

## SECTION - 29

### SWITCHYARD ERECTION

#### 1.0 EQUIPMENT ERECTION DETAILS

- 1.1 For equipment interconnection, the surfaces of equipment terminal Aluminium tube, conductor & terminal clamps and connectors shall be properly cleaned. After cleaning, contact grease shall be applied on the contact surfaces of equipment terminal pad, Aluminium tube/conductor and terminal clamps to avoid any air gap in between. Subsequently bolts of the terminal pad/terminal connectors shall be tightened and the surfaces shall be cleaned properly after equipment interconnection.
- 1.2 Muslin or leather cloth shall be used for cleaning the inside and outside of hollow insulators.
- 1.3 All support insulators, circuit breaker, interrupters and other fragile equipment shall preferably be handled with cranes having suitable booms and handling capacity.
- 1.4 Bending of Aluminium tube should be avoided. The equipments /Supports height to be designed to have uniform height of aluminium busbar.
- 1.5 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.
- 1.6 Handling of equipment shall be done strictly as per manufacturer's/supplier's instructions/instruction manual.
- 1.7 Handling equipment, sling ropes etc, should be tested periodically before erection for strength.
- 1.8 The slings shall be of sufficient length to avoid any damage to insulator due to excessive swing, scratching by sling ropes etc.
- 1.9 For inter connection of 765 KV Breaker,CT, Isolators and supports 4.5 " Aluminium bus to be used. For 400 KV Breaker, CT and Isolator interconnection 4.0" Aluminium Bus to be used.

#### 2.0 STORAGE

The Contractor shall provide and construct adequate storage shed for proper storage of equipments, where sensitive equipments shall be stored indoors. All equipments during storage shall be protected against damage due to acts of nature or accidents. The instructions of the equipments manufacture/Owner shall be strictly adhered to. rolled provided they are rolled slowly and in proper direction as marked on the drum.

#### 3.0 INSTALLATION OF CABLES

- 3.1 Cabling in the control room and switch yard shall be done on ladder type cable trays. Trays should be neatly laid and inter connected in the trench as per standard practice.
- 3.2 All cables from bay cable trench to equipments including and all interpole cable (both power and control) for all equipment, shall be laid in PVC pipes of minimum 50 mm nominal outside diameter of class 4 as per IS 4985 which shall be buried in the ground at a depth of 250 mm below finish formation level. Separate PVC pipe shall be laid for control and power cables.
- 3.3 Cables shall be generally located adjoining the electrical equipment through the pipe insert embedded in the floor, in the case of equipment located away from cable trench either pipe inserts shall be embedded in

the floor connecting the cable trench and the equipment or in case the distance is small, notch/opening on the wall shall be provided. In all these case necessary bending radius as recommended by the cable manufacturer shall be maintained.

- 3.4 Cable racks and supports shall be painted after installation with two coats of metal primer (comprising of red oxide and zinc chromate in a synthetic medium) followed by two finishing coats of aluminium paint. The red oxide and zinc chromate shall conform to IS 2074
- 3.5 Suitable arrangement should be used between fixed pipe/cable trays and equipment terminal boxes, where vibration is anticipated.
- 3.6 Power and control cables in the cable trench shall be laid in separate tiers. The order of laying or 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
- 3.7 Power and control cables shall be securely fixed to the trays/supports with self locking type nylon ties with de-inter locking facility at every 5 metre interval for horizontal run. Vertical and inclined cable runs shall be secured with 25 mm wide and 2 mm thick aluminum strip clamps at every 2m.
- 3.8 Cables shall not be bent below the minimum permissible limit. The permissible limits are as follows;

Table of cable and	Minimum bending radius
Power cable	12 D
Control cable	10 D D is overall diameter of cable

