Content Community Connection

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Substation Grounding Training

View Course Details

COURSE DATES AND TIMES

December 10-11 , 2026

10:00 am - 4:30 pm ET

Why Substation Grounding Training Matters

Proper substation grounding is fundamental to electrical safety and power system reliability. Grounding systems protect personnel by controlling step and touch potentials, stabilizing voltage during faults, and ensuring fault currents dissipate safely into the earth. Substations rely on well-engineered grounding grids to prevent dangerous voltage gradients, minimize equipment damage, and maintain service continuity during abnormal conditions.

A grounding system can deteriorate through corrosion, soil changes, mechanical damage, or aging infrastructure. Without proper testing and evaluation, these weaknesses may go undetected until a fault occurs. This course equips participants to identify grounding risks early, implement effective grounding designs, and apply modern testing methods that validate system performance. The result is safer work environments, reduced downtime, and improved operational integrity across utility and industrial facilities.

Course Description

This course provides a comprehensive foundation in grounding system design and field application. Participants learn how to evaluate soil characteristics, perform soil resistivity measurements, select and size grounding conductors, and configure grounding grids that safely manage fault energy. The curriculum blends theory with practical field concepts, emphasizing how grounding behavior changes with soil composition, system configuration, and load conditions.

Advanced topics include multi-layer soil modeling, current distribution analysis, equipment bonding practices, and protective grounding for maintenance operations. Participants also

learn how grounding integrates with lightning protection systems, surge protection components, and overall substation protection coordination.

Benefits of Taking This Course

• Gain confidence in designing grounding systems that reduce electrical hazards and improve reliability.
• Learn how to evaluate soil conditions and apply resistivity test results to grounding design decisions.
• Strengthen your ability to detect deterioration, corrosion, or weak bonding points in existing grounding systems.
• Improve your understanding of fault current behavior and how grounding controls ground potential rise.
• Develop practical skills for installing temporary working grounds that protect field crews.
• Enhance compliance with industry standards and safety codes governing grounding in high-voltage systems.
• Increase your value to employers seeking personnel trained in grounding, bonding, and high-voltage safety.

Course Topics Include

• Principles of high-voltage grounding system design
• Soil resistivity testing and two-layer soil model analysis
• Grounding system testing, impedance, current distribution, and bonding integrity
• Inspection and maintenance techniques for substation grounding systems
• Safety standards for grounding of substation equipment
• Installation and testing of temporary protective grounds
• Surge and lightning protection grounding practices
• Grounding conductors, sizing, material selection, and corrosion considerations
• Grounding applications in utility transmission, distribution, and industrial substations
• Electrical bonding and equipotential safety practices

Learning Outcomes

After completing this course, participants will be able to:

• Understand the fundamentals of high-voltage grounding and why grounding is essential for safety and system stability.
• Apply correct bonding practices that improve equipotential safety and minimize hazardous voltage differences.
• Select and size grounding conductors based on system requirements, soil conditions, and safety standards.
• Perform and interpret soil resistivity tests to support effective grounding design strategies.
• Test and maintain grounding systems using proven diagnostic methods that identify weaknesses and ensure long-term performance.
• Integrate surge protection and lightning protection principles into grounding system

designs.
• Ensure compliance with grounding and safety regulations while reducing risk to personnel and equipment.

Related Training and Resources

To enhance your understanding of electrical infrastructure, see our related courses and guides:

- Substation Training
- Electrical Substation Design Training
- Substation Automation Training
- Substation Relay Protection Training
- Substation SCADA Monitoring Training
- Substation Maintenance Training

WHO SHOULD ATTEND

This course is designed for engineering project managers, engineers, and technicians from utilities who have built or are considering building or retrofitting substations or distribution systems with SCADA and substation integration and automation equipment.

- Utility and Industrial Electrical Engineers and Engineering Technicians
- Transmission planning engineers
- Distribution planning engineers
- Substation Design Engineers
- Consulting Electrical Engineers
- Substation network management engineers
- Substation maintenance and construction engineers & technologists

STUDENTS RECEIVE

- Substation Grounding Training Certificate of Course Completion
- 1.2 Continuing Education Unit (CEU) Credits (12 Professional Development Hours)
- $100 Coupon Toward Any Future Electricity Forum Event (Restrictions Apply)
- 100+Page Electrical Grounding Handbook

- FREE Electricity Today Magazine Subscription (Value $25.00)
- Course Presentation Materials In PDF Format

COURSE OUTLINE

Substation Grounding Training Course Outline

DAY ONE

SESSION 1: DEFINITIONS AND INTERPRETATIONS

- Determination of Need of Personal Protective Grounding
- Basic Criteria for Safe Grounding Practices
- Electric Shock Hazard
- Grounding Practices
- Basic Design Options
- Soil Resistivity
- Ground Fault Currents
- Fault clearing Time

SESSION 2: GROUNDING STANDARDS AND GUIDELINES

- IEEE 80, IEEE Guide for Safety in AC Substation Grounding
- ASTM F 855 Standard Specifications for Temporary Protective Grounds
- IEEE 1246, IEEE Guide for Temporary Protective Grounding Systems Used in Substations
- IEEE 1048, IEEE Guide for Protective Grounding of Power Lines
- FIST 5-1 Personal Protective Grounding for Electric Power Facilities (U.S.B.R.)

