

TECHNICAL SPECIFICATIONS FOR
EARTH ELECTRODES AND EARTH ENHANCING MATERIALS REQUIRED

IN

33KV SUB-STATIONS

**TECHNICAL SPECIFICATION FOR EARTHING ELECTRODES AND EARTHING MATERIAL
FOR 33 KV SUB-STATIONS.**

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**TECHNICAL SPECIFICATION FOR EARTHING ELECTRODES TO BE USED IN 33KV
SUBSTATIONS ALONG WITH EARTH ENHANCING MATERIAL**

1.0 SCOPE:

1.1 This specification covers design manufacture testing & supply of Earthing Electrodes along with the enhancing material required for maintaining the resistance to earth almost to zero for Earthing in 33kv substations at various sites in Maharashtra state.

1.2 The material offered shall conform to relevant standard and high quality and workmanship capable to perform continuous and satisfactory operations in the actual service conditions at site.

2.0 STANDARDS:

All components used in the manufacture of the earthing electrodes shall confirm to the relevant Indian standard specification and especially to the followings:

2.1	IS: 3043/1987	Code of practice for Earthing. Reaffirmed 2006.Ammendment 1 Jan2006 Amendment 2 in Jan2010
2.2	IS 1239 part1/2004	Steel Tubes, Tubular and Other Wrought Steel Fittings Amended up to date
2.3	IS 1239 part 2/1992	Part 2 Mild steel tubular and other wrought steel pipe fittings pipe fittings amended up to date
2.3	IEEE-80 /2012	IEEE Guide for Safety in AC Sub Station Grounding
2.4	IEEE-837 /2014	Standard for Qualifying permanent connection in Sub Station Grounding

3.0 GENERAL REQUIREMENTS:

This specification covers the specifications for earth Electrodes and earth enhancing material required in earthing system of 33KV Sub-stations which includes supply of earth electrodes & earth enhancement materials as per specifications. Supplier may also quote separate rates for installation of earth electrode in suitable pit size, construction of earth pit with cover for the installation, Laying of earth mat & connection of earth electrode to equipment with equipotential bus of suitable size.

3.1 EARTH ELECTRODE:

3.1.1 The earth electrode is the main component of the earthing system which is in direct contact with the ground and thus provides a means of releasing or collecting earth leakage currents. The material should have good electrical conductivity & should not corrode in a wide range of soil conditions. For effective earthing system the earth electrode shall be manufactured with pipe in pipe technology

3.12 Pipe in pipe technology concept involves two mild steel pipes one inserted inside the other. Both the pipes are subjected to Hot dip galvanization of 250-300 microns The empty space in the pipes shall be filled with a specially developed crystalline conductive mixture. For uniform distribution of fault currents an earth electrode must be cylindrical in shape.

3.13 Crystalline conductive mixture is a combination of metal alloys such as copper & aluminum powder, conductive carbon and bonding material etc. mixed in different proportions. Conductive mixture contents shall be 70% Carbon powder & 30% metal powder preferably pure copper or aluminum material along with the required quantity of bonding materials. Granule size of the carbon & metal powder shall be 100 meshes. The mixture is forced (Pressurized) inside the earth electrode in empty space of inner pipe & in empty space between the inner & outer pipe of the earth electrode, in paste form and after solidification of the same the bottom end cap as well as top end cap is provided. The metal alloys helps in conducting the current and conductive carbon has an excellent anticorrosive property. The bonding material helps in keeping all the above bonded together and gives the required strength to the mixture. The top end of the inner pipe is pressed to have flat surface at the top end for connecting bus bar connection plate. Necessary precaution shall be taken as to have no air gap inside the pipe while pressing. The crystalline conductive mixture which is machine pressed in the pipes should not disintegrate or collapse when the outer pipe corrodes. Resistivity of the material shall be less than 0.2 ohm meter. Resistivity shall be tested by making a 20cm cube of the material & checking the resistance across the opposite faces of the cube.

