
Arabian Institute For Training

Grounding Systems Design & Application

INTRODUCTION

- Effective implementation of ground connections in large power systems and distribution and load centres plays an important role in maintaining power system safety and reliability. In fact, grounding systems provide a common point of reference to the live electrical conductors of a power supply network, and provide a path for surge currents to flow to the soil mass. This ensures the safety of the personnel and the public by clamping the exposed conducting enclosure of electrical equipment at ground potential. Correct grounding techniques have a decisive role in controlling and mitigating electrical noise, while improper grounding can result in many problems in the power system and associated control and communication systems.
- Therefore, professional engineers and technicians dealing with power supply equipment and networks need to master the principles of grounding system design and its role in the safety of equipment and personnel that can help avoid mistakes in grounding system design criteria and assumptions. In fact, such mistakes can inflict massive financial losses to the system due to failures and long downtime.
- This Electrical Engineering training course on Grounding Systems Design & Application focuses on the concepts of grounding as applies to utility networks, industrial plant distribution systems and their associated control equipment. This training covers different grounding methods and their applications. This training seminar discusses the pros and cons of each grounding method as recommended by most acceptable global standards.
- This Electrical Engineering training course on Grounding Systems Design & Application is enriched in many related grounding concepts and also common power system failures and damages that are related to either inefficiency of the grounding system and its configuration, or to the wrong selection of protection devices in specific areas. This training seminar involves a wealth of worked examples and case studies for better understanding and practice of the participants.
- This Electrical Engineering training seminar, in fact provides a quick review on the principles of electrical grounding practices and it concentrates on the technical specifications of earthing grids as well as the operation and response of power system protection devices and controllers.

This training seminar will highlight:

- Ground connections and bonding
- Different grounding practices and their features
- Power system disturbances and mitigation techniques using grounding systems
- Surge and lightning protection
- Substation grounding system design and calculations
- Selection of suitable grounding protection devices

OBJECTIVES

At the end of this training seminar, you will learn:

- Main concepts of grounding system design and associated calculations
- Risk assessment and mitigation techniques as related to power system disturbances
- How to analyze and calculate appropriate grounding systems for substations
- Soil layers specifications, testing, and selection of earthing rods
- Principles of lightning and surge protection

TRAINING METHODOLOGY

- This Electrical Engineering training course on Grounding Systems Design & Application will be presented by means of power point slides through which all the required theory and equations will be provided. This training seminar also includes case studies where the participants are required to take part in class activities including system analysis, calculations, relay settings, etc. The instructor will also use training videos for better understanding of the participants. The participants will be progressively assessed during the course via quizzes, questions, assignments, and worked examples.

ORGANISATIONAL IMPACT

On successful completion, the organizational impact would be:

- Learn about the need for effective grounding systems plus technical considerations
- Identify power system hazards and learn about safety measures
- Get a good understanding of different grounding methods and equipotential bonding
- Develop a structured approach to establish efficient substation earthing grid and its components
- Learn about harmonics, power swing and oscillations, switching impulse, and electrical noise
- Become familiar with soil resistivity testing and selection of grounding electrodes

PERSONAL IMPACT

Participants from different sectors of engineering companies will enormously benefit from this training course because they will become quite familiar with:

- Grounding systems objectives and configurations
- Hazards due to improper grounding system including touch and step potentials
- Step-by-step procedure for the establishment of grounding system in substations
- Power quality issues and the associated mitigation techniques

WHO SHOULD ATTEND?

- We encourage the staff involved in the operation, planning, design, and maintenance of power systems to attend this course. This Electrical Engineering training course is suitable to a wide range of professionals but will greatly benefit:
- Project Engineers / Managers
- Electrical Engineers / Technicians
- System Operators
- Design Engineers
- Asset Engineers / Managers
- Planning Engineers / Managers
- Protection, Instrumentation, and Commissioning Engineers / Technicians

Course Outline

Need for Grounding Systems

- Electric Fault
- Consequences of Fault
- Arc Flash Boundary
- Types of Fault
- Protective Personal Equipment (PPE)
- Grounding Fundamentals
- Bonding
- Ground Electrodes
- Grounding of Electrical Substations
- Elimination of Static Charges by appropriate Grounding
- Impact of Lightning on Power Systems
- Surge Protection
- Noise Mitigation
- Lightning Strike
- Effect of Lightning on Power Lines
- Lightning Protection Methods
- Formation of Static Charges
- Hazards associated with Static Charge Build-up
- Spark Energy and Ignition Capability
- Assessment & Control of Static Charge

Types of Grounding Systems

- Ungrounded Systems
- Solidly Grounded Systems
- Resistance Grounding using NER
- Impedance Grounding using Neutral Reactor
- Shock Hazard
- Grounding of Equipment
- Protective Devices
- Thermal Capability
- Touch Potential
- Step Potential
- Induced Voltage Mitigation
- EMI Suppression
- Metal Enclosure for Grounding Conductors
- Surge Protection via Grounding Connections
- Earth Fault Protection Sensitivity
- TN Systems
- TN-C System
- TN-S System
- TN-C-S System
- TT System

Ground Faults and Related Protection Techniques

- Circuit Breaker Protection
- Fuse Protection
- Relay Protection
- Protection Criteria
- Sequence Networks
- Per Unit System
- Measuring Transformers (CT and VT)
- Overcurrent Protection
- Earth Fault Protection
- IDMT O/C & E/F Protection
- Transformer O/C and E/F Protection

Grounding Systems Studies

- Soil Resistance
- Soil Resistivity Measurement Techniques & Interpretations
- Resistance of Dingle Rod Electrode
- Use of Multiple Ground Electrodes (earthing rods) in Parallel
- Current carrying capacity of Ground Electrodes
- Measurement of Ground Electrode Resistance
- Chemical Electrodes and Corrosion Problems
- Approach to Grounding System Design
- Ground Fault Current
- Grounding of HV Substations
- Grounding of MV & LV Installations
- Grounding Grid for HV Outdoor Substation
- Soil Resistivity Calculations using Multi-layer Models
- Transferred Voltage
- Design considerations for Effective Substation Grounding
- Lightning Strike Probability & Incidence
- Lightning Risk Assessment

Lightning Protection & Noise Mitigation

- Impacts of Lightning impacts on Power Lines
- Principles of Lightning Protection
- Power Systems Surges and their Impacts
- Equipotential Bonding
- Principles of Surge Protection
- Selection of Lightning / Surge Arrestor
- Electrical Noise and its Impacts
- Noise Categories
- Noise Disturbance on Distribution Systems and Data Cables
- Ground Loop as a Source of Noise
- Electrostatic / Capacitive Coupling
- Shielded Isolation Transformer
- Ground Loop Mitigation
- Power System Harmonics and their Impacts
- UPS Configurations


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