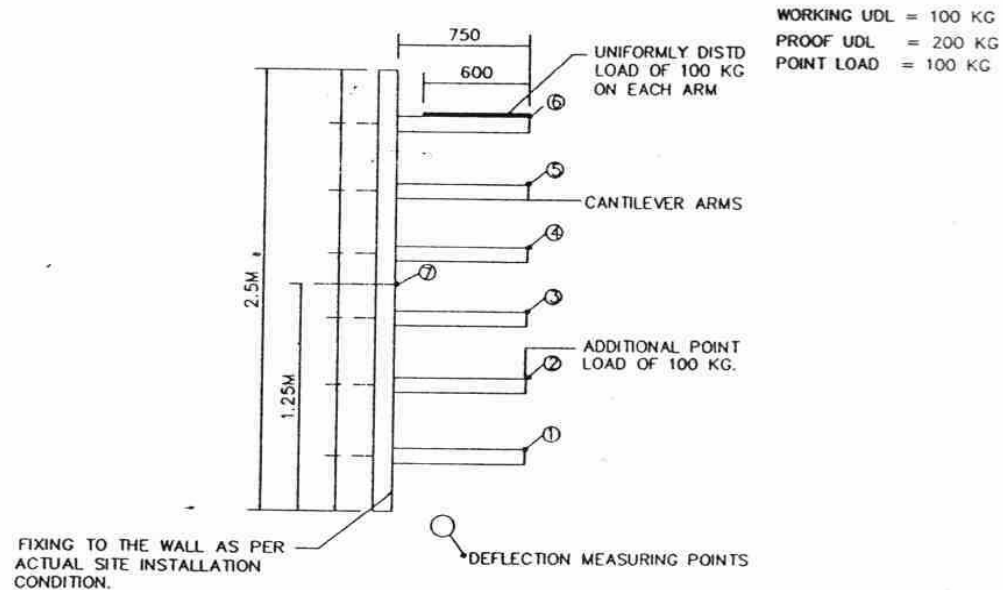
CAD FILE NAME : STAND-211-038.DWG



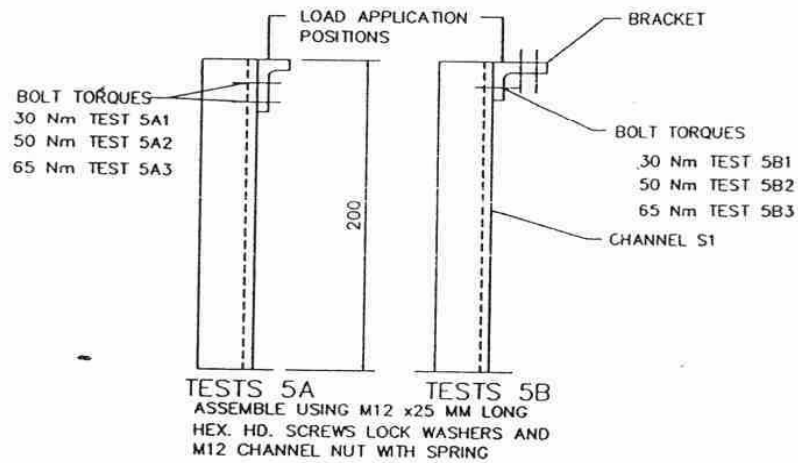
CLAUSE NO.

## CABLING, EARTHING &amp; LIGHTNING PROTECTION (E12)

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TEST 4 CHANNEL INSERT



TESTS 5A 1,2,3 &amp; 5B 1,2,3 CHANNEL NUT SLIP CHARACTERISTIC.

## NOTES

ALL DIMENSIONS ARE IN MM  
(SCALE-NTS)

RA	FOR TENDER PURPOSE ONLY										
REV. NO.	DESCRIPTION	DRAWN	DESIGN	CHECKED	M	E	C	C&I	ARCH	APPRO	DATE
		CLEARED BY									
		नेशनल थर्मल पावर कॉर्पोरेशन लिमिटेड National Thermal Power Corporation Ltd. (A GOVERNMENT OF INDIA ENTERPRISE) ENGINEERING DIVISION									
PROJECT		STANDARD									
TITLE		TYPICAL DETAILS OF STRUCTURE FOR TESTING									
SIZE	SCALE	DRG. NO.								REV. NO.	
A4	NTS	0000-211-POE-A-039								RA	

CAD FILE NAME : STAND-211-039.DWG



## ANNEXURE-E

### SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES FOR ERECTION HARDWARE

#### 1.0 SCOPE

The scope of this specification is to specify all details required by a supplier for supply of galvanized hardware for projects being executed by BHEL on turnkey basis.

#### 2.0 SPECIFIC TECHNICAL REQUIREMENTS

##### 2.1 BOLTS:

Bolts as per BOQ shall be used in equipment mounting and earthing connection.

All bolts for member connections in towers, beams & equipment support structures shall conform to IS: 12427 - 2001 and for step bolts shall conform to IS: 10238 – 1982.

The mechanical properties shall conform to property class 5.6 of IS:1367 (part 3) - 1991.

All bolt heads shall have hexagonal shape, the heads being forged out of the solid material truly concentric and square with the shank, which must be perfectly straight.

All bolts shall be threaded with metric standard thread to take the full depth of the nut and permit firm grip of the member.

All bolts shall be hot dip galvanized as per IS: 1367 (Part 13) – 1983.

##### 2.2 NUTS:

All nuts shall conform to IS: 1363 (Part 3) –1992.

The mechanical properties shall conform to property class 5 of IS:1367 (part 6) – 1980.

The nuts shall be capable of being worked with fingers along the entire threaded portion of the bolt with a neat fit capable of developing the full strength of the bolt.

All nuts shall be hot dip galvanized as per IS: 1367 (Part 13) – 1983.

##### 2.3 PLAIN WASHERS:

All plain washers shall be punched washers, A type conforming to IS: 2016-1967.

These shall be hot dip galvanized as per IS: 4759 – 1984.

##### 2.4 SPRING WASHER:

All spring washers shall be of spring steel, positive lock type and conforming to type B of IS: 3063-1972. The thickness of spring washer shall be as per IS: 3063 – 1994 (Table 1A & 1B)

These shall be electro-galvanized as per IS: 1573 – 1986 and shall have service grade number – 4 as per IS:1573 – 1986 (Appendix A).

#### 3.0 QUANTITIES:

Each nut bolt set will generally have two plain washers and one spring washer

Sl. No.	Bolt Size	Length (mm)	Threading	Spring Washer	Plain Washer
01	M12 – M33	40 - 140	Fully Threaded	Service grade number – 4 as per IS: 1573 – 1986 (Appendix A).	As per table 2 of IS: 2016-1967



## ANNEXURE-G: PROJECT DETAILS

### 3.1 PROJECT DETAILS

	Particular	Details
a)	Customer	NTPC Ltd.
b)	Engineer/Consultant/ Inspector	NTPC Ltd.
c)	Project Title	NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW): 132kV Switchyard
d)	Project Location	The project can be accessed from Siliguri via Ghoom in Darjeling district of West Bengal or from Jorhang in Sikkim by road. Bagdogra is nearest airport. New Jalpaiguri is the nearest broad gauge railway station. The proposed project site is connected by all-weather metalled road from Siliguri.
e)	Latitude & Longitude	North: 27°6'00", 27°9'00" and East: 88°8'00", 88°14'00"
f)	Nearest Railway Station	New Jalpaiguri
g)	Distance of project location from the Railway station	75kms (approx.)
h)	Nearest Major Town	Siliguri
i)	Distance of the town from the project site	140km.
j)	Nearest commercial airport	Bagdogra
k)	Distance of airport from the project site	-
<b><u>SITE CONDITIONS</u></b> (for design purposes)		
a)	Design ambient temperature	40°C
b)	Maximum Relative humidity	Max. <95% & ^Min. >35%
c)	Height above mean sea level	Less than 910meter
d)	Pollution Severity	Class-III, Heavy (25mm/kV)
e)	Criteria for Wind Resistant design of structures and equipment	Standard Applicable - IS 875 (Part 3) 1987
f)	Basic Wind speed "Vb" at ten meters above the mean ground level.	47 m/ sec
g)	Category of terrain	Cat -2
h)	Risk Coefficient "K1"	1.07

#### 3.1.1 SYSTEM PARAMETERS:

Sl.No.	Parameters	
		132 kV
1	Highest system voltage	145 kVrms
2	Lightning Impulse voltage	650 kV
3	Switching impulse voltage	NA
4	Power frequency withstand for 1 min (rms)	275 kV
5	Max. fault level (1 sec.)	31.5 kA
6	Minimum creepage distance	3625 mm



### 3.1.2 AUXILIARY POWER:

Sl.No.	Nominal Connection Voltage	Variations in Voltage	Frequency	Phase	Neutral
1	415V	±10%	50±5%	3Phase , 4 Wire	Solidly Earthed
2	240V	±10%	50±5%	1 phase	Solidly Earthed

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

**3.1.3** The various minimum heights of the switchyard shall be as given below from plinth level:

Voltage	Equipment /1st Level	2nd Level	3rd Level
132kV	5000mm	11500mm	14000mm/18000mm

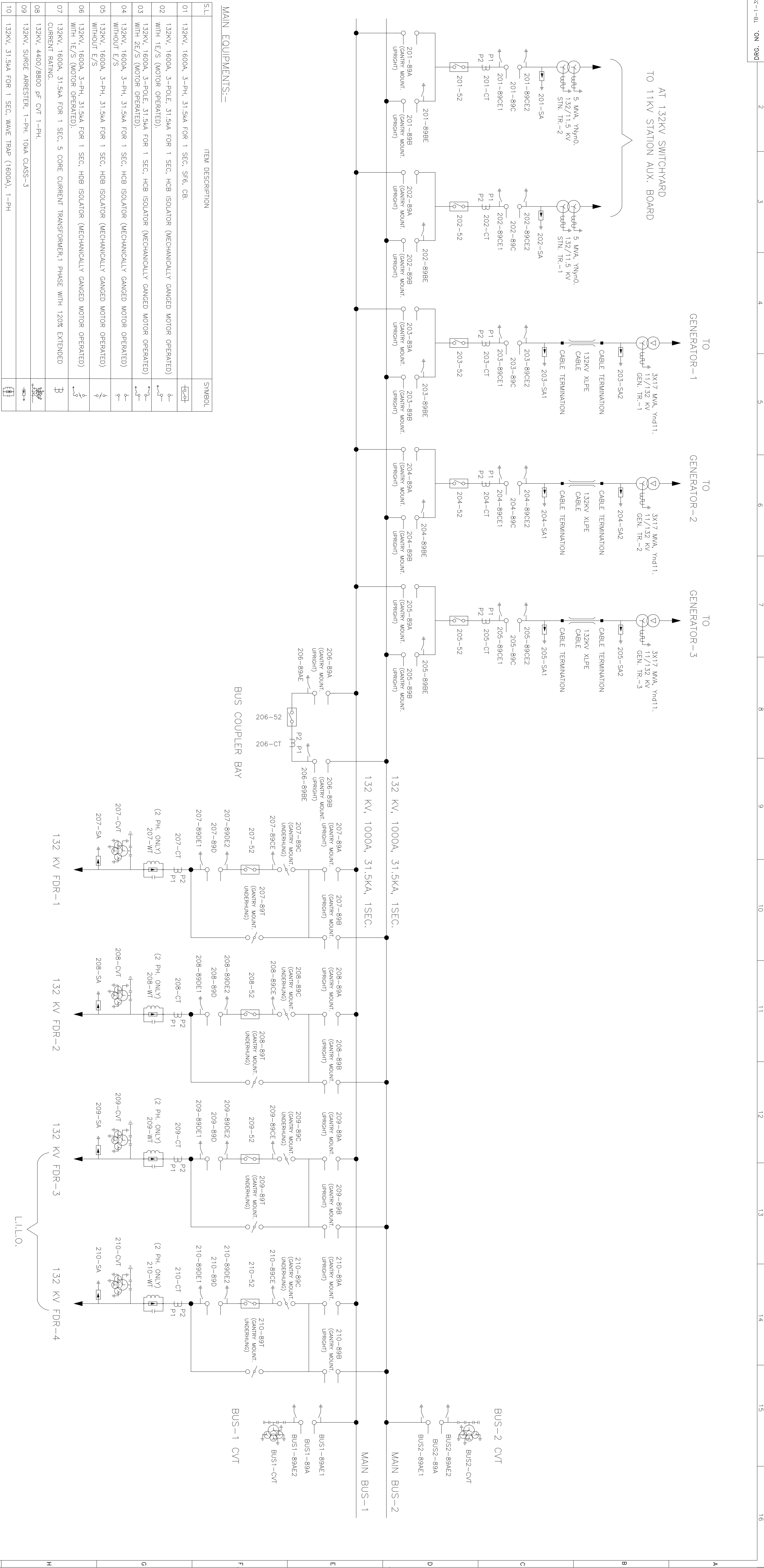
The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or support insulators to the bottom of the equipment structure, where it rests on the foundation pad shall be 2250mm.

**3.1.4** The minimum clearances for 132 kV switchyards shall be as given below:











#### **132kV**

Phase to earth clearance	1300 mm
Phase to phase clearance	1300 mm
Section clearance	3800 mm





#### MAIN EQUIPMENTS:-

S.L.	ITEM DESCRIPTION	SYMBOL
01	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. SF6. CB.	
02	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. HCB ISOLATOR (MECHANICALLY GANGED MOTOR OPERATED) WITH 1E/S (MOTOR OPERATED).	
03	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. HCB ISOLATOR (MECHANICALLY GANGED MOTOR OPERATED) WITH 2E/S (MOTOR OPERATED).	
04	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. HCB ISOLATOR (MECHANICALLY GANGED MOTOR OPERATED) WITHOUT E/S	
05	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. HCB ISOLATOR (MECHANICALLY GANGED MOTOR OPERATED) WITHOUT E/S	
06	132KV, 1600A, 3-PH, 31.5KA FOR 1 SEC. HCB ISOLATOR (MECHANICALLY GANGED MOTOR OPERATED) WITH 1E/S (MOTOR OPERATED).	
07	132KV, 1600A, 31.5KA FOR 1 SEC. 5 CORE CURRENT TRANSFORMER, 1 PHASE WITH 120% EXTENDED CURRENT RATING.	
08	132KV, 4400/8800 pF CUT 1-PH.	
09	132KV, SURGE ARRESTER, 1-PH, 10KA CLASS-3	
10	132KV, 31.5KA FOR 1 SEC. WAVE TRAP (1600A), 1-PH	

GEN.-1, 2 & 3 CT PARAMETERS:-

No.	Core	RATIO	Output Burden at lowest Tap (VA)	Max. Exiting current at lowest tap (Amps)	Max CT secondary resistance (Ohm)	Ace Class	Purpose
5	1200-600-	-	1200-600- 300V	30-60-120	63.2	PS	PROTECTION
4	1200-600-	-	1200-600- 300V	30-60-120	63.2	PS	PROTECTION
3	1200-600-	20VA	300V	-	-	0.2	METERING
2	1200-600-	-	1200-600- 300V	30-60-120	63.2	PS	PROTECTION
1	1200-600-	-	1200-600- 300V	30-60-120	63.2	PS	PROTECTION

132kV FDR-1, 2 & 3 CT PARAMETERS:-

Core No.	RATIO	Output Buried at lowest Tap	Min FVW (V)	Max. Exchng current at 1200V	Max CT secondary resistance	Acc Class	Purpose
5	1200:600-	-	2400-1200-	30:60-120	6.5/2	PS	PROTECTION
4	1200:600-	-	2400-2100-	30:60-120	6.5/2	PS	PROTECTION
3	1200:600-	20VA	-	-	-	0.2	METERING
2	1200:600-	-	1200:600-	30:60-120	6.5/2	PS	PROTECTION
1	1200:600-	-	1200:600-	30:60-120	6.5/2	PS	PROTECTION

CVT PARAMETERS:-

Ratio	$\frac{132\text{KV}}{\sqrt{3}} / \frac{110\text{V}}{\sqrt{3}} / \frac{110\text{V}}{\sqrt{3}} / \frac{110\text{V}}{\sqrt{3}}$
Sec-I	Class - 3P, 50VA
Sec-II	Class - 3P, 50VA
Sec-III	Class -0.2, 50VA

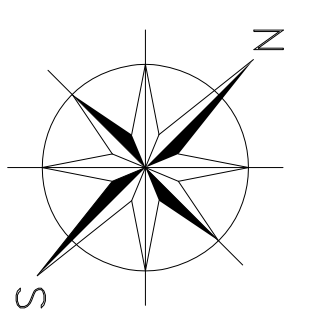
NOTES : -

- 01) EQUIPMENT RATING LEVEL=31.5/44 FOR SEC FOR 132KV.
  - 02) 132KV WAVE TRAP SHALL BE PROVIDED IN TWO PHASES ONLY.
  - 03) ISF FOR THE METERING CORE OF CT SHALL BE LESS THAN 5.
  - 04) RATING OF CT AND PT SHALL BE SUBJECT TO FINALIZATION SIZING OF CT AND PT IN A SEPARATE DOCUMENT.
  - 05) WAVE TRAP RATING SHALL BE FURNISHED BY NTPC AFTER RECEIVING FROM WESTCOAL AND SAME WILL BE MENTIONED IN DATA SHEET OF WAVE TRAP.
- 06) FOR THE DETAIL OF GENERATING TRANSMISSION AREA AND 11KV STATION AUX. REFER DWG. NO. 5602-003-14250-PE-P-001 MAIN SINGLE LINE DIAGRAM.

[illegible]

CUSTOMER :									
<div><div>एन टी पी सी</div><div>NTPC</div></div> <div>एन. टी. पी. सी. लिमिटेड</div> <div>NTPC LIMITED</div> <div>( A GOVERNMENT OF INDIA ENTERPRISE )</div>									
PROJECT									
NTPC RAMMAM STAGE-III HDRO ELECTRIC PROJECT (3X40MW)									
TITLE									
<div><div>बी भार्गव ई एन</div><div>BEEL</div></div>					BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOLDA				
132KV SINGLE LINE DIAGRAM									
SUB-VENDOR NAME									
WEIGHT (kg)									
SCALE									
<div><div></div><div></div></div>									
SHEET NO. 01									
NO. OF SHIT. 01									
REV.									
03									





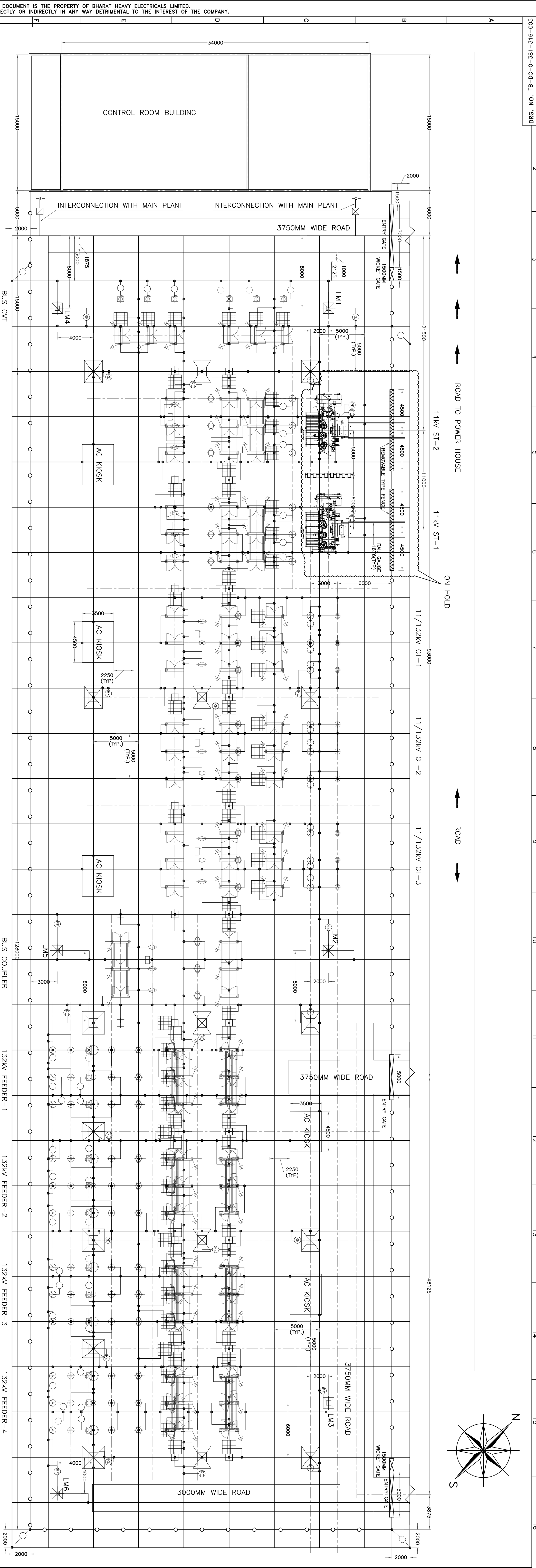
15	HEIGHT OF EQUIPMENT CONNECTION (LEAF FROM PLUMB)		1320
14	EQUIPMENT INTER CONNECTION		SYSTEM
13	MAX BAY 1 & 2		1340
12	CONDUCTOR STATIC TENSION		1340
11	SUB CONDUCTOR SPACING		1340
10	BASED SPACE CROWN CURRENT FOR 135C DIRECTION		3
9	WUL CLEARANCE		5000
8	WUL CLEARANCE DISTANCE		1300MM
7	MAX. RATIO INTERFERENCE VOLTAGE RISE FREQUENCY 120W SYSTEM		1300MM
6	CROWN CLEARANCE VOLTAGE		1300MM
5	ONE MOUNT POWER FREQUENCY (WY & WIT)		275W
4	ONE MOUNT POWER FREQUENCY (WY & WIT)		275W
3	BASED RESONANCE LENGTH		6500W
2	BASED FREQUENCY		3
1	SYSTEM OPERATING VOLTAGE OF THE SYSTEM (mm)		1320

<div>CUSTOMER :</div> <div><div><div><div>पूँजी चामल</div><div>NTPC</div></div><div><div>एन.टी.पी.सी. लिमिटेड</div><div>NTPC LIMITED</div><div>( A GOVERNMENT OF INDIA ENTERPRISE )</div></div></div></div>									
PROJECT NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)									
<div><div><div>पूँजी चामल</div><div>NTPC</div></div><div><div>भारत हेवी इलेक्ट्रिकल्स लि.</div><div>TRANSMISSION BUSINESS GROUP</div><div>NOIDA</div></div></div>		<div><div><div>DRPT. CODE</div><div>DRN DM</div><div>HSE CKD MS</div><div>415 APMD VK/AS</div><div>SUB-VENDOR DRG. NO.</div></div><div><div>NAME</div><div>—SD—</div><div>—SD—</div><div>—SD—</div><div>PO REF</div></div><div><div>SIGN</div><div>—SD—</div><div>—SD—</div><div>—SD—</div><div></div></div><div><div>DATE</div><div>06.11.15</div><div>06.11.15</div><div>06.11.15</div><div></div></div></div>							
TITLE		1.32kV SWITCHYARD LAYOUT							
REV. DATE		ALTERED DM		REV. DATE		ALTERED DM		REV. DATE	
05 23.07.16		CHECKED MS APPD. AS		04 26.04.16		CHECKED SK APPD. AS		REV. DATE	
ZONE		REVISED TO SEPARATE BUS CXT ISOLATOR STRUCTURE FROM MAIN GANTRY.		ZONE		REVISED AS PER CUSTOMER COMMENT LETTER DATED. 26.04.16		REV. DATE	
REFERENCE DRAWING:—									
1. SINGLE LINE DIAGRAM FOR 132KV S/S AT NTPC RAMMAM – DRG. 5602-003-H230-PYE-F-105									
2. TENDER PLAN & SECTION DRAWING NO. 5602-003-F-E-A-108									









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EARTHING NOTES :-

- 1) ALL EQUIPMENTS AND STRUCTURES SHALL, IN GENERAL, BE GROUNDED AT TWO POINTS AT OPPOSITE CORNERS WHETHER SHOWN IN DRAWING OR NOT AND THESE SHALL BE CONNECTED TO DIFFERENT PARTS OF THE MATS WHEREVER POSSIBLE IN ADDITION ALL EARTHING AS PER TYPICAL EARTHING DETAIL IN DRG. NO. 5602-003-H230-PVE-E-100 TO BE FOLLOWED.
- 2) GROUNDING CONDUCTORS IN OUTDOOR AREAS SHALL BE BURIED AT LEAST 600MM BELOW FGL UNLESS STATED OTHERWISE.. WHENEVER A GROUNDING CONDUCTOR CROSSES ROADS, CABLE TRENCHES, UNDERGROUND SERVICE DUCTS, PIPE TUNNELS, RAILWAY TRACKS, OIL RECOVERY TANK, TRANSFORMER SOAK PIT ETC. SHALL BE LAID AT LEAST 300MM BELOW THEM, AND SHALL BE REROUTED ROUND THE EQUIPMENT/STRUCTURE FOUNDATIONS.
- 3) GROUNDING CONDUCTORS EMBEDDED IN CONCRETE SHALL HAVE APPROXIMATELY 50mm CONCRETE COVER, IF POSSIBLE IN ADDITION ALL EARTHING AS PER TYPICAL EARTHING DETAIL IN DRG. NO. 5602-003-H230-PVE-E-100 TO BE FOLLOWED.
- 4) CONNECTION WITH EQUIPMENT EARTHING PAD SHALL BE BOLTED TYPE CONNECTION BETWEEN EQUIPMENT GROUNDING LEADS AND MAIN GROUND CONDUCTORS SHALL BE WELDED TYPE. FOR RUST PROTECTION THE WELDS SHALL BE CLEANED WITH WIRE BRUSH, TREATED WITH TWO COAT OF RED PRIMER AND AFTERWARDS THICKLY COATED WITH BITUMEN FOR GROUND CONNECTIONS SHALL BE MADE BY ELECTRIC ARC WELDING. ALL WELDED JOINTS SHALL BE ALLOWED TO COOL DOWN GRADUALLY TO ATMOSPHERIC TEMPERATURE BEFORE PUTTING ANY LOAD ON THEM. ARTIFICIAL COOLING SHALL NOT BE ALLOWED.
- 5) BENDING OF LARGE DIAMETER ROD/THICK CONDUCTOR SHALL BE DONE BY GAS HEATING.
- 6) ALL ARC WELDING OF LARGE DIAMETER CONDUCTORS SHALL BE DONE BY NORMAL LOW HYDROGEN CONTENT ELECTRODES.
- 7) LOCATION OF Ⓡ ROD ELECTRODES WITH TEST LINK, ○ ROD ELECTRODES WITHOUT TEST LINK & Ⓢ PIPE ELECTRODE WITH TREATED PIT ARE SHOWN TENTATIVELY.
- 8) 3000MM PIPE ELECTRODE SHALL BE PROVIDED.
- 9) EARTHING TERMINAL OF EACH SURGE ARRESTER, CVT AND LIGHTNING DOWN CONDUCTOR SHALL BE DIRECTLY CONNECTED TO ROD ELECTRODE WHICH IN TURN SHALL BE CONNECTED TO STATION EARTHING GRID.
- 10) GROUNDING CONDUCTORS ALONG THEIR RUN ON CABLE TRENCH, LADDER, COLUMNS, BEAMS, WALLS, ETC. SHALL BE SUPPORTED BY SUITABLE WELDING/CLEANING AT INTERVALS OF 600MM. EARTHING CONDUCTORS ALONG CABLE TRENCHES SHALL BE ON THE WALL NEARER TO THE EQUIPMENT. WHEREVER IT PASSES THROUGH WALLS, FLOORS ETC. GALVANIZED IRON SLEEVES SHALL BE PROVIDED FOR THE PASSAGE OF THE CONDUCTOR. BOTH ENDS OF THE SLEEVES SHALL BE SEALED TO PREVENT THE PASSAGE OF WATER THROUGH THE SLEEVES.
- 11) ALL STEEL COLUMNS, METALLIC STAIRS ETC. SHALL BE CONNECTED TO THE NEAREST GROUNDING CONDUCTOR BY GROUNDING LEADS.
- 12) LIGHTING POLES, JUNCTION BOXES ON THE POLES, CABLE BOXES/GLANDS, SWITCHES ETC. SHALL BE CONNECTED TO CONDUCTOR RUNNING ALONGWITH THE SUPPLY CABLE WHICH IN TURN SHALL BE CONNECTED TO THE GROUNDING GRID CONDUCTOR AT LEAST TWO POINTS WHETHER SPECIFICALLY SHOWN OR NOT.
- 13) 75X12 mm STEEL FLAT SHALL BE USED FOR EARTHING OF CABLE TRENCHES. ALL TRENCHES SHALL BE EARTHED AT AND INTERVAL OF 30m ALONG THE LENGTH OF THE TRENCH.
- 14) FOR EQUIPMENT, FENCE, GATE, AUXILIARY EARTH MAT ETC. EARTHING DETAILS REFER EQUIP EARTHING DWG. NO. 5602-003-H230-PVE-E-100.
- 15) EVERY POST OF FENCE AND GATE SHALL BE CONNECTED TO EARTHING LOOP BY ONE LEAD.
- 16) THE RISER CONNECTION TO EARTH MAT WILL BE 40mm DIA ROD. THE RISER TO EQUIPMENT/ STRUCTURE CONNECTION WILL BE BY 75X12mm G.I. FLAT & 50X6mm G.S. FLAT FOR OPERATING BOXES/CUBICLES.
- 17) IN CASE HIGH TEMPERATURE IS ENCOUNTERED AT SOME LOCATION THE EARTHING CONDUCTOR SHALL BE LAID MINIMUM 1500mm AWAY FROM SUCH LOCATIONS.

LEGENDS

- AUX. EARTHMAT (1500MMX1500MM)
- INTERCONNECTION WITH TEST LINK
- EARTH MAT CONDUCTOR 40mm DIA MS ROD
- ROD ELECTRODE WITHOUT TEST LINK
- ROD ELECTRODE WITH TEST LINK
- PIPE ELECTRODE WITH TREATED PIT
- RISER FOR EQUIPMENT/ STRUCTURE EARTHING

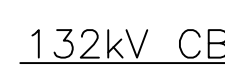
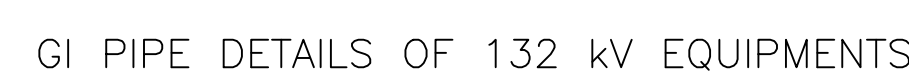
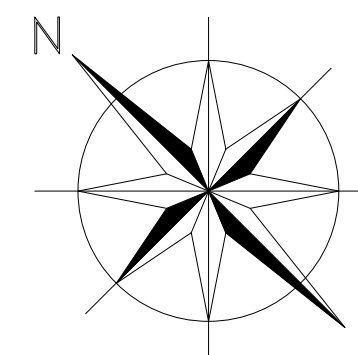
QUANTITIES OF MATERIALS	
40 MM DIA MS ROD (INCLUDING ROD ELECTRODES) FOR MAIN EARTH MAT, AUX. EARTH MAT AND RISERS.	80 MT (7750m)
75X12 MM GS FLAT	45 MT (6300m)
50X6 MM GS FLAT	5 MT (7700m)
40mm DIA, 3000mm LONG, MS ROD ELECTRODE WITH TEST LINK (L.M. TOWER WITH PEAK)	23 NOS.
40mm DIA, 3000mm LONG, MS ROD ELECTRODE WITHOUT TEST LINK (L.A. CVT, FENCE)	58 NOS.*
40mm DIA, 3000mm LONG, GS PIPE ELECTRODE WITH TREATED PIT (TRANSFORMER)	8 NOS.
EARTH WIRE(SHIELD WIRE/DOWN COND.) 7/3.6mm GI	1060m
EARTHING OF LIGHTING FIXTURE 16 SWG	1 LOT

\* - QTY INCLUDES 09 NOS. ELECTRODES PROVIDED FOR LA IN GENERATING TRANSFORMER YARD.

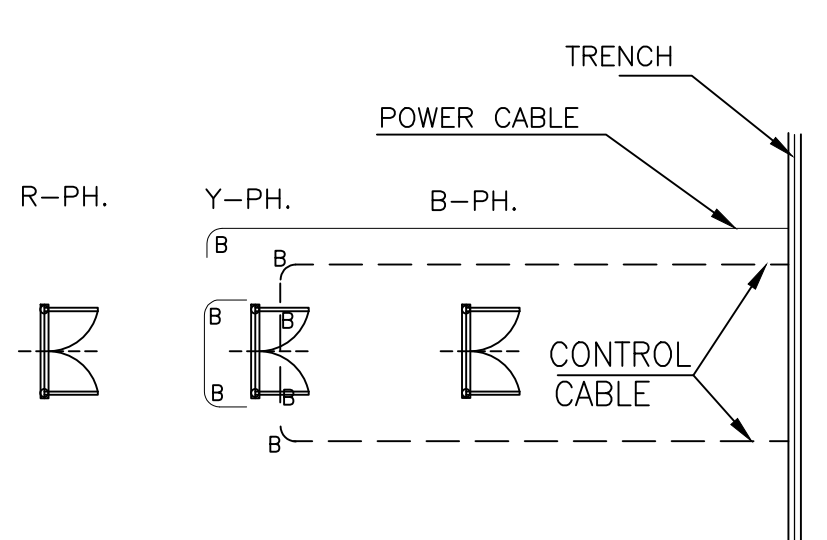
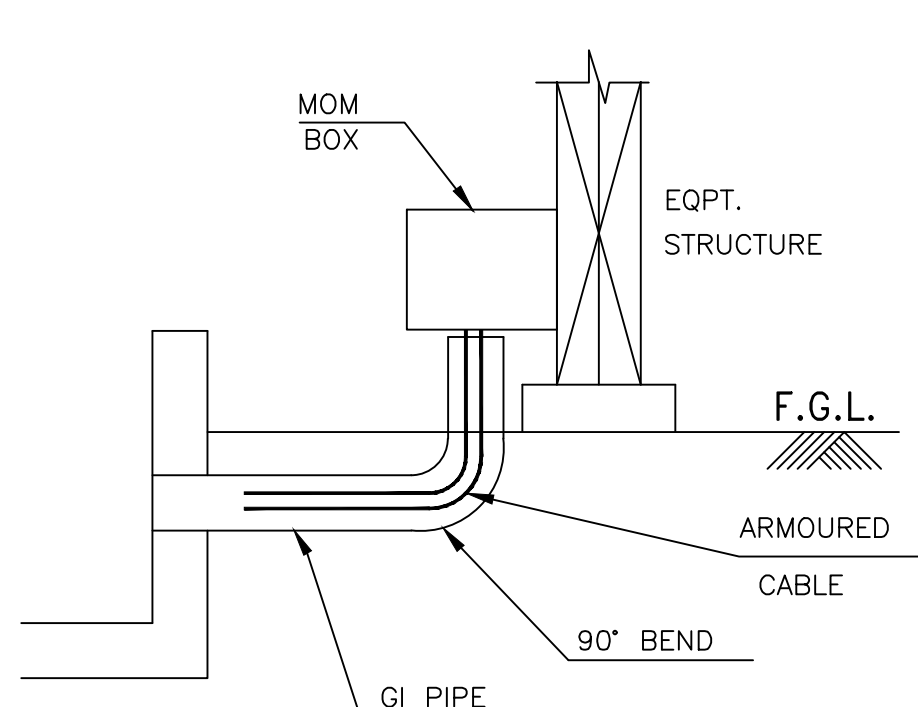
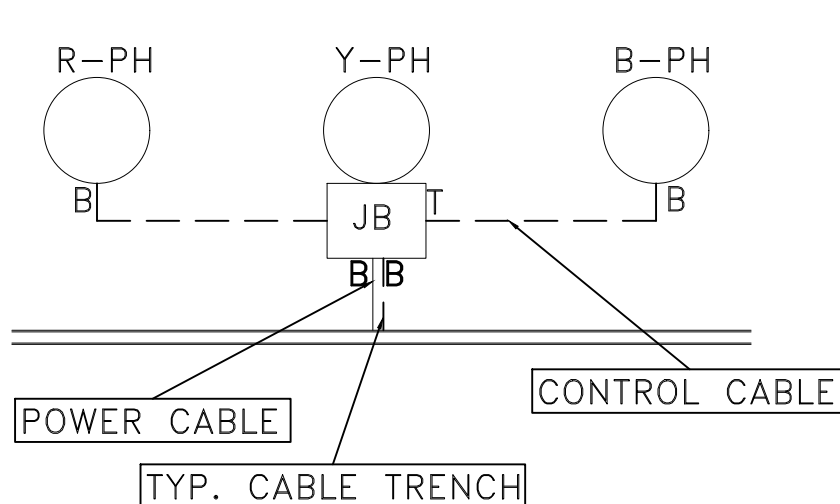
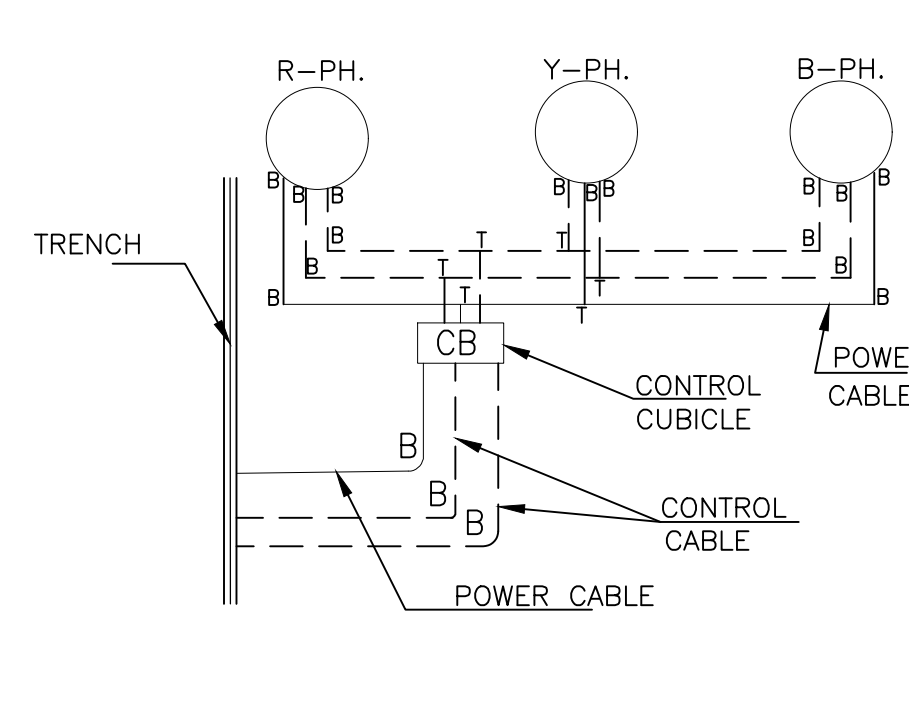
S.NO.	EQUIPMENT	NO. OF RISERS PER EQPT
01	132kV CB, 3-PH	07
02	132kV HCB ISO (W/O ES), 3-PH	16
03	132kV HCB ISO (IES), 3-PH	18
04	132kV HCB ISO (ZES), 3-PH	20
05	132kV HDB ISO (W/O ES), 3-PH	16
06	132kV HDB ISO (IES), 3-PH	18
07	132kV CT	02
08	132kV CVT	02
09	120kV SA	03
10	MK, JB, AC KIOSK	02
11	132kV PI/CSE	02
12	TOWER WITHOUT PEAK	02
13	TOWER WITH PEAK, LM	03
14	STATION TRANSFORMER	08
15	MISC. TRANSFORMER	08
16	WAVE TRAP	06

CUSTOMER:		PROJECT	
BHARAT HEAVY ELECTRICALS LTD.		NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)	
TRANSMISSION BUSINESS GROUP			
Noida			
TITLE		SUB-VENDOR DRG. NO.	
132kV EARTHMAT LAYOUT		NTPC DRG. NO. 5602-003-H230-PVE-F-106	
SUB-VENDOR NAME		REV. DATE	
		03 30.09.16	
WEIGHT (kg)		SCALE	
		TB-DG-0-381-316-005	
SHEET NO. 01		NO. OF SHIT. 01	
		REV. DATE	
		03	





ROUTING OF CABLE INSIDE

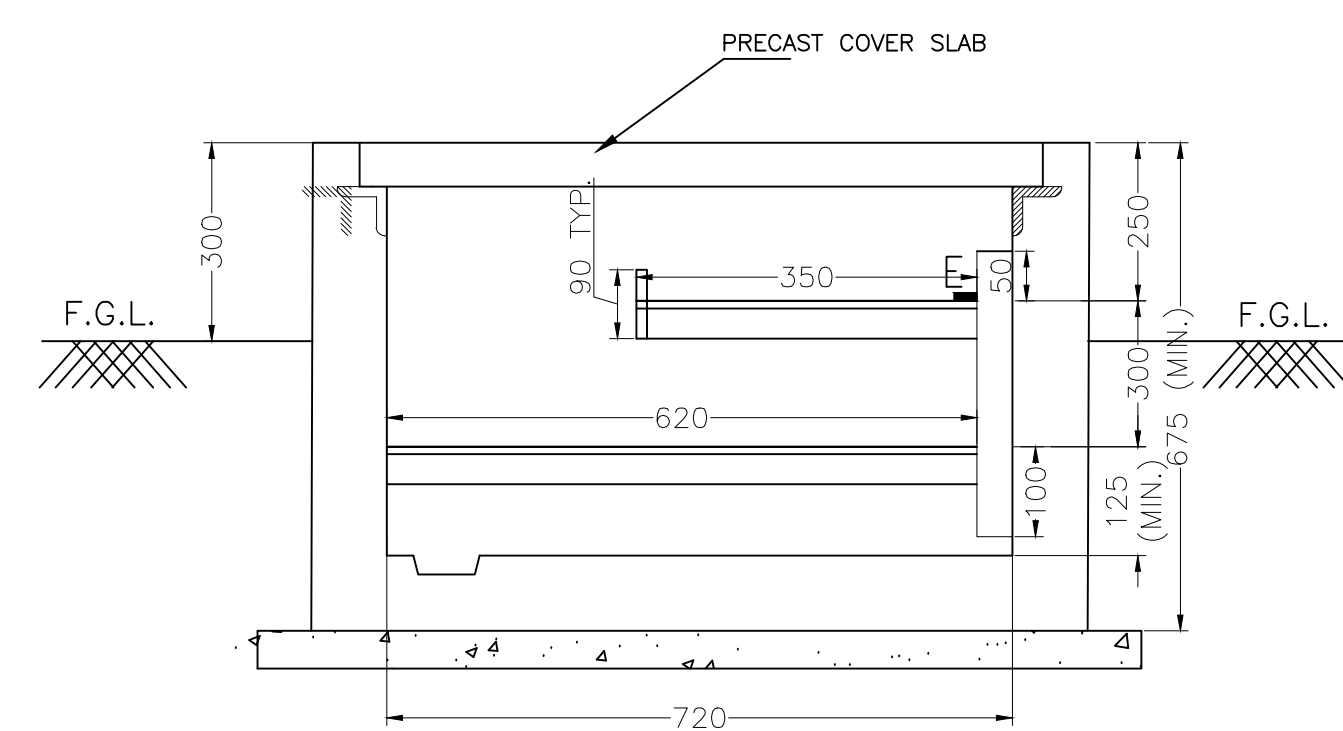


LEGEND

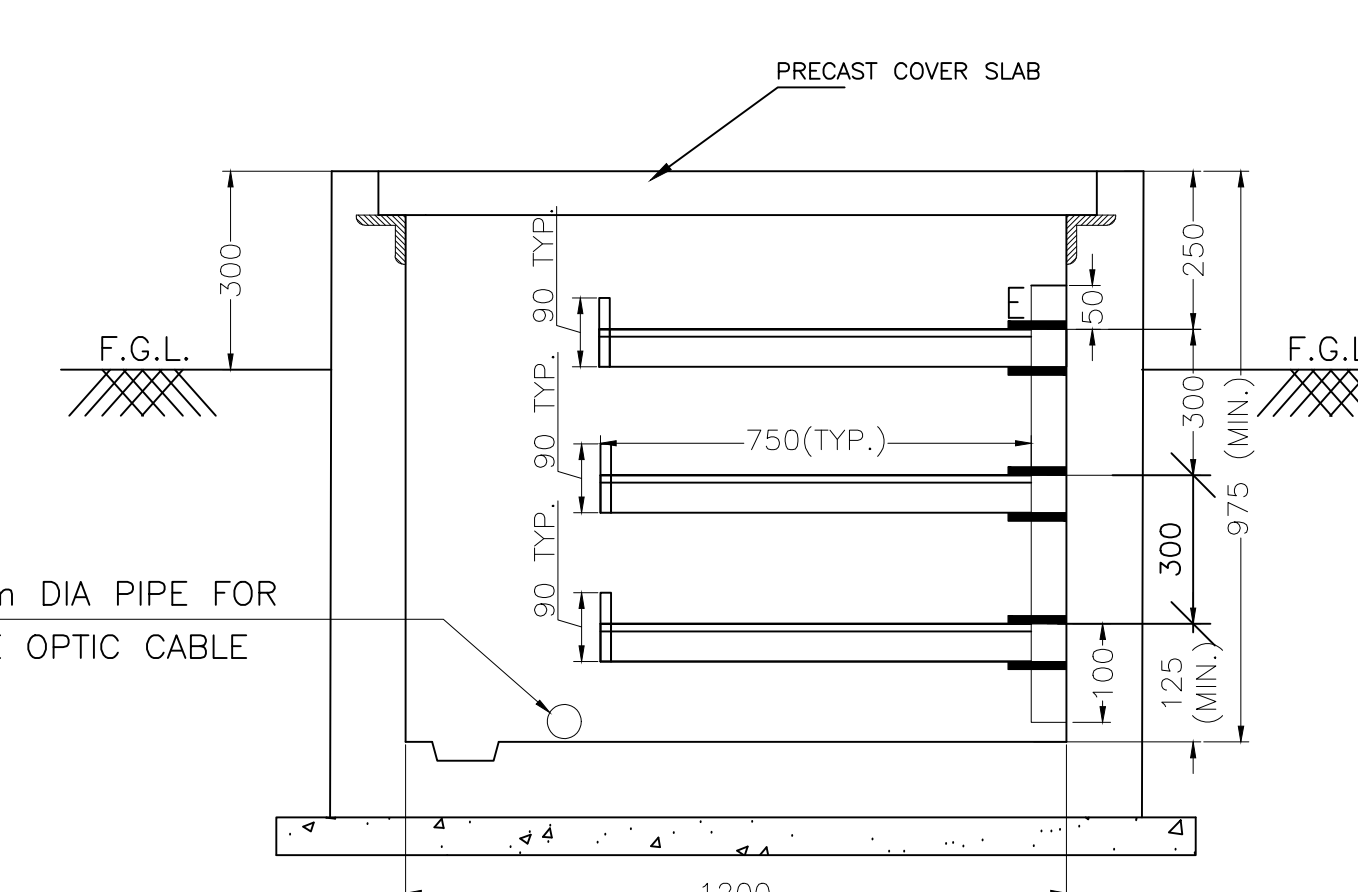
1. ——— 50MM GI PIPE  
2. — — — 100MM GI PIPE  
3. B INDICATE 90 deg BEND  
4. T INDICATE TEE BEND

MK FIXING DETAIL ON TRENCH & JB ON EQUIPMENT STRUCTURE  
A & B DIMENSIONS ARE AS PER MK DRAWING.  
X-TRENCH WALL THICKNESS.

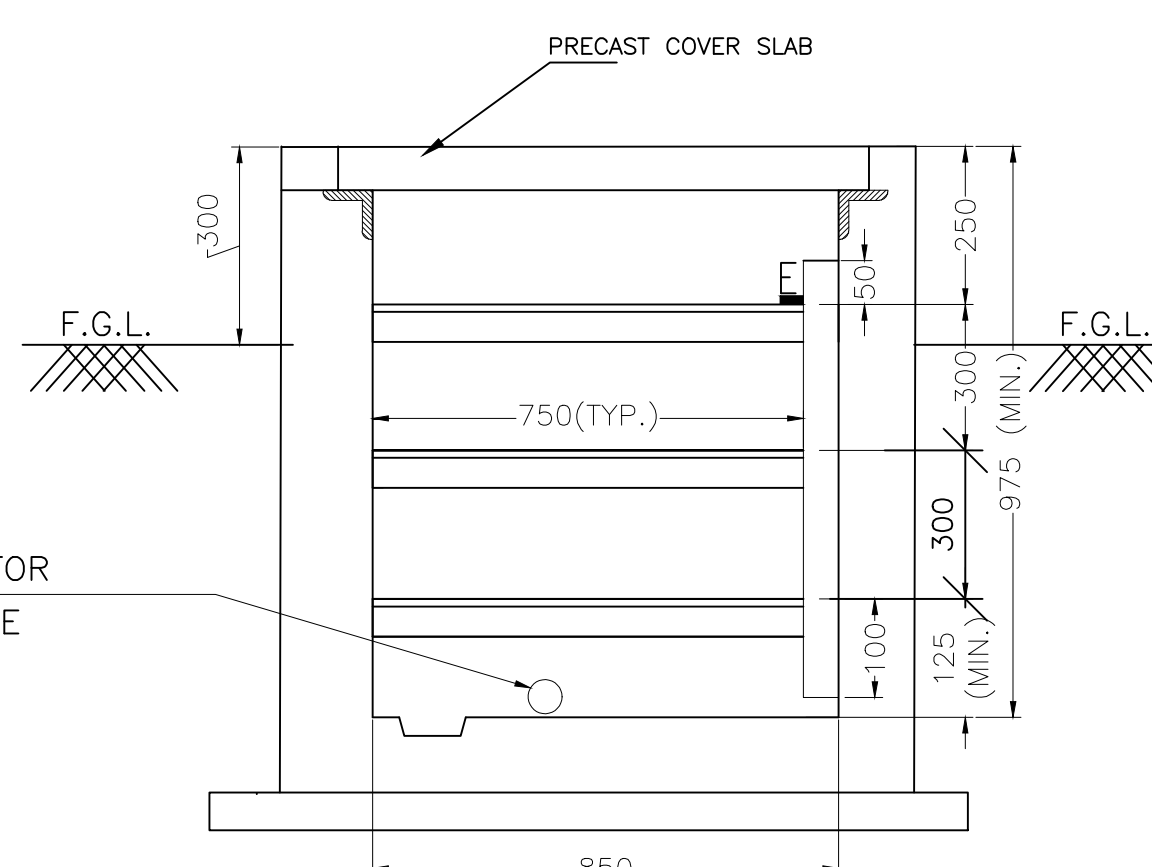
QUANTITY  
MK- 10 NOS.  
JB- 16 NOS.



SECTION 4-4  
OUTER MAXIMUM DIMENSION (900 (W) X 800 (D))



SECTION-2-2  
OUTER MAXIMUM DIMENSION(1500 (W) X 1200 (D))



TR 2-2 (A)  
OUTER DIMENSION (1000 (W) X 1200 (D))

NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. THE LOCATION OF CABLE TRENCHES MARKED IN THIS DWG MAY BE SLIGHTLY MODIFIED TO SUIT SITE CONDITIONS.
3. OPENINGS FOR TAKING OUT OF PIPIES TO EQUIPMENTS SHALL BE PROVIDED IN CABLE TRENCHES. OPENING OF SIZE SUITABLE TO DIA. 50/100 PIPE SHALL BE PROVIDED BELOW TOP CABLE SUPPORT.
4. **[H/M]** - INDICATES MARSHALLING TASK.
5. **[M/S]** SHALL BE PLACED IN THE LOCATION SHOWN. EXACT COORDINATES TO BE SUITABLY DECIDED AT SITE. JB TO BE SHOWN ON CIV/TV STRUCTURE.
6. 1/19" CONTROL CABLE SHALL BE PLACED IN MULTILAYER ON CABLE RACK SUPPORT (ANGLE). MULTILAYER CABLE SHALL BE PROVIDED AT 500mm INTERVAL.
7. AUXILIARY POWER CABLES SHALL BE LAID IN TOP TERS AND CONTROL CABLES IN BOTTOM TERS.
8. CABLES FOR LIGHTING PURPOSE SHALL BE LAID IN GI PIPE/ TRENCH. SEPARATE DRAWING SHALL BE SUBMITTED FOR LIGHTING SYSTEM.
9. EARTH CONDUIT 75X12 GI FLAT TO BE WELDED IN VERTICAL ON CABLE SUPPORT BEFORE INSTALLATION OF CABLES.
10. CABLES CROSSING ROAD SHALL BE PLACED IN PIPE CULVERT.
11. FOR POWER & CONTROL CABLES, SEPARATE PIPES SHALL BE USED CONSIDERING 60% VOID FOR EACH PIPE (I.E. 40% FILL).
12. ALL OTHER DETAILS PERTAINING TO CIVIL WORKS SHALL BE REFLECTED IN THE RESPECTIVE CIVIL DRAWINGS.
13. GI PIPES SHALL BE SECURELY FIXED AT BOTH ENDS.
14. AFTER LAYING THE CABLES THE ENDS OF GI PIPES SHALL BE FULLY SEALED TO PREVENT INGRESS OF WATER INSIDE THE PIPE.
15. CONTROL CABLES & POWER CABLES MUST BE LAID IN SEPARATE GI PIPES.
  - TO BE USED AS CIVIL INPUT FOR CABLE TRENCH.
  - FOR ERECTION OF CABLE RACKS AT SITE.
  - FOR CABLE LAYING AND ROUTING AT SITE.
16. THE CABLE OF CIV/TV BETWEEN SECONDARY TERMINAL BOX AND JUNCTION BOX SHALL BE LAID IN 100/50MM GI PIPE.
17. **[H/M]** POWER CULVERT. CABLES CROSSING ROAD SHALL BE LAID IN BOX/PIPE CULVERT.
18. SUMP AND DRAINAGE SHALL BE SHOWN IN SEPARATE CIVIL DRAWING.
21. --- --- --- INDICATES GI PIPE FOR CABLEING.
22. **CABLE TRENCH FROM GSE TO OT-WARD IS UNDER-HOAS-AS INDICATED IN DRAWINGS AND SHALL BE FURNISHED AFTER CABLE LAYING-CALCULATION.**
23. **PIPIES MAY BE EMBEDDED IN CONCRETE AT 500mm INTERVAL FOR FIXING CABLE SUPPORT.**
24. **FIBER OPTIC CABLE BETWEEN CA AKIOSH AND CONTROL ROOM SHALL BE LAID IN 50mm DIA GI PIPE AND SAME SHALL BE ROUTED THROUGH BOTTOM OF CABLE TRENCH. 50mm DIA GI PIPE USED FOR POWER CABLES SHALL BE SUITABLY CLAMPED TO AVOID MOVEMENT.**

25. Equipment connection to cable trench shall be done through GIPVC conduit.  
26. For 132 KV Cable trench details, please refer drawing no.: 5602-003-H211-PVE-F-051.  
27. GIPVC conduits shall be provided where ever required in line with requirement of TS/BHEL Standard practice.  
28. Provision of drainage of cable trench shall be indicated in respective civil drawings by BHEL.  
29. Earthing of cable trays shall be carried out in line with requirement of TS.

REFERENCE DRAWING:—

1. LAYOUT OF FOUNDATION OF TOWER AND EQUIPMENT - DRG. No. 5602-003-H230-PVE-F-258 Rev.04

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED	02	08.06.20	CHECKED	01	04.10.16	CHECKED
		APPD.			APPD.			APPD.
ZONE			ZONE	REVISED ACC TO FND LAYOUT		ZONE	REVISED AS PER CUSTOMER COMMENT LETTER DATED 20.09.16	

CUSTOMER :



एन.टी.पी.सी. लिमिटेड  
**NTPC LIMITED**  
( A GOVERNMENT OF INDIA ENTERPRISE )

PROJECT

NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)



BHARAT HEAVY ELECTRICALS LTD  
TRANSMISSION BUSINESS GROUP  
NOIDA

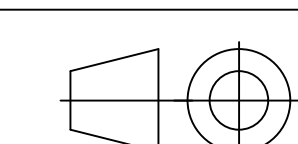
TITLE	
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## CABLE TRENCH ROUTING LAYOUT

	SUB-VENDOR NAME
--	-----------------

WEIGH (kg)
---------------

	SCALE
--	-------



DEPT. CODE	NAME	SIGN	DATE	NO. OF VAR
DRN				
HSE	CKD			
415	APPD			
SUB-VENDOR DRG. NO.			PO REF	NO. OF ITEMS
NTPC DRG. NO. 5602-003-H230-PVE-F-109				
BHEL DRG. NO. TB-DG-1-381-316-004				REV. 02
SHEET NO. 01		NO. OF SHT.		



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COMPUTER DRG. PATH NAME :

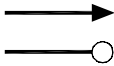
REF. DRG. NO. 5602-003-H230-PVE-F-106

SIGN & DATE

INVENTORY NO.

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHECKED			CHECKED			CHECKED
		APPD			APPD			APPD
						JOB No. 84009		

LEGEND



CONNECTION TO GROUND MAT THROUGH RISER.  
CONNECTION TO ROD ELECTRODE WITH TREATED PIT.

GENERAL NOTES:

- 1 EARTH STRIP CLEATED TO LATTICE /PIPE TYPE STRUCTURE AT AN INTERVAL OF 1.0M SUITABLE PROVISION SHALL BE MADE WITH SUPPORT STRUCTURE.
- 2 ALL EARTH STRIPS SHALL BE TAKEN ALONG EDGE OF STRUCTURE. DRAWING SHOWS TYPICAL ARRANGEMENT ONLY.
- 3 ALL STRUCTURES/EQUIPMENTS SHALL BE EARTHED AS SHOWN IN THE FOLLOWING SHEETS.
- 4 BOLT SIZE FOR CONNECTING EARTHING FLAT TO THE EQPT/STRUCTURE SHALL BE TO SUIT RESPECTIVE HOLE SIZE.
- 5 ALL EARTHING SHALL BE DONE IN ACCORDANCE WITH IS:3043 UNLESS OTHERWISE STATED IN TECHNICAL SPECIFICATION
- 6 EACH RISER OF A PARTICULAR EQUIPMENT SHALL BE CONNECTED TO A DIFFERENT EARTHROD (EITHER HORIZONTAL OR VERTICAL CONDUCTORS OF MAIN EARTHMAT).
- 7 FOR WELDING DETAILS REFER SHEET #20 & 21
- 8 E/WIRE DOWN CONDUCTOR SHALL BE CLEATED AT AN INTERVAL OF 2.0 M ALONG WITH STRUCTURE.



SHEET NO. DESCRIPTION

01. TITLE
02. NOTES
03. 132kV SF6 CIRCUIT BREAKER
04. 132 kV CVT
05. 132kV POST INSULATOR (SOLID CORE TYPE)
05. LIGHTNING ARRESTER (120kV)
06. MARSHALLING KIOSK
07. 132kV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITHOUT EARTH SWITCH (GANTRY MOUNTED UPRIGHT)
08. 132kV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH ONE EARTH SWITCH (GANTRY MOUNTED UPRIGHT)
09. 132kV HORIZONTAL CENTER BREAK ISOLATOR (TYPICAL) WITH TWO EARTH SWITCH
10. 132kV HORIZONTAL DOUBLE BREAK ISOLATOR (TYPICAL) WITHOUT EARTH SWITCH (GANTRY MOUNTED UNDERHUNG)
11. 132kV HORIZONTAL DOUBLE BREAK ISOLATOR (TYPICAL) WITH ONE EARTH SWITCH (GANTRY MOUNTED UNDERHUNG)
12. 132kV HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTH SWITCH
13. TOWER WITH PEAK
14. TOWER WITHOUT PEAK
15. LIGHTNING MAST
16. 400kV & 132kV CURRENT TRANSFORMER
17. CABLE TRENCH
18. PIPE EARTH ELECTRODE WITH TREATED PIT
19. ROD EARTH ELECTRODE WITHOUT TEST PIT
20. ROD EARTH ELECTRODE WITH TEST PIT

SHEET NO. DESCRIPTION

21. RAIL BONDING
22. TRANSFORMER
23. SWITCHYARD SERVICE TRANSFORMER
24. AUXILIARY EARTH MAT FOR ISOLATOR MAIN MECH.,E/S MECH. BOX
25. CONTROL AND RELAY PANELS
26. GATE/FENCE POST
27. TYPICAL ARRANGEMENT OF BOLTED JOINTS
28. WELDING DETAILS

E1. Pls incorporate the 132kV outdoor Cable Termination with structure.

NTPC DRAWING NO. 5602-003-H230-PVE-E-100									
CUSTOMER				एन.टी.पी.सी. लिमिटेड <b>NTPC LIMITED</b> ( A GOVERNMENT OF INDIA ENTERPRISE )					
PROJECT : NTPC RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3X40MW)									
CONTRACTOR		BHARAT HEAVY ELECTRICALS LTD. TRANSMISSION BUSINESS GROUP NOIDA				DEPT CODE		NAME SIGN DATE	
						DRN		DM	12.08.16
						CHD		MS	12.08.16
						APPD		AS	12.08.16
TITLE Equipment Earthing Philosophy & Details									
						DEPT. SCALE		DRAWING NO.	
						SIGN		TB-DG-4-381-316-006	
						DATE		SHEET 01 OF 28 REV. 00	



1. RISER FROM THE EARTH GRID SHALL BE 40MM DIAMETER MILD STEEL ROD. RISER SHALL RISE FROM THE GROUND ALONG THE NEAREST EQUIPMENT FOUNDATION/BUILDING COLUMN/WALL TO AVOID ANY OBSTRUCTION TO MOVEMENT OF PERSONNEL.
2. CONNECTION TO ALL EQUIPMENT AND TOWERS SHALL BE BY BOLTED JOINTS. CONTACT SURFACES SHALL BE THOROUGHLY CLEANED BEFORE CONNECTIONS. EQUIPMENT BOLTED CONNECTIONS AFTER BEING TESTED AND CHECKED SHALL BE PAINTED WITH ANTI CORROSIVE PAINT/COMPOUND.
3. CONNECTIONS BETWEEN EQUIPMENT EARTHING LEADS AND BETWEEN MAIN EARTHING CONDUCTORS SHALL BE OF WELDED TYPE. FOR RUST PROTECTION THE WELDS SHOULD BE TREATED WITH RED LEAD COMPOUND AND AFTERWARDS THICKLY COATED WITH BITUMEN COMPOUND.  
THE SURFACES TO BE WELDED SHALL BE CLEANED OF DIRT, OIL, GREASE AND OXIDES BEFORE WELDING. ANY OXIDE FILMS THAT MAY HAVE FORMED DURING WELDING MUST BE REMOVED FROM THE WELDED JOINT.
4. EARTHING CONDUCTOR FOR EQUIPMENT SHALL BE OF GALVANISED M.S. OF SIZE 75x12 mm.  
THE CONDUCTOR BELOW THE GROUND LEVEL SHALL BE 40 mm DIA MS ROD.
5. IN THE ATTACHED DRAWINGS GL REPRESENTS GROUND LEVEL.
6. ALL THE EQUIPMENTS SHALL BE EARTHED AT TWO POINTS WITH 75x12 mm. G.S. FLAT EVEN THOUGH THEY ARE SHOWN OR NOT IN THE DRAWING DUE TO CLARITY.
7. ALL OPERATING MECHANISM BOXES, CONTROL CABINETS SHALL BE EARTHED AT TWO POINTS WITH 50x6mm G.S. FLAT BY TWO SEPARATE AND DISTINCT EARTH CONNECTERS AS SHOWN IN DRG.  
ALL MK, JB SHALL BE EARTHED AT TWO POINTS WITH 75X12MM GS FLAT AT TWO SEPARATE AND DISTINCT POINTS ON THE MAIN MAT.
8. EARTHING CONDUCTORS FROM EQUIPMENT STRUCTURES SHALL BE CONNECTED TO THE NEAREST POSSIBLE EARTH MAT RISER. EQUIPMENT EARTHING SHALL BE AS PER IS 3043.
9. ALL JOINTS BETWEEN 40 DIA M.S. ROD AND 75x12 mm G.S. FLAT SHALL BE BELOW GRAVEL LEVEL.
10. FOR WELDED JOINTS LOW HYDROGEN CONTENT ELECTRODES SHALL BE USED.
11. CABLE AND CABLE BOXES/GLANDS, LOCKOUT SWITCHES ETC. SHALL BE CONNECTED TO THE EARTHING CONDUCTOR RUNNING ALONGWITH THE SUPPLY CABLE WHICH, IN TURN, SHALL BE CONNECTED TO EARTHING GRID CONDUCTOR AT MINIMUM TWO POINTS, WHETHER SPECIFICALLY SHOWN OR NOT.
12. EQUIPMENT BOLTED CONNECTIONS AFTER BEING TESTED AND CHECKED SHALL BE PAINTED WITH ANTI CORROSIVE PAINT/COMPOUND.
13. LOCATION OF EARTHING CONDUCTORS/RISERS SHOWN IN THE EARTHING DRAWING MAY CHANGE TO SUIT THE SITE CONDITION.
14. FOR SURGE ARRESTER, EARTHING LEAD FROM SURGE COUNTER TO MAIN EARTH MAT SHALL BE SHORTEST IN LENGTH AS PRACTICALLY AS POSSIBLE.
15. AN ADDITIONAL AUXILIARY GRID OF 1500MMX1500MM COMPRISING OF CLOSELY SPACED(300MMX300MM) 40 DIA CONDUCTORS AT A DEPTH OF 300MM FROM FINISHED GROUND LEVEL SHALL BE PROVIDED BELOW THE OPERATING HANDLE OF ISOLATORS AND EARTH SWITCHES. THIS GRID SHALL BE CONNECTED TO THE MAIN GROUND GRID. THE EARTH CONNECTION TO OPERATING HANDLE SHALL BE MADE OF FLEXIBLE CONNECTION. THE MOM BOX OF THE ISOLATOR TO BE CONNECTED TO THIS AUX. GRID.
16. ALL NON CURRENT CARRYING METALIC PARTS SHALL BE EARTHED AT TWO DIFFERENT PLACES.
17. ALL EQUIPMENT DRAWINGS SHOWN ARE INDICATIVE ONLY.
18. WELDING OF EARTHING CONDUCTOR SHALL BE CONNECTED IN VERTICAL PLANE WHEREVER POSSIBLE.



## EQUIPMENT EARTHING DETAILS

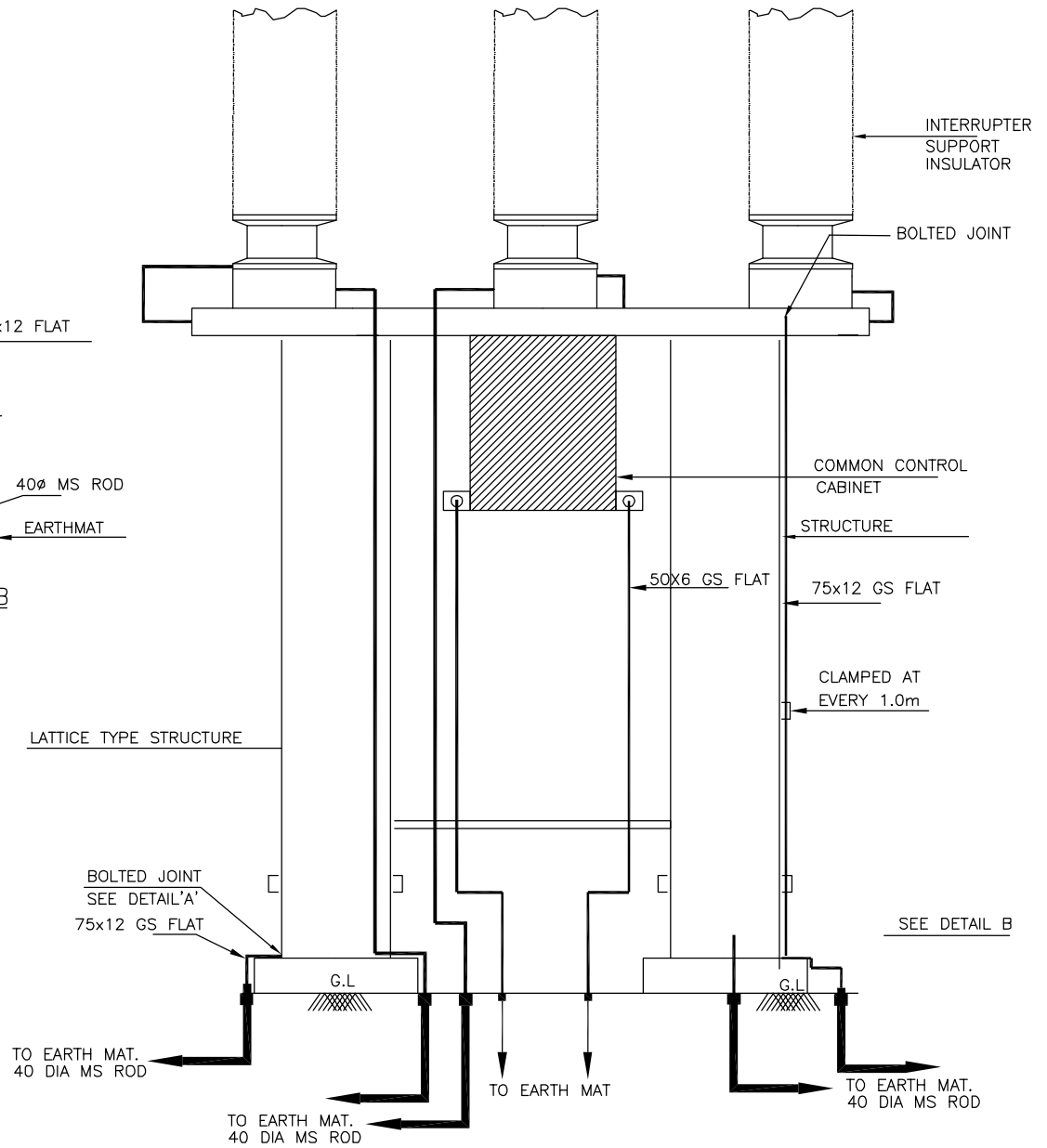
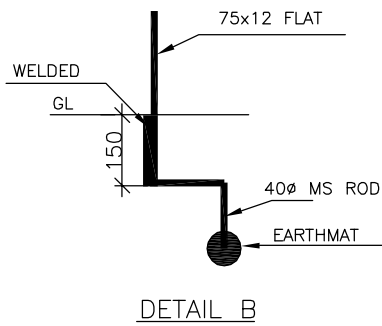
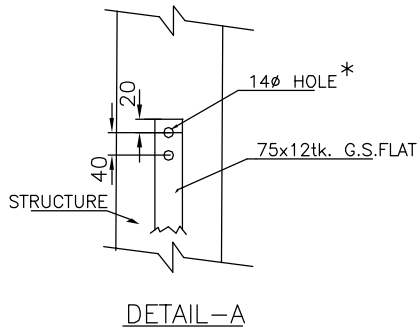
### NOTES

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
02





#### NOS. OF RISERS

- = 1 NOS. PER CB
- + 2 NOS. FOR COMMON CONTROL CUBICLE
- + 1 NOS. PER STRUCTURE

#### NOTE:

- 1) \* BOLT SIZE AND HOLE SIZE SHALL BE TO SUIT RESPECTIVE EQPT./STRUCTURE.



## EQUIPMENT EARTHING DETAILS

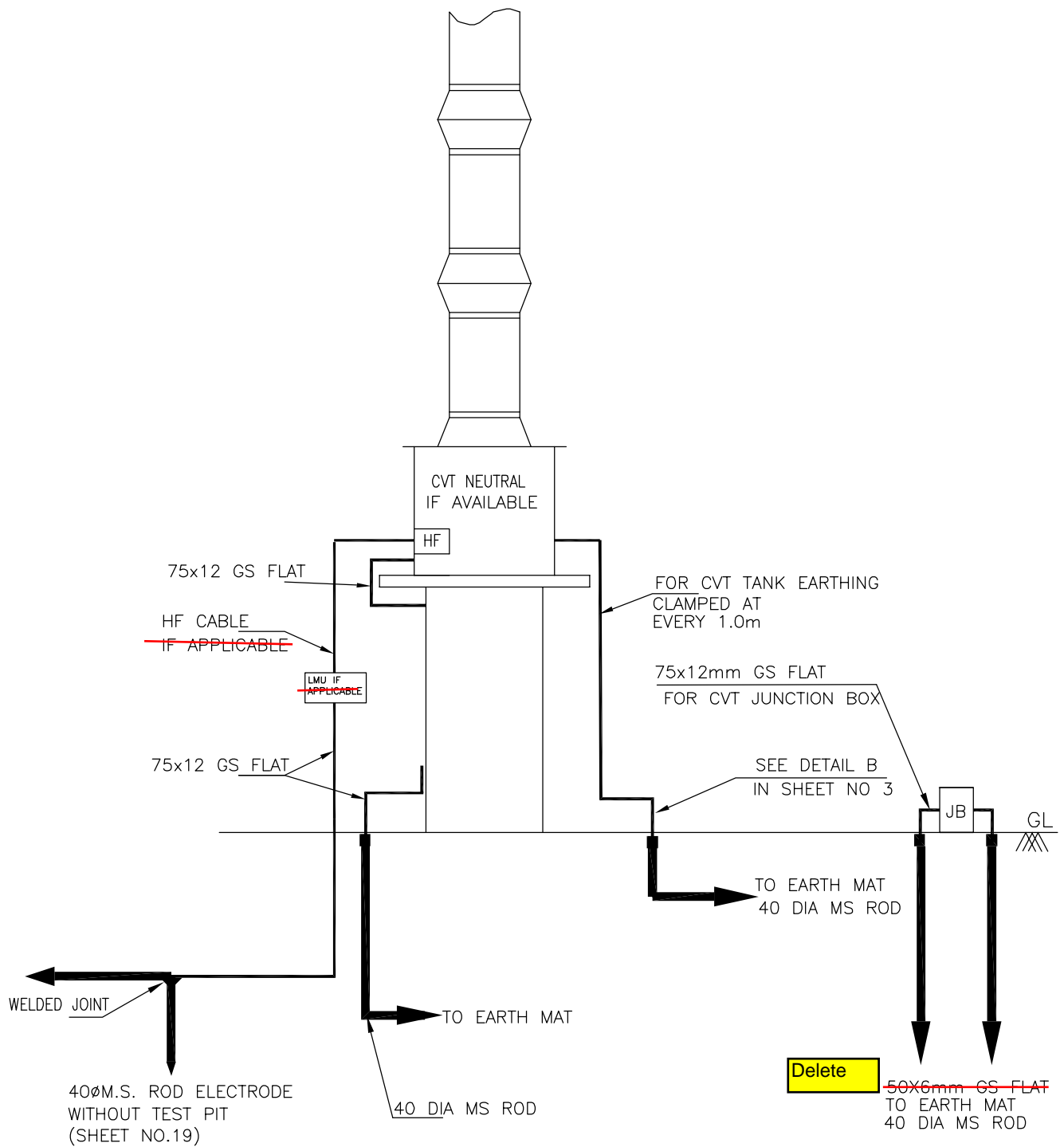
### 132kV SF6 CIRCUIT BREAKER

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
03





#### NOS. OF RISERS

= 2 NOS. PER PHASE

+ 2 NOS. FOR CVT JUNCTION BOX

ROD ELECTRODE = 1 NO. PER CVT IF NEUTRAL IS CONNECTED TO GROUND VIA LMU



## EQUIPMENT EARTHING DETAILS

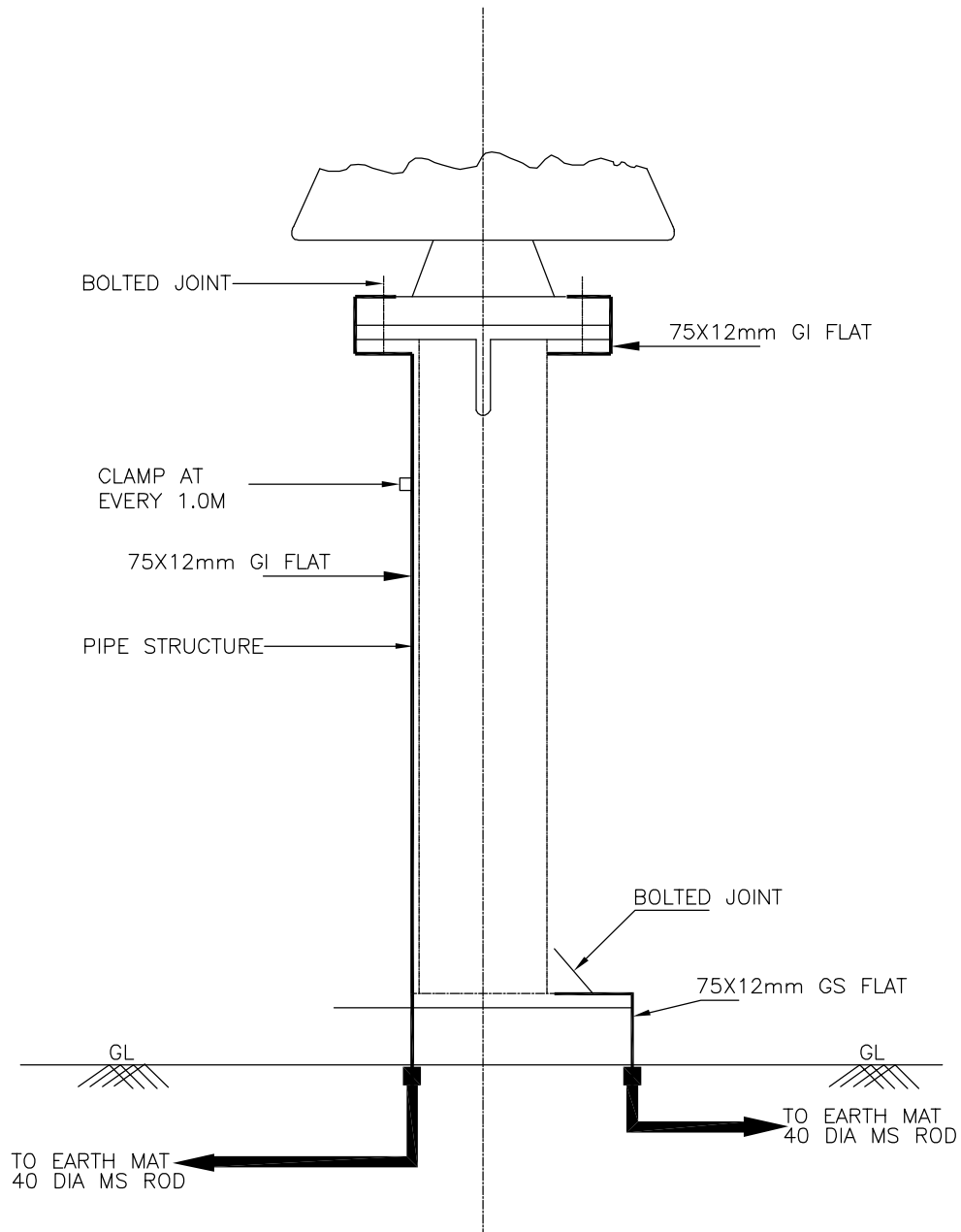
### 132kV CVT

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
04





NOS. OF RISERS = 2 NOS.



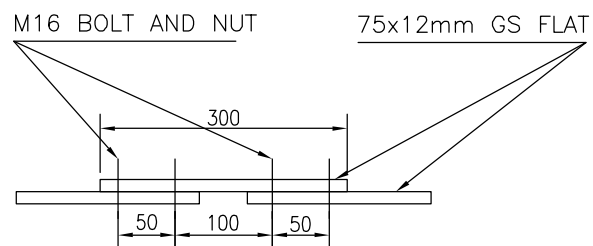
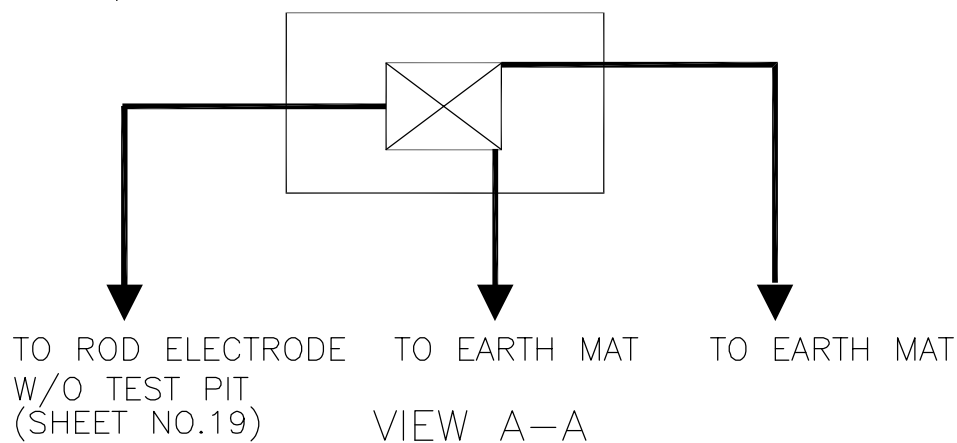
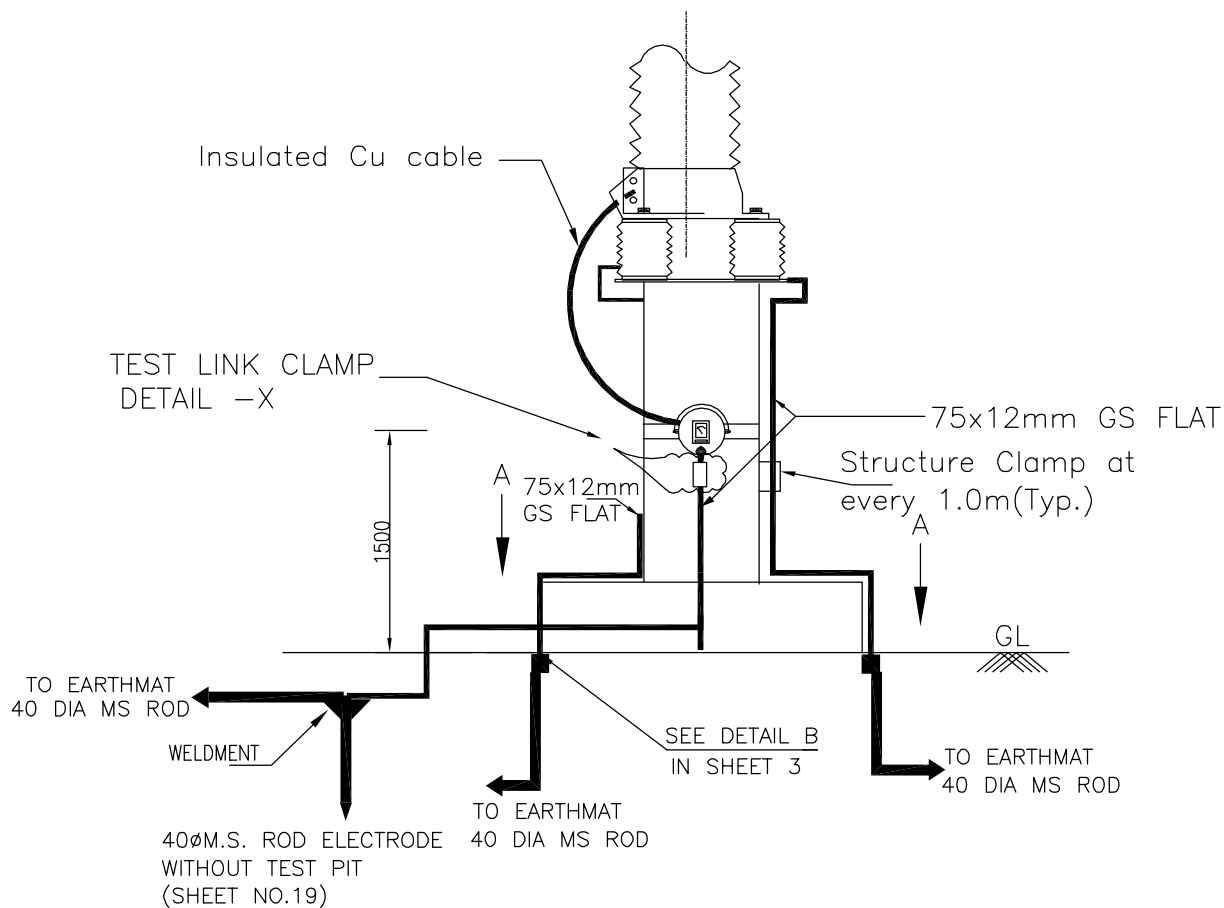
# EQUIPMENT EARTHING DETAILS 132kV POST INSULATOR (SOLID CORE TYPE)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
05





(DETAIL -X)

NOTES:—

1. LA SHALL BE EARTHED THROUGH EARTH  
TERMINAL OF SURGE COUNTER
2. NO. OF ROD ELECTRODE : 1 NO.  
NO OF RISERS = 3 NOS.
3. TEST LINK SHALL HAVE PROVISION TO BOLT TEST LEAD BEFORE ISOLATING THE  
MAIN EARTHING CONNECTIONS (AS PER SKETCH ABOVE) = 1NO.



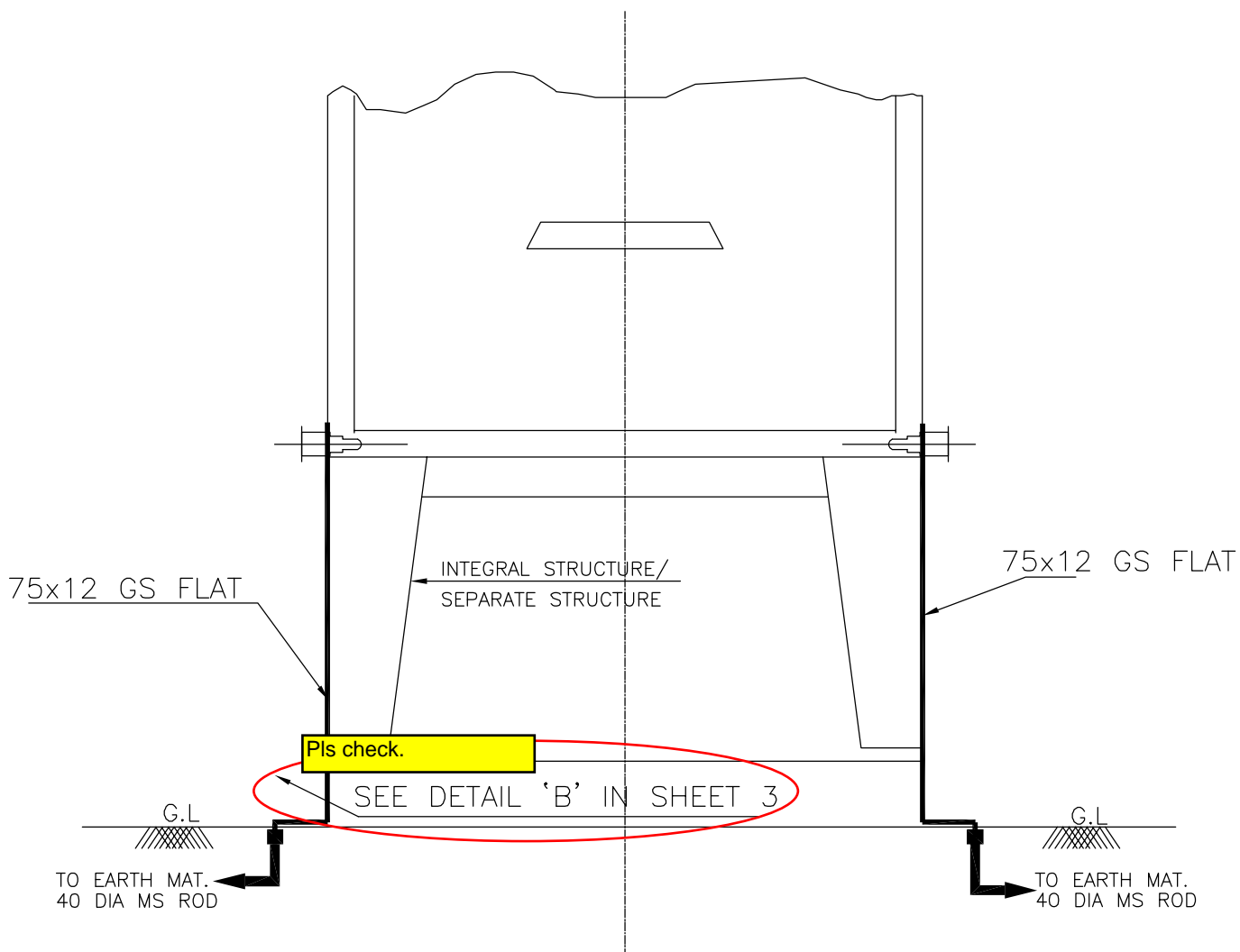
EQUIPMENT EARTHING DETAILS  
LIGHTNING ARRESTER (120kV)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
06





NOS. OF RISERS = 2 NOS.



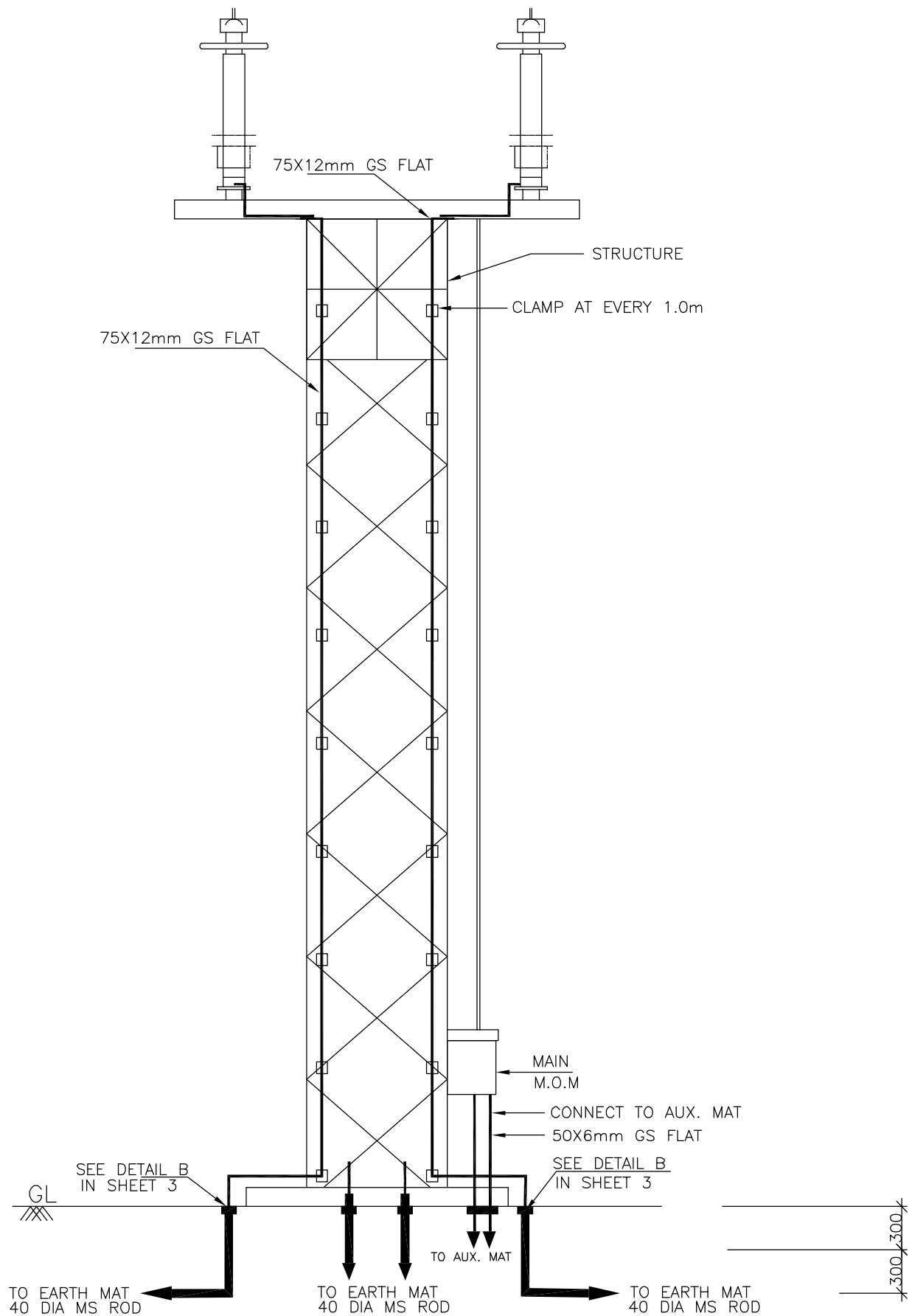
# EQUIPMENT EARTHING DETAILS MARSHALLING KIOSK

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
07





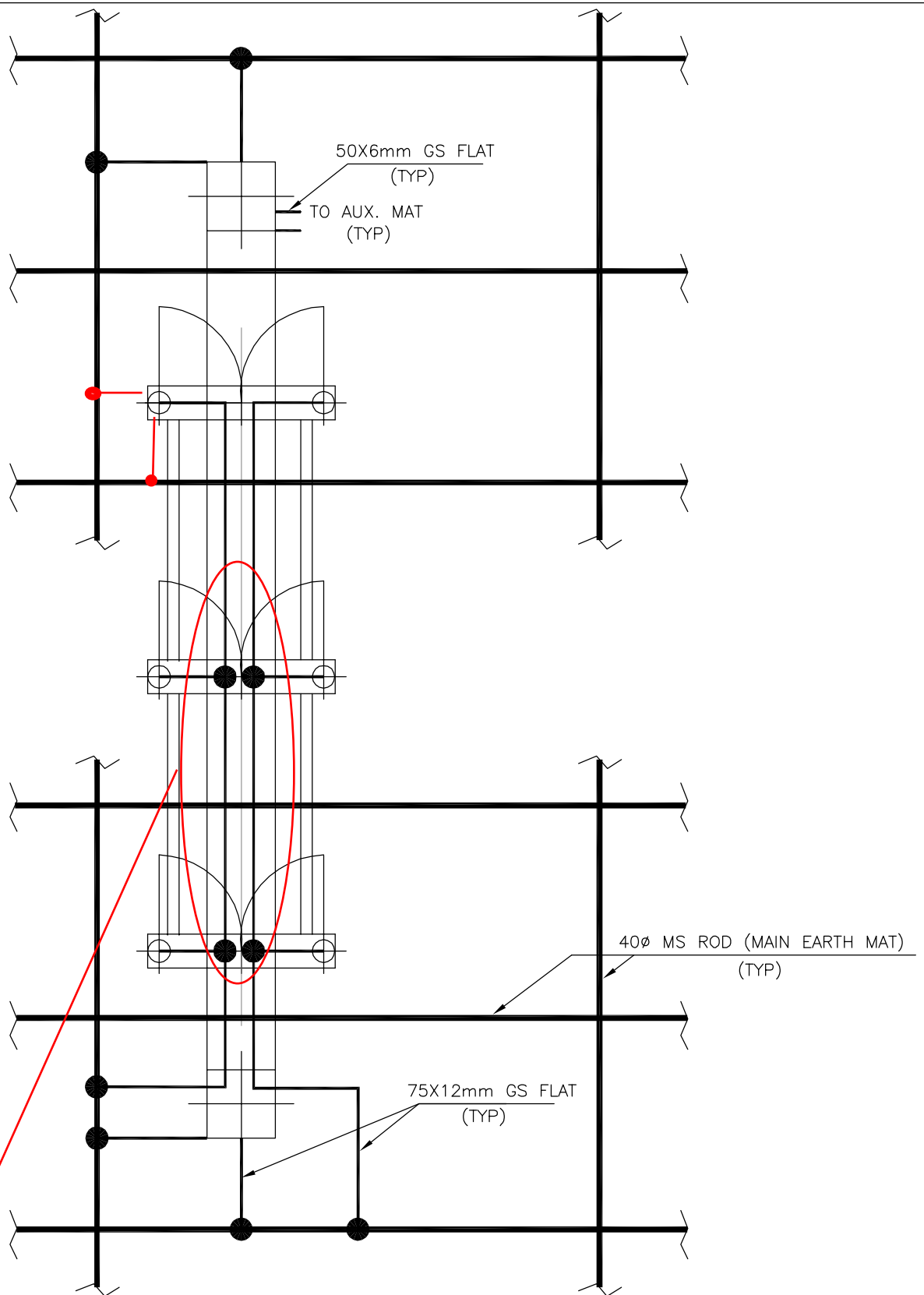
# EQUIPMENT EARTHING DETAILS 132 kV HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTH SWITCH (GANTRY MOUNTED UPRIGHT)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
8A





E2. Pls check & confirm the risers  
12 nos per isolator.

#### NOTES

1. AUXILIARY EARTH MAT SHALL BE PROVIDED NEAR EVERY MOM BOX (REFER SHEET 15)
2. LOCATION OF MOM BOX SHALL BE AS APPROVED OGA DRAWING.

● RISER =06 NOS PER ISOLATOR + 2 NO RISER PER MOM BOX



## EQUIPMENT EARTHING DETAILS

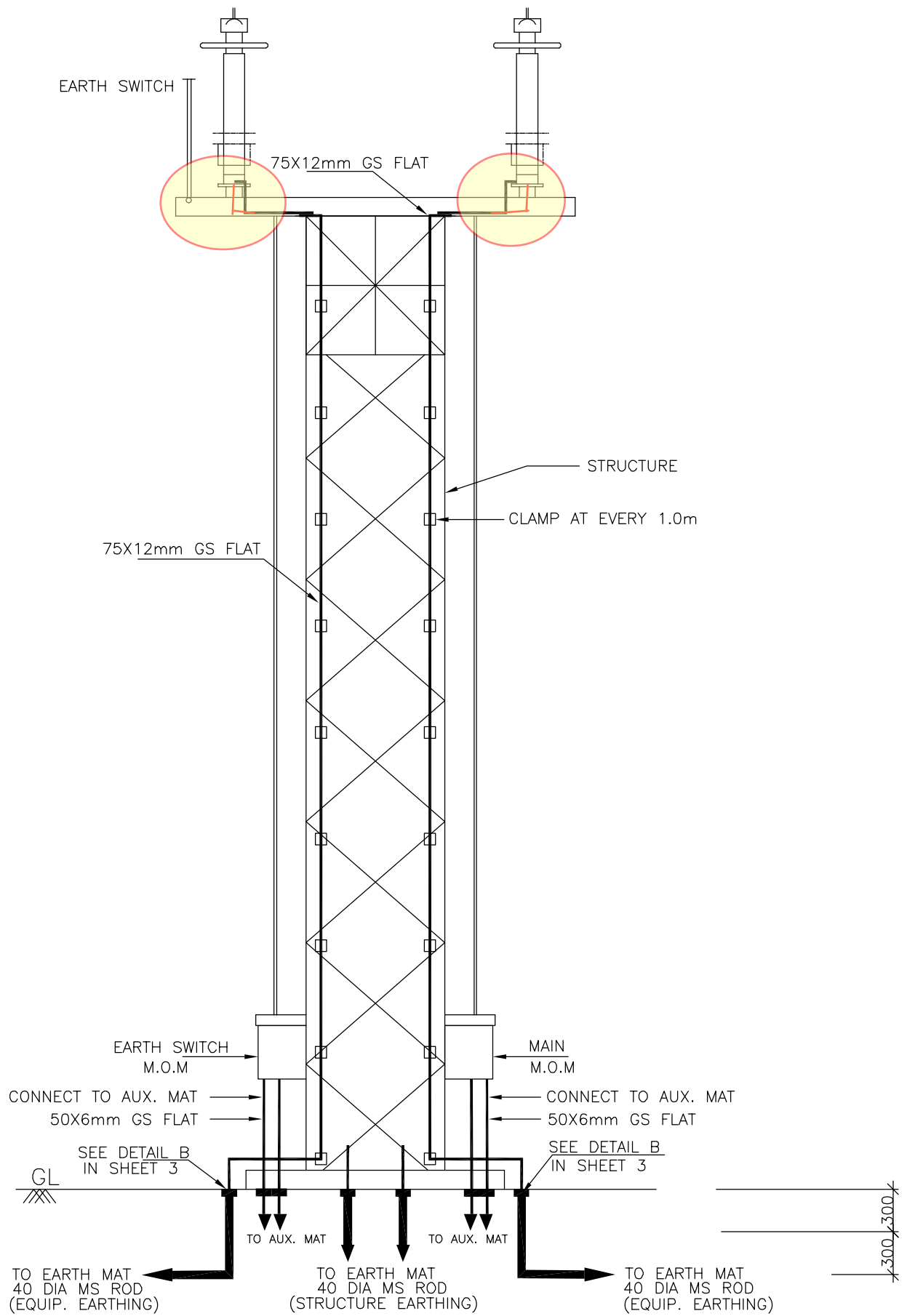
132 kV HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTHSWITCH  
(GANTRY MOUNTED UPRIGHT)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
8B





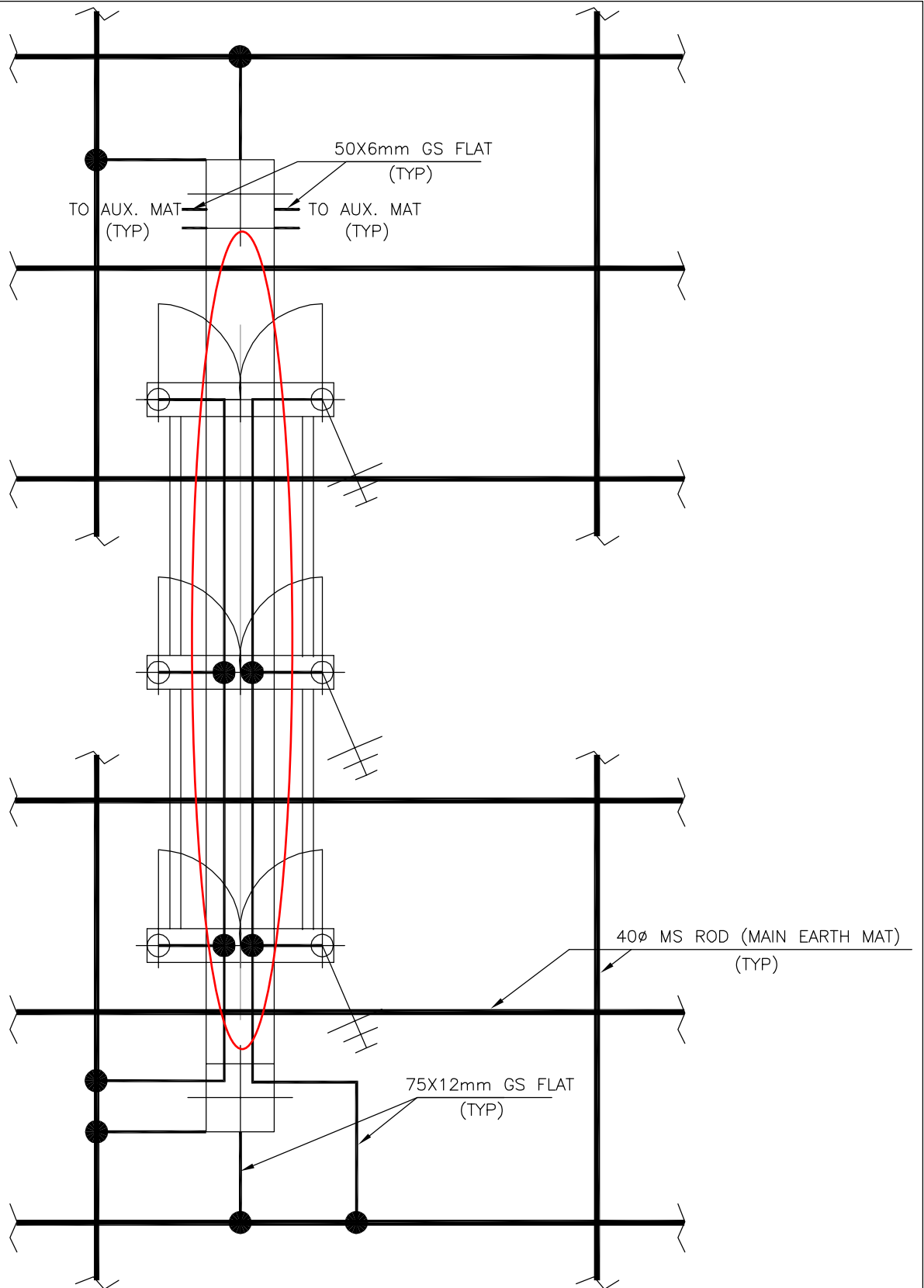
# EQUIPMENT EARTHING DETAILS 132 kV HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH (GANTRY MOUNTED UPRIGHT)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
9A





#### NOTES

1. A **Refer E2.** WITH MAT SHALL BE PROVIDED NEAR EVERY MOM BOX (REFER SHEET 15)
  2. LOCATION OF MOM BOX SHALL BE AS APPROVED OGA DRAWING.
- RISER = 06 NOS PER ISOLATOR + 2 NO RISER PER MOM BOX



### EQUIPMENT EARTHING DETAILS

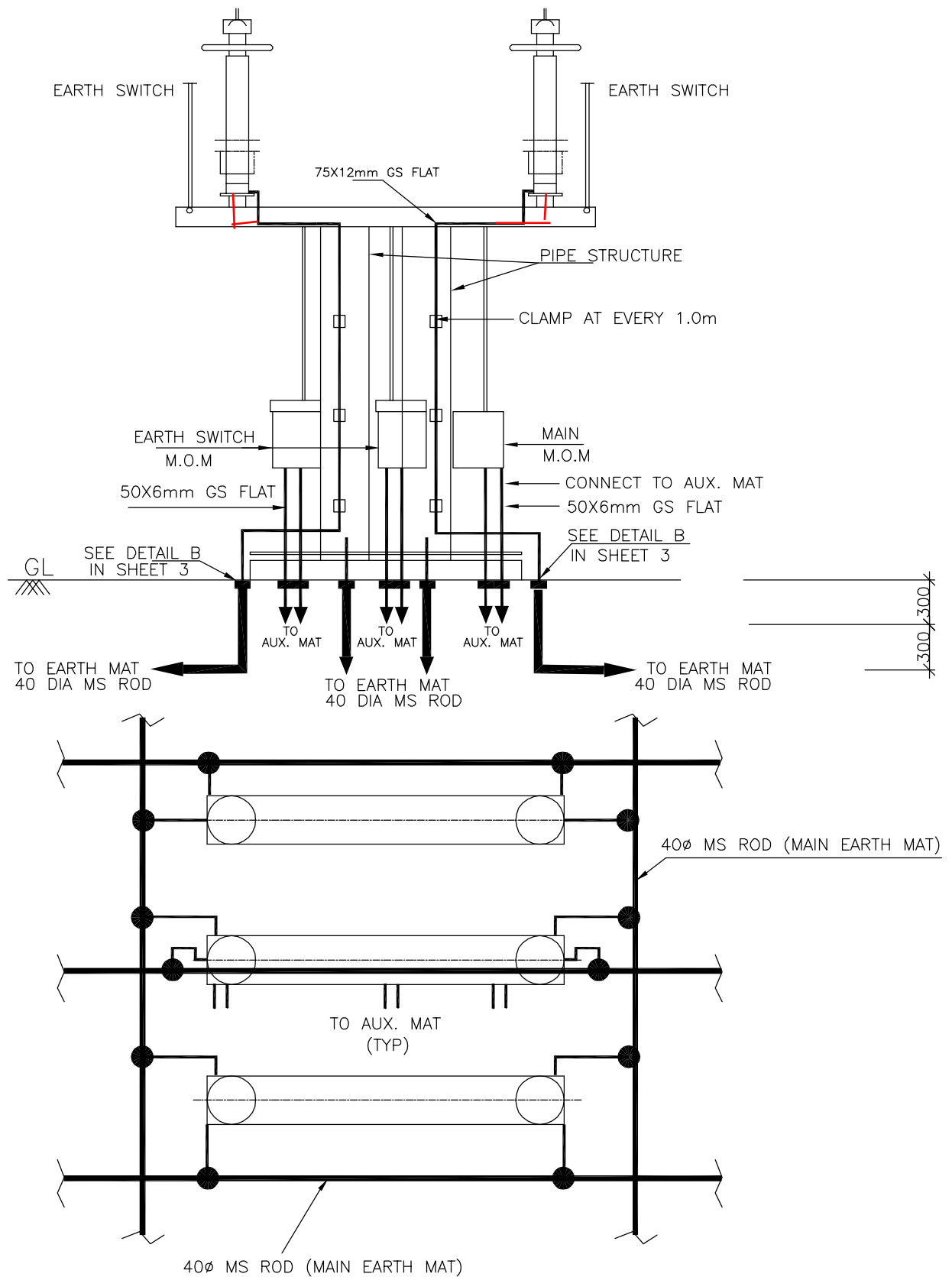
132 kV HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH  
(GANTRY MOUNTED UPRIGHT)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
9B





#### NOTES

1. AUXILIARY EARTH MAT SHALL BE PROVIDED NEAR EVERY MOM BOX (REFER SHEET 15)
  2. LOCATION OF MOM BOX SHALL BE AS APPROVED OGA DRAWING.
- RISER = 12 NOS PER ISOLATOR + 2 NO RISER PER MOM BOX



### EQUIPMENT EARTHING DETAILS

132 kV HORIZONTAL CENTER BREAK ISOLATOR WITH TWO EARTHSWITCH

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
10



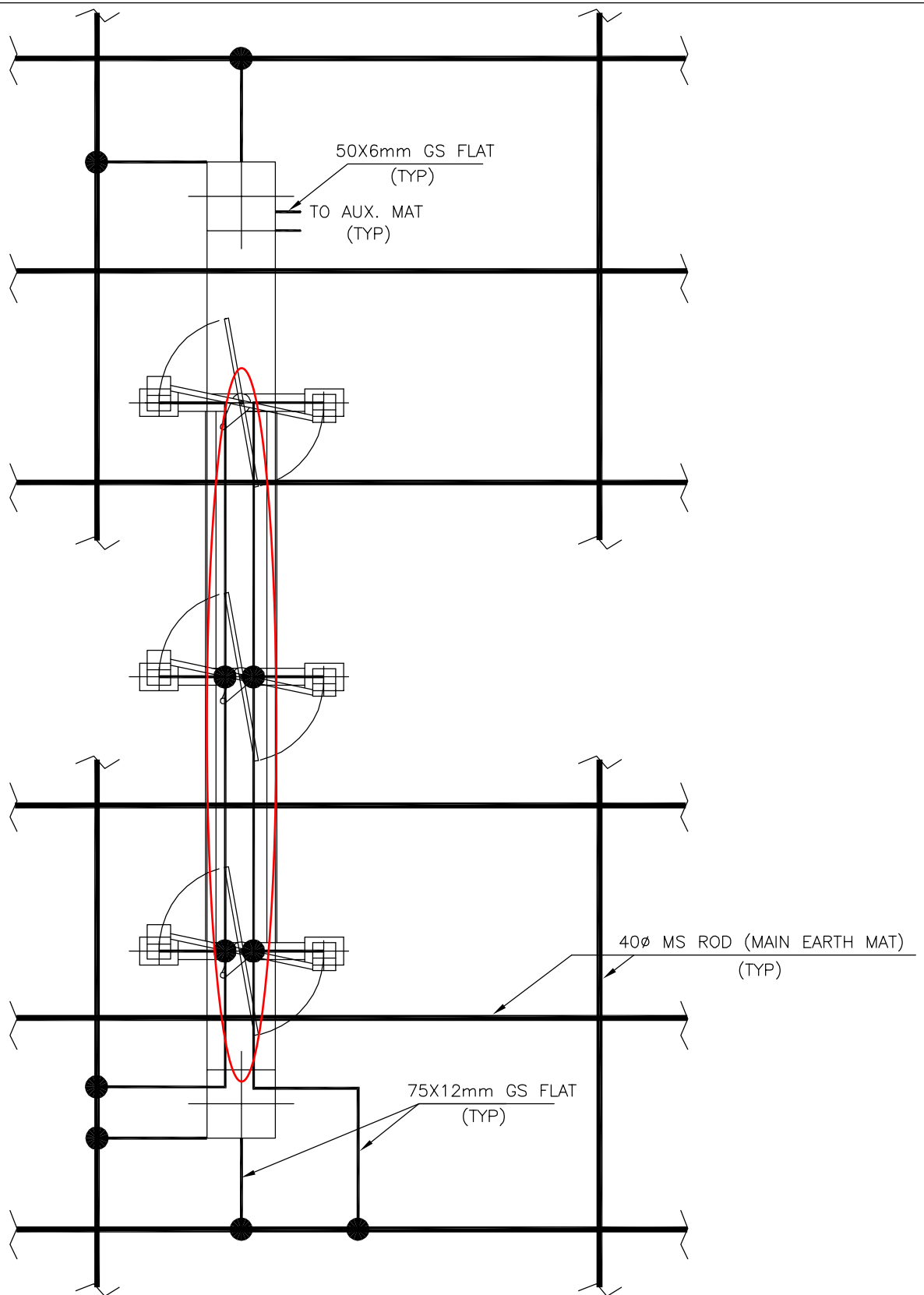


132 kV HORIZONTAL DOUBLE BREAK ISOLATOR WITHOUT EARTHSWITCH  
(GANTRY MOUNTED UNDERHUNG)

5602-003-H230-PVE-E-100

SHEET No.  
11A





#### NOTES

1. Refer E2. MAT SHALL BE PROVIDED NEAR EVERY MOM BOX (REFER SHEET 15)
  2. LOCATION OF MOM BOX SHALL BE AS APPROVED OGA DRAWING.
- RISER = 06 NOS PER ISOLATOR + 2 NO RISER PER MOM BOX



### EQUIPMENT EARTHING DETAILS

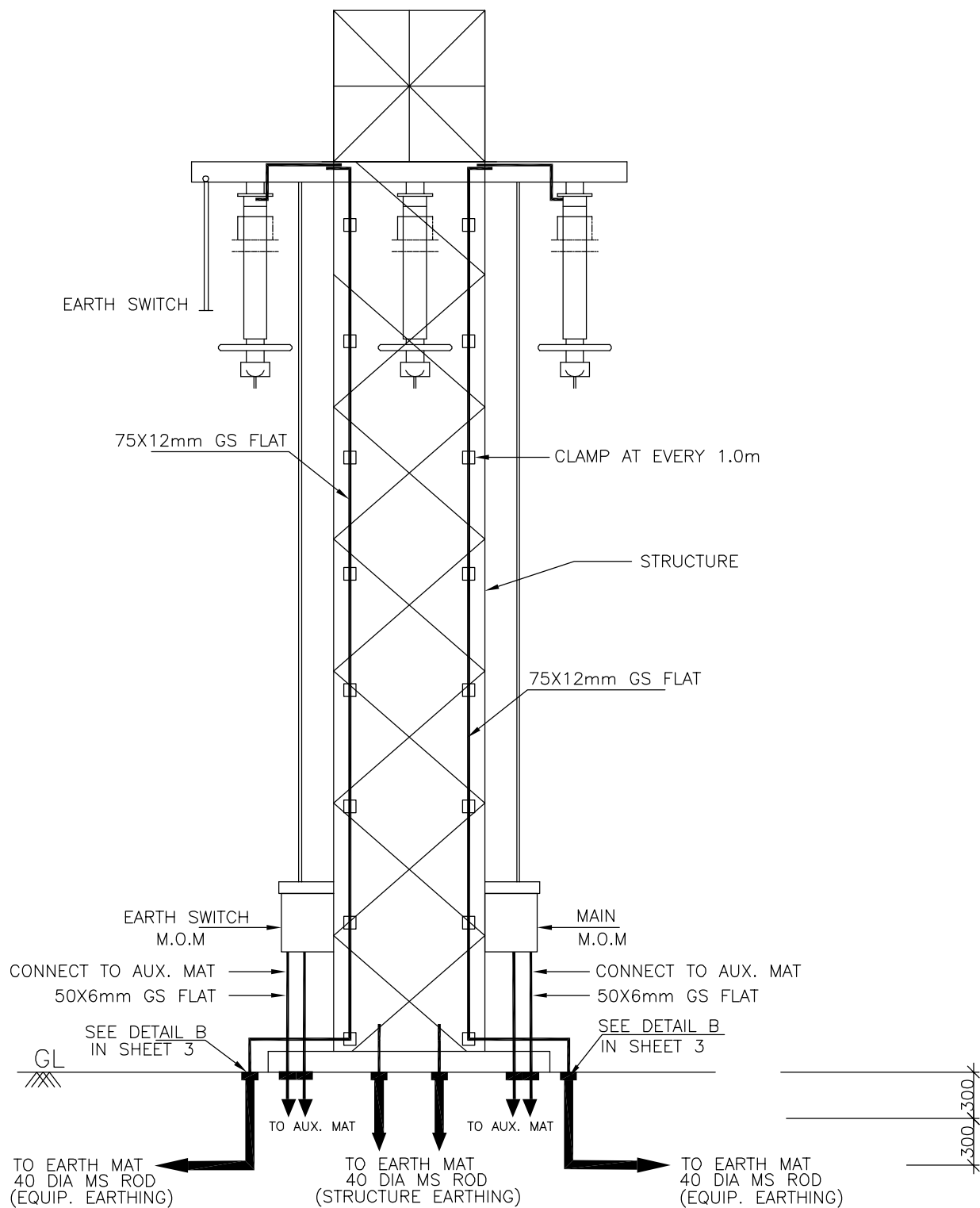
132 kV HORIZONTAL CENTER BREAK ISOLATOR WITHOUT EARTH SWITCH  
(GANTRY MOUNTED UNDERHUNG)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
11B





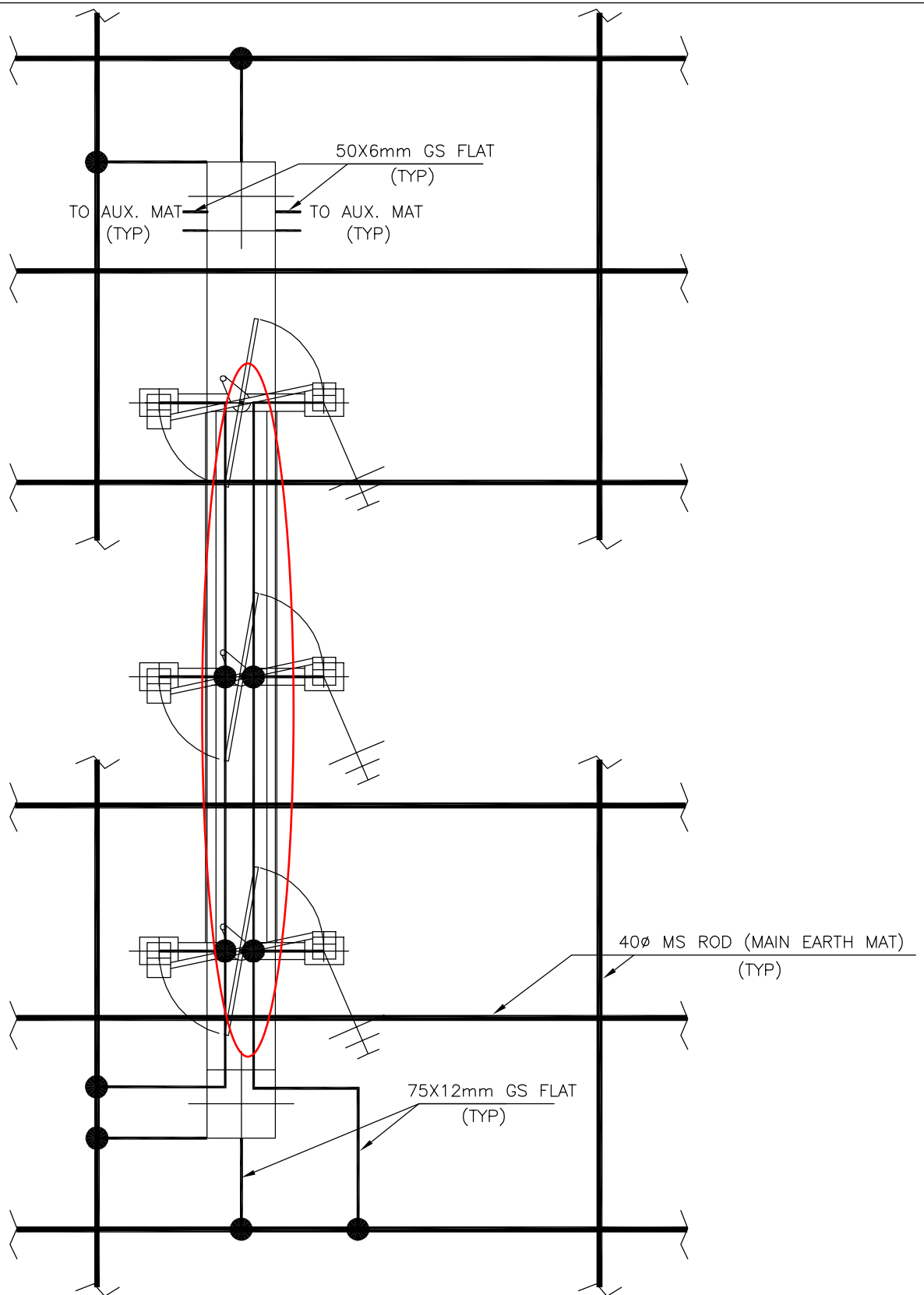
# EQUIPMENT EARTHING DETAILS 132 kV HORIZONTAL DOUBLE BREAK ISOLATOR WITH ONE EARTH SWITCH (GANTRY MOUNTED UNDERHUNG)

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
12A





#### NOTES

1. AUX. MAT SHALL BE PROVIDED NEAR EVERY MOM BOX (REFER SHEET 15)
2. LOCATION OF MOM BOX SHALL BE AS APPROVED OGA DRAWING.
- RISER = 06 NOS PER ISOLATOR + 2 NO RISER PER MOM BOX



### EQUIPMENT EARTHING DETAILS

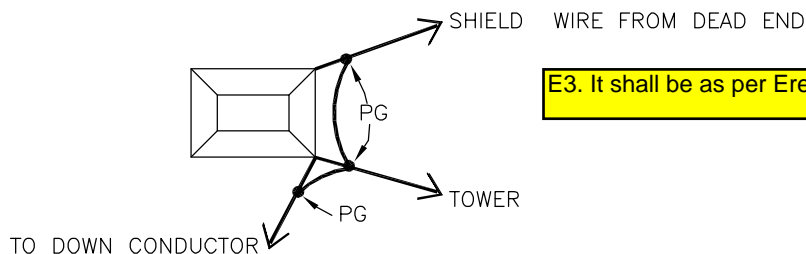
132 kV HORIZONTAL CENTER BREAK ISOLATOR WITH ONE EARTH SWITCH  
(GANTRY MOUNTED UNDERHUNG)

DRG. No.

5602-003-H230-PVE-E-100

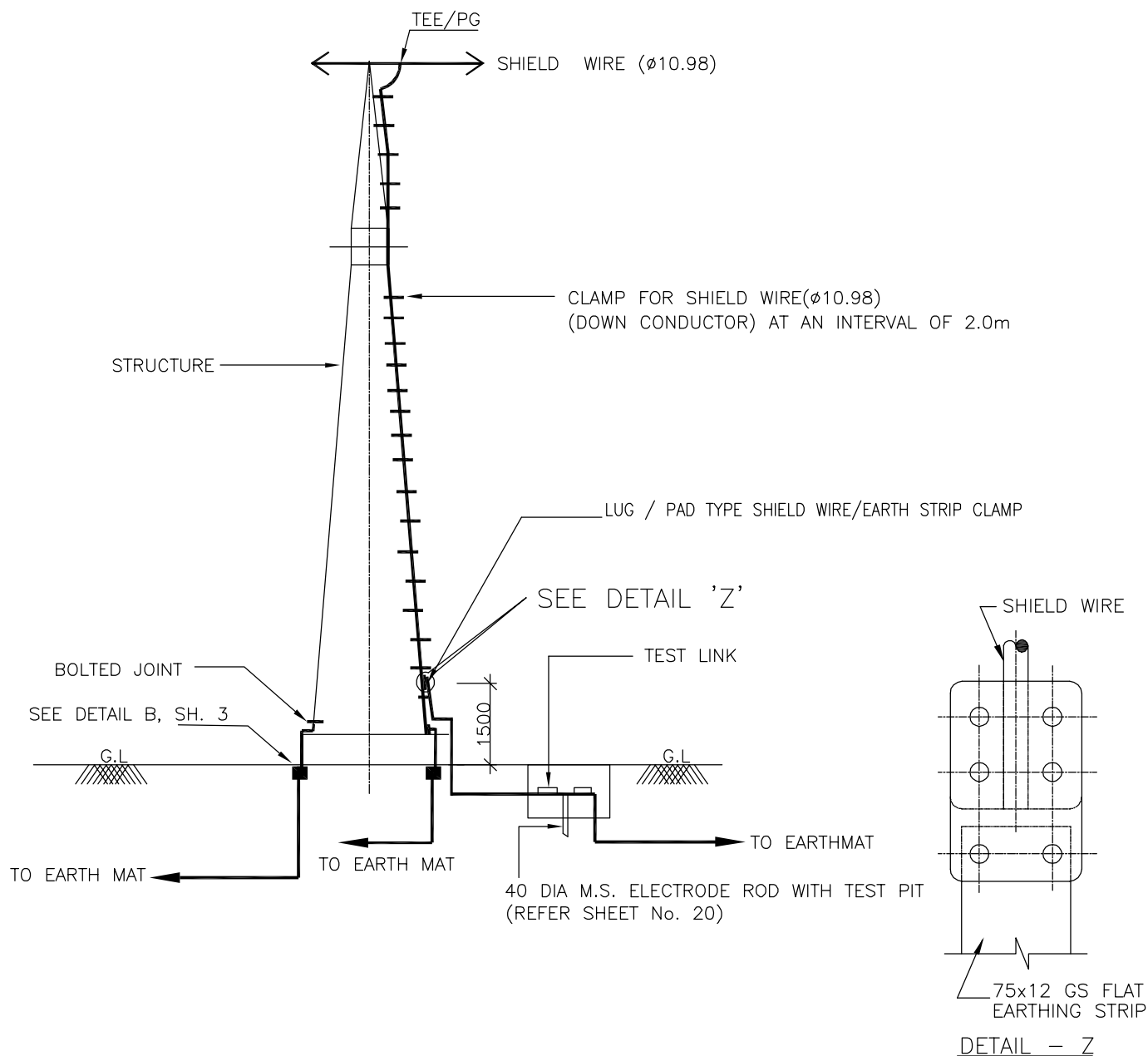
SHEET No.  
12B





E3. It shall be as per Erection key Diagram.

### DETAIL WHEN 2 & E/WIRE TERMINATES A TOWER



### NOTE:

1. TWO EARTHING STRIP SHALL BE CONNECTED TO ONE RISER.
2. NO. OF ROD ELECTRODE : 1 NO. PER TOWER WITH DOWN CONDUCTOR.
3. NO. OF RISERS = 2 NOS.



## EQUIPMENT EARTHING DETAILS

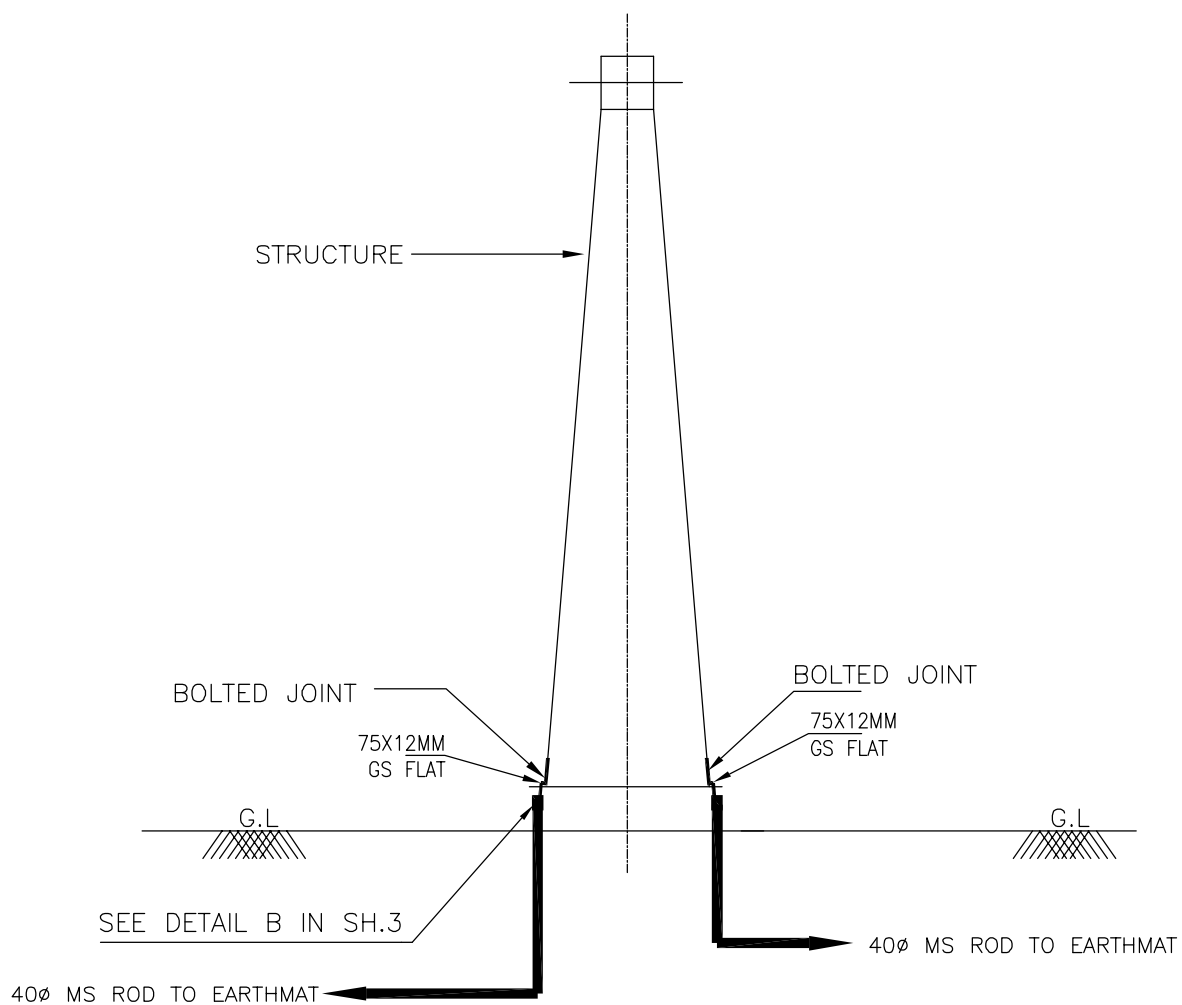
### TOWER WITH PEAK

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
13





NOS. OF RISERS = 2 NOS. PER TOWER



## EQUIPMENT EARTHING DETAILS

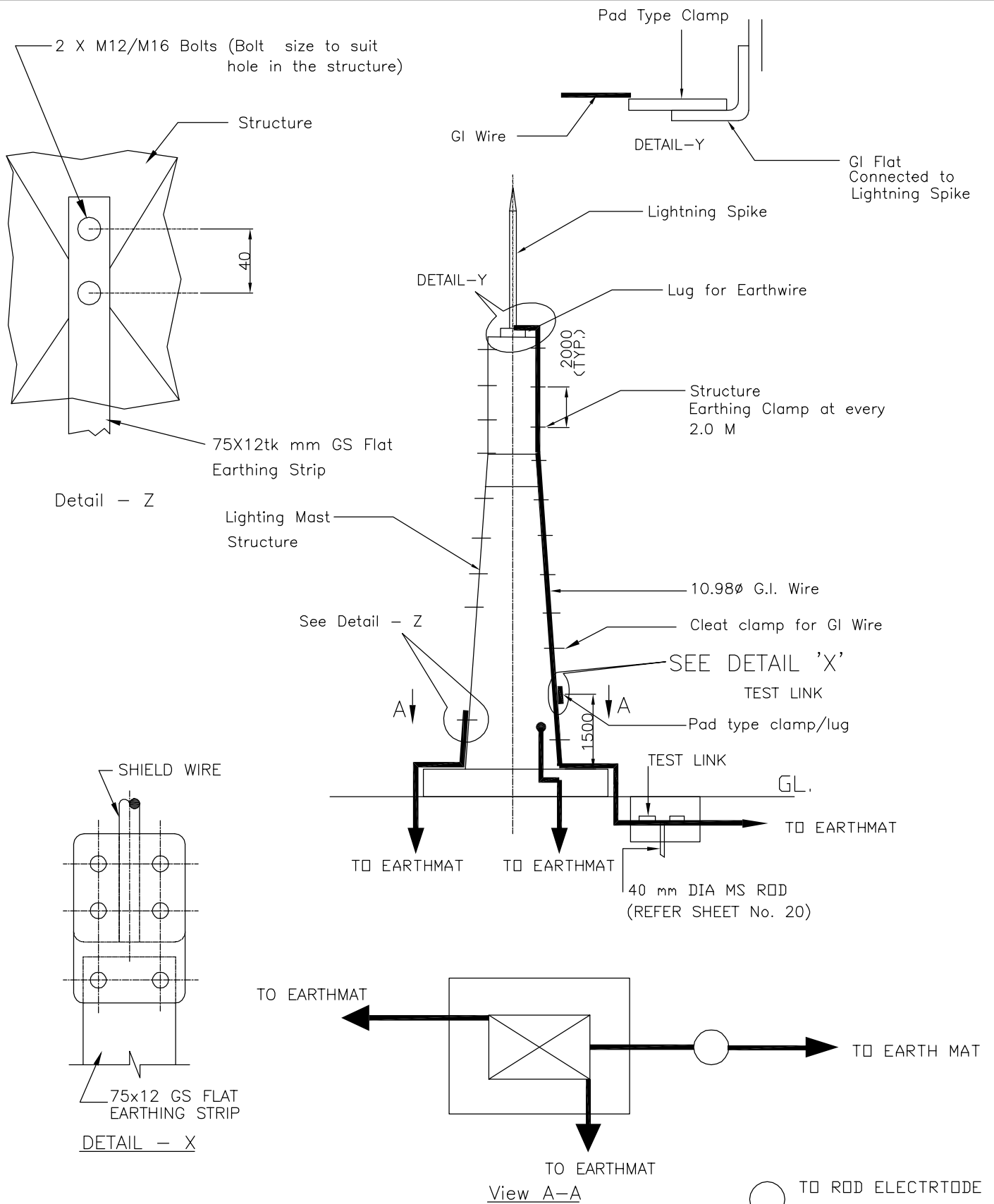
### TOWER WITHOUT PEAK

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
14





**NOTE:**

1. TWO EARTHING STRIP SHALL BE CONNECTED TO ONE RISER.
2. NO. OF ROD ELECTRODE WITH TEST PIT : 1 NO.
3. PAD TYPE CLAMP 1 NOS.
4. THE DOWN CONDUCTORS (E/WIRE) SHALL BE CONNECTED TO EARTH ELECTRODE.



## EQUIPMENT EARTHING DETAILS

### LIGHTING MAST

DRG. No.

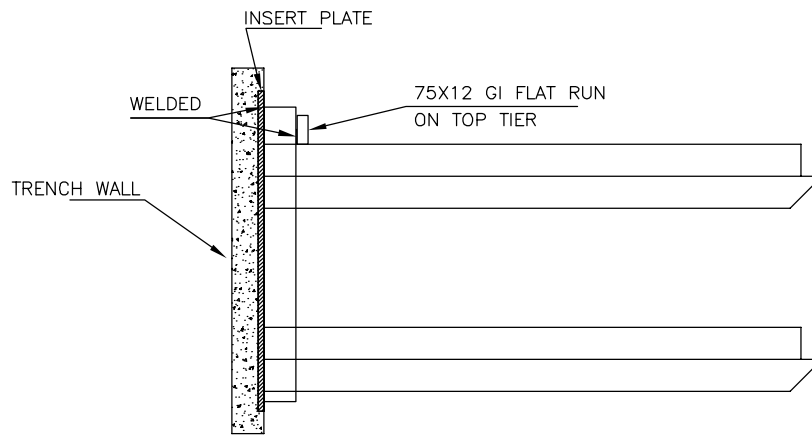
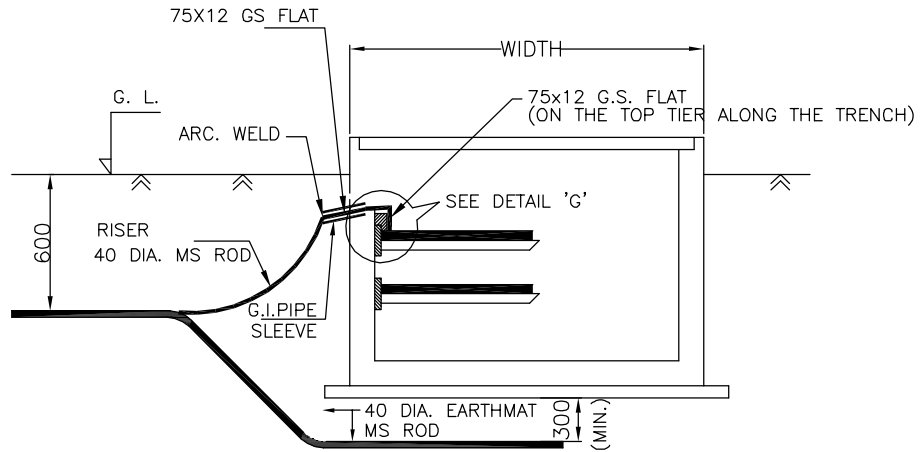
5602-003-H230-PVE-E-100

SHEET No.  
15









DETAIL 'G'

DETAIL FOR CONNECTING GI FLAT RUNNING  
ON TOP TIER TRENCH TO EMBEDDED PLATE.

NOTE:

1. RISERS SHALL BE PROVIDED AT AN INTERVAL OF 20M ALONG THE LENGTH OF TRENCH.
2. THE EARTH STRIP (75x12 G.S. FLAT) SHALL BE WELDED/CLEATED TO TOP RACK ALONG THE TRENCH RUN AT EVERY 0.75M.
3. WHERE THE CABLE RACKS ARE PROVIDED ON BOTH SIDES OF THE TRENCH, BOTH SIDES SHALL BE EARTHED AS PER ABOVE.
4. CABLE & CABLE TRAY EARTHING SHALL BE DONE AS PER SPECIFICATION.



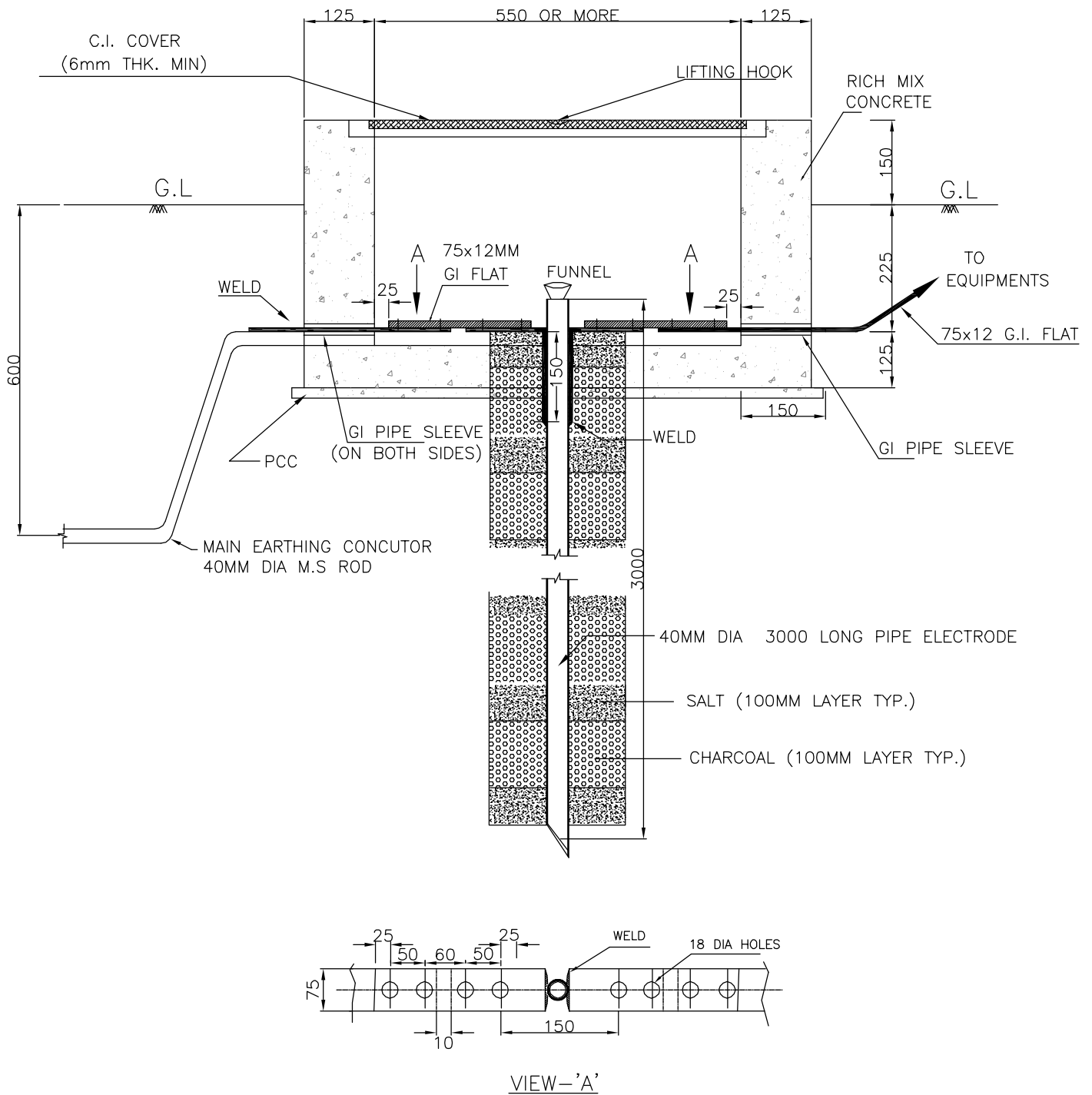
EQUIPMENT EARTHING DETAILS  
CABLE TRENCH

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
17





**NOTE:**

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT  
EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. TO BE USED FOR CONNECTING TRANSFORMER NEUTRAL



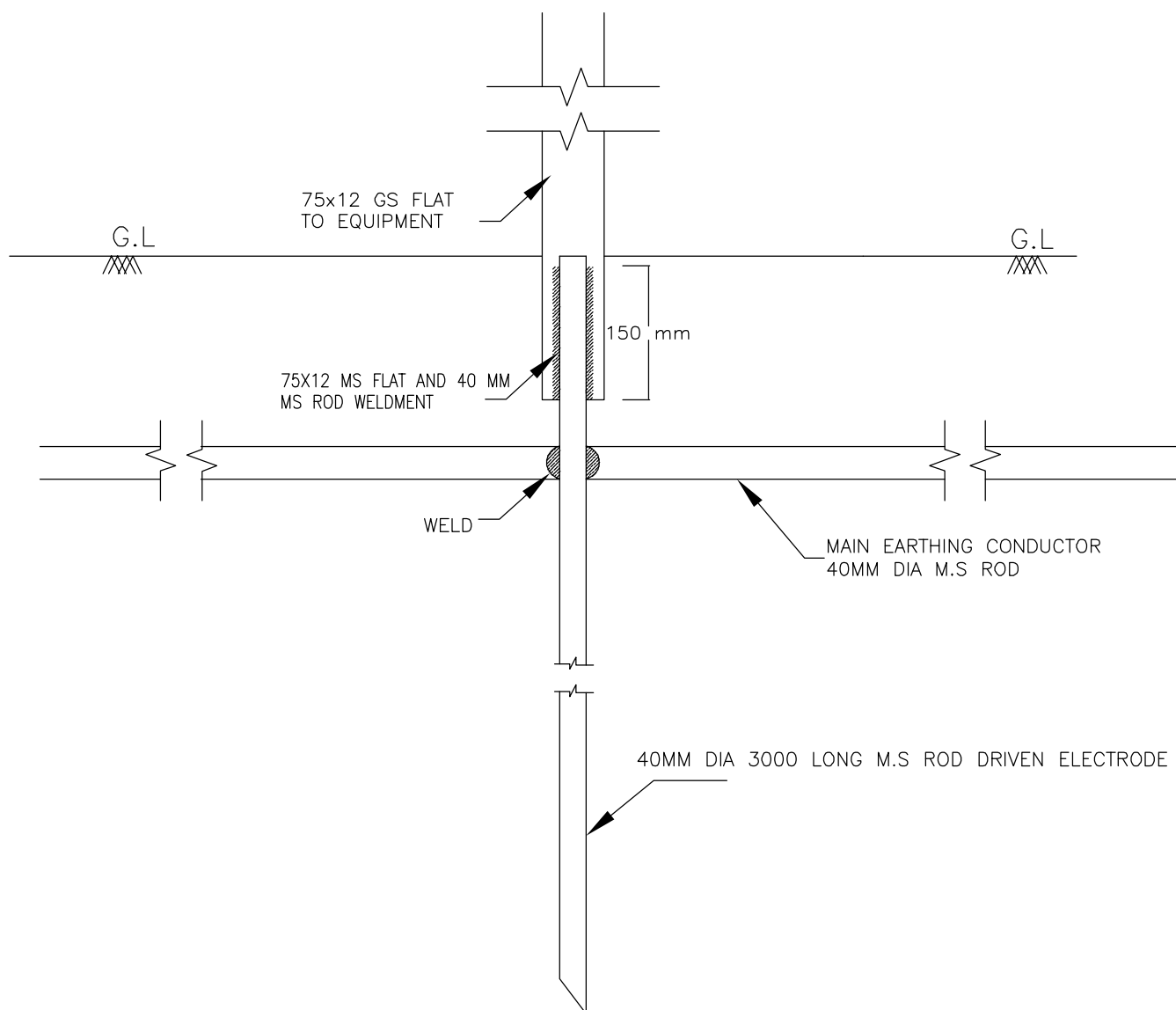
**EQUIPMENT EARTHING DETAILS**  
**PIPE EARTH ELECTRODE WITH TREATED PIT**

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
18





#### NOTES:—

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. ALL NUTS, BOLTS & WASHERS SHALL BE GALVANISED.



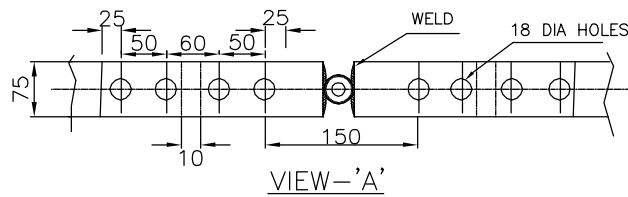
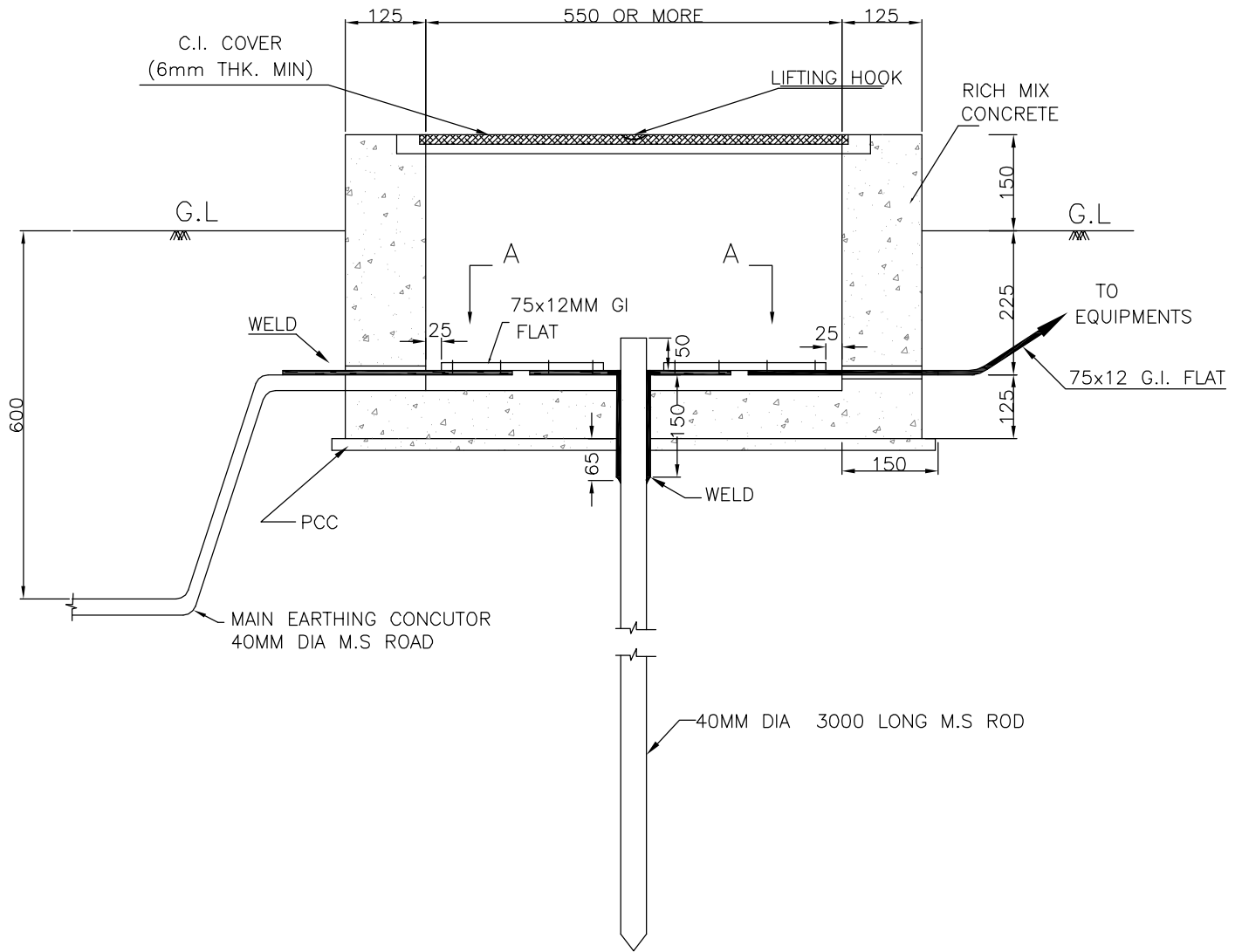
## EQUIPMENT EARTHING DETAILS ROD EARTH ELECTRODE WITHOUT TEST PIT

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
19





#### NOTES:—

1. SUPPLY OF FIXING BOLTS NUTS & WASHERS FOR GI FLAT  
EARTHING CONDUCTOR IS ALSO FORMS PART OF THE SCOPE.
2. TO BE USED FOR CONNECTING DOWN CONDUCTOR OF  
LIGHTNING PROTECTION SYSTEM. **AND TOWERS WITH PEAK.**



## EQUIPMENT EARTHING DETAILS

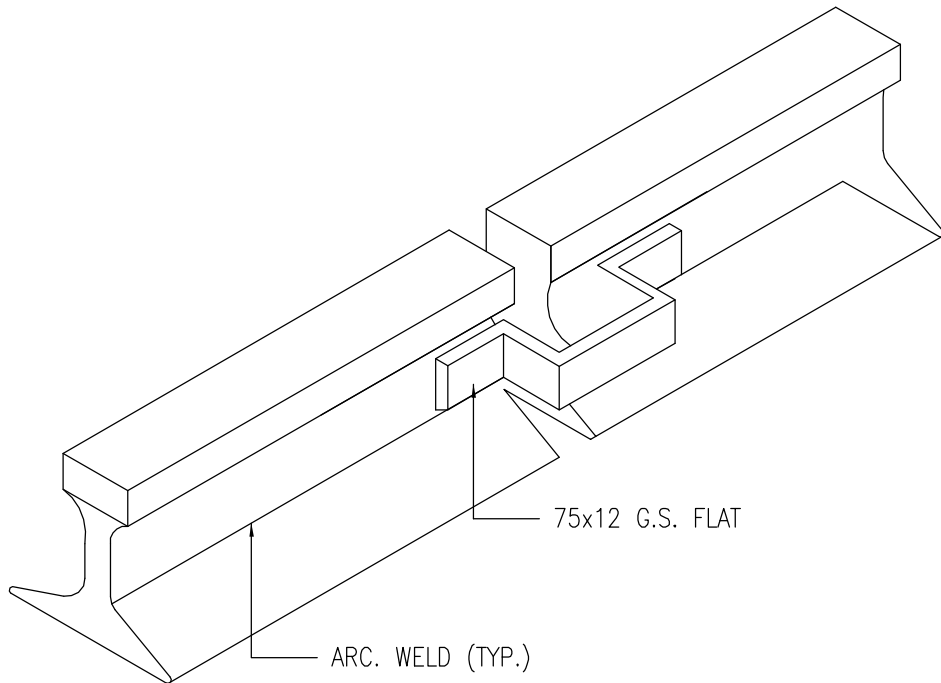
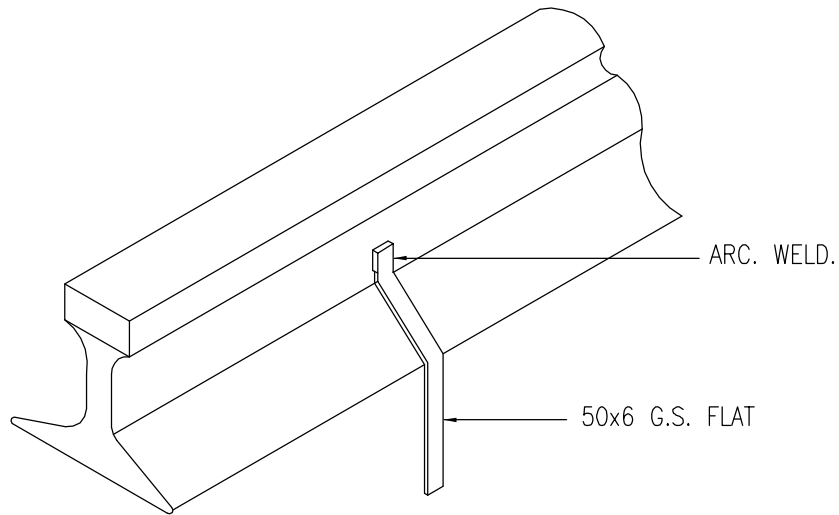
### ROD EARTH ELECTRODE WITH TEST PIT FOR TOWERS AND LM

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
20





NOTE:—

1. RAILWAY TRACKS WITHIN SWITCHYARD AREA SHALL BE EARTHED AT A SPACING OF 30m, IF APPLICABLE AND ALSO AT BOTH ENDS.



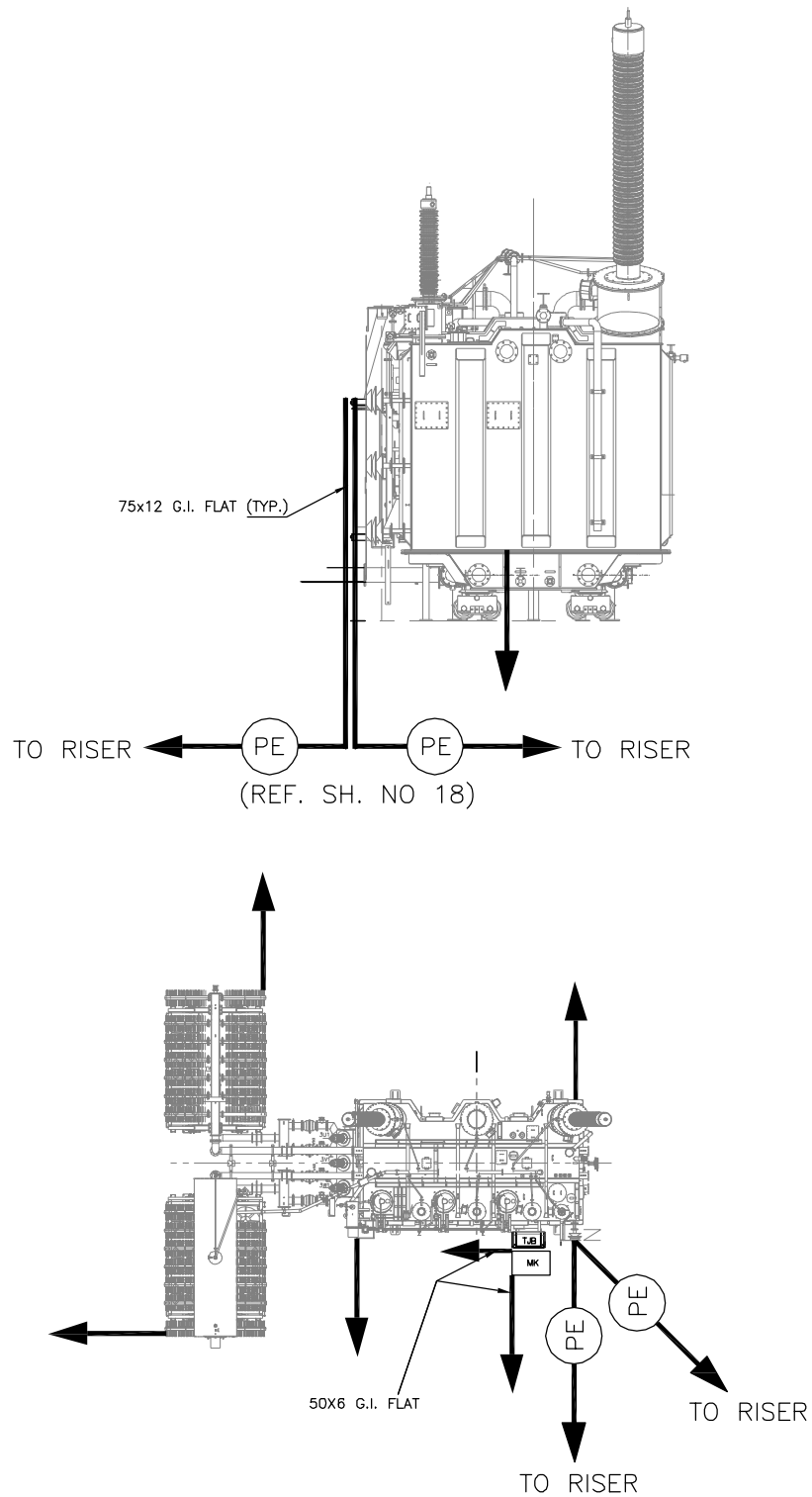
EQUIPMENT EARTHING DETAILS  
RAIL BONDING

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
21





#### NOTES:—

NO.OF PIPE EARTH ELECTRODE WITH TREATED PIT (REFER SHEET NO. 18) = 2 NOS.

NO.OF RISERS = 8 NOS. FOR EARTHING OF FOLLOWING PARTS OF TRANSFORMER

BY 75X12 GI FLAT (TWO EARTHING STRIPS CAN BE CONNECTED TO ONE RISER):

MAIN TANK	2 Nos.
RADIATOR BANK	2 Nos.
MARSHALLING BOX	2 Nos.
NEUTRAL EARTHING	2 Nos.

**EACH**



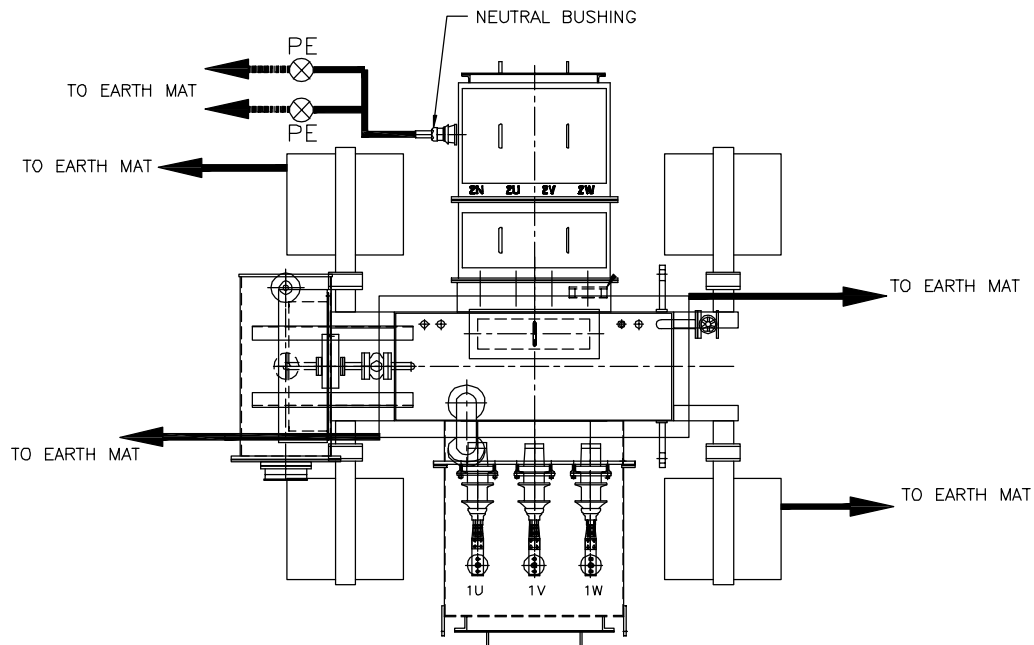
## EQUIPMENT EARTHING DETAILS TRANSFORMER

DRG. No.

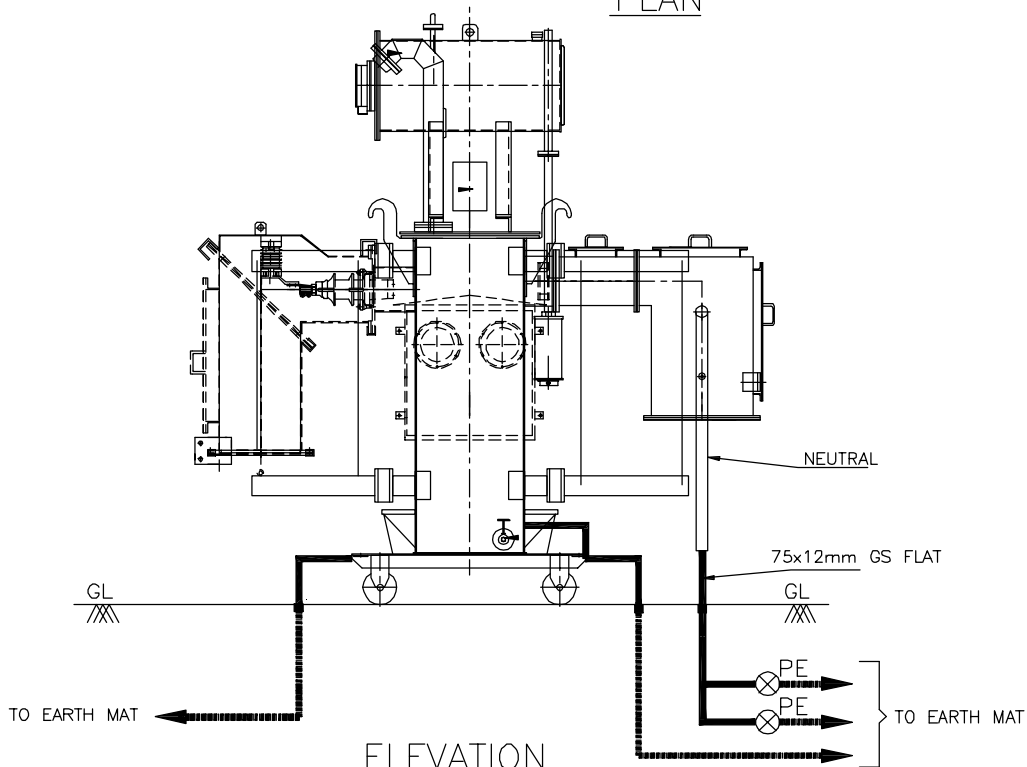
5602-003-H230-PVE-E-100

SHEET No.  
22





PLAN



ELEVATION

MINIMUM DISTANCE OF 6000MM SHALL BE MAINTAINED BETWEEN TWO TREATED (PIPE) ELECTRODES.

NO.OF PIPE ELECTRODE WITH TREATED PIT (REFER SHEET NO. 11) = 2 NOS.

NO.OF RISERS = 6 NOS. FOR EARTHING OF FOLLOWING PARTS OF TRANSFORMER

(TWO EARTHING STRIPS CAN BE CONNECTED TO ONE RISER):

MAIN TANK 2 Nos. (75x12 GS FLAT)

RADIATOR BANK 2 Nos. (75x12 GS FLAT)

NEUTRAL EARTHING 2 Nos. (75x12 GS FLAT THROUGH PIPE ELECTRODE)

MARSHALLING BOX 2 Nos. (75x12 GS FLAT) IF APPLICABLE



## EQUIPMENT EARTHING DETAILS

### SWITCHYARD SERVICE TRANSFORMER

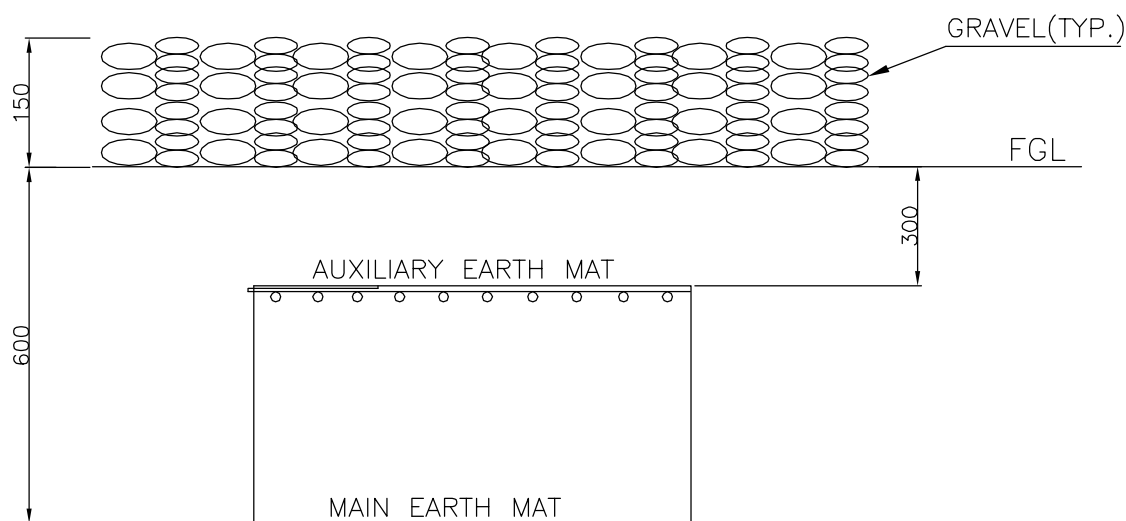
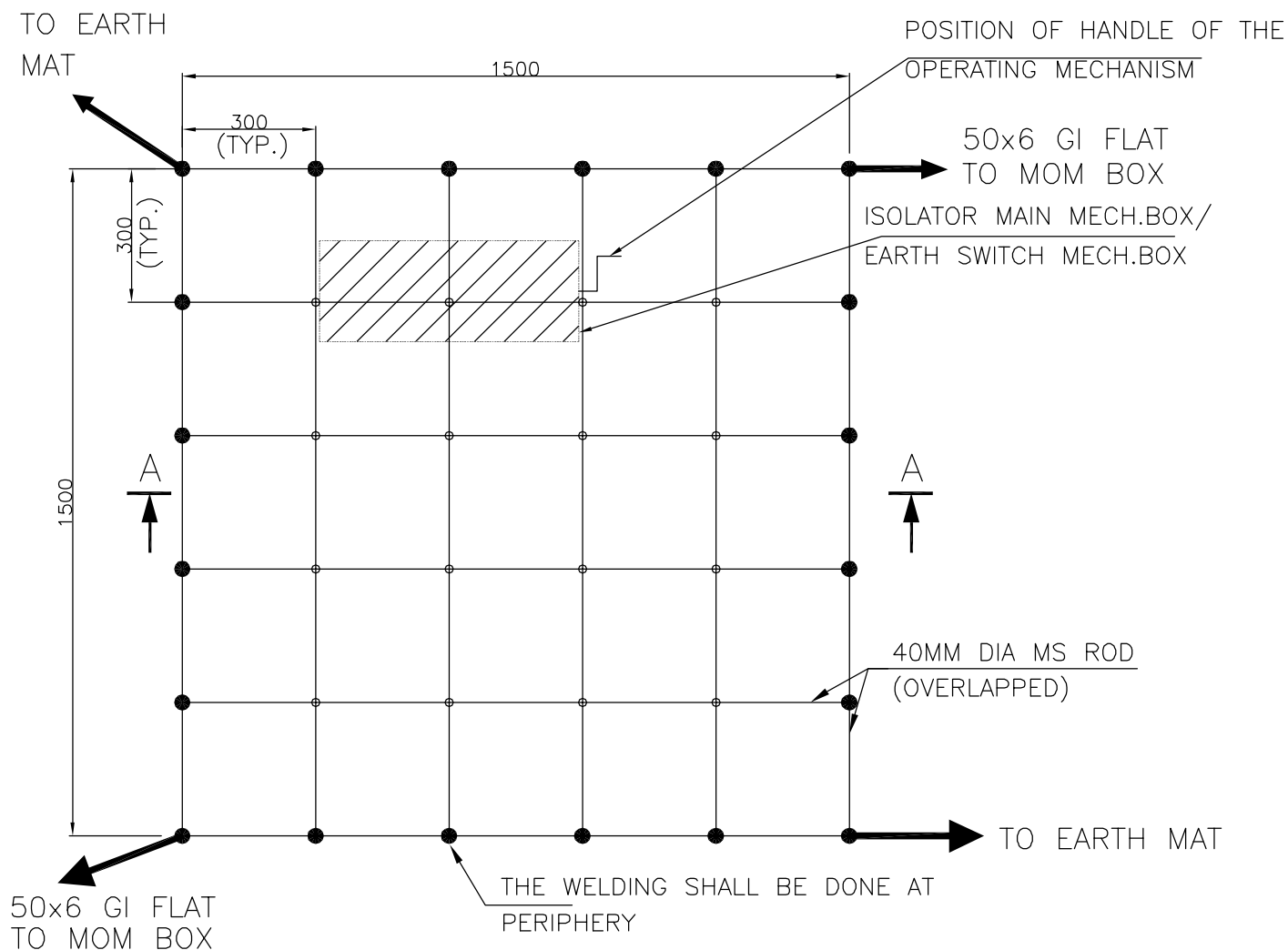
DRG. No.

