



**Training Program:**

**Safe Isolation Of Building And Equipment**

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## Introduction:

Electrical safety plays an important role in electrical power systems in maintaining the safety to human being and equipment. Also it will maintain the continuity of power supply and power quality to the industrial and commercial consumers. A properly plan, design and operation of the electrical power system should ensure the safety and reliability of the system. Understanding the steps and procedures employed in a good electrical safety program requires an understanding of the nature of electrical hazards. Understanding the nature of the hazards is useless unless protective strategies are developed to protect the worker. This course includes a synopsis of the types of protective strategies that should be used to protect the worker. This course covers all aspects of safety issues of Electrical power system including regulatory and environmental requirements, general design considerations, application of switching and power equipment, and safe grounding design.

## Who Should Attend?

Electrical power generation systems and distribution engineers and technicians in utilities and industrial plants, managers of private electricity producers and large power consumers, substation engineers, consulting engineers, manufacturers of power equipment and technologists and other technical personnel involved in the design, operation and maintenance of high/medium/low voltage power systems.

## Methodology

This interactive Training will be highly interactive, with opportunities to advance your opinions and ideas and will include;

- Lectures

- Workshop & Work Presentation
- Case Studies and Practical Exercise
- Videos and General Discussions

## Accreditation:

**BTS** attendance certificate will be issued to all attendees completing a minimum of 80% of the total course duration.

## Course Objectives:

- To present the recommended practices, and guides, of which NFPA 70E contained, which are developed through a consensus standards development process approved by the American National Standards Institute.
- To provide The Safety Standards.
- To provide a practical understanding of electrical power system safety.
- To declare the regulatory and legal safety requirements.
- To demonstrate the earthing systems Safety and Risk Assessment.
- To explain the relation between maintenance activities for various equipment and safety.
- To select and maintain the electrical equipment in hazardous areas and its standard.
- To indicate arc flash hazard and mitigation.

- To introduce main recommendations for electrical safety.
- To review of general work and plant safety rules.

## Course Outline

### Hazards of Electricity

- Hazard Analysis
- Shock
- Arc definition, description and characteristics
- Arc Burns
- Blast
- Affected Body Parts (Skin, The Nervous System, Muscular System Heart , The Pulmonary System )
- Summary of Causes—Injury and Death
- Shock Effect
- Arc Flash Effect
- Causes of Injury
- Causes of Death
- Protective Strategies

## Earthing Systems Safety And Risk Assessment

1. Equipment Earthing
2. System Earthing
  - Unearthed systems
  - Solid earthing
  - Resistance earthing
  - Reactance earthing
3. Classification Of Supply / Installation System Earthing
4. Earthing Via Neutral Earthing Compensator
  - Distribution transformers
  - Zig Zag transformers
5. Comparison of Methods (Advantages/Disadvantages)
  - Evaluation of earthing methods
6. Touch And Step Voltage
7. Effect of electric shock on human beings
8. Electric shock and sensitive earth leakage protection
9. Sensitive earth leakage protection
10. Risk assessment principals
11. How to assess the risks in your workplace?
12. How to conduct risk assessment?
13. Risk assessment Job Briefing and Planning Checklist
14. Case Studies

## Arc Flash Hazard Analysis And Mitigation

- Short history of arc flash research
- NPFA-70E-2004 application

- Calculating the Required Level of Arc Protection (Flash Hazard Calculations)
- Arc flash hazard assessment
- Traditional methods for reducing arc flash
- New strategies for reducing arc flash hazards and suggestions for Limiting Arc-flash and Shock Hazards
- Standardizing Arc Flash Hazard Labels
- The Role of Over-current Protective

## **Electrical Safety Equipment**

- General Inspection and Testing Requirements for Electrical Safety Equipment
- Flash and Thermal Protection (Clothing and materials)
- Head, Eye, and Hand Protection
- Rubber-Insulating Equipment (Gloves, Mats, Covers,....)
- Hot Sticks (description, application , testing)
- Insulated Tools
- Barriers and Signs
- Safety Tags, Locks, and Locking Devices
- Voltage-Measuring Instruments
- Safety Grounding Equipment
- Ground Fault Circuit Interrupters
- Safety Electrical One-Line Diagram
- The Electrician's Safety Kit

## **Safety Procedures and Methods**

### **The Six-Step Safety Method**

### **Pre-Job Briefings**

## **Energized or De-Energized?**

### **Safe Switching of Power Systems**

- Remote Operation
- Operating Medium-Voltage Switchgear
- Operating Low-Voltage Switchgear
- Operating Molded-Case Breakers and Panel boards
- Operating Enclosed Switches and Disconnects
- Operating Open-Air Disconnects
- Operating Motor Starters

### **Energy Control Programs**

- General Energy Control Programs
- Specific Energy Control Programs
- Basic Energy Control Rules

### **Lockout-Tagout**

- Definition and Description
- When to Use Locks and Tags
- Locks without Tags or Tags without Locks
- Rules for Using Locks and Tags
- Responsibilities of Employees
- Sequence
- Lock and Tag Application

- Isolation Verification
- Removal of Locks and Tags
- Safety Ground Application
- Control Transfer
- Nonemployees and Contractors
- Lockout-Tagout Training
- Procedural Reviews

## **Voltage-Measurement Techniques**

### **Placement of Safety Grounds**

### **Flash Hazard Calculations and Approach Distances**

### **Barriers and Warning Signs**

### **Tools and Test Equipment**

### **Field Marking of Potential Hazards**

### **The One-Minute Safety Audit**

## **Safety-Related to Maintenance Requirements**

- General Maintenance Requirements
- The Safety-Related Case for Electrical Maintenