

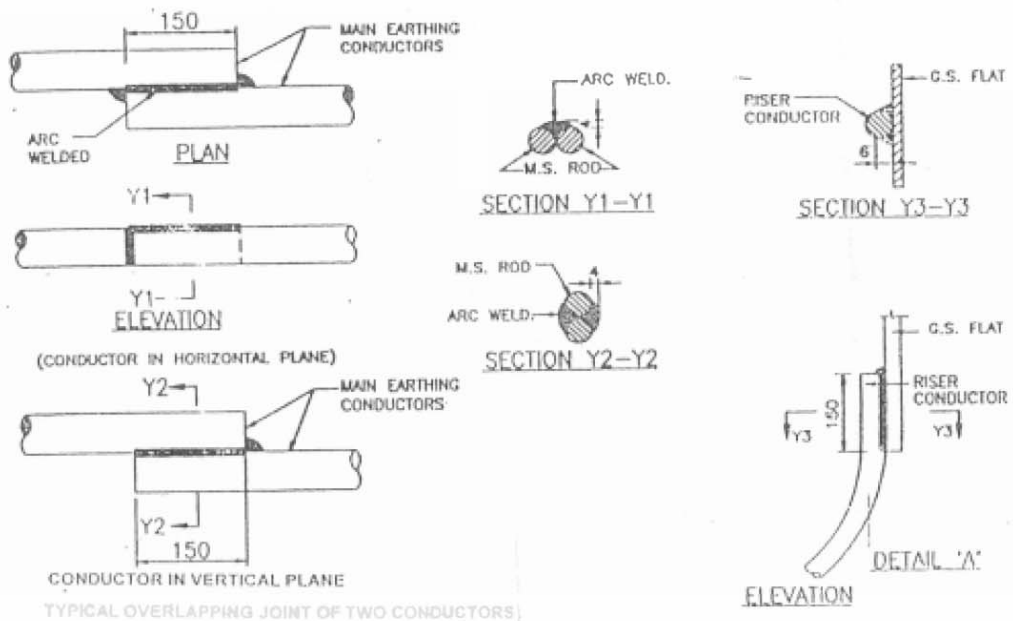
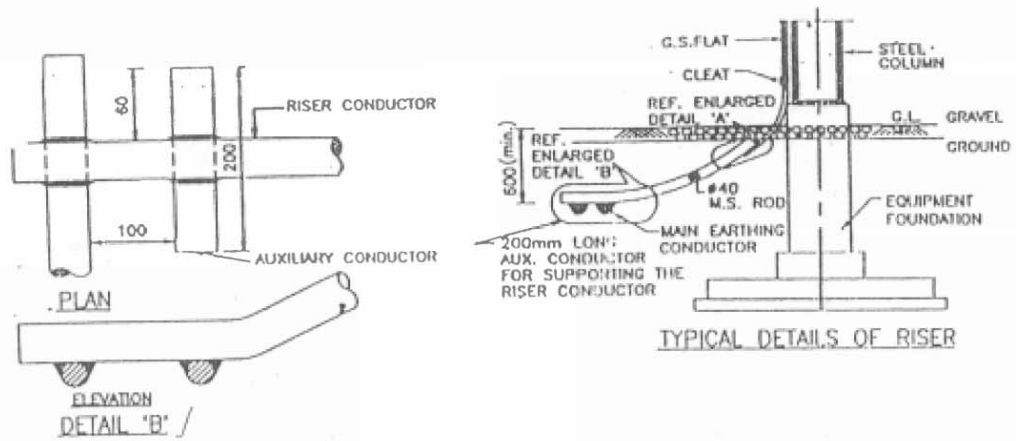


