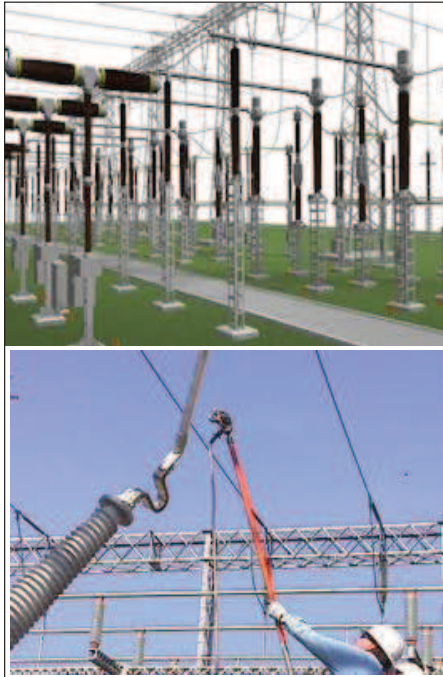


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# EARTHING, SHIELDING AND SURGE PROTECTION OF ELECTRICAL EQUIPMENT FOR INSTRUMENTATION AND CONTROL



## WHAT YOU WILL LEARN:

- Basic principles of earthing of electrical systems
- Function of power system earthing and the various options available
- Role of protective earthing in ensuring safety; sizing of earthing conductors
- Importance of equipotential bonding in ensuring safety
- Role of earthing in protecting structures from lightning hazard
- Control of static electricity-related hazards by earthing and bonding
- Design of ground electrodes and measurement of soil resistivity and ground electrode resistance
- Role of earthing in surge protection of power distribution equipment and sensitive systems
- Noise in electrical systems and the role of earthing in noise mitigation
- Power quality, UPS systems and earthing of separately derived UPS output supply

## WHO SHOULD ATTEND:

- Instrumentation and Control Engineers
- Consulting Engineers
- Electrical Engineers
- Project Engineers
- Maintenance Engineers
- Power System Protection and Control Engineers
- Building Service Designers
- Data Systems Planners and Managers
- Electrical and Instrumentation Technicians

## The Workshop

Few topics generate as much controversy and argument as that of earthing and the associated topics of lightning and surge protection of electrical and electronic systems, shielding and bonding. Poor earthing practice can be the cause of continual and difficult-to-diagnose problems in a facility.

This workshop looks at these issues from a fresh yet practical perspective and enables you to reduce expensive down time on your plant and equipment to a minimum by correct application of these principles. This workshop is designed to demystify the subject of earthing and presents the subject in a clear, straightforward manner and presents a number of case studies illustrating the importance of correct earthing practices.

Essentially this course is broken down into earthing, shielding and surge protection for both power and electronics systems. Earthing and surge protection for telecommunications and IT systems are examined in detail. Finally, the impact of lightning is examined and simple techniques for minimising its impact described.

### Pre-requisites

Some working knowledge of basic electrical equipment is required, although this will be covered at the beginning of the course. Real-life experience with such equipment and hands-on testing will enable the workshop to be placed in context.

## The Program

### INTRODUCTION AND EARTHING BASICS

- Basics of earthing and bonding
- Lightning and its effect on electrical systems
- Static charges and need for bonding
- Ground electrodes and factors affecting their efficacy
- Noise in signaling circuits and protective measures such as shielding
- Surge protection of electronic equipment
- UPS systems and their role in power quality improvement
- Importance of local codes

### EARTHING OF POWER SUPPLY SYSTEMS

- Types of system earthing and comparison
  - Ungrounded systems
  - Solidly grounded systems
  - Impedance and resonant earthing using neutral reactor
  - Impedance earthing through neutral resistance
- Point of earthing in power supply systems without a neutral point

### EQUIPMENT (PROTECTIVE) EARTHING

- Shock hazard
- Earthing of equipment
- Operation of protective devices
- Thermal capability
- Touch potential during ground faults
- Induced voltage problem
- Mitigation by multiple ground connection
- Mitigation by reduction of conductor spacing
- EMI suppression
- Metal enclosures for earthing conductors
- Earthing connections for surge protection equipment
- Sensing of ground faults
- Equipotential bonding

### EFFECT OF LIGHTNING ON BUILDINGS AND ELECTRICAL SYSTEMS

- Physics of lightning
- Probability of lightning stroke
- Method of lightning protection
- Planning for lightning protection
- Improvements to lightning protection
- Factors governing decision whether or not to protect
- Effect of lightning strike on electrical lines

### STATIC ELECTRICITY AND PROTECTION

- What is static electricity?
- Generation of charge
- Some common examples of static build up
- Energy of spark and its ignition capability
- Dangers of static electricity buildup
- Control of static electricity
- Assessment of static risks and planning prevention

### GROUND ELECTRODE SYSTEMS

- Earthing electrodes
- Soil resistance
- Measurement of soil resistivity
- Resistance of a single rod electrode
- Current carrying capacity of an electrode
- Use of multiple ground rods in parallel
- Measurement of ground resistance of an electrode
- Concrete encased electrodes
- Corrosion problems in electrical earthing systems
- Maintenance of earthing system
- Chemical electrodes

### SURGE PROTECTION OF ELECTRONIC EQUIPMENT

- What is a surge?
- Bonding of different ground systems as a means of surge proofing
- Surges and surge protection
- Principle of surge protection
- Surge protection of electronic equipment
- Achieving graded surge protection
- Positioning and selection of lightning/surge arrester
- A practical view of surge protection for sensitive equipment

### ELECTRICAL NOISE AND MITIGATION

- Definition of electrical noise and measures for noise reduction
- How are sensitive circuits affected by noise?
- Frequency analysis of noise
- Categories of noise
- Disturbances from other equipment in the same distribution system
- Earth loop as a cause of noise
- The ways in which noise can enter a signal cable and its control
- Electrostatic or capacitive coupling
- Shielded isolation transformer
- Avoidance of earth loop
- Use of Insulated Ground (IG) receptacle
- Zero signal reference grid and signal transport ground plane
- Harmonics in electrical systems

### UPS SYSTEMS AND THEIR EARTHING PRACTICES

- Power quality issues
- Definitions of abnormal voltage conditions
- Susceptibility and measures to handle voltage abnormalities
- Regulating transformer
- Standby sources
- Electro-mechanical UPS systems
- Solid state UPS systems
- Multiple units for redundancy
- Considerations in selection of UPS systems for ADP facilities
- Earthing issues in static UPS configurations
- UPS configurations and recommended earthing practices