

PART-II

TECHNICAL SPECIFICATION

CHAPTER – E13: INSTALLATION

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	CHAPTER- E13: INSTALLATION	
1.00.00	EARTHING The earthing shall be done in accordance with requirements given in Annexure-I of this section and drawing enclosed with the specifications. Earthing of panels shall be done in line with the requirements given in respective equipment section of this specification. The cost of welding laying etc of earth flats and rods is deemed to be included in the cost of respective item.	
2.00.00	CIVIL WORKS The civil works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.	
3.00.00	STRUCTURAL STEEL WORKS The structural steel works shall be done in accordance with requirements stipulated under Part-II, Section-II of this specification.	
4.00.00	BAY EQUIPMENT	
4.01.00	The disposition of equipment to be supplied are shown in enclosed single line diagrams and layout drawings.	
4.02.00	The Contractor shall prepare layout drawings and submit the same for approval of the Employer. The approval of org. shall not absolve Contractor from his responsibility regarding designing & engineering of switchyard and Contractor shall be fully responsible for all works covered in the scope of this specification.	
5.00.00	LIGHTNING PROTECTION	
5.01.00	Direct stroke lightning protection (DSLPP) shall be provided in the switchyard by lightning masts (at least 50 m high) and shield wires.	
5.02.00	Lightning protection System down conductors shall not be connected to other conductors above ground level. Also no intermediate earthing connection shall be made to Surge arrester, Voltage Transformer, earthing leads for which shall be directly connected to rod electrode.	
5.03.00	Every down conductor shall be provided with a test joint at about 150mm above ground level. The test joint shall be directly connected to the earthing system.	
5.04.00	The lightning protection system shall not be in direct contact with underground metallic service ducts and cables.	
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Clause No.	TECHNICAL REQUIREMENTS			
6.00.00	EQUIPMENT ERECTION NOTES a) All support insulators, circuit breaker interrupters and other fragile equipment shall be handled with cranes with suitable booms and handling capacity. b) Where, assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustments/alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, ~~transportation~~ , storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense. The contractor shall strictly follow manufacturer's recommendations for handling and erection of equipment. c) The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc. Handling equipment, sling ropes etc. should be tested before erection and periodically thereafter for strength. d) Bending of piping should be done by a bending machine and through cold bending only. Bending shall be such that inner diameter of pipe is not reduced. The pipes shall be thoroughly cleaned before installation. e) Cutting of the pipes wherever required shall be such as to avoid flaring of the ends. Hence only a proper pipe cutting tool shall be used. Hack saw shall not be used. f) For cleaning the inside and outside of hollow insulators only Muslin or leather cloth shall be used. g) ~~The rigid busbars for equipment interconnections shall have rigid connections at one end and expansion / flexible at the other end. The tubular aluminium connections shall have not more than one joint per span. Since no wastages are permissible, the bidder shall work out the cut lengths of aluminum tube based on finalized layout and dispatch the same to site without requiring owners's approval. Corona bells shall be provided at the end of the rigid busbars.~~			
7.00.00	STORAGE OF EQUIPMENT Contractor is responsible for the proper storage and maintenance of all materials/equipment entrusted to him. The Contractor shall provide & construct adequate storage shed for proper storage of equipment. Sensitive equipment shall be stored indoors. All equipment during storage shall be protected against damage due to acts of nature or accidents. Contractor shall take all required steps to carryout subsequent inspection of materials/equipment stored as well as erected			
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	until the same is taken over by the Employer. The storage instruction of the equipment manufacturers/Engineer-in-Charge shall be strictly adhered to.	
8.00.00	CABLING	
8.01.00	Cabling shall be on cable racks, in trenches, vertical shafts, excavated trenches for direct burial, pulled through pipes and conduits run clamped on steel structures etc.	
8.02.00	Cables inside the switchyard shall be laid on ~~bolted~~ GI angle supports at 600mm spacing with separate tiers for control and power cables. The GI angles shall be ~~bolted~~ welded to galvanized insert plates inside RCC trenches. Prefabricated GI angles welded ~~to bolted~~ to galvanized insert plates before embedment in RCC shall be preferred.	
8.03.00	Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the ground. In the case of equipment located away from cable trench either pipe inserts shall be embedded in the ground connecting the cable trench and the equipment or in case the distance is small, notch/opening shall be provided. In all these cases necessary bending radii as recommended by the cable supplier shall be maintained.	
8.04.00	Cabling in the control room shall be done on ladder type cable trays.	
8.05.00	All interpole cables (both power & control circuit) for equipments shall be laid in cable trenches/G.I. Conduit Pipe of NB 50/100mm which shall be buried in the ground at a depth of 300mm.	
9.00.00	CONDUITS, PIPES AND ACCESSORIES	
9.01.00	The conductor shall ~~supply and~~ install all rigid conduits, mild steel pipes, flexible conduits, ~~hume pipes~~ etc. including all necessary sundry materials, such as tees, elbows, check nuts, bushings, reducers, enlargers, wooden plugs, coupling caps, nipples, gland sealing fittings, pull boxes etc. ~~The size of the conduit/pipes shall be selected on the basis of maximum 40% fill criterion.~~ All conduits/pipes shall have their ends closed by caps until cables are pulled. After cables are pulled, the ends of conduits/pipes shall be sealed in an approved manner, to prevent damage to threaded portion and entrance of moisture and foreign material.	
9.02.00	~~Rigid conduits shall be flow-coat metal conduits of Nagarjuna Coated Tubes or equivalent make. The outer surface of the conduits shall be coated with hot-dip zinc and chromate coatings. The inner surface shall have silicone epoxy ester coating for easy cable pulling. Mild steel pipes shall be hot-dip galvanised. All rigid conduits/pipes shall be of a reputed make.~~	
9.03.00	~~The hume pipes and accessories shall be of reinforced concrete conforming to class NP2 of IS: 458. All tests on hume pipes shall be conducted as per IS: 458.~~	
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9.04.00	~~Flexible conduits shall be of heat-resistant lead coated steel, water-leak, fire and rust proof and be of PLICA make or equivalent.~~	
10.00.00	~~JUNCTION BOXES~~ ~~Contractor shall supply and install junction boxes complete with terminals as required. The brackets, bolts, nuts and screws required for the erection shall be included in the installation price. The junction boxes shall conform to the requirements of sec. AUX.~~	
11.00.00	CABLE TAGS AND MARKER	
11.01.00	Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.	
11.02.00	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.	
11.03.00	Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate.	
11.04.00	Location of underground cable joints shall be indicated with cable marker with an additional inscription "Cable joint".	
11.05.00	The marker shall project 150mm above ground and shall be spaced at an interval 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.	
11.06.00	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. Cable tags shall be provided inside the switchgear, motor control centres, control and relay panels etc., wherever required for cable identification, such as where a number of cables enter together through a gland plate.	
11.07.00	The price of cable tags and markers shall be included in the installation rates for cables /conduits quoted by the Contractor.	
11.08.00	Specific requirements for cabling, wiring ferrules as covered in respective equipment section shall also be complied with.	
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12.00.00	CABLE GLANDS	
12.01.00	Double compression type tinned/Nickel plated (coating thickness not less than 20 microns in case of Tin and 10 to 15 Microns in case of Nickel) brass cable glands shall be provided by the Contractor for all power and control cables to provide dust and weather proof terminations. The cable glands shall be tested as per BS : 6121. They shall comprise of heavy duty brass casting, machine finished and tinned to avoid corrosion and oxidation. Rubber components used in cable gland shall be neoprene and of tested quality.	
12.02.00	Required number of packing glands to close unused openings in gland plates shall also be provided.	
13.00.00	CABLE LUGS	
13.01.00	Cable lugs shall be tinned copper solderless crimping type conforming to IS: 8309 and 8394 suitable for aluminium or copper conductor (as applicable). Solderless crimping of terminals shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.	
13.02.00	The cable lugs shall be of Dowell make or equivalent.	
13.03.00	Crimping tool used shall be of approved design and make.	
14.00.00	STORAGE AND HANDLING OF CABLE DRUMS	
	Cable drums shall be unloaded, handled and stored in an approved manner and rolling of drums shall be avoided as far as practicable. 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 it was rolled during taking up the cables.	
15.00.00	CABLE SUPPORTS AND CABLE TRAY MOUNTING ARRANGEMENTS	
15.01.00	Cable trays in the control room are normally provided with embedded steel inserts on concrete floors/walls. The Contractor shall secure supports by welding to these inserts or available building steel structures.	
15.02.00	~~However, in cases where no such embedded steel inserts are available, the Contractor shall have to secure the supports on wall or floors by suitable anchoring at no extra cost to the Employer. Details of fixing steel plates by anchor fasteners shall be decided during detailed engineering stage. The provision of fixing arrangement including supply of necessary angles etc. shall be included in the installation rates quoted by bidder.~~	
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Clause No.	TECHNICAL REQUIREMENTS	
15.03.00	~~The cable supports shall conform to the requirements of Sec. E12 of this Specification.~~	
15.04.00	Insert plates will be provided at an interval of 600mm wherever cables are to be supported without the use of cable trays, while at all other places these will be at an interval of 2000mm.	
16.00.00	CABLE TERMINATIONS AND CONNECTIONS	
16.01.00	The termination and connection of cables shall be done strictly in accordance with cable and termination kit manufacturer's instructions, drawing and/or as directed by the Employer.	
16.02.00	The work shall include all clamping, fittings, fixing, plumbing, soldering, drilling, cutting, taping, heat shrinking, (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.	
16.03.00	Cost of all consumable material like cable lugs, ferrules, cable glands & termination for power and control cables shall be included in the erection rates quoted.	
16.04.00	The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The Contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.	
16.05.00	The contractor shall tag/ferrule the control cable cores at all terminations, as instructed by the Employer. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.	
16.06.00	Spare cores shall be similarly tagged with cable numbers and coiled up.	
16.07.00	Control cables shall have stranded copper conductor. Bare portion of the solid conductors shall be tinned after removing the insulation and shall be terminated directly without using cable lugs.	
16.08.00	All cable entry points shall be sealed and made vermin and dust proof. Unused openings shall be effectively closed.	
16.09.00	The entry of cables to the panels through floor openings shall be suitably sealed by using fire proof cable penetration system as per BS – 476 part – 20, type A sealing system which would be either silicone foam or equivalent foam system or using individual blocks for each cable along with individual blocks for each cable along with suitable frame work rated for one hour.	
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16.10.00	If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the contractor as directed by the owner.	
16.11.00	DIRECTLY BURIED CABLES	
16.11.01	The Contractor shall construct the cable trenches required for directly buried cables. The scope of work and unit rates for construction of cable trenches for cables shall include excavation, preparation of sand bedding, soil cover, supply and installation of brick or concrete protective covers, back filling and reaming, supply and installation of route markers and joint markers. The bidder shall ascertain the soil parameters prevailing at site, before quoting the unit rates.	
16.11.02	Laying the cable and providing protective covering shall be as per approved drawing.	
16.12.00	INSTALLATION OF CABLES	
16.12.01	Power and control cables shall be laid in separate tiers. The order of laying of various cables shall be as follows, for cables other than directly buried.	
	a	Power cables on top tiers.
	b	Control, instrumentation and other service cables in bottom tiers.
16.12.02	Single core cables in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meters .All multicore cables shall be laid in touching formation. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable. After completion of cable laying work in the particular tray all the control cables shall be bound to trays / supports by aluminum strips at every 5 meter interval and at every bend. All power cables shall be laid with a minimum centre to centre distance equal to twice the diameter of the cable.	
16.12.03	Power and control cables shall be securely fixed to the trays/supports. Horizontal runs in cable trays and trenches shall be secured by using self locking type nylon cable straps with deinterlocking facilities at every 5 m interval. Vertical and inclined cable runs shall be secured at every 1 m by nylon cable straps.	
16.12.04	Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows :	
	a)	Type of cable & voltage grade Minimum bending radius
	b)	Power cable 12 D
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c)	Control cables	10 D		
	Where D is overall diameter of cable.			
16.12.05	Where cables cross roads, drains and rail tracks, the cables shall be laid in reinforced spun concrete or steel pipes, buried at not less than one metre depth.			
16.12.06	In each cable run some extra length shall be kept at a suitable point to enable one (for LT Cables) or two (for H.T cables) straight through joints to be made, should the cable develop fault at a later date.			
16.12.07	Selection of cable drums for each run shall be so planned as to avoid using straight through joints. ~~In case joints are necessary the same shall be supplied by the Contractor.~~ Cable splices will not be permitted except where called for by the drawings, unavoidable or where permitted by the Employer.			
16.12.08	Control cable terminations inside equipment enclosures shall have sufficient lengths so that switching of termination in terminal blocks can be done without requiring any splicing.			
16.12.09	Metal screen and armour of the cable shall be bonded to the earthing system of the station, wherever required.			
16.12.10	Rollers shall be used at intervals of about 2.0 metres, while pulling cables.			
16.12.11	All due care shall be taken during unreeling, laying and termination of cable to avoid damage due to twist, kink, sharp bends etc.			
16.12.12	Cable ends shall be kept sealed to prevent damage.			
16.12.013	Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS: 1255 and other Indian Standard Codes of practices.			
16.12.14	Wherever cables pass through floor or through wall openings or other partitions, wall sleeves with bushes having a smooth curved internal surface so as not to damage the cables, shall be supplied, installed and properly sealed by the Contractor at no extra charges.			
16.12.15	The erection work shall be carried out in a neat workmanlike manner and the areas of work shall be cleaned of all scrap materials, etc. after the completion of work in each area every day. Contractor shall remove the RCC/steel bench covers before taking up the work and shall replace all the trench covers after the erection work in that particular area is completed or when further work is not likely to be taken up for some time.			
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Clause No.	TECHNICAL REQUIREMENTS			
16.12.16	Contractor shall furnish three copies of the report on work carried out in a particular week, such as cable numbers and a date on which laid, actual length and route, testing carried out, alongwith the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.			
16.12.17	Contractor shall paint the tray identification number on each run of trays at an interval of 10m.			
16.12.18	In case the outer sheath of a cable is damaged during handling/installation, the Contractor shall repair it at his own cost, and to the satisfaction of the Engineer-in-Charge. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable, at no extra cost i.e. the Contractor shall not be paid for installation and removal of the damaged cable.			
16.12.19	All cable terminations shall be appropriately tightened to ensure secure and reliable connections. The Contractor shall cover the exposed part of all cable lugs whether supplied by him or not with insulating tape, sleeve or paint.			
16.13.00	Conduits, Pipes and Duct Installation			
16.13.01	~~Contractor shall supply all conduits, pipes and ducts as specified and to be shown in detailed engineering drg. Flexible conduit should be used between fixed conduit and equipment terminal boxes. Where vibration is anticipated, the flexible conduit shall be as per the relevant IS.~~			
16.13.02	Contractor shall have his own facility for bending, cutting and threading the conduits at site. Cold bending should be used. All cuts & threaded ends shall be made smooth without leaving any sharp edges. Anti corrosive paint shall be applied at all field threaded portions. The Contractor shall supply and apply this protective material.			
16.13.03	All conduit/pipes shall be extended on both sides of wall/floor/openings. Exposed conduits/pipes shall be adequately clamped at an interval of about 2m. The fabrication and installation of supports and the clamping shall be included in the scope of work by Contractor.			
16.13.04	When two lengths of conduits are joined together through a coupling, running threads equal to twice the length of coupling shall be provided on any length to facilitate easy dismantling of two conduits.			
16.13.05	Conduit installation shall be permanently connected to earth by means of special approved type of earthing clamps. G.I. Pull wire of adequate size shall be laid in all conduits before installation.			
16.13.06	Each conduit run shall be painted with its designation as indicated on the drawings, such that it can be identified at each end.			
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16.13.07	Embedded conduits shall have a minimum concrete cover of 50mm. Positioning and ensuring proper alignment during concrete by other agencies shall be the responsibility of the Contractor.	
16.13.08	Conduit runs sleeves shall be provided with the bushings at each end.	
16.13.09	Metallic conduit runs at termination shall have two locknuts and a bushing for connection. Flexible conduits shall also be suitably clamped at each end. Bushings shall have rounded edges so as not to damage the cables.	
16.13.10	Where embedded conduits turn upwards from a slab or fill, the termination dimensions shown on the drawings, if any, shall be taken to represent the position of the straight extension of the conduit external to and immediately following the bend. At least one half the arc length of the bend shall be embedded.	
16.13.11	For underground runs, Contractor shall excavate and back fill as necessary.	

