

### **1.03 INSTALLATION OF EARTHING SYSTEM:**

#### **1.03.1 BASIC REQUIREMENT**

Provision of adequate earthing system in a Substation is extremely important for the safety of the operating personnel as well as for proper system operation and performance of the protective devices. The primary requirements of a good earthing system in a Sub-station are:-

- i) The earth resistance of Substation should be as low as possible but it should not exceeds 1.0 (one) Ohm.
- ii) The Step Potential, which is the maximum value of the potential difference possible of being shunted by a human body between two accessible points on the ground separated by the distance of one pace (which may be assumed to be one metre), should be within safe limits.
- iii) Touch Potential, which is the maximum value of potential difference between a point on the ground and a point on an object likely to carry fault current such that the points can be touched by a person, should also be within safe limits.
- iv) To meet these requirements, an earthed system comprising of an earthing mat buried at a suitable depth below ground and supplemented with ground rods at suitable points is provided in the Sub-stations.
- v) All the structures & equipments in the Sub-station are connected to the earthing mat so as to ensure that under fault conditions, none of these parts is at a potential higher than that of the earthing mat.
- vi) The neutral points of different voltage levels of transformers/reactors are separately earthed at two different points. Each of these earthed points should be interconnected with the station earthing mat.

#### **1.03.2 SCOPE:**

Installation of earthing system for the substation shall be carried out as per the earth mat arrangement drawing enclosed with the bid document. The contractor's scope shall include:

- i. Earthing connections with equipment earthing pads shall be bolted type. Contact surfaces shall be free from scale, 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. Installation of earthing conductor for the main earthing mat/Grid of 40 mm size M.S. round for 400 KV switchyards and welding of joints shall be as per the drawing provided by the MPPTCL.
- iii. For 220/132 KV sub-stations, installation of earthing conductor for the main earthing mat shall be of M.S. flat of size 75 X 8 mm for the 220 KV & 132 KV switchyards and welding of joints shall be as per the drawing provided by the MPPTCL.
- iv. For 132/33 kV sub-stations, installation of earthing conductor for the main earthing mat shall be of M.S. flat of size 65 X 8 mm for the 132 kV & 33 kV switchyards and welding of joints shall be as per the drawing provided by the MPPTCL.
- v. Installation of earth riser (M.S. Flat of size 50X6 mm ) connection leads to the equipments and risers on steel structures etc shall be as per drawings enclosed. The welding/brazing of risers/ leads at regular intervals

as required to the main earth mats and providing bolting joints at the equipment earthing terminals. All welded and brazed joints of riser/conductor shall be coated with bituminous paint. Galvanized steel conductors shall be touched up with the zinc rich paint where holes are drilled at site for bolting to the equipment/structures. The risers should be painted "Green".

- vi. Preparation of earthing pits as per drawing enclosed with the bid document which includes excavation (Irrespective of the soil encountered) embading of 4 No. GI Pipes of size 40 mm Dia, 3 Mtrs. long, back filling with B.C. soil (to be arranged by the contractor) free from boulders and harmful mixture. These GI pipes are to be welded with MS flats by making mesh frame and cutting of pipes as also making holes in the pipe for water seepage. The earth pit is to be connected with equipments and earth mesh at least at two points with MS round or MS flats.
- vii. Installation of galvanized earthing rods (25 mm Dia, 3.0 Mtr length) in earth by making drilling of 6" Dia. and test pits, providing connection to the main earthing grid, excavation and back filling of earthing pits with bentonite soil and all materials as required, placing the rod in position, and connecting to main earth grid conductors.
- viii. The material such as bolts, washers, nuts, screw, clamps, anchors, fasteners, etc. to complete the job in all respect shall be arranged by the contractor.
- ix. It is to be insured that the earth resistance of the sub-station is less then 1.0 (one) Ohm. If the value of earth resistance found more than the above after installation of earthing system, the same shall have to be improved to permissible limit of earth resistance by way of drilling of bore installation of MS flats of size 75x8mm. In case the earth resistance is still not improved to permissible limit, counterpoise earthing shall be provided to limit earth resistance of the sub-station, less then 1.0 (one) Ohm for which bore as specified in the document shall have to be provided. The bore shall be thereafter filled with black cotton soil or bantonite clay properly. The connecting earth flat of size 75x8mm shall be buried 500mm deep in ground and BC soil shall be filled around earth flat trench.
- x. Other better way for improving the earth resistance in consultation with MPPTCL can be acceptable.

