DOCUMENT CONTROL

Document Number	**TPDF02-DIS01-OCP-012**	
Title of Document	**EARTHING OF ELECTRICAL DISTRIBUTION EQUIPMENT**	
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1	1	0	01.12.2021	First Issue	Shilajit Ray Satish Shah	Snehal Shah Abdulrashid Shaikh
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1. PURPOSE

1.1. Earthing of Electrical Distribution Equipment

2. SCOPE OF DOCUMENT

2.1. The scope of this document is to define a structured activity-level flow for Earthing of Electrical Distribution Equipment

2.2. The process document aims to define the guidelines to ensure the process effectiveness as required by the Integrated Management System whenever implemented.

3. FIELD OF APPLICATION

3.1. This procedure is used for Earthing of Electrical Distribution Equipment in TPL-D's Franchisee areas of Bhiwandi & SMK.

4. FREQUENCY

4.1. As and when required

5. AUTHORITIES AND RESPONSIBILITY

5.1. The Head of Distribution is responsible for implementation of this procedure for effectiveness.

5.2. The Head of HT O&M/Projects at respective locations are responsible for execution of this procedure for effectiveness.

6. REFERENCES

6.1. MERC Regulations (with its latest amendments)

6.2. Central Electricity Authority (Measures Relating to Safety & Electric Supply) Regulations 2010 (with its latest amendments)

6.3. OEM manual

6.4. OCP # TPDF02-STO01-OCP-006 Operational Control Procedure for Handling, Collection, Storage and Management of Hazardous Waste

6.5. OCP # TPDF02-STO01-OCP-007 Waste Management of Non-Hazardous Waste

7. SPECIFIC COMPETENCY REQUIREMENTS

7.1. Technician / GET / Jr. Exe/Exe/AM/M should have Knowledge of

(1) Operation of Feeders, Distribution Transformers, Switchgears, Switching & Sub-station equipment

(2) Safe working practices and use of PPE

7.2. Technician / GET / Jr. Exe/Exe/AM/M having valid authorization from General Manager Distribution shall have authority for electrical isolation and issue of Permit to Work (PTW).

7.3. As per competency profile and assessment.

8. INTERFACE WITH OTHER DEPARTMENTS/SECTIONS, IF ANY

8.1. Control room / NPC for Outage Related Information

8.2. Store department for material issue

9. TOOLS AND TACKLES

9.1. Tools for excavation

9.2. Ladder as per site requirement.

9.3. Tools Kit

9.4. Welding set

9.5. DG set (if required)

10. PERSONAL PROTECTIVE EQUIPMENTS / SAFETY TOOS

Following PPEs shall be used to carry out work at site.

10.1. Safety Shoes.

10.2. Safety helmet.

10.3. Safety belt

10.4. Safety Goggles

10.5. Barricading tape (if required)

10.6. Caution board / “Men at work” sign board (if required)

10.7. Barricading cone (if required)

11. SIGNIFICANT RISK PARAMETERS

11.1. Quality Management System: Medium

11.2. Impact on Environment: High

11.3. Health and Safety Risk: High

11.4. Energy Management: Low

11.5. Asset Management Risk: Low

12. PROCEDURE

12.1. PREPARATION

(1) Visit the site location for prelims for necessary tools, manpower and material requirement

(a) Site visit for verifying the No. & type of Electrical Network components to be given earth connection.

(b) To decide the route of running Hot dip GI strip from main earth pit up to common earth terminal for transformer neutral.

(c) To decide the route of running Hot dip GI strip from main earth pit up to

common earth terminal for body earthing.

(2) Ensure that the contractor / technician gang has necessary manpower to carry out the job and all the persons to work at site should have valid gate pass issued by HR department, TPL.

(3) Issue earthing related material to contractor.

(4) Transportation the earthing material at site.

12.2. **PRECAUTIONS**

(1) Barricading the working area by barricading tape with appropriate sign board indicating the hazard shall be displayed near the barricade whenever required.

