

Electrical Hazards & Safety Management Course

Course Code: TR-A-3, Duration: 2 days

Day 1-1 Overview of Electrical Hazards & Safety

- Key Elements of an Effective Electrical Safety Program
- Electrical Hazards: Understanding the Danger
- Electrical Incident Causes
 - Unsafe Switching Acts
 - Not following Operating Procedure
 - Unsafe Working Conditions
 - Not following Maintenance procedures
- Arc Flash Danger Statistics
- Electrical safety equipment for safe isolation purposes
- Effect of Electric Shock
- Electrical Hazard Protections

Day 1-2 Arc Flash Hazard analysis

- Electrical Hazards Analysis
- Determination of Arcing Fault Clearing Time
- Determining Arc Flash Hazard Risk Category
- Incident Energy Exposure Calculations
- Understanding and Applying NFPA 70E Tables
- Shock Protection Boundaries
- Limits of Approach
- Energized Work Permit
- Limited Approach Boundary
- Restricted Approach Boundary
- Prohibited Approach Boundary
- Determining Arc Flash Hazard Risk Category
- Evolution of Arc-Resistant Standards

- OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S
- NFPA 70E-2004, "Standard for Electrical Safety in the Workplace"
- IEEE 1584-2002, "Guide for Arc Flash Hazard Analysis"
- IEEE C37.20.7-2007, IEEE Guide for Testing MV Metal-Enclosed Switchgear for Internal Arcing Faults

- Arc Hazard – pressure, thermal radiation, sound levels and arc blast
- Personal Protective Equipment (PPE) – Types, Tests & Categories
 - NFPA Categories 0 to 4

Day 1-3 Minimizing Arc-Flash and Other Electrical Hazards

- Design a Safer System
- Use and Upgrade to Current-limiting
- Proper Selection of Overcurrent Protective Devices
- Implement an Electrical Safety Program
- Use of Personal Protective Equipment (PPE)
- Use Warning Labels
- Use an Energized Electrical Work Permit
- Establish a Safe Work Practices
- Requirements for Resetting Circuit Breakers
- Arc Flash - Mitigation Techniques
 - Redirecting energy away from workers
 - Reducing the arcing current
 - Increasing the working distance
 - Using remote racking device, remote operating devices incident energy might be reduced
 - Reducing the clearing time
 - Zone selective interlocking
 - Bus bar protection
- Precautions against equipment malfunction such as inadvertent trips

Day 2-1 Electrical isolation and Safety procedures

- Isolation and Switching in LV supply system
- Need of Secondary Isolation & Identifying location of Secondary Isolation
- Secondary Isolation Tagout/Lockout procedure
- Hazards of Improper secondary Isolation
- Regulations relating to secondary isolations
- Various situations requiring secondary isolation with example showing secondary isolation points
 - Inspection, testing & Maintenance of Metering & Protection Circuit
 - Checking the correctness of Bus Wiring

- IR Tests on Control wiring
 - Functional Checks on Alarm/ Annunciation Scheme
 - Functional and Interlock Checks on Breaker
 - Interlock Check between Feeders
 - Maintenance and Testing of DC Battery system
 - Maintenance Work on the Pilot cable route.& Pilot termination
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- Safety procedures required for avoiding fire hazards during Battery charging
 - Safety procedures required for preventing fire in LV PVC Cable
 - Permit procedures applicable for secondary isolation (entire flow to be discussed)
 - Restoration after completion of work and return of permit
 - Equipment used in achieving secondary isolation
 - Precautions against inherent hazards
 - Planning for secondary isolation
 - Job risk analysis specific to secondary isolation
 - Schematics to be considered while planning
 - Importance of consulting the latest updated documentation
 - Filling in a typical secondary isolation schedule and its approval
 - Special precautions to be observed/importance of correct sequencing during isolation and restoration

Day 2-2 Safety Procedure & Isolation in HV System

- Isolation and Switching in HV supply system
- Secondary Isolation as a part of Maintenance work in HV systems
- High Voltage Access Permit Procedure
- Safety procedures required for work on or near live equipment
- Precautions against Equipment malfunctions in achieving Secondary Isolation
- Safety Features available in Modern Switchgear for Secondary Isolation
- Safe maintenance policies, including safe working practice in switch rooms, indoor and outdoor substations

- The main causes for safety & internal arc are:
 - Operational and maintenance faults
 - Atmospheric and switching over voltages
 - Dielectric faults of solid insulation materials (e.g. cable terminations, VT, CT)
 - Overstress of load break switches, circuit breakers , Isolator

Day 2-3 Proper Grounding/Equivalent Bonding practices

- Proper Grounding and Bonding for Safety
- Applicable Standards and Recommended Practices
- Main substation earthing and bonding
- Step and touch potentials – danger to personnel
- Routine testing and certification of substation earthing
- Safe working in a substation environment
- Typical Grounding/Bonding Errors, Problems & Resolutions
- Key Considerations for Performance Grounding
- Ground Loops – Causes & Corrections
- Single Point vs. Multi-Point Grounding
- Grounding and Bonding for Lightning Protection

Day 2-4 CONCLUSION

- Recommended Safety Measures, Live working & risk assessments
 - Job risk analysis specific to secondary isolation
 - Risk assessment and management
 - Developing a strategy for evaluating Arc Flash & Shock Hazards
- Live Case study on Electrical Safety related Hazards

CALL US ON +91-9374076950

EMAIL: rayaradhana@yahoo.com

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VADODARA