- 3.9 Where cables cross roads, drains and rail tracks, these shall be laid in reinforced spun concrete or steel pipes buried at not less than one metre depth.
- 3.10 In each cable run some extra length shall be kept at a suitable point to enable one for LT cable straight through joints to be made in case the cable develop fault at a later date.
- 3.11 Selection of cable drums for each run shall be so planned as too avoid using straight through joints. Cable splices will be permitted except where called for by the drawings, unavoidable or where permitted by the owner. If straight through joints are unavoidable, the contractor shall used the straight through joints kit of reputed make.
- 3.12 Control cable terminations inside equipment enclosures shall have sufficient lengths so that changing of termination in terminal blocks can be done without requiring any splicing.
- 3.13 Metal screen and armour of the cable shall be bonded to the earthing system to the station, wherever required by the owner.
- 3.14 Rollers shall be used at intervals of about two metres while pulling cables
- 3.15 All due care shall be taken during unreeling, laying and termination of able of avoid damage due to twist, Kinks, sharp bends, etc.
- 3.16 Cables ends shall be kept sealed to prevent damage. In cable, vault, fire resistant seal shall be provided underneath the panels.
- 3.17 Inspection on receipt, unloading and handling of cables shall generally be in accordance with IS:1255 and other Indian Standard Codes of practices
- 3.18 Wherever cable pass through floor or through wall openings or other partitions, GI/PVC wall sleeves with bushes, having a smooth curved internal surface so as not to damage the cable, shall be supplied, installed and properly sealed by the contractor at no extra charges.

- 3.19 contractor shall remove the RCC/steel trench 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.
- 3.20 Contractor shall furnish three copies of the report on work carried out in a particular week, indicating cable numbers, date on which laid, actual length and route, testing carried out, terminations carried out, along with the marked up copy of the cable schedule and interconnection drawing wherever any modifications are made.
- 3.21 Contractor shall paint the tray identification number on each run of trays at an interval of 10 m.
- 3.22 In case the outer sheath of a cable is damaged during handling/installation, the contractor shall repair it at his own cost to the satisfaction of the owner. In case any other part of a cable is damaged, the same shall be replaced by a healthy cable at no extra cost to the owner, I.e the contractor shall not be paid for installation and removal of the damaged cable.
- 3.23 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 insulation tape, sleeve or paint.

**3.24 Cable Trays.**

- a) The cable trays shall be of G.S. sheet and minimum thickness of sheet shall be 2mm.
- b) The contractor shall perform all tests and inspection to ensure that material and workmanship are according to the relevant standards. Contractor shall have to demonstrate all tests as per specification and equipment shall comply with all requirements of the specification.
- c) Test of galvanizing (Acceptance Test) The test shall be done as per approved standards.
- d) Deflection Test (Type Test)

A 2.5 metre straight section of 300 mm, 600mm, wide cable tray shall be simply supported at two ends. A uniform distributed load of 76 kg/m shall be applied along the length of the tray. The maximum deflection at the mid span shall not exceed 7 mm.

**4.0 TESTING AND COMMISSIONING**

- 4.1 An indicative list of test for testing and commissioning is given below contractor shall perform any additional test based on specialties of the items as per the field Q.P/instructions of the equipment contractor, or all equipments instruments and auxiliaries required for testing and commissioning of equipments along with calibration certificates and shall furnish the list of instruments to the owner for approval.

**4.2 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 order/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 wherever necessary.

- 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 manufacturers 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 18.5 times the rated pressure shall be conducted.

#### 4.3 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 galvanized surfaces.
- e) Dip test on earth conductor prior to use.

#### 4.4 AAC/ACSR STRINGING WORK, TUBULAR BUS WORK AND POWER CONNECTORS.

- a) physical check for finish
- b) electrical clearance check
- c) testing of torque by torque wrenches on all bus bar power connector and other accessories.
- d) millivolt drop test on all power connector
- e) sag and tension check on conductors

#### 4.5 ALUMINIUM TUBE WELDING

- a) physical check
- b) millivolt drop test on all joints
- c) dye penetration test & Radiography test on 10% sample basis on weld joints.
- d) Test check on 5% sample joints after cutting the weld piece to observe any voids etc.
- e) Necessary inner sleeves to be provided for all joints in addition to welding.