3.14 The dimensions of the concentric pipe earth electrode shall be as follows.

Sr. No.	Current Capacity	Primary conductor (Inner pipe Diameter)	Electrode Dimensions (Outer pipe Dimensions) (Dia x Length)
1	50 KA	50 mm	100 mm x 3000 mm

Concentric pipe earth electrode shall consist of Inner M.S. pipe of 50mm diameter & outer M.S. pipe of 100mm diameter having ISI mark. M. S. pipes shall be of class B as per IS 1239. Thickness of the M.S. pipes wall shall be 12 SWG.

3.15 Mild Steel Electro galvanized Busbar of size 350mmx50mmx6mm shall preferably be welded to earth electrode pipes or connected with the help of 2 no's of stainless steel nut bolts of appropriate size. This bus bar connection plate shall have 3 holes of 12mm dia. placed at 50mm apart on either side (Total 6 holes) for connecting earth conductor. Three stainless steel washers & one spring washer shall be supplied along with each stainless steel nut & bolt for necessary connection.

3.2 EARTH ENHANCEMENT MATERIAL:

Earth enhancement material (Back fill compound) shall be a superior conductive material that improves earthing effectiveness especially in areas of poor conductivity such as rocky ground, sandy soil & areas of moisture variation. It may contain conductive cement (20%), graphite carbon powder (50%), hydrous aluminum silicate (10%), sodium montmorillonite (20%) etc. It shall be placed around earth electrode in the earth pit to improve the conductivity of earth electrode & ground contact area. The material shall be supplied in sealed moisture proof bags. These bags shall be marked with the name of the manufacturer or trade name, quantity, batch no., date of manufacture etc. It shall have following characteristics.

- i) It should have low resistivity preferably bellow 0.2 ohm-meter. (Resistivity shall be tested by making a 20cm cube of the material & checking the resistance across the opposite faces of the cube.)
- ii) It shall not depend on the continuous presence of water to maintain its conductivity.
- iii) It should be a little alkaline in nature with pH value of > 7 & < 9. Test certificate from NABL approved laboratory to be provided for the compound so designed.
- iv) It should have better hygroscopic properties to absorb moisture. It should absorb & release the moisture in the dry weather condition and help in maintaining the moisture around the earth electrode.
- v) It should have capacity to retain more than 10% moisture at 105°C. Test certificate for the same from NABL approved laboratory shall be submitted.
- vi) Material shall be in granular form of size 0.1mm to 3mm and shall absorb water to the extent of @ 51%. Specific gravity of BFC material shall be between 2.5 to 2.7.
- vii) Material shall be nontoxic, nonreactive, non explosive & noncorrosive.
- viii) Material shall be thermally stable between temperature range of -10°C to 60°C.
- ix) Material shall not decompose or leach out with time.
- x) It shall not pollute the soil or local water table & shall meet environmental friendly requirement for landfill.
- xi) It should expand & swell considerably & remove entrapped air to create strong connection between earth electrode & soil.
- xii) It should diffuse in to the soil pores & create conductive roots enlarging conductive zone of the earth pit.
- xiii) It shall not require periodic charging treatment or replacement. It shall not cause burns, irritation to eye, skin etc.

Minimum quantity requirement per pit of size 5'x5'x10' shall be 75Kg. and for 300mm bore type pit shall be 50 Kg.

4 TESTS:

4.1 TYPE TESTS

The materials offered in the tender should have been successfully type tested for the tests in line with the relevant standard and technical specification. The bidder shall be required to submit complete set of the type test reports along with the offer. Following type tests shall be carried out.