Clause No.	TECHNICAL REQUIREMENTS																
		ANNEXURE-I															
1.00.00	EARTHING NOTES																
1.00.01	GENERAL																
	Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches and structure by 75 X 12 mm GS flat.																
1.00.02	Neutral points of systems of different voltages, metallic enclosures and frame works associated with all current carrying equipments and extraneous metal works associated with electric system shall be connected to a single earthing systems unless stipulated otherwise.																
1.00.03	Earthing system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, relevant Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.																
1.00.04	~~Bolts and nuts required for earthing all main equipment structures and for connecting with earthing system as explained in Cl. 1.00.02 above shall be in the scope of the Contractor.~~																
2.00.00	DETAILS OF EARTHING SYSTEM																
	<table> <tr> <th>Item</th><th>Size</th><th>Material</th></tr> <tr> <td>Main Earthing conductor</td><td>40mm dia rod</td><td>Mild steel</td></tr> <tr> <td>Conductor above ground & earthing leads (for equipment)</td><td>75 x 12/ G.S. Flat 50 x 6 mm</td><td>Galvanized steel</td></tr> <tr> <td>Rod Electrode</td><td>40mm dia, 3000mm</td><td>Mild steel</td></tr> <tr> <td>G.I. Earthwire</td><td>7/8 SWG</td><td>GI</td></tr> </table>	Item	Size	Material	Main Earthing conductor	40mm dia rod	Mild steel	Conductor above ground & earthing leads (for equipment)	75 x 12/ G.S. Flat 50 x 6 mm	Galvanized steel	Rod Electrode	40mm dia, 3000mm	Mild steel	G.I. Earthwire	7/8 SWG	GI	
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3.00.00	~~EARTHING CONDUCTOR LAYOUT~~																
3.00.01	~~Earthing conductors in outdoor areas shall be burried atleast 600mm below finished grade level unless stated otherwise.~~																
3.00.02	~~Minimum 6000mm or higher spacing between rod electrodes shall be provided based on the earthmat design calculations.~~																
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3.00.03	~~Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks etc., it shall be laid atleast 300mm below them and shall be re-routed in case it fouls with equipment/structure foundations.~~	
3.00.04	~~Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid. Otherwise, "earth insert" with temporary wooden cover or "earth riser" shall be provided near the equipment foundation/pedestal for future connections to the equipment earthing terminals.~~	
3.00.05	Earthing conductor along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding/cleating at intervals of 750mm. 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.	
3.00.06	Earthing conductor around the building shall be buried in earth at a minimum distance of 1500mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500mm away from such location.	
3.00.07	~~In outdoor areas, tap connections shall be brought 300mm above ground level for making connections in future, in case equipment is not available at the time of grid installations.~~	
3.00.08	~~Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.~~	
3.00.09	~~Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.~~	
4.00.00	EQUIPMENT AND STRUCTURE EARTHING	
4.00.01	The connection between earthing pads and the earthing grid shall be made by short and direct earthing leads free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with engineer.	
4.00.02	Metallic pipes, conduits and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.	
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4.00.03	Metallic conduits shall not be used as earth continuity conductor.	
4.00.04	A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.	
4.00.05	Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, etc. and steel reinforcement in concrete it shall be bonded to the same.	
4.00.06	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.	
4.00.07	~~Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.~~	
4.00.08	Earthing conductor shall be buried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop by one lead.	