#### 4.6 INSULATOR

Visual examination for finish, damage, creepage distance etc.

- 4.7 All pre/ commissioning activities and works work for substation equipment shall be carried out in accordance with owner's pre commissioning procedure and formats for substation equipments" by the contractor.

#### 4.8 ILLUMINATION OF SWITCHYARD :-

The contractor shall design the switchyard lighting for the entire substation area. The recommended levels of illumination is

General horizontal	: 21.52 Lux.
Specific vertical (on disconnects)	: 21.52 Lux.

These levels of illumination shall be designed to be achieved by using LED bulbs. The lighting masts in the substation have lightning platforms for mounting of these lamps at 12.5 metre and 25 metre levels. These platforms have to be made use of for mounting the lightning fixtures. The contractor can propose separate masts for the 765 KV yard lights, 400 KV yard lights and where additional masts are required for 765 KV yard lights. These masts shall be designed by the contractor only after detailed discussion with the purchaser

regarding the height, location and numbers etc, and the design shall be submitted within 60 days of award of contract.

The LED bulb fitting along with fixtures shall be procured by the contractor erected and commissioned with necessary lamp control switches and switch boxes. The brand names of the fittings and lamps should be got approved before ordering. Tentative quantity has been indicated in the schedule.

Illumination for the entire switch yard to be designed as per standard practice and LED lamps to be erected in the sub station structures, Lightning mast, 6 Mts stepped GI tubular post. Each fitting has to be provided with necessary Vermin proof junction box, HRC fuse carrier and fuse link. The yard light should be grouped in such a way that minimum lights can be switched on by generator set. Necessary main switches main switches to be erected in the yard by grouping and over all control from control room. The LED bulb fitting with fixture, of reputed make with ISI mark and only copper cable to be used from fitting to junction box etc..and testing for burning condition.

#### 4.9 OTHERS :-

Sand drum made out of oil drum of Size 580mm dia and 420 mm height with conical cover made out of tin sheet provided with handle including the cost barrel, sand and consumables as directed by the field Engineer. Supply of different sizes of identification Boards for Equipments, Earth pits, Fire stand etc, duly painted and writing details as directed by field engineer.

### **CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST**

#### 1 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).

#### 2 Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

#### 3 Test Methods for RIC:

3.1 RIV tests shall be made according to measuring circuit as per International Special – Committee on Radio Interference (CISPR) Publication 16-1 (1993) part-1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of RIC, temporary additional external corona shielding may be provided. In measurements of RIC only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no Variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400 kV listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

#### 4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. the test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e 85%, 100%, 115% and 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using panchromatic film with an ASA daylight equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

In case corona inception does not take place at 130%, voltage shall not be increased further and corona extinction voltage shall be considered adequate.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up location shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by purchasers inspection after determining the best camera location be the

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of purchaser's inspector if, in his opinion, it will not prejudice other test.

## **5.0 Test Records:**

In addition to the information previously mentioned and the requirements specified as per CISR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 micro volts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

### **KEY BOARD/LC BOARD**

One Number each Key Board and LC Board to be supplied and fixed in the control room duly drawing SLD and other required details. LC / Key Board of size 3000 mm , length 1500 mm height made out of 75 x 25 mm aluminium frame embedded with 12mm pre laminated wood particle Board using screws rear 2 Nos. of plain glass of 5mm thick fixed with metal roller moving on aluminium channel should be provided on front with locking arrangements. Glass pieces should be fastened on the glass shutter for opening and closing. Wall clamps made out of 6mm GI plate / Angle should be provided on top & Bottom. Single line drawing & Other required details to be written in finished surface on Boards with good quality enamel paint.