(2) Aware all persons for nearby live equipment to maintain safe clearance and safety while working.

(3) Use all required PPEs during execution of the job.

(4) Following steps to be followed for working at height if required.

(a) Person who has to climb on the pole must use full body harness with lanyard which is be hooked & locked properly on pole at convenient height where the person has to perform the job.

(b) Ladder is to be erected in safe working condition and its top end is to be tied with pole by means of rope.

(c) All the materials should be lifted or lowered by means of hand line only and nothing should be thrown up by the ground helper or thrown down by the lineman. As there is tendency, many times on the part of the work man to throw smaller items such as spanner, bolts, nuts etc. from the ground to the top or from the top to the ground to save the labour and time which may lead to an accident hence it is should be strictly avoided.

(d) All the persons working shall wear helmets.

12.3. **ISOLATIONS**

(1) For isolation equipment from the system follows the procedure as per OCP No: TPDF02-DIS01-OCP-005 for Distribution Network Isolation and Normalisation as per the switching requirement.

(2) Authorized person issue “Permit to Work” as applicable to competent person after required isolation and local earthing

12.4. **PROCEDURE**

(1) Following earthing as standardised in Electrical Distribution network system shall be complied.

(a) CI Plate Earthing:

I. In this, CI plate of size 600mm X 600mm X 6.3 mm thick plate shall be used as earth plate. This is being connected with Hot dip GI main earth strip of size 50mm X 6mm thick X 2.5 meter long by means of

nut, bolts & washers of required size. The main earth strip is connected with hot dip GI strip of size 40mm X 3mm of required length as per the site location up to the equipment earth/ neutral connection. The earth plate is backfilled & covered with earthing material (alternate layers of charcoal & salt) by 150mm from all six sides. The remaining pit is backfilled with excavated earth. Along with earth plate, rigid GI pipe of 2.5-meter long is also provided in the earth pit for watering purpose.

(b) All joints of earth strips from main earth strip to equipment body/neutral earth connection is recommended by means of welded joints, except at body and neutral earth connection and at earth plate side where bolted connections are preferred. This is to ensure

I. Better earth connection during fault current passing

II. Chances of hot spot created due to improper connection will be less.

III. Chances of theft of earth strip being stolen will be reduced.

IV. earth pit for watering purpose.

(c) All earth pits shall be interconnected with GI strip of 50 mm x 6mm of suitable length. Effort should be made to reduce strip jointing as far as possible during interconnection. If jointing is still required, then butt weld with minimum 100 mm overlap shall be done. Earth strips shall be two side bolted with the earth pits to facilitate individual pit measurement also.

(2) Earthing Process:

(a) Earth Pit: As per the type of earthing as well as equipment to be given earth connection, size and No. of earth pit will be decided.

I. Minimum five (05) Nos. of pits for Distribution Substation equipment earthing. (Two separate Earth Pit for DTC & FSP Neutral and balance for body earthing).

II. Distance between two earth pits shall be @ 2 meters wherever possible. However, in congested area the above distance may be adjusted as per the site requirement with resistance value.

III. Prior to decide for earth pit location ensure safeguarding other utility like drainage line, Telephone line, gas line etc. So that during excavation work same is not being damaged, if required location may be changed accordingly.

IV. For Plate type of earthing, required size of pit is to be excavated (3 feet wide X 3 feet in length X 6 feet in depth) wherever possible. However, in congested area the above distance may be adjusted as per the site requirement with proper records & resistance value.

(b) Cover the excavation area with barricading tape properly with caution board.

(c) If the excavated earth is sandy, the proper steps are required to be provided during excavation to avoid any land slide and accident during excavation or earthing work in the pit.

(d) Put Charcoal and Salt in layers around earth plate

(e) Back fill the remaining portion of earth pit by excavated earth.