CLAUSE NO.	TECHNICAL REQUIREMENTS			<div>एनटीपीसी NTPC</div>
	ANNEXURE-I			
a)	EARTHING NOTES FOR SWITCHYARD			
	GENERAL			
i)	Earthing of operating boxes, cubicles shall be done by 50 X 6 mm GS flat while cable trenches and structure by 75 X 12 mm GS flat.			
ii)	Neutral points of systems of different 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.			
iii)	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.			
b)	DETAILS OF EARTHING SYSTEM			
	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	
c)	For Step and Touch potential the following parameters shall be considered			
	i) Current distribution factor – 1(One)			
	ii) Duration of fault current - 0.5 sec			
	iii) Human body weight - 50kg			
d)	Grid resistance shall be less than 1(one) ohm.			
e)	EARTHING CONDUCTOR LAYOUT			
i)	Earthing conductors in outdoor areas shall be burried atleast 600mm below finished grade level unless stated otherwise.			
ii)	Minimum 6000mm or higher spacing between rod electrodes shall be provided based on the earthmat design calculations.			
iii)	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.			
iv)	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.			
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v)	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.			
vi)	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.			
vii)	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.			
viii)	Earthing conductors crossing the road shall be either installed in hume pipes or laid at greater depth to suit the site conditions.			
ix)	Earthing conductors embedded in the concrete fibre shall have approximately 50mm concrete cover.			
f)	EQUIPMENT AND STRUCTURE EARTHING			
i)	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.			
ii)	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.			
iii)	Metallic conduits shall not be used as earth continuity conductor.			
iv)	A separate earthing conductor shall be provided for earthing lighting fixtures, lighting poles, receptacles, switches, junction boxes, lighting conduits, etc.			
v)	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.			
vi)	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.			
vii)	Railway tracks within switchyard area shall be bonded across fish plates and connected to earthing grid at several locations.			
viii)	Earthing conductor shall be burried 2000mm outside the switchyard fence. Every post of the fence and gates shall be connected to earthing loop.			
ix)	Flexible earthing connectors shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.			
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x)	Equipment earthing (Riser & welding of two conductors) shall be done as per enclosed sketch.			
g)	JOINTING			
i)	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.			
ii)	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.			
iii)	Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.			
iv)	Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.			
v)	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.			
vi	Bending of large diameter rod/thick conductor shall be done preferably by gas heating.			
vii	All arc welding with large diameter conductors shall be done with low hydrogen content electrodes.			
h)	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.			
i)	SPECIFIC REQUIREMENT FOR EARTHING SYSTEMS			
i)	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.			
ii)	Auxilliary earthing mat of 1500mmX1500mm size comprising of closely spaced conductors at 300mm x 300mm spacing and at 300mm below ground shall be provided below the operating handles of the isolators. Operating handle shall be directly connected to earthing mat.			
j)	SPECIFIC REQUIREMENTS FOR LIGHTNING PROTECTION SYSTEM			
i)	Conductors of the lightning protection system shall not be connected with the conductors of the safety earthing system above ground level.			
ii)	Down conductors shall be cleated on the structures at 2000mm interval.			
iii)	Connection between each down conductor and rod electrodes shall be made via test joint located approximately 150mm above ground level.			
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- iv) Lightning conductors shall not pass through or run inside G.I. conduits.