1. M.S. pipe shall be ISI marked & type tested as per IS: 1239.
2. Current carrying capacity Test shall be carried out on the concentric pipe electrode as per relevant IS & it shall withstand capacity rating as mentioned in the specifications (i. e. 50KA for 1 sec.)
3. To analyze effect of corrosion, salt spray test as per relevant IS shall be carried out at any NABL approved laboratory.
4. Electrical properties test on conductive materials as specified in the specifications
5. Physical, chemical & electrical properties on earth enhancement material.
6. Toxic Content test on Conductive materials & earth enhancement material as per standard.

All the type tests as per the relevant standard shall be carried out by the successful bidder in presence of purchaser's representative free of cost before commencement of supply. The undertaking to this effect should be furnished along with the offer without which the offer shall be liable for rejection.

Even if the material has been type tested earlier, the purchaser reserves the right to demand repetition of one or more tests included in the list of type test on requisite number of samples from any of the lots during the tenure of the supply, at purchaser's cost in the presence of purchaser's representatives. For this purpose the bidder shall quote unit rates for carrying out each test included in the list of type tests as per relevant standard and the tender specification. If the material does not withstand the type test, then the material supplied till then will be liable for rejection.

4.2 ACCEPTANCE TESTS:

The inspecting officer will carry out the acceptance tests on the materials as specified in the relevant standard with latest amendments and & this technical specification.

- 1) Physical check for concentric pipe type earth electrode as per clause 3.1.4 of this specification.
- 2) Resistivity of the complete earth electrode & Earth enhancement material shall be tested
- 3) Chemical Composition Test on crystalline conductive material used in earth electrode & Earth enhancement material (BFC) shall be checked.

5. TEST CERTIFICATES:

The tenderer shall furnish detailed type test reports of the offered material for the tests as per relevant IS and this specification. All these Type Tests shall be carried out at laboratories that are accredited by the National Accreditation Board of Testing and Calibration Laboratories (NABL) of Government of India. These tests should have been carried out within 5 years prior to the date of opening of this tender. The detailed type test reports along with the relevant oscillograms/ certified drawings, etc., are to be submitted in sealed cover along with the offer. The successful tenderer shall take approval of type tests and drawings from C.E. (Testing), M.S.E.D.C.L. Prakashgad, Bandra, Mumbai, prior to commencement of supply.

6. INSPECTION:

The purchaser or his nominee shall have right of free access to the works of the manufacturer & to be present at all reasonable times and shall be given facilities by the manufacturer to inspect the manufacturing process at any stage of manufacture. He shall have the right to reject whole or part of any work or material that does not conform to the terms of the specifications. All the reasonable/complete facilities considered necessary for the inspection by the inspecting authorities shall be supplied by the manufacturer free of cost.

In case any component tested & inspected in accordance with this specification fail to pass the requirements of the specifications, another two samples shall be selected from the same lot & inspected/ tested in accordance with the specifications. If one of the additional sample fail to pass the test, complete lot shall be rejected.

7.0 DETAILED SPECIFICATION FOR INSTALLATION OF EARTHING SYSTEM:

General arrangement for earth system & earth electrode shall be as per the drawing attached. Procedure to be adopted for construction of earth electrode shall be as follows.

7.1 CONSTRUCTION OF UNIT EARTH AND EARTH MAT

1. Make 5ft x 5ft x 10ft. earth pit. If it is not possible to make such a pit due to hard rocky soil or any other reasons, 300mm bore up to 10 ft. deep shall be made using earth auger or any other method.
2. Sleeve the soil and remove the gravels and stones. If soil quality is good (without murum & rocks) then add some quantity of earth enhancement material in the soil for using as backfill.
3. If the soil seems unusable (Containing large quantity of gravel, stones, murum, sand etc.) the replace the soil with black cotton soil.

4. Insert the electrode at the centre of the earth pit and arrange to keep it vertical in the pit.
5. Arrange for adequate quantity of water supply for the pit. (Approx. 600 litres).
6. Fill the pit with the backfill material and keep on adding the earth enhancement material surrounding the electrode and simultaneously watering the pit.
7. With a steel bar or pipe keep on peking the soil and stirring intermittently for removing the air pockets and proper settlement of the pit.