(3) Laying and connection of 40mm X 3mm Hot dip GI strip for earthing:

(a) Before laying and connection of GI strip in indoor substation, remove trench covering stones.

(b) Connection of earthing electrode to neutral of transformer bus bar.

(c) Reinstall all trench covering stones after completion of work.

(d) All earth strips up to the equipment earthing terminals are to be laid in the ground at least 300mm below the ground surface & to be covered by excavated earth properly.

(e) If earth strips are laid in substation trench it should be aligned & laid properly & it should not be hindrances during any cable laying or cable related work in trench.

(f) Also, earth strip run through any structure, it should be aligned, laid and to be given bend & shape as per the structure fittings. Also same is to be clamped along the pole at required distance. Aesthetically entire earth strip connection as well as its run along the structure fitting should look good.

(g) In substation for transformer earthing, normally two separate earthing for neutral & two separate earthing for body of transformer are provided.

(h) Two earth pits of neutral as well as for two pits of body earthing are connected with each other by common earth strip.

(i) In between earthing terminal & earth strips connected to main earth pit, earth link has been provided which is welded in between GI strip of size 40mm X 3 mm at suitable locations to facilitate for measurement of earth resistance of above earth pits by clamp on type earth resistance measuring instrument through this earth link.

(j) All joints of earth strip are recommended for welded/Bolted joints. It is recommend overlapping the strip by at least 100 mm and all its overlapped four edges are to be welded through and entire surface nearby welding area is to be painted with black bituminous compound to prevent any corrosion from above welding joint.

(4) Equipment earthing Connection.

(a) Transformer Earthing:

I. Two earthing for Neutral: Two separate earthing from Neutral earth pit through hot dip GI strip is to be run up to each common neutral earth terminal. From the each of above common neutral earth terminal, 40mm x 3mm GI strip is to be connected to neutral bus bar of transformer.

II. Ensure insulating sleeve to be provided on neutral earth strip to isolate the strip from equipment body and body earthing wherever

required. Efforts shall be made to avoid earth strips outside substation fencing.

III. Two earthing for transformer Body: Hot dip GI strip from each Body earth pit is to be run up to each common body earth terminal. Provide in between earth link such that by clamp on type earth resistance meter measurement through this link can be taken as and when required. From the reach of above common body earth terminal, 40mm x 3mm GI strip is to be connected to body earth terminal of transformer.

(b) HT Switch gear Earthing.

I. Two body earthing: From each of common body earth terminal, 50mm x 6mm GI strip is to be connected to body earth terminal of HT Switch gear.

(c) FSP Earthing:

I. Two earthing for Neutral: From above common neutral earth terminal/grid, 40mm x 3mm GI strip is to be connected to neutral bus bar of FSP.

II. Ensure insulating sleeve to be provided on neutral earth strip to isolate the strip from equipment body and body earthing

III. Two body earthing: From common body earth terminal/grid, 40 mm x 3mm GI strip is to be connected to body earth terminal of FSP.

(d) APFC Panel

I. Two earthing for Neutral: From above common neutral earth terminal/grid, 40mm x 3mm GI strip is to be connected to neutral bus bar of APFC Panel.

II. Ensure insulating sleeve to be provided on neutral earth strip to isolate the strip from equipment body and body earthing

III. Two body earthing: From common body earth terminal/grid, 40mm x 3mm GI strip is to be connected to body earth terminal of APFC Panel.

(e) Pole Earthing

I. One earthing for Body: One separate earthing from Body earth pit through hot dip GI strip is be laid up to pole body earth terminal. Provide in between earth link such that by clamp on type earth resistance meter measurement through this link can be taken as and when required. The laying and connection of GI strip should be as described

(f) CSS Earthing (wherever available)

I. Provide earthing as per OEM guidelines

(5) Measurement of Earthing Resistance

(a) Using digital earth tester measure the earth resistance of distribution substation & other network equipments.

(b) Using digital multi meter measure the NE voltage at LT panel.