## SECTION - 30

### EARTHING

1.1 a) The earth mat design shall be done by the Contractor as per IEEE-80. The main earthmat shall be laid in the switchyard area in accordance with the approved drawing.

b) The substation earthing shall be designed such a way that their rated short time withstand current is 50 KA (rms)/1 sec for 765 KV system and 63 KA (rms)/ 1sec for 400KV system.

1.2 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 system unless stipulated otherwise.

1.3 Earthing and lightning protection 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 systems in installed.

- a) code of practice for Earthing IS:3043
- b) Code of practice for the protection of Building and allied structures against lightning IS: 2309.
- c) Indian Electricity Rules 1956 with latest amendments.
- d) National Electricity safety code IEEE 80.

#### 1.4 Details of Earthing System

Item	Size	Material
a) Main Earthing Conductor to be buried in ground	40mm dia	Mild Steel rod
b) Conductor above ground & earthing leads (for equipments)	75X12mm M.S. flat	Mild Steel
c) Conductor above ground & earthing leads (for columns & aux. structures)	75X12mm	Mild Steel



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|--|--------------------------|------------|
| d) Earthing of indoor LT panels,<br>Control panels and out door<br>Marshalling boxes, MOM<br>Boxes, junction boxes &<br>Lighting panels etc. | 50X8mm                   | Mild Steel |
| e) Rod Earth Electrode   | 40mm dia,<br>5000mm long | Mild Steel |
| f) Earthing conductor<br>along outdoor cable trenches  | 50X8mm MS Flat           | Mild Steel |
| g) Earthing of Lighting Poles  | 50 x 8 mm MS Flat        | Mild steel |

The size of the earthing conductor indicated above are the minimum sizes.

#### 1.5 Earthing Conductor Layout.

- 1.5.1 Earthing conductors in outdoor areas shall be buried at least 800mm below finished ground level and refilled unless otherwise.
- 1.5.2 Wherever earthing conductor crosses cable trenches, underground service ducts, pipes, tunnels, railway tracks etc, it shall be laid minimum 300 mm below them and shall be circumvented in case it fouls with equipment/structure foundations.
- 1.5.3 Tap connections from the earthing grid to the equipment/structure to be earthed, shall be terminated on the earthing terminals of the equipment/structure.
- 1.5.4 Earthing conductor or leads along their run on cable trench, ladder, walls etc. shall be supported by suitable welding/cleating at intervals of 750 mm. wherever it passes through walls, floors, etc., galvanized iron sleeves shall be provided for the passage of the conductor and both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.
- 1.5.5 Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.
- 1.5.6 Earthing conductors crossing the road shall be laid 500 mm below load or at greater depth to suit the site conditions.

#### 1.6 Equipment and Structure Earthing

- 1.6.1 Earthing pads shall be provided for the apparatus/equipment at accessible position. The Connection between earthing pads and the earthing grid shall be made by two short earthing leads (one direct and another through the support structure) 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 owner.
- 1.6.2 Whether specifically shown in drawings or not, steel/RCC columns, metallic stairs etc. shall be connected to the nearby earthing grid conductor by two earthing leads. Electrical continuity shall be ensured by bonding different section of hand rails and metallic stairs.
- 1.6.3 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 systems.
- 1.6.4 Metallic conduits shall not be used as earth continuity conductor.
- 1.6.5 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.
- 1.6.6 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.
- 1.6.7 Earthing conductor shall be buried 2000 mm outside the switchyard fence. All the gates and every alternate post of the fence shall be connected to earthing grid.

The stone spreading shall also be done 2000 mm outside switchyard fence. The criteria for stone spreading shall be followed in line with requirement specified elsewhere in the specification.