SESSION 3: GROUNDING OPTIONS

- Ground Cable Assemblies
- Grounding Cable Ampacities
- Grounding Cable Reactance
- Parallel Grounds
- Grounding Clamps
- Grounding Insulated Power Cable
- Ground Potential Rise (GPR) in Medium- and High-Voltage Systems

SESSION 4: SUBSTATION GROUNDING SYSTEMS

- Ground grid conductors
- Ground rods
- Soil and rock layers
- Connections to equipment and grounded tanks
- Connectors used for ground grid application (IEEE 837)
- Substation fence and gate grounding
- Ground grates and switch operating platforms
- Grounding transformer tanks and surge arresters
- Grounding wood and metal structures
- Use of line terminal grounding switches
- Lightning protection (shielding)

SESSION 5: SUBSTATION LOW-VOLTAGE GROUNDING CONSIDERATIONS

- Grounding for substation DC circuits and batteries
- Grounding auxiliary power circuits
- Current transformer (CT) and voltage transformer (VT) grounding
- Communication circuit grounding
- Equipment enclosure grounding

SESSION 6: GROUND GRID DESIGN FOR SUBSTATIONS

- Determining maximum fault current available
- Exposure Voltage Calculations for Switchyards
- Soil resistivity
- Measuring soil resistivity
- Selection of the Right Connector
- Horizontal Grid Design IEEE STD 80
- Introduction to 2-Layer Soil Model
- Vertical Rods Connected by a Grid
- Insulating rock layer
- Ground Potential Rise (GPR)
- Touch and Step Potential
- Transferred Potential
- Limiting step potentials
- Limiting touch potentials
- Temporary Grounding

DAY TWO

SESSION 7: SUBSTATION GROUND GRID TESTING

- Ground grid corrosion
- Measuring ground rod resistance
- Measuring substation grid resistance

- Equipment for ground grid verification
- Finding and repairing deteriorated ground connections

SESSION 8: SOFTWARE-AIDED DESIGN FOR SUBSTATION GROUND GRID SYSTEMS

- IEEE 80 calculations
- Input parameters needed
- Using software (WinIGS) for ground grid design
- Impacts of reducing or increasing grid dimensions
- Impacts of adding ground rods / ground wells
- Optimizing designs for safety and cost

SESSION 9: ELECTRICAL HAZARDS FOR SUBSTATION WORKERS

- Effect of current on a person from AC & DC Currents (IEEE 524a, IEEE 1048)
- Step and touch potentials
- Electric fields (capacitive coupling)
- Magnetic fields (inductive coupling)
- Preventing shock through isolation, insulation, equipment bonding
- Protection against inadvertent energization through Personal Protective Grounds (PPG)
- Arc flash hazards

SESSION 10: PERSONAL PROTECTIVE GROUNDS (PPG)

- Use of PPG and procedures
- Single-point grounding compared to bracket grounding
- Sizing for PPG cables and PPG cable types
- PPG clamps – type, class, and grade (ASTM 855)
- PPG for various applications (busbar, wires, underground cables, switches, etc)
- Paralleling PPG
- Procedures for applying PPG
- Grounding capacitors and cables
- Grounding vehicles
- Testing PPG

SESSION 11: SWITCHYARD AND SUBSTATION PROTECTIVE GROUNDING

- General Considerations for Placement of Protective Grounds
- Power Circuit Breakers and Transformers
- Disconnect Switches and Bus
- Insulated High Voltage Cable
- Cable Terminations
- Midsections and Splices

- Grounding Transformers and Phase Reactors
- Capacitor Banks

SESSION 12: TECHNICAL CONSIDERATIONS IN PROTECTIVE GROUNDING IN SUBSTATIONS AND SWITCHYARDS

- Substation Grounding System
- Typical Shock Situations - Conditions of Danger
- Structure Touch
- Electric Circuit for Switch Operator Sources of Hazardous Current on De-energized Equipment
- Grounding and Jumpering Requirements
- IEE Std 80

Review of expectations
Questions and Answers

COURSE TIMETABLE

Both days:
Start: 10:00 a.m. Eastern Time
Finish: 4:30 p.m.