(c) Record the results.

(d) Record switchgear body earthing value.

(e) Record Distribution transformer body and neutral earthing value.

(f) Record HT poles, DT fencing, DT structure earthing values

(g) Earth wire maintenance

(6) In case of more than standard value of earth pit value (5 ohm or less other than DTC), 20 ohm or less for HT poles, earthing maintenance required.

(a) Check for tightness of connecting nut bolts.

(b) Clean the contacts of adjoining strips.

(c) Trace for any open links in the earthing grid.

(d) After completing above steps remeasure earthing value.

(e) In case of earth strip, connect with main earth strip by means of welding if required.

(f) Check for the earthing resistance, If the value is still more than the specified value prepare new earthing pit. And reconnect the equipments.

(7) Re-charging / replacement & interconnection of earth-pit in DTCs

(a) For checking and reconnecting earthing connection of neutral bus bar of transformer / FSP / LT-APFC panel, if power is required to be switched "OFF", carryout the switching as per OCP No: TPDF02-DIS01-OCP-005 for Distribution Network Isolation and Normalisation.

(b) Measurement earth-pit resistance & re-charging / replacement of existing earth-pit

- Earth pit resistance measurement to be done in dry season
- If Earth pit resistance measurement to be done in other than above period, refer past results of which measurement done in above period.
- On the base of above Earth-pits can be classified in three categories.
    - Earth pit is OK
    - Charging of Earth pit required
    - New Earth pit required
- The guidelines for categorization of Earth Pit as follows.
    - Earth pit is OK
        - The value of Earth pit is less than 5 ohms.
    - Charging of Earth pit required
        - The value is above 5 ohms but less than 15 ohms.

- New Earth pit required
  - The value of Earth pit is above 15 ohms.

(c) Interconnection of Earth-pits: Interconnection to be carried out from one Earth pit to another Earth pit with following guidelines:

- Use G.I. earth strip of 50 x 6 mm for pit interconnection
- Min. two path per equipment should be provided & connected to the grid
- Earth strip should be at min 300 mm below the ground level
- Interconnect all body earth pits together to make body earth grid
- Interconnect all neutral earth pits together to make neutral earth grid
- Interconnecting strips of different grids should not overlap or touch each other & if overlapped proper insulation should be provided at cross over points.
- Strip should be twin bolted with the pit electrode & equipment (DTC, FSP) and wherever welding is required, minimum overlap should not be less than 100 mm

For 7 Earth pits

- Interconnection of 3 Pits to be used for Neutral of DT & FSP
- Interconnection of 4 Pits to be used for DT & FSP body, DT structure, Fencing, LA

For 6 Earth pits

- Interconnection of 3 Pits to be used for Neutral of DT & FSP
- Interconnection of 3 Pits to be used for DT & FSP body, DT structure, Fencing, LA

For 5 Earth pits

- Interconnection of 2 Pits to be used for Neutral of DT & FSP
- Interconnection of 3 Pits to be used for DT & FSP body, DT structure, Fencing, LA

(d) For less than 5 Earth pits, add required Earth pits (Total Min-5 Nos.)

(e) PCC with aggregates if required: After completion of pit interconnection & grid is ready, 100 mm PCC shall be done inside DTC premise with 80 mm layer of aggregates over the PCC.

(f) Quick reference table

Earth Pit Condition	Earth Pit Configuration		
	7 Earth pits (4B + 3N)	6 Earth pits (3B + 3N)	5 Earth pits (3B + 2N)
Individual Earth Pit	Pit Resistance Value (ohm)		
Acceptable	<= 5	<= 5	<= 5
Require Charging	> 5, < 15	> 5, < 15	>5, < 10
Require new pit	> 15	> 15	> 10

Interconnected Earth Pit	Grid Resistance Value (ohm)
Acceptable	<= 5
Require Charging	>5, < 10
Require new pit & interconnect with respective grid	> 10

(8) Identification and numbering of earth pit

(a) Identify the Nos of pit available

(b) Appropriate numbering to be provided to each pit available

(c) Earthing pit numbering to be maintained for individual transformer

(9) Site housekeeping

(a) Remove all packing, waste material and dump, Collect and submit to stores.