### 10.03.3 DETAILS OF EARTHING SYSTEM:

For 400/220/33 KV Sub-Stations:

S. No.	ITEM	SIZE	MATERIAL
1	Main earthing conductor	40 mm dia M.S. Rod/ 75X8 mm Flats.	Mild steel
2	Earthing of equipments structures, cable trays	50X6 mm Flat	Mild steel
3	Earthing rod electrodes	25 mm dia, 3000 mm long rod	Mild steel (Hot dip galvanized)
4	G.I. Pipe of 40 mm dia. 3000 mm length, 4mm thick	4 Nos. to be used for one earth pit & interconnect to each other	G.I.

**For 220/132 kV Sub-Stations:**

S. No.	ITEM	SIZE	MATERIAL
1	Main earthing conductor	75X8 mm M.S. Flats (in 220 kV & 132 kV yard)	Mild steel
2	Earthing of equipments structures, cable trays	50X6 mm Flat	Mild steel
3	Earthing rod electrodes	25 mm dia, 3000 mm long rod	Mild steel (Hot dip galvanized)
4	G.I. Pipe of 40 mm dia. 3000 mm length, 4mm thick	4 Nos. to be used for one earth pit & interconnect to each other	G.I.

**For 132/33 kV Sub-Stations:**

S. No.	ITEM	SIZE	MATERIAL
1	Main earthing conductor	65X8 mm M.S. Flats (in 132 kV & 33 kV yard)	Mild steel
2	Earthing of equipments structures, cable trays	50X6 mm Flat	Mild steel
3	Earthing rod electrodes	25 mm dia, 3000 mm long rod	Mild steel (Hot dip galvanized)
4	G.I. Pipe of 40 mm dia. 3000 mm length, 4mm thick	4 Nos. to be used for one earth pit & interconnect to each other	G.I.

**10.03.4 DETAILED SPECIFICATION FOR INSTALLATION OF EARTHING SYSTEM:**

- i. The Contractor shall install earthing conductor required for the system and individual equipment earthing. The earth mat arrangement drawing enclosed with the bid document for the purpose shall be referred. All work such as cutting, welding, bending, clamping, bolting and connecting into structures, pipes, equipment frames terminals, rails or other devices shall be in the contractor's scope of work. The contractor shall also carry-out the excavation and trenching work involved. The contractor shall be responsible for maintaining excavation, bracing shoving, pumping and disposal of water without damage to the property. The Contractor shall also back-fill and reinstate the trenches after installation of earthing conductors.
- ii. Earthing shall conform to the latest editions of the Indian Standard code of practice IS:3043 and Indian Electricity Rules Installation work shall be in accordance with the MPPTCL drawings and any change in routing, size of conductors etc. shall be subject to the prior approval of the MPPTCL.
- iii. All earthing conductors to be buried in ground shall be laid 500 mm below ground level, unless otherwise stated in the drawings. Backfill materials to be placed over buried / over earth conductor shall be free from stones and other harmful mixtures. Back fill materials shall be placed in layers of 150 mm, uniformly spread along the ditch, and tempered utilizing tampers or other approved means. Planks or other protections shall be placed over conductors in hazardous areas, after layer of earth has been placed over the conductor, but before placement of balance of backfill. If the excavated soil is found unsuitable for back filling, the contractor shall arrange for suitable soil from outside without any expense to the MPPTCL.