NOTE : WELDING OF EARTHING CONDUCTOR SHALL BE CONDUCTED IN VERTICAL PLANE
WHEREVER POSSIBLE

EQUIPMENT EARTHING DETAILS
STANDARD DRAWING

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4.05.05	All the cores of the control cable to be terminated shall have identification by providing ferrules at either end of the core, each ferrule shall be indelible, printed single tube ferrule and shall include the complete wire number and TB number as per the drawings. The ferrule shall fit tightly on the core. Spare cores shall have similar ferrules with suffix sp1, sp2, ---etc along with cable numbers and coiled up after end sealing.			
4.05.06	All cable terminations shall be appropriately tightened to ensure secure and reliable connections.			
5.00.00	EARTHING SYSTEM			
5.01.00	Earthing system shall be in strict accordance with IS:3043 and Indian Electricity Rules/Acts. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The Contractor shall furnish the detailed design and calculations for Employer's approval. Contractor shall obtain all necessary statutory approvals for the system.			
5.02.00	The earth conductors shall be free from pitting, laminations, rust, scale and other electrical, mechanical defects			
5.03.00	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
5.04.00	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	65 x 8mm GS flat
	b)	33kV/11kV/6.6kV/3.3 kV/ switchgear equipment and 415V switchgear	---	65 x 8mm GS flat
	c)	415 V MCC/ Distribution boards / Transformers	---	50 x 6mm 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 House power motor	---	8 SWG GS wire
	e)	Control panel & control desk	---	25 x 3 mm GS flat
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CLAUSE NO.	TECHNICAL REQUIREMENTS			
	f)	Push button station / Junction Box	---	8 SWG GI wire
	g)	Columns, structures, cable trays and bus ducts enclosures	---	50 x 6mm GS flat
	h)	Crane, rails, rail tracks & other non-current carrying metal parts		25 x 6mm GS flat
5.05.00	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 approved. 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.			
5.06.00	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 meter. Wherever earth mat is not available, necessary connections shall be done by driving an earth electrode in the ground			
5.07.00	Neutral points of HT transformer shall be earthed through NG resistors. The Contractor shall connect the NGR earthing point to earth electrodes by suitable earth conductors.			
5.08.00	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.			
5.09.00	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.			
5.10.00	Suitable earth risers as approved shall be provided above finished floor/ground level, if the equipment is not available at the time of laying of main earth conductor.			
5.11.00	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.			
5.12.00	Resistance of the joint shall not be more than the resistance of the equivalent length of conductors.			
5.13.00	Earthing conductors buried in ground shall be laid minimum 600 mm below grade 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.			
5.14.00	Earthing conductors embedded in the concrete floor of the building shall have approximately 50 mm concrete cover.			
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5.15.00	A minimum earth coverage of 300 mm shall be provided between earth conductor and the bottom of trench/foundation/underground pipes at crossings. Earthing conductors 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.																																			
5.16.00	Earthing conductors along their run on columns, walls, etc. shall be supported by suitable welding / cleating at interval of 1000mm and 750mm respectively.																																			
5.17.00	Earth pit shall be of treated type & 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 salt and charcoal as per IS:3043. Test links shall be provided with bolted arrangement alongwith each earth pit, in order to facilitate measurement of earth resistance as & when required.																																			
5.18.00	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 and recorded. All equipment required for testing shall be furnished by contractor.																																			
5.19.00	Earthing conductor shall be buried at least 2000mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead.																																			
5.20.00	<div>Other Requirements of Earthing System:</div> <table><tr><td>Standard/Code</td><td colspan="2">IEEE 80, IS 3043</td></tr><tr><td>Earthing System</td><td colspan="2"></td></tr><tr><td>Life expectancy</td><td colspan="2">40 Years</td></tr><tr><td>System Fault Level</td><td colspan="2">As per system requirement (B0)</td></tr><tr><td>Soil resistivity</td><td colspan="2">Actual as per site conditions.</td></tr><tr><td>Min. Steel corrosion</td><td colspan="2">0.12mm/year</td></tr><tr><td>Depth of burial of main earth conductor</td><td colspan="2">600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.</td></tr><tr><td>Conductor joints</td><td colspan="2">By electric arc welding, with resistance of joint not more than that of the conductor.</td></tr><tr><td colspan="3">Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.</td></tr><tr><td>Surface resistivity</td><td>- Gravel</td><td>3000 ohm-meter</td></tr><tr><td></td><td>- Concrete</td><td>500 ohm-meter</td></tr></table>			Standard/Code	IEEE 80, IS 3043		Earthing System			Life expectancy	40 Years		System Fault Level	As per system requirement (B0)		Soil resistivity	Actual as per site conditions.		Min. Steel corrosion	0.12mm/year		Depth of burial of main earth conductor	600mm below grade level; where it crosses trenches, pipes, ducts, tunnels, rail tracks, etc., it shall be at least 300mm below them.		Conductor joints	By electric arc welding, with resistance of joint not more than that of the conductor.		Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.			Surface resistivity	- Gravel	3000 ohm-meter		- Concrete	500 ohm-meter
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6.00.00	LIGHTNING PROTECTION SYSTEM																																			
6.01.01	Lightning protection system shall be in strict accordance with IS:2309 .																																			
6.01.02	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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