8.0 SCHEDULES:

The tenderer shall fill in the following schedule, which is part and parcel of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule 'A'- Guaranteed Technical Particulars

Schedule 'B' – Tenderer's experience

SCHEDULE – A

**GUARANTEED TECHNICAL PARTICULARS FOR
EARTH ELECTRODES & EARTH ENHANCEMENT MATERIALS**

Sr. No.	Particulars	MSEDCL Requirement	To Be Offered by Bidder
1.	Name & Address of Manufacturer	Mfg. to give details	Text
A- EARTH ELECTRODE ASSEMBLY			
2.	Type of earth electrode	Mfg. to give details	Text
3.	Whether Inner & Outer pipes of the earth electrodes are marked with ISI mark as per IS:1239	YES	Text
4.	Dimensions of the Outer Pipe (Dia x Length x Thickness in mm)	100 mm x 3000 mm x 12 SWG	Text
5.	Dimensions of the inner Pipe (Dia x Length in mm)	50 mm x 2925 mm	Text
6.	Whether M. S. Pipes are hot dip galvanized as per this specification & the level of hot dip galvanizing in microns	Hot dip galvanization of 250-300 microns	Text
7.	Whether the conductive material in the pipe electrodes is machine pressed to have homogeneous solid mixture	YES	Text
8.	Contents of the Conductive materials (in Percentage) filled in between the two pipes & in the inner side pipe	70% Carbon powder & 30% metal powder	Text
9.	Whether the material is tested for resistivity as per clause no. 3.1.3 of this specification.	Yes	Text
10.	Size of bus bar connecting M. S. Plate (Hot dip Galvanized) welded to the electrode for earth connection.	350mmx50mmx6mm	Text
11.	Hardness of the Conductive material after setting	Mfg. to give details	Text
12.	Earth Resistivity of the earth electrode assembly after Setting	0.2 Ohm meter	Text
13.	Total weight of the earth electrode assembly	Mfg. to give details	Text
B- EARTH ENHANCEMENT MATERIAL			
14.	Brand name of the earth enhancement material (if any)	Mfg. to give details	Text
15.	Contents of the earth enhancement material (Percentage of various components in the mixture & their Chemical Composition etc.)	Mfg. to give details	Text
16.	Resistivity of the earth enhancement material	0.2 Ohm meter	Text
17.	PH value of the earth enhancement material	> 7 & < 9	Text
18.	Moisture retaining capacity at 105°C	10% moisture at 105°C	Text
19.	Granular size of the material	0.1mm to 3mm	Text
20.	water solubility (in Percentage)	Mfg. to give details	Text
21.	Thermal stability of the material (Temperature Range)	(-10°C to 60°C)	Text
22.	Weight of material per bag	Mfg. to give details	Text

Sr. No.	Particulars	MSEDCL Requirement	Parameter type
23.	Whether the Material is nontoxic, nonreactive, Non explosive & noncorrosive as per the specification	YES	Text
24.	Whether the material is packed in proper bags & bags marked with details such as Brand name, Batch no. , Year & month of manufacture & tender reference etc.	YES	Text
25.	Whether type tests as applicable for the materials offered are submitted if so Give details	YES	Text

SCHEDULE – ‘B’

SCHEDULE OF TENDERER'S EXPERIENCE

Tenderer shall furnish here a list of similar orders executed / under execution by him to whom a reference may be made by Purchaser in case consider such a reference necessary.

Sr. No.	Name of Client & Description order.	Value of order along with size & qty.	Period of supply and commissioning	Name & Address to whom reference may be made.
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NAME OF FIRM _____

NAME & SIGNATURE OF TENDERER _____

DESIGNATION _____

DATE _____

TECHNICAL SPECIFICATION FOR EARTHING ELECTRODES AND EARTHING MATERIAL FOR 33 KV SUB-STATIONS

