MAHAVITARAN

Maharashtra State Electricity Distribution Co. Ltd.

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SPECIFICATION NO. MSEDCL/ DIST:MSC-III/EARTH ELECTRODES /3/10/R0 (300410)

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 pillars shall confirm to the relevant Indian standard specification and especially to the followings:

2.1	IS: 3043/ 1987	Code of practice for Earthing
2.2	IS 1239 part 1/2004	Steel Tubes, Tubulars and Other Wrought Steel Fittings - Specification - Part 1 : Steel Tubes
2.3	IS 1239 part 2/1992	Mild steel tubes, tubulars and other wrought steel fittings, Part 2 Mild steel tubulars and other wrought steel pipe fittings
2.3	IEEE-80	IEEE Guide for Safety in AC Sub Station Grounding
2.4	IEEE-837	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.

3.1.2 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.

3.1.3 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 mesh. 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 in side 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.

3.1.4 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 consists 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.

3.1.5 Mild Steel Electro galvanized bus bar of size 350mmx50mmx6mm shall preferably be welded to earth electrode pipes or connected with the help of 2 nos 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, nonexplosive & 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.

In case the type tests are conducted earlier than five years, 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 Compopsition Test on crystalline conductive material used in earth electrode & Earth enhancement material (BFC)shall be checked.

4.3 ROUTINE TESTS:

All the material offered shall be subjected to the routine tests at the manufacturer's works as specified in the relevant standards & this specification.

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. However, the tenderers who have supplied the material to this Distribution Co. against order from M.S.E.D.C.L. shall be exempted from submission of type test reports against this tender, provided offered material is already fully type tested at Laboratories accredited by the National Accreditation Board of Testing and Calibration Laboratories (NABL) within five years prior to the date of opening of the tender and there is no change in the design composition of already type tested material and those offered against this tender. Such tenderers shall furnish an undertaking in the format scheduled 'F' enclosed herewith.
The detailed type test reports along with the relevant oscillograms/ certified drawings, etc. or undertaking seeking exemption from their submission in the format schedule 'F', are to be submitted in sealed cover along with the offer.
The successful tenderer shall take approval/waiver of type tests from C.E. (Dist.), 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 materialin 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. Procedure to be repeated till completion of the filling of the earth pit along with the packing materials and sufficient watering & adequate ramming.
9. The pit shall be very compactly rammed and watering for 2-3 days and addition of soil if required be done.
10. Make trench of 600mm (Depth) x 300mm wide for connecting the earth pit to nearest point of connection.
11. Construct inspection chamber with cover for the installation.
12. Measure the earth resistance as per IS-3043-1987 code of practice. Earth resistance value shall be less than 1 ohm in nonrocky/non-sandy surface by single electrode installation.
13. The bidder shall install earthing material required for the system and individual equipment earthing. All work such as cutting, bending, supporting, soldering, coating, drilling, brazing, clamping, bolting and connecting into structures, pipes, equipment frames terminals, rails or other devices shall be in the bidder's scope of work. The bidder shall also carryout the excavation and trenching work involved. The bidder shall also back-fill and reinstates the trenches after installation of earthing conductors.
14. Metallic frames of all electrical equipments shall be earthed by two separate and distinct connections with earthing system.
15. Neutral connection shall never be used for the equipments earthing.
16. A separate earth electrode pit shall be provided adjacent to structures supporting lightning arrester. Earth connections shall be as short and as straight as practicable.
17. On completion of the installation, continuity of all conductors and joint shall be tested.

In case of contract for complete earthing, the supplier/licensed electrical contractor shall quote his rates for errection of complete earth mat with earth electrodes separately.

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 'C' - Tenderer's experience
Schedule 'F' - Proforma of Undertaking.

SCHEDULE – A

GUARANTEED TECHNICAL PARTICULARS FOR EARTH ELECTRODES & EARTH ENHANCEMENT MATERIALS

Sr. No.	Parameter Name	Parameter type
1.	Name of Manufacturer	Text
	A- EARTH ELECTRODE ASSEMBLY	
2.	Type of earth electrode	Text
3.	Whether Inner & Outer pipes of the earth electrodes are marked with ISI mark as per IS:1239	Text
4.	Dimensions of the Outer Pipe (Dia x Length x Thickness in mm)	Text
5.	Dimensions of the inner Pipe (Dia x Length x Thickness in mm)	Text
6.	Whether M. S. Pipes are hot dip galvanized as per this specification & the level of hot dip galvanizing in microns	Text
7.	Whether the conductive material in the pipe electrodes is machine pressed to have homogenious solid mixture	Text
8.	Contents of the Conductive materials (in Percentage) filled in between the two pipes & in the inner side pipe	Text
9.	Whether the material is tested for resistivity as per clause no. 3.1.3 of this specification.	Text
10.	Size of bus bar connecting M. S. Plate (Hot dip Galvanized) welded to the electrode for earth connection.	Text
11.	Hardness of the Conductive material after setting	Text
12.	Earth Resistivity of the earth electrode assembly after setting	Text
13.	Total weight of the earth electrode assembly	Text
	B- EARTH ENHANCEMENT MATERIAL	
14.	Brand name of the earth enhancement material (if any)	Text
15.	Contents of the earth enhancement material (Percentage of various components in the mixture & their Chemical Composition etc.)	Text
16.	Resistivity of the earth enhancement material	Text
17.	pH value of the earth enhancement material	Text
18.	Moisture retaining capacity at 105°C	Text
19.	Granular size of the material	Text
20.	water solubility (in Percentage)	Text
21.	Thermal stability of the material (Temperature Range)	Text
22.	Weight of material per bag	Text

23.	Whether the Material is nontoxic, nonreactive, nonexplosive & noncorrosive as per the specification	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.	Text
25.	Whether type tests as applicable for the materials offered are submitted if so Give details	Text

SEAL & SIGNATURE OF THE TENDERER

SCHEDULE – 'C'

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.