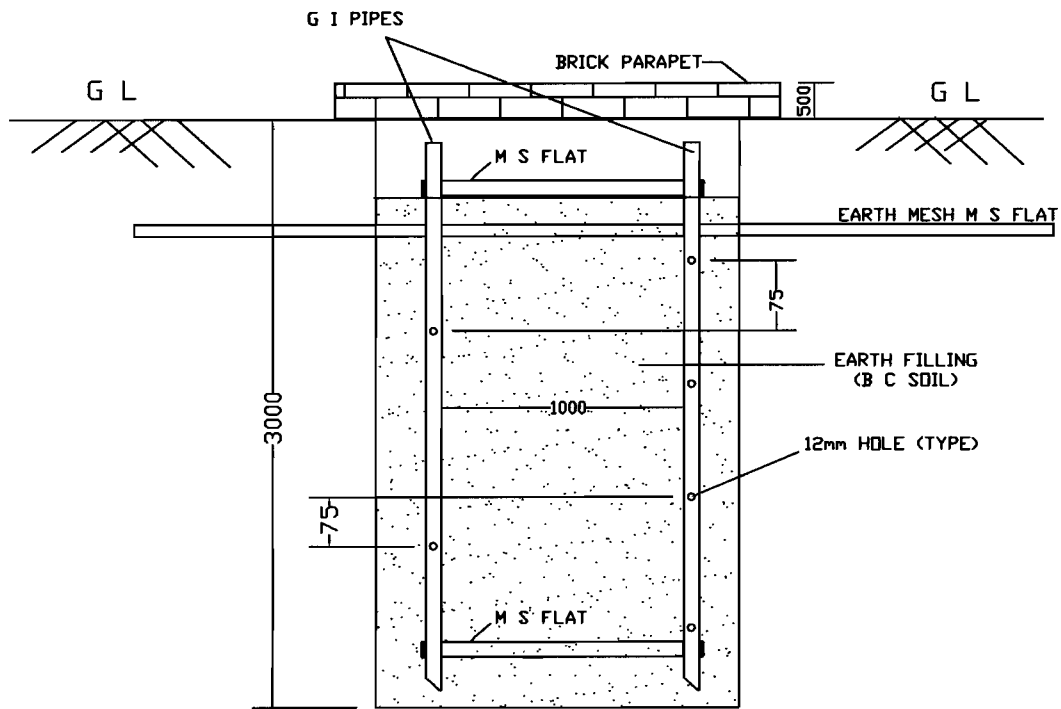
- iv. Metallic frames of all electrical equipments shall be earthed by two separate and distinct connections with earthing system.
- v. Neutral point of EHV transformer/reactors shall be earthed not less than two separate and distinct connections with earthing system. Neutral points of systems of different voltages, metallic enclosures and frame
- vi. Light poles, junction boxes on the poles, cable and cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running along with the supply cable which in turn shall be connected to earthing grid conductor at a minimum two points whether specifically shown or not.
- vii. Cable sheaths and armour shall be bonded to earthing system as stipulated in code of practice IS:1255. Metal pipes and conduit through which cables run shall be sufficiently bonded and earthed. For conduits, armoured cable and metal raceways, the connections to the earthing system shall be as near possible to the point where conductors in the raceways receive supply.
- viii. Flexible earthing connectors shall be provided for the moving parts.
- ix. All lighting panels, junction boxes, fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. rules
- x. Shield wire in substations shall be connected to the earthing grid at every alternative switchyard postal tower.
- xi. All underground connections for the earthing system shall be brazed/welded, connection to equipments and devices shall be normally of the bolted type.
- xii. 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.
- xiii. Earthing of portable tools, appliances and welding equipments shall conform to the code of practice for earthing, IS: 3043.
- xiv. Neutral connection shall never be used for the equipments earthing.
- xv. An earthing pad shall be provided under each operating handle of the isolator. Operating handles of the isolator and supporting structure shall be bonded together by a flexible connection and converted to the earthing grid.
- xvi. A separate earth pit shall be provided adjacent to structures supporting lightning arrestor and coupling capacitors. Separate earth connections for each unit shall be provided.
- xvii. The welding equipments and consumable items such as welding rods required for installation of the earthing system shall be arranged by the contractor.
- xviii. On completion of the installation, earth grid integrity test shall be conducted in presence of MPPTCL's representative. The earth resistance of all the earth pits shall also be tested in presence of the MPPTCL's representative. All equipments necessary for the test shall be arranged by the contractor without any extra cost to MPPTCL.