5602-003-H230-PVE-E-100

SHEET No.

23





SECTION AA

NOTES:—

AUX. EARTH MAT SHALL BE SO POSITIONED THAT THE FOOT OF THE OPERATOR ALWAYS LIE OVER THE AUX. EARTH MAT AREA WHILE ATTENDING / OPERATING THE MECH. BOX THE CABLE TRENCH ROUTING SHALL BE PLANNED ACCORDINGLY.



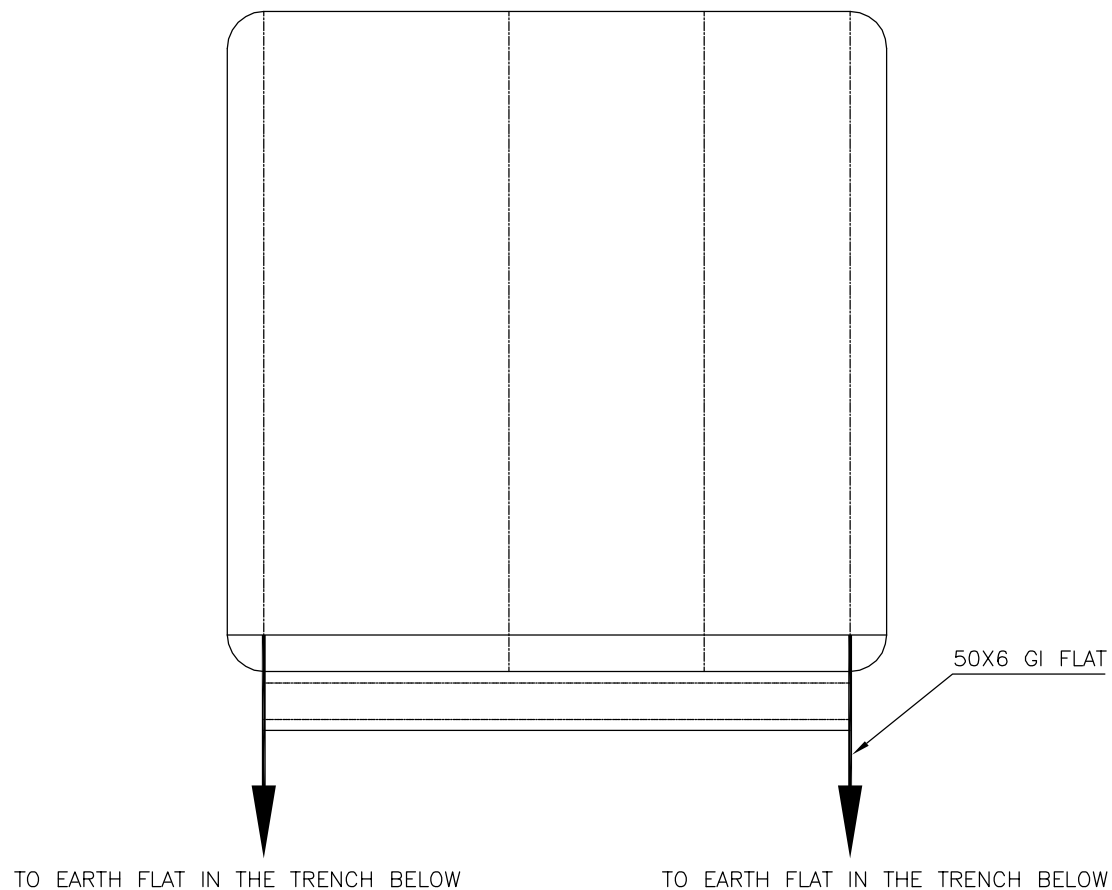
# EQUIPMENT EARTHING DETAILS AUXILIARY EARTH MAT FOR ISOLATOR MAIN MECH.,E/S MECH. BOX

DRG. No.

5602-003-H230-PVE-E-100

SHEET No.  
24





EQUIPMENT  
CONTROL & RELAY PANELS



# EQUIPMENT EARTHING DETAILS CONTROL AND RELAY PANELS

DRG. No.

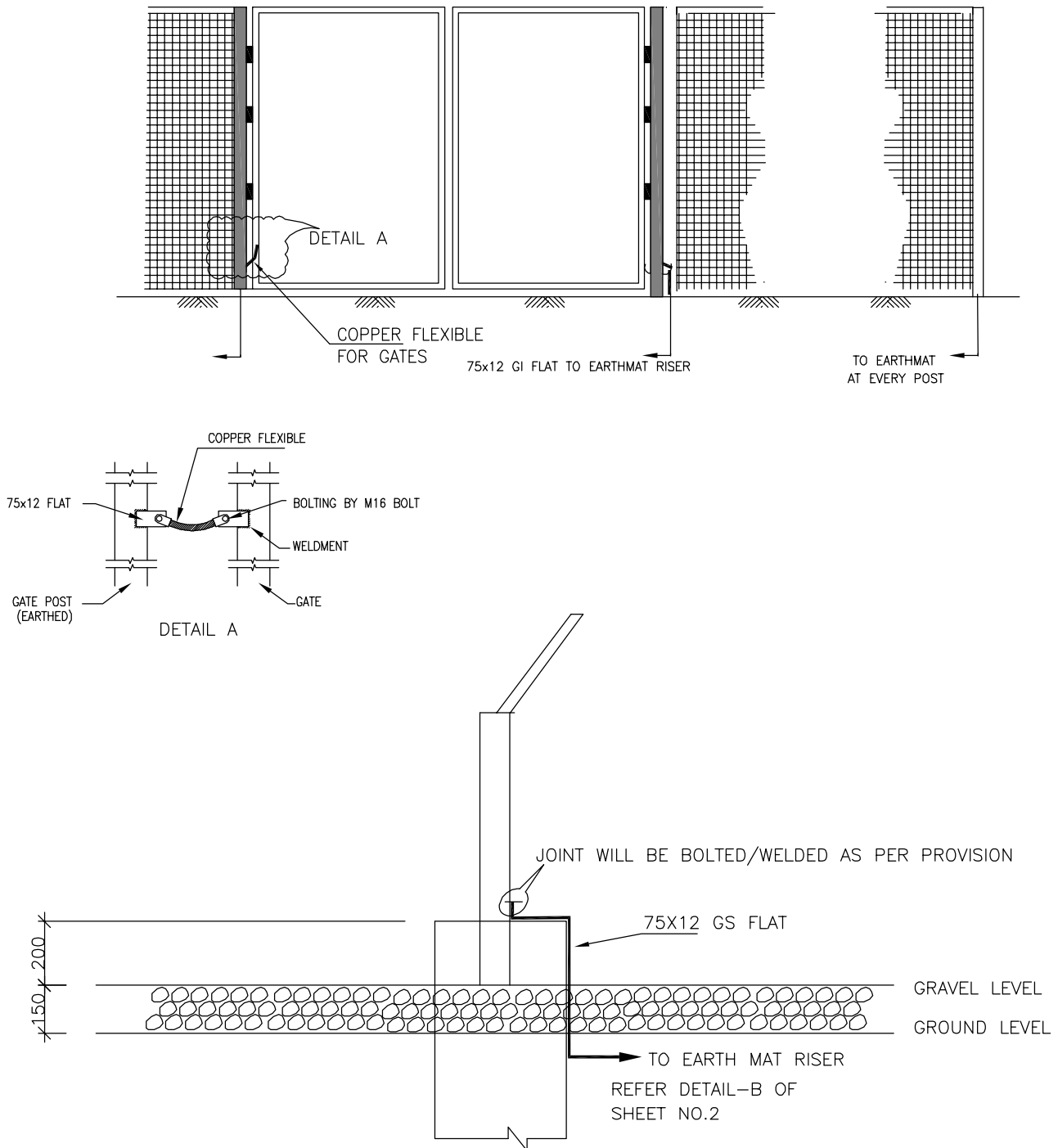
5602-003-H230-PVE-E-100

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## FENCE GATE

## FENCE GROUNDING



EVERY POST OF FENCE & GATES SHALL BE CONNECTED TO EARTHING LOOP BY 75X12 MM GS FLAT.  
EARTHING CONDUCTOR SHALL BE BURIED 2000mm OUTSIDE THE SWITCHYARD FENCE.

## FENCE EARTHING



## EQUIPMENT EARTHING DETAILS

E4. Pls correct as  
GATE/FENCE POST

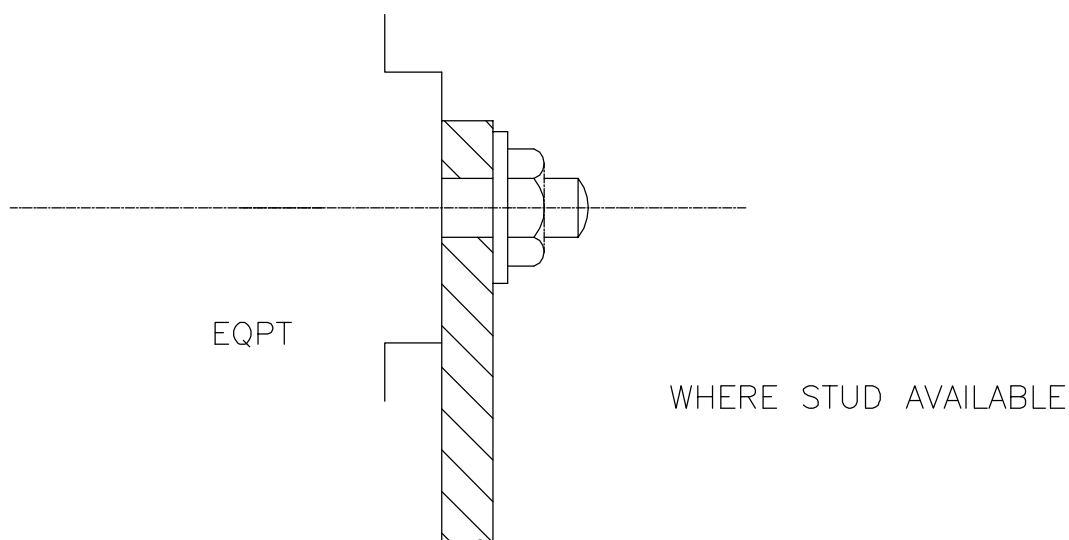
AND RELAY PANELS

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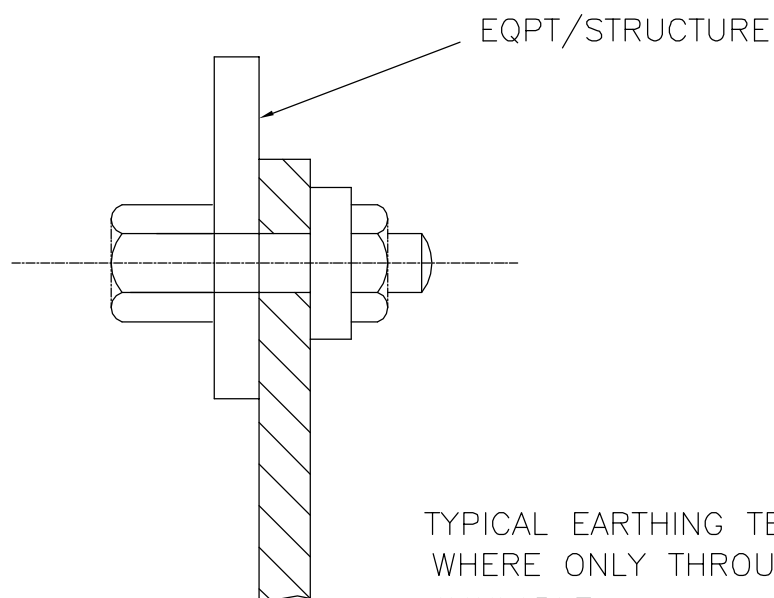
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TYPICAL EARTHING TERMINAL JOINT



### NOTE

1. THIS IS GENERAL TYPICAL BOLTING ARRANGEMENT APPLICABLE TO ALL PANELS, EQUIPMENT, ETC, WHERE BOLTING ARRANGEMENT IS PROVIDED.
2. IN CASE EARTHING TERMINAL COMPRISES ONLY A TAPPED HOLE SUITABLE BOLT/ SCREW WITH WASHER MAY BE USED FOR EARTHING CONDUCTOR TERMINATION



## EQUIPMENT EARTHING DETAILS

### TYPICAL ARRANGEMENT OF BOLTED JOINTS

DRG. No.

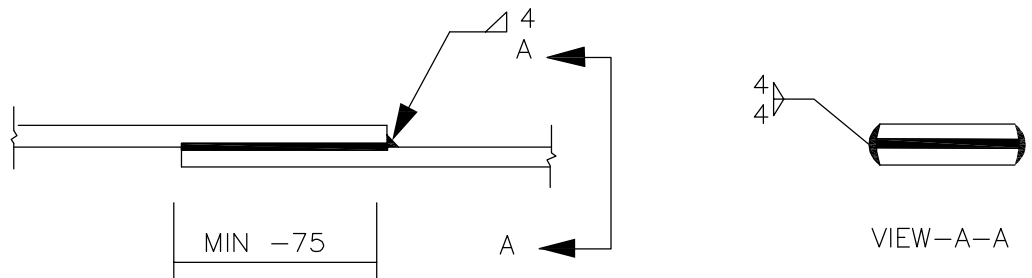
5602-003-H230-PVE-E-100

SHEET No.  
27

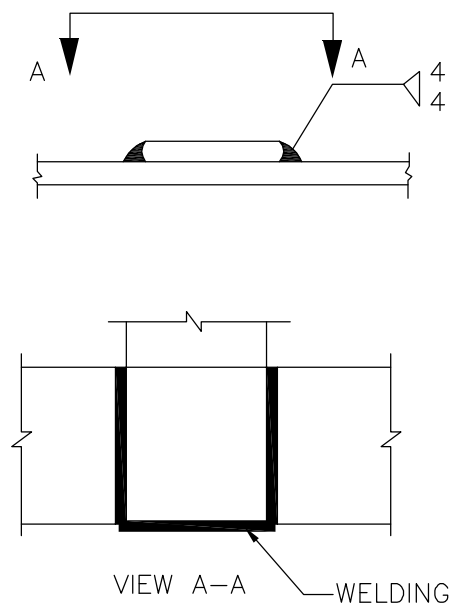


## C. STRIP TO STRIP (50X6 MS FLAT)

### 1. STRAIGHT LAP JOINT/RISER



### 2. CROSS LAP JOINT



## EQUIPMENT EARTHING DETAILS

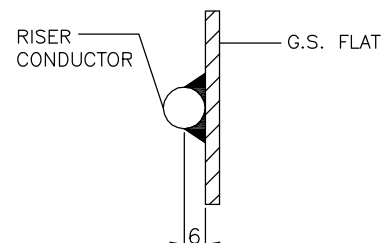
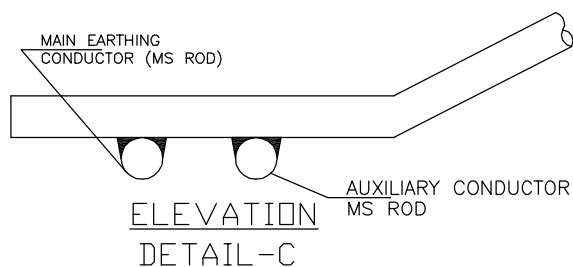
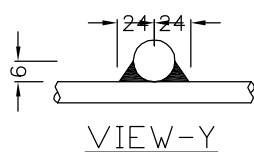
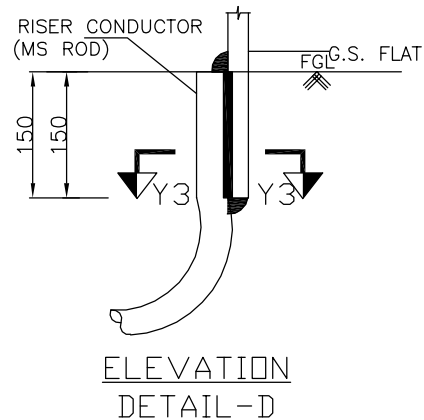
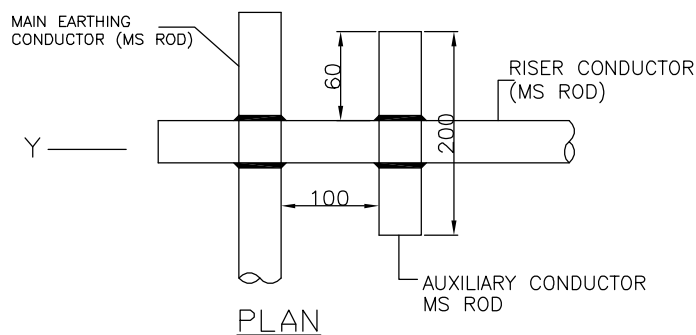
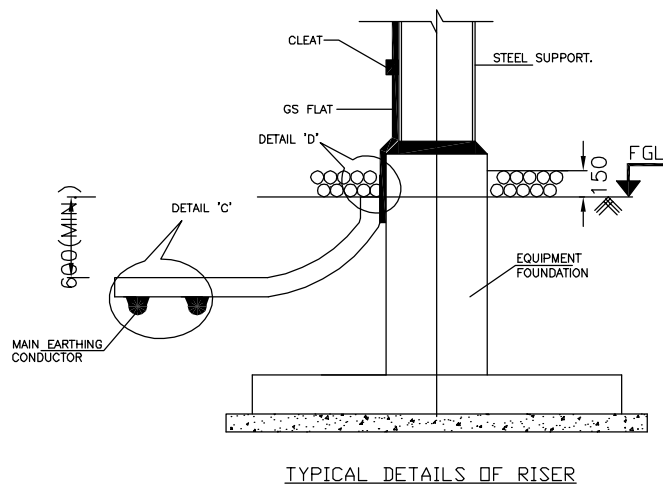
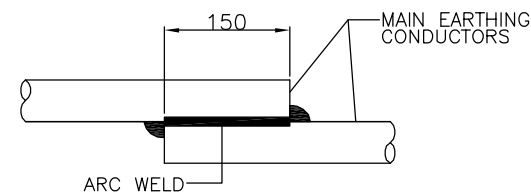
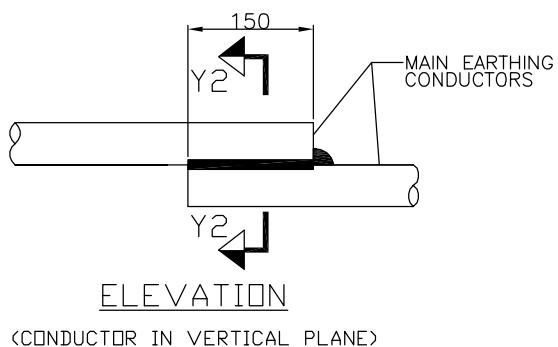
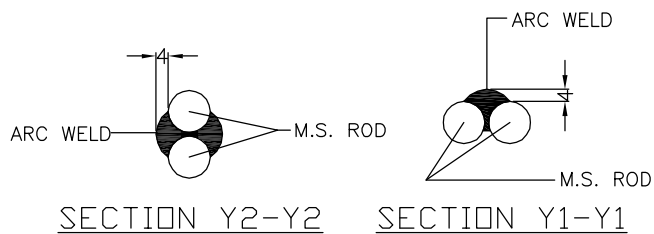
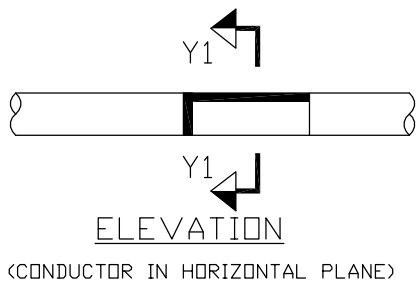
### WELDING DETAILS

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SHEET No.  
28A





**TYPICAL OVERLAPPING JOINT OF TWO CONDUCTORS**



## EQUIPMENT EARTHING DETAILS WELDING DETAILS

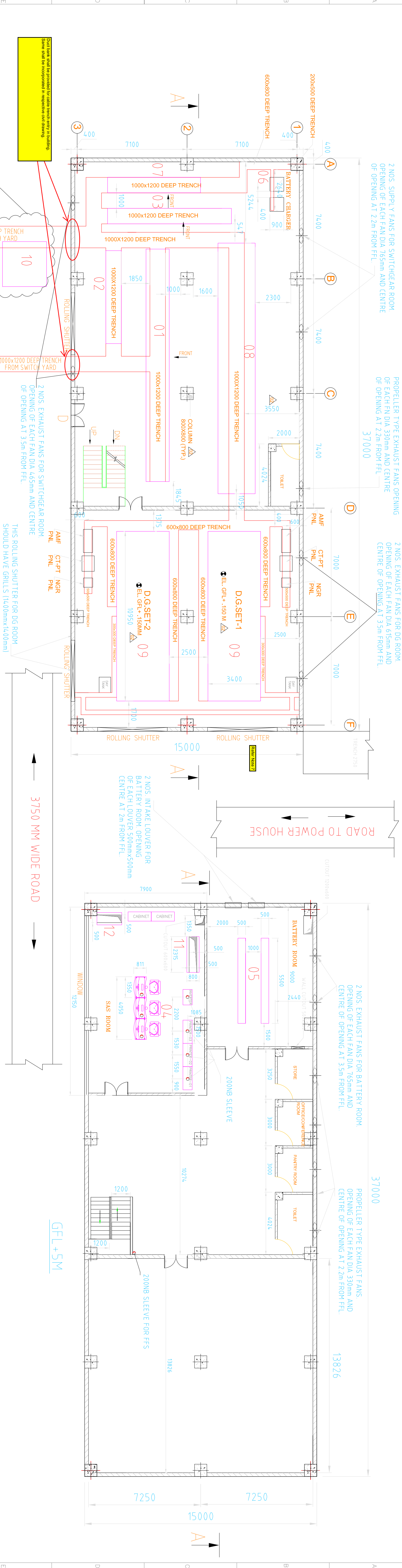
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SHEET No.  
28B



59861000021 ON SHG



GROUND FLOOR PLAN

INDICATIVE ONLY ACTUAL LOCATION OF TRANSFORMER & TRENCH LAYOUT SHALL BE SHOWN IN CABLE TRENCH LAYOUT DRAWING TO BE SUBMITTED BY BHEL-TBG

22674

EL. GFL+10M

El Equipment engineering shall be carried out by BHEL to suit the layout requirements. Modifications (if cost of BHEL.