4.00.09	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.	
4.00.10	~~Equipment earthing (Riser & welding of two conductors) shall be done as per enclosed sketch. Drg. No. 9561-572-POE-A-015.~~	
5.00.00	JOINTING	
5.00.01	Earthing connections with equipment earthing pads shall be of bolted type. Contact surfaces shall be free from scales, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested, shall be painted with anti-corrosive paint/compound.	
5.00.02	Connection between equipment earthing lead and between main earthing conductors shall be welded/brazed type. For rust protections, the welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.	
5.00.03	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.	
5.00.04	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.	
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Clause No.	TECHNICAL REQUIREMENTS			
5.00.05	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. Artificial cooling shall not be allowed.			
5.00.06	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.			
5.00.07	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.			
6.00.00	POWER CABLE EARTHING			
	Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.			
7.00.00	SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS			
7.00.01	Earthing terminal of each surge arrester, capacitor voltage transformer and lightning down conductors shall be directly connected to rod electrode which in turn, shall be connected to station earthing grid.			
7.00.02	Earthing mat comprising of closely spaced (300mm x 300mm) conductors shall be provided below the operating handles of the isolators.			
8.00.00	SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM			
8.00.01	Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.			
8.00.02	Down conductors shall be cleated on the structures at 2000mm interval.			
8.00.03	Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.			
8.00.04	Lightning conductors shall not pass through or run inside G.I. conduits.			
8.00.05	Lightning protection system installation shall be in strict accordance with the latest editions of Indian Electricity Rules, Indian Standards and Codes of practice and Regulations existing in the locality where the system is installed.			
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Clause No.	TECHNICAL REQUIREMENTS			
A.	PROCEDURE FOR NON DESTRUCTIVE TESTING			
a)	LIQUID PENETRANT EXAMINATION OF WELDED JOINTS			
	Evaluation of indications:			
	Relevant indications are those which result from mechanical discontinuities. Rounded indications or indications which are circular or elliptical with the length less than three times the width.			
	Linear indications are those indications in which the length is more than three times the width.			
	Any questionable or doubtful indications, shall be retested to verify whether or not actual defects are present.			
	Localised surface imperfections, such as may occur from machining marks, surface conditions, may procedure similar indications which are not relevant to the detection of unacceptable discontinuities.			
b)	Acceptance Standards			
	All surfaces to be examined shall be free of			
	linear indications;			
	four or more rounded defects with any dimensions more than 1.6mm in a line separated by 1.16 inch (1.6mm) or less (edge to edge).			
c)	Defect removal and repair:			
	Unacceptable imperfections shall be removed and re-examination made to assure the complete removal. Whenever a defect is removed and subsequent repair by welding is not required, the excavated area shall be blended into the surrounding surface so as to avoid sharp notches, crevices or corners. Where welding is required after removal of a defect, the area shall be cleaned and welding performed in accordance with a qualified welding procedure. Completed repairs shall be re-examined by the method originally used for detection of the defect.			
d)	Treatment of imperfections believed non-relevant:			
	Any indication of an imperfection which is believed to be non-relevant shall be regarded as a defect unless, on re-evaluation, it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning that no unacceptable defect is present.			
