Grounding and Bonding for Industrial, Commercial and Institutional Power Systems

LEARNING OUTCOMES

Proper and adequate grounding and bonding is extremely important for personnel and equipment safety, operation of the electrical and controls systems, and operating cost reductions. Over 80% of electrical faults/problems and hazards are related to improper grounding and bonding. Clear understanding of the grounding/bonding fundamentals, best practices, applicable standards and codes, and most common problems is essential for the design, implementation, and maintenance of effective grounding systems. This course will provide participants with the following knowledge and skills:

- Understanding fundamentals and basic concepts of grounding and bonding per IEEE and CEC
- Help you understand why things are done in a particular way.
- Illustrating a number of common grounding and bonding problems in industrial and commercial facilities.
- Provide practical and proven solutions for the common problems rising from improper grounding and bonding.
- Help you establish good engineering practices for design, implementation & maintenance of grounding systems
- Provides a list of applicable codes, standards, and design methodologies.
- Help you understand the extent of the electrical hazards in your facility.
- Provides recommendations on general requirements for upgrading your facility electrical systems.
- Familiarize you with the latest standards and good practices for the installation of grounding systems.
- Help you upgrade your maintenance procedures and processes to comply with current standards and codes.
- Help you understand why and how to measure/test grounding system parameters.

COURSE OUTLINE - 2 DAYS

Day 1

Grounding Fundamentals

- Overview
- Why Grounding
- Objectives of Proper Grounding & Bonding
- Grounding Major Systems / Subsystems
- Grounding and Bonding Symbols
- Fundamentals of an Electric Circuit
- Grounding & Bonding Definitions
- Grounding & Bonding per CEC

- Equipment Bonding versus System Grounding
- Different Types of Systems Grounding for Industrial Applications

1. Ungrounded
2. Solid Grounding
3. Low-Resistance Grounding
4. High-Resistance Grounding
5. Other Types of System Grounding (Impedance, Reactance, Hybrid)
6. Comparison Table of various System Grounding
7. Factors Influencing the Selection of the Proper System Grounding

- Examples of Systems Grounding Types per CEC
- Different Circuit Operation
- Fault Types
- Various Faults in Power Systems
- Ground Faults (origin and Characteristics)
- Ground Fault Detection & Sensing
- Definition of Positive / Negative / Zero Sequences
- Personal Safety and Electric Shock Hazards
- Human Body Tolerances
- Grounding Minor Systems / Subsystems
- Different Types of Grounding Electrodes
- Different Types of Grounding Connections
- Case Study
- Grounding Standards and Codes
- Electrical Equipment Testing and Maintenance Sources

Substation Grounding (IEEE 80)

- Objectives of Grounding System Design per IEEE 80
- Substation Grounding Definitions

1. Touch Voltage
2. Step Voltage
3. Mesh Voltage
4. Transferred Voltage
5. Ground Potential Rise
6. Grounding Grid
7. Ground Resistance

- Maximum Available Fault Current
- Basic Shock Situations per IEEE 80
- Important Design Considerations / Electrical Safety Criteria
- Main Design Parameters
- Fault Current Distribution
- Typical Grounding Design Using IEEE 80
- Typical Grounding Layout (buried conductors, auxiliary and supplementary electrodes)
- IEEE80 Design Procedure Block Diagram

- Soil Resistivity and Soil Models
- Grounding Electrode
- Simple Ground Electrode (Fundamentals & Ground Resistance)
- Factors Affecting Grounding Resistance (Fluke)
- Fluke Recommendations
- Grounding System Measurements

1. Soil Resistivity Measurement
2. Ground Resistance Test Methods
3. Determination of Step Voltage
4. Determination of Touch Voltage
5. Ground Impedance Measurement (Integrity Test)
6. Selective Measurement
7. Stakeless Measurement

- Available Software for Grounding Design/Study
- Grounding for GIS Substations
- Outdated Grounding Systems
- Maintenance Recommendations / Grounding Integrity Measurements
- Case Study

Day 2:

Instrumentation and Control Systems Grounding (Sensitive Electronic Equipment)

- Sensitive Electronic Equipment
- Objectives of Grounding Design
- Grounding Types for Sensitive Electronic Equipment
- Neutral Point
- Noise Definition
- Clean Ground Versus Dirty Ground
- Zero Reference
- Minimizing Noise Impacts
- Signal Reference Ground
- Grounding Methods

1. Isolated Ground
2. Isolated Signal Reference Ground / Electrodes
3. Single-Point Grounding System
4. Multi-Point Grounding System

- Isolation Transformers
- Ground Loop
- Main and Remote Subsystems
- Optical Coupling
- Normal Mode Noise Versus Common Mode Noise
- EMI and RFI
- Stray / Induced Currents
- Transient Voltages

- Power Quality
- Skin Effect
- Electrostatic Sources, Protection Facts and Grounding
- Grounding Mat
- Temperature, Corrosion, and Moisture Impacts
- Inductive and Capacitive Couplings (Shielding Solutions)
- Shielding concept
- EMI shielding
- Electrostatic shielding
- Coaxial Cables
- Shielding Techniques for Low Frequency Circuits Versus High Frequency Circuits
- Master Ground Bar
- Common Design / Construction Problems
- Other Symptoms of Common Design/Construction Problems
- Case Studies and Sample Design

Grounding Good Practices

- Bad Practices (Grounding Problems)

1. Apply Safe Work Practices
2. Neutral Conductors Grounding (Safety)
3. Wiring Errors in Isolated Ground Systems

- Power Distribution System Grounding
- Calculation of Neutral Grounding Resistors
- Bonding Methods for Equipment, Structures, Cable Trays, etc.

INSTRUCTOR

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Mark Moosaei graduated with B.A.Sc. in electrical engineering from the Isfahan University of Technology in 1993, and obtained M.A.Sc. Degree from the Concordia University, Montreal, in 2003. Mark is a principal engineer with Rastin Engineers, and has over 25 years of experience working for major EPCM consulting engineering firms in Canada and Internationally.

Mark's areas of expertise includes designing, commissioning, and managing electrical, instrumentation, and control systems for Port and Terminal, Mining, Water and Wastewater, Oil and Gas, Utility, Pulp and Paper, and Metal Refining. His expertise also includes practical experience with industrial power distribution systems, emergency systems, analysis software, motor controls, VFDs, PLCs, and HMIs. Mark has a thorough knowledge of the Canadian Electrical Code, industry standards and safety codes.

Mark is a Project Management Professional (PMP) and registered electrical engineer (P.Eng.) in British Columbia and Alberta. He has published academic papers on the topic of control systems with the Institute of Electrical and Electronics Engineers (IEEE).

WHO SHOULD ATTEND

The course is intended for professional engineers, engineers-in-training, electrical managers, project managers, designers, electricians, construction contractors, maintenance supervisors and any other personnel who have basic knowledge and understanding of power distributions for electrical, instrumentation, controls, and communication systems.

WHEN & WHERE

T.B.D.

REGISTRATION FEES

CAD $775 + GST includes hardcopies of the 2-day course presentation materials, and refreshments and lunch for both days.

Get $50 off the price for new university/college graduates and students. The $50 amount will be refunded after the successful completion of the course.

For companies, register 3 persons and get the 4th person registration free of cost.