NAME OF FIRM_____

NAME & SIGNATURE OF TENDERER_____

DESIGNATION_____

DATE_____

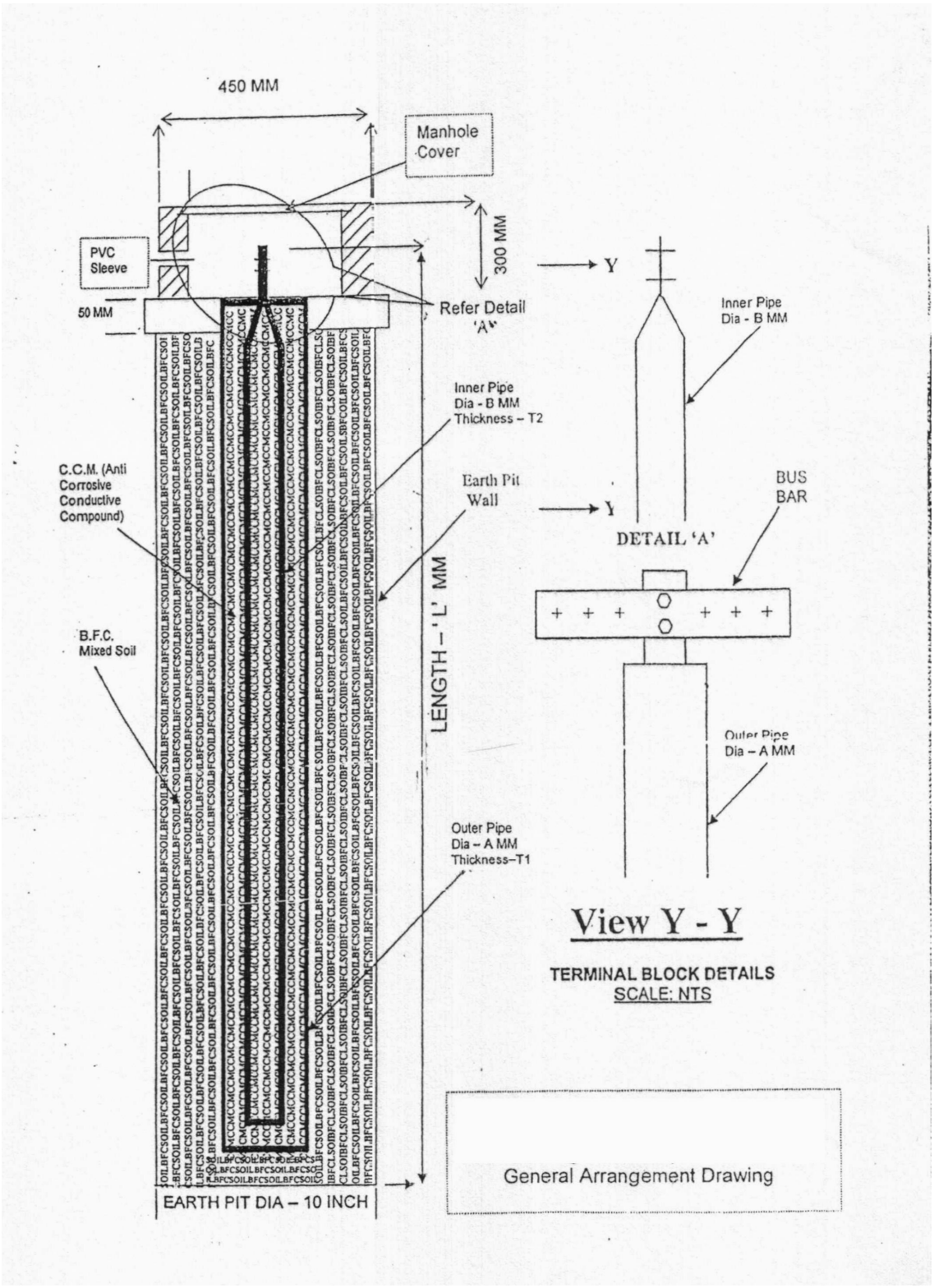
SCHEDULE – 'F'

PROFORMA OF UNDERTAKING

We hereby confirm that the materials offered by us against this tender are of the same design and type as have been supplied to MSEDCL against earlier order No. _____ dtd. _____ and all the Type Test Reports thereof were approved by C.E. (Dist.) vide letter No. _____ dtd. _____ (copy enclosed.)

We further confirm that the said Type Test have been carried out at _____are within five years prior to the date of opening of present tender.

SEAL AND SIGNATURE OF TENDERER


450 MM
Manhole Cover
300 MM
PVC Sleeve
50 MM
Refer Detail 'A'
Y
Inner Pipe Dia - B MM
Inner Pipe Dia - B MM Thickness – T2
C.C.M. (Anti Corrosive Conductive Compound)
Earth Pit Wall
BUS BAR
DETAIL 'A'
B.F.C. Mixed Soil
LENGTH – 'L' MM
Outer Pipe Dia – A MM
Outer Pipe Dia – A MM Thickness–T1
View Y - Y
TERMINAL BLOCK DETAILS
SCALE: NTS
General Arrangement Drawing
EARTH PIT DIA – 10 INCH