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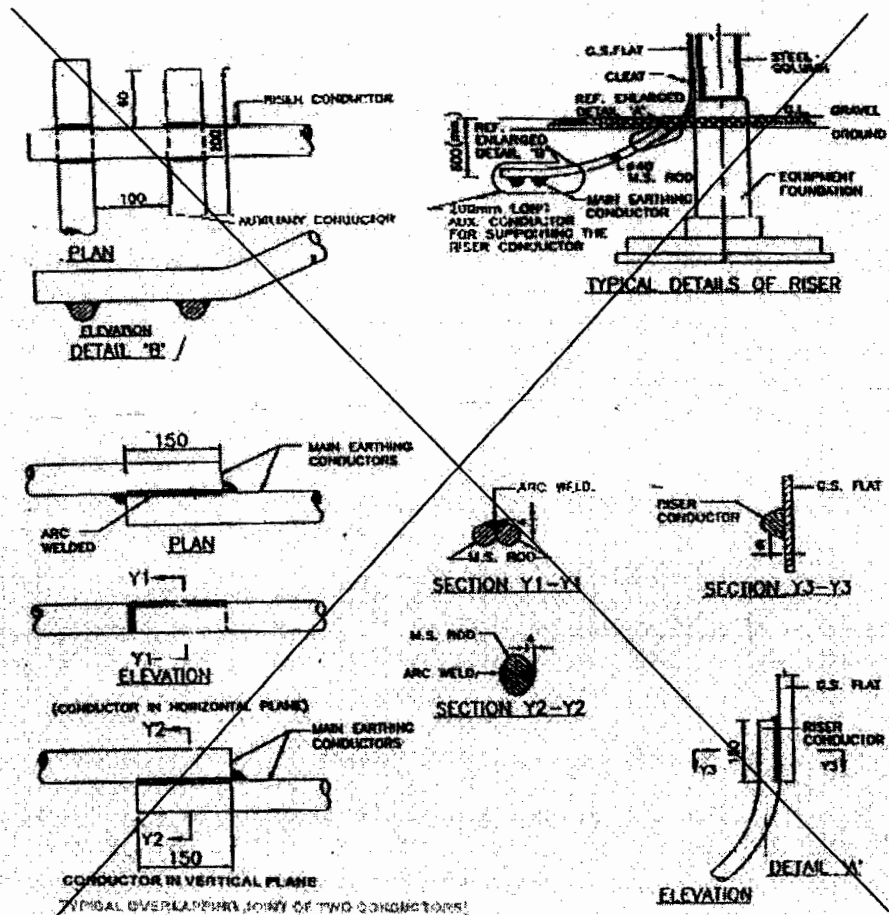
Clause No.	TECHNICAL REQUIREMENTS	
e)	Examination of areas from which defects have been removed: After a defect is thought to have been removed and prior to making weld repairs, the area shall be examined by suitable methods to ensure the defect has been eliminated.	
f)	Re-examination of repaired area: After repairs are made, the repaired areas shall be blended.	
B.	RADIOGRAPHIC EXAMINATION OF WELDED JOINTS Radiographic examination shall cover minimum 10% of weld seam and acceptance standard for visual examination and Radiography shall be as follows: Any of the following imperfections shall not be acceptable:	
i)	Cracks	
ii)	Zone of incomplete fusion or penetration, which exceed 10% of the weld length of the joint. In longitudinal or transverse butt weld, where full penetration is intended by the weld procedure, some lack of penetration is acceptable. The total length of weld with lack of penetration shall not exceed 10% of the overall weld length. At no place, shall weld penetration be less than 90% of the thickness of the material. Continuous occurrence of lack of penetration is permitted, but shall not exceed 50mm in any 500mm length of weld.	
iii)	Inadequate weld dimensions, Root Cavity (shrinkage) and incompletely filled groove greater than 10% effective throat thickness.	
iv)	Excess penetration shall be permitted provided it does not exceed 25% of the wall thickness or 4mm whichever is smaller.	
v)	Weld reinforcement: Build up in excess of 25% of the effective throat thickness shall be dressed. Any reinforcement shall be substantially symmetrical about the centreline of the weld and shall be of smooth contour blending smoothly at the toes with the parent material.	
vi)	Undercutting and overlapping greater than 10% effective throat thickness.	
vii)	Elongated cavities and/or worm holes exceeding 3mm dia or equivalent area in length provided the limitations on porosity are met with.	
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Clause No.	TECHNICAL REQUIREMENTS				
viii)	Copper, tungsten or oxide inclusions greater than 1/4 or 3mm dia or its equivalent area, whichever is smaller.				
ix)	Crater pipes exceeding 25% effective throat thickness or 3mm whichever is smaller.				
x)	Porosity: Scattered porosity not exceeding 0.5% by volume is acceptable. In general, the size of the pores shall not exceed 0.8mm dia, but occasional 1.6mm dia pores may be acceptable, provided the following limits are not exceeded: Where pore size is 0.4mm or less, upto 150t pores may be permitted in 1000mm sq. area or radiograph. Where pore size is 0.8 mm dia or less, upto 19t pores may be permitted in 1000mm sq. area or radiograph. Where pore sizes are generally 0.8mm dia or less, but occasional 1.6mm dia pores are present, upto 9t of 0.8mm dia may be permitted in 1000mm sq. area of radiograph, provided the number of pores upto 1.6mm in dia does not exceed it. However, visible surface porosity > 1mm dia is not acceptable. Note: In all cases, t = thickness of the thinnest section of the weld under examination. Unacceptable weld defects shall be repaired in accordance with the original welding procedure. All repairs shall be 100% inspected in accordance with original testing procedure.				
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Clause No.	TECHNICAL REQUIREMENTS	
	~~Erection Drawings to be submitted by the Contractor~~ 1. Single line diagram 2. Switchyard layout (Plan & Section) 3. Equipment & Foundation Cable trench layout 4. Structural Arrangement Drawing 5. Earthmat Layout 6. Composite G.A. Drawing 7. Clearance Diagram 8. Cable Trench Section 9. Equipment Earthing details 10. Welding Details 11. All Design Calculations 12. G.A. of Clamps and Connectors Drawings 13. G.A. and Part Drawing of Insulator String and Hardware 14. G.A. and Schematics of all Marshalling Kiosks and cabinets 15. Data Sheets and Drawings of all Other Miscellaneous Items	
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Clause No.

