Earthing and Lightning Protection: System Earthing, Bonding, Earth Testing and Surge Protection

4 – 8 January 2027
London - Central London four-star



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Introduction:

Earthing and lightning protection faults stay hidden until a fault current, lightning strike or static discharge finds them: corroded electrodes, broken bonds, rising earth resistance and unprotected incoming services turn routine events into shock, fire and equipment damage. This Core Concept course equips plant and utility electrical staff to select earthing arrangements, earth generator and transformer neutrals, measure soil resistivity and earth resistance, judge step and touch potential at substations, apply lightning and surge protection and inspect bonding in hazardous areas. Participants build a Site Earthing and Lightning Protection Assessment File for an installation of their own.

Course Objectives:

- Select TN, TT or IT earthing arrangements to IEC 60364 and choose solid, resistance or reactance neutral earthing for generators and transformers
- Design earth electrode systems from measured soil resistivity and specify conductor, electrode and bonding materials against fault current and corrosion
- Measure earth electrode resistance with the fall-of-potential method and interpret the results against design values and earlier readings
- Assess step, touch and mesh voltage and earth potential rise around substation earth grids using IEEE 80 concepts
- Apply IEC 62305 lightning protection zoning and select surge protective devices for power, control and signal circuits
- Inspect protective bonding, static earthing and lightning protection installations and plan periodic testing and remedial maintenance

Target Audience:

- Plant electrical engineers responsible for earthing and bonding across process units, buildings and outdoor structures
- Utility substation engineers who design, extend or verify earth grids and neutral earthing equipment
- Electrical maintenance technicians who test earth electrodes, bonds and lightning protection components
- Instrument and control technicians who install surge protection and signal earthing for field and control room equipment
- Electrical inspection staff who survey earthing and static bonding in hazardous areas and loading facilities

Course Outline:

Day 1: Earthing Purposes, System Arrangements and Neutral Earthing

- Functional, Protective and Lightning Earthing: Purposes and Interfaces
- IEC 60364 Letter Codes and TN-S, TN-C, TN-C-S, TT and IT Arrangement Comparison
- Generator and Transformer Neutral Earthing: Solid, Low Resistance and High Resistance
- Reactance Earthing and Zigzag Earthing Transformer Application for Unearthed Windings
- Existing Site Earthing Records and Drawing Gap Survey Checklist

Day 2: Protective Earthing, Equipotential Bonding and Earth Electrode Design

- IEC 61140 Protection Against Electric Shock and Exposed-Conductive-Part Earthing
- Main and Supplementary Equipotential Bonding Conductor Sizing and Routing
- Soil Resistivity Measurement with Wenner and Schlumberger Arrays and Layered Soil Interpretation
- Rod, Strip, Plate and Ring Electrode Selection and Resistance Estimation Formulae
- Electrode Material, Joint Method and Corrosion Allowance Selection Sheet

Day 3: Earth Resistance Testing and Substation Earth Grid Assessment

- Fall-of-Potential Test Set-Up, Probe Spacing and Resistance Curve Reading
- Clamp-On, Selective and Continuity Test Methods for Bonds and Interconnected Electrodes
- Earth Potential Rise and Fault Current Split Between Grid, Cable Sheaths and Overhead Earth Wires
- IEEE 80 Step, Touch and Mesh Voltage Concepts and Surface Layer Effect
- Earth Grid Layout Review: Mesh Spacing, Perimeter Conductors and Fence Earthing

Day 4: Lightning Protection, Surge Protective Devices and Static Electricity

- IEC 62305 Risk Assessment Outcome, Lightning Protection Levels and Lightning Protection Zones
- Air-Termination Placement with Rolling Sphere, Mesh and Protection Angle Methods
- Down Conductor, Separation Distance and Earth-Termination Arrangement Checks
- IEC 61643-11 Surge Protective Device Types, Voltage Protection Level and Coordination to IEC 61643-22
- Static Electricity Bonding for Tanks, Road Tanker Loading, Pipework Flanges and Personnel in Hazardous Areas

Day 5: Inspection Walkthrough and Site Assessment File Build

- Guided Walkthrough: Substation Earth Grid and Neutral Earthing Resistor Inspection
- Guided Walkthrough: Fuel Loading Bay Static Earthing and Bonding Verification
- Test Record Trending and Defect Ranking for Electrodes, Bonds and Down Conductors
- Periodic Inspection and Test Schedule for Earthing and Lightning Protection Assets
- Site Earthing and Lightning Protection Assessment File Presentation and Peer Challenge

Skills You Will Gain:

- Earthing Arrangement Selection
- Neutral Earthing Specification
- Soil Resistivity Interpretation
- Earth Resistance Measurement
- Step and Touch Voltage Assessment
- Lightning Protection Design Checking
- Surge Protection Coordination
- Static Hazard Bonding Verification

Why Attend This Course:

- Return with a Site Earthing and Lightning Protection Assessment File covering the earthing, bonding and lightning protection of an installation from your own site
- Read a fall-of-potential curve and soil resistivity data with confidence and tell a sound electrode from one that is drifting out of limits
- Find broken bonds, missing surge protection and static earthing gaps before a fault, strike or discharge exposes them
- Compare earthing practice with engineers and technicians from power utilities, oil and gas, petrochemicals, water and manufacturing

Conclusion:

Earthing, bonding and lightning protection work only when they are designed, tested and maintained as one system. The course moves from earthing arrangements and neutral earthing, through protective bonding, soil resistivity and electrode design, to fall-of-potential testing and substation step and touch potential, then lightning protection, surge protective devices and static bonding in hazardous areas. The final day applies these methods in guided inspection walkthroughs and produces a Site Earthing and Lightning Protection Assessment File ready for the next inspection round.