- 1.6.9 Flexible earthing connecting of the moving parts.
- 1.6.10 All lighting panels, junction boxes, receptacles fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. rules.
- 1.6.11 A continuous ground conductor of 16 SWG GI wire shall be run all along each conduit run. The conductor shall be connected to each panel ground bus. All junction boxes, receptacles, switches, lighting fixtures etc. shall be connected to this 16 SWG ground conductor.
- 1.6.12 50mmX8mm MS flat shall run on the top ties and all along the cable trenches and the same shall be welded to each of the racks. Further this flat shall be earthed at both ends and at an interval of 30 mtrs. The M.S. flat shall be

finally painted with two coats of Red oxide primer and two coats of post Office red enamel paint.

1.6.13 A 40 mm dia, 5000 mm long MS earth electrode with test link, CI frame and cover shall be provided to connect down conductor of lightning mast and towers with peak.

1.6.14 A metallic grid (chicken mesh) to be formed along the concrete walls of the kiosk. The shell is to be connected to the substation earthmats through two links one each at the diagonally opposite corners of the kiosk.

## 1.7 Jointing

1.7.1 Earthing connections with equipment earthing pads 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 and corrosive paint/compound.

1.7.2 Connection between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded type for rust protections, the welds should be treated with red lead and afterwards coated with two layer bitumen compound to prevent corrosion.

1.7.3 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.

1.7.4 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

1.7.5 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.

1.7.6 Bending of earthing rod shall be done preferably by gas heating.

1.7.7 All arc welding with large dia, conductors shall be done with low hydrogen content electrodes.

1.7.8 All the earth flat shall be clamped with the equipment support structures at least 1000mm interval.

1.8 Power Cable Earthing Metallic sheaths and armour of all multi core power cable shall be earthed at both equipment and switchgear end. Sheath and armour of single core power cables shall be earthed at switchgear end only.

## 1.9 Specific Requirement for Earthing Systems.

- 1.9.1 Each earthing lead from the neutral of the power transformer/Reactor shall be directly connected to two electrodes in treaded earth pit (as per IS). All the earth pits in the yard to be provided with cement collar and permanent water arrangement to be done. All accessories associated with transformer/reactor like cooling banks, radiators etc. shall be connected to the earthing grid at minimum two points.
- 1.9.2 Earthing terminal of each lightning arrester & Capacitor voltage transformer shall be directly connected to rod earth electrode which in turn, shall be connected to station earthing grid.
- 1.9.3 Auxiliary earthing mat comprising of 40mm dia M.S rods closely spaced (300mm x 300mm) conductors shall be provided at depth of 300mm from ground level below the operating handless of the M.O.M box of the isolators. M.O.M boxes shall be directly connected to the auxiliary earthing mat.
- 1.9.4 All earthing flats connecting to the equipments above the yard levels and upto the equipments to be painted with one coat of red oxide and green paint as per standard.
- 1.10 The earth electrode to be fabricated for 5 mts length without joints with provision for inter connecting at least two numbers earth flats from main earth mat /structures etc. The electrode to be erected by rigging 140/150 mm dia. bore using power rig and to be filled with mixer of A4 grade Bentonite powder,salt and available site soil.
- 1.10 Earth spikes to be fabricated for 3 Mts length and to be erected in lightening mast
- 1.11 600mm mean dia,300mm height,36mm thick cement collar for identification of earth electrode location including 1 primer and 2 coat of colour wash to be provided.
- 1.12 GENERAL
  - 1.12.1 The sizes of flats mentioned in this specifications are indicative purposes only.The exact sizing should be decided during detailed engineering.
  - 1.12.2 Combined earth resistance should be less than 0.1Ω.
  - 1.12.3 Individual earth rod resistance shall be <10Ω.
  - 1.12.4 The design value of step,touch,GTR & TGPR should be measured as per IEEE-80.
  - 1.12.5 The multi layer soil resistivity shall be taken for the earth resistivity calculations and advance softwares like DCEGS shall be used to design the earth grid.Earthing layout and earthing design calculation prepared as above should be got approved.
  - 1.12.6 Precommissioning test is to be conducted on any equipment installed at this proposed substation permitted only after the validation of earthing test as per approved earthing design.

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