#### **1.04 ERECTION OF SUBSTATION STRUCTURE:**

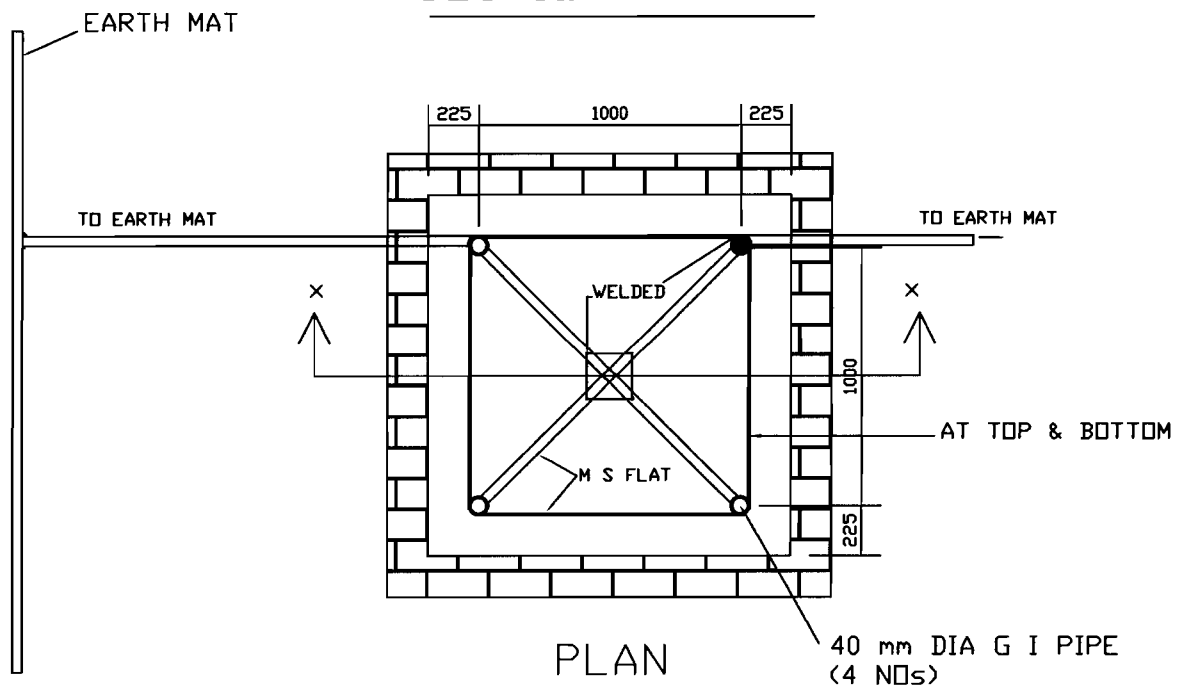
**1.04.1** Assembly/erection of all type of structures including bolts, nuts, washers, step bolts, shall have to be carried-out by the contractor strictly as per directions given in the structural drawings to be provided by the MPPTCL to the successful bidder.

The work of assembly and erection includes fixing and alignment of templates for grouted/bolted type structure foundations along with tightening of structural parts with nut-bolts and washers including alignment and leveling of structures as stipulated in structural drawings. The punching of bolts shall be carried out by the contractor after

# DETAILS OF EARTH PIT



SECTION AT X-X



PLAN

FOR TENDER PURPOSE ONLY.