(b) Remove barricades, temporary stakes etc.

(c) Clean the area of dirt, loose soil etc.

(d) Ensure the backfilled areas are level with ground surface.

(e) Remove caution boards, traffic bollards (plastic cones) if placed during job.

12.5. **RESTORATION**

(1) If isolation of the system is taken then, remove shorting & earthing link from HT as well as from LT side. Remove LOTO / Padlock and caution board from respective location.

(2) Take clearance from concerned person and Cancel “Permit to work”

(3) Shift all the manpower and tools and tackles from the site.

(4) Remove excess material & scrap from the job area.

(5) For normalisation of above switching follow the procedure as per OCP No: TPDF02-DIS01-OCP-005 for Distribution Network Isolation and Normalisation.

(6) Check power available on FSP/DT Meter

(7) Inform Control room regarding normalisation of section.

(8) Remove the temporary switching from the control room giving all relevant details.

12.6. **WORK CHECKLIST**

(1) Update entries in Standard Format as mentioned in List of attachment.

12.7. **UPDATION**

(1) Upload site photographs of allocated job on respective order in SAP or Field Force Application if required

13. IMPACT ANALYSIS OF SIGNIFICANT RISKS

13.1. **QUALITY MANAGEMENT SYSTEM**

(1) Details of Quality Issues involved

(a) Improper Depth

(b) Incompetent manpower (Poor workmanship)

(2) Details of Quality Assurance plan

(a) Work Quality/OCP Training

(b) Effective supervision

(c) Penalty mechanism

13.2. **HEALTH AND SAFETY**

(1) Details of Health and Safety Hazard involved

(a) Electric shock due to improper earthing of welding / Other electrical tools

(b) working/travelling in extreme weather condition

(c) Working in congested area

(d) Contact with Hot welded Part

(e) Animal/ insect bite

(f) Use of faulty Tools

(g) Negligence of use of safety PPEs / Non usage of PPEs/ Use of faulty PPEs

(h) Penetration of metal particles in eyes during cutting work

(i) Slips, trips and Falls of Persons

(j) Consumer aggression

(k) Contact with Live terminal/ cable/ wire/ busbar

(l) Contact with sharp edges

(m) Fall of person from Height

(n) Penetration of dust particles in eyes during excavation

(o) Working in bending position / Awkward Posture

(p) Ingress of polluted water in excavated pit

(2) Health and Safety Precautions required

(a) Ensure use of PPEs

(b) Ensure that authorized person should work

13.3. **ENVIRONMENT**

(1) Details of Environmental impact

(a) Resource Depletion

(b) Air Pollution

(c) Land Contamination

(2) Precautions to minimize Environmental impact

(a) Ensure that all persons working at site are aware about the significant environmental impacts

(b) Ensure that all persons working at site are aware about the significant environmental impacts.

(c) Ensure that there is no ignition source present near to the site

(d) Ensure that all type of generated waste including hazardous waste should be collected and submitted to stores as per OCP no: TPDF02-STO01-OCP-006 & 007.

(e) Material / Scrap Reconciliation in SAP System

13.4. **ENERGY MANAGEMENT**

(1) Details of energy use involved

(a) Fuel consumption in transportation/ material movement

(2) Precautions to minimise energy use

(a) Ensure Optimum Usage & Turn off the engine when not in use

13.5. **ASSET MANAGEMENT**

(1) Not applicable

14. LIST OF ATTACHMENTS

Sr	Document /Record Description	Reference No.
1	Earthing measurement format	TPDF02-DIS01-OCP-012-F01
2	Deviation format	TPDF02-DIS00-FOR-001

***** End of Procedure *****