TECHNICAL REQUIREMENTS



EQUIPMENT EARTHING DETAILS
STANDARD DRAWING

PART-II

TECHNICAL SPECIFICATION

**CHAPTER – E14:
SITE TESTING AND COMMISSIONING**

PART-II

TECHNICAL SPECIFICATION

CHAPTER – E14: SITE TESTING AND COMMISSIONING

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3.00.00	Circuit Breakers	E14-1
4.00.00	Isolators	E14-2
5.00.00	Current Transformers	E14-2
6.00.00	Voltage Transformers	E14-2
7.00.00	Surge Arrestors	E14-2
8.00.00	Phasing out	E14-2
9.00.00	Station Earthing	E14-2
10.00.00	Conductor Stringing and Power Connectors	E14-3
11.00.00	Insulators	E14-3

Clause No.	TECHNICAL REQUIREMENTS	
	CHAPTER- E14: SITE TESTING AND COMMISSIONING	
1.00.00	INTRODUCTION An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field QP/ instructions of the equipment supplier or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.	
2.00.00	GENERAL CHECKS a) Check for physical damage. b) Visual examination of zinc coating/ plating c) Check from name plate that all items are as per older/ specification. d) Check tightness of all bolts, clamps and connecting terminals using torque wrenches. e) For oil filled equipment check for oil leakage, if any. Also check oil level and top up. f) Check ground connections for quality of weld and application of zinc rich paint over weld joint of galvanized surfaces. g) Check cleanliness of insulator and bushings. h) All checks and tests specified by the manufactures in their drawings and manuals as well as all tests specified in the relevant code of erection. i) Check for surface finish of grading rings (corona control ring.) j) Pressure test on all pneumatic lines at 1.5 times the rated pressure shall be conducted.	
3.00.00	CIRCUIT BREAKERS a) Insulation resistance of each pole. b) Check adjustments, if any, suggested by manufacturer. c) Breaker closing and tripping time. d) Slow and power closing operation and opening e) Trip free and anti pumping operation. f) Minimum pick up volts of coils g) Contact resistance h) Functional checking of compressed air plant and all accessories i) Functional checking of control circuits, interlocks, tripping through protective relays and auto-reclose operation. j) Insulation resistance of control circuits, motor etc. k) Resistance of closing and tripping coils.	
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Clause No.	TECHNICAL REQUIREMENTS				
4.00.00	ISOLATORS a) Insulation resistance of each pole b) Manual and electrical operation on interlocks c) Insulation resistance of control circuits and motors. d) Ground connections e) Contact resistance f) Proper alignment to minimise the vibration to the extreme possible during operation. g) Measurement of operating torque for isolator and Earth switch h) Resistance of operating and interlocking coils.				
5.00.00	CURRENT TRANSFORMERS a) Insulation Resistance Test b) Polarity test. c) Ratio identification test-checking of all ratios on all cores by primary injection of current. d) Dielectric test of oil (wherever applicable) e) Magnetizing characteristics test.				
6.00.00	VOLTAGE TRANSFORMERS a) Insulation resistance test b) Polarity test c) Ratio test d) Dielectric test of oil (if applicable)				
7.00.00	SURGE ARRESTER a) Grading leakage current b) Resistance of ground connection.				
8.00.00	PHASING OUT The phasing out of all supplies in the station system shall be carried out.				
9.00.00	STATION EARTHING a) Check soil resistivity b) Check continuity of grid wires c) Check earth resistance of the entire grid as well as various sections of the same. d) Check for weld joint and application of zinc rich paint on galvanised surface. e) Dip test on earth conductor prior to use.				
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Clause No.	TECHNICAL REQUIREMENTS					
10.00.00	CONDUCTOR STRINGING AND POWER CONNECTORS					
	a) Physical check for finish					
	b) Electrical clearance check					
	c) Testing of torque by torque wrenches on all bus power connectors and other accessories.					
	d) Milli volt drop test on all power connectors.					
	e) Sag and tension check on conductors.					
11.00.00	INSULATORS					
	Visual examination for finish damage, creepage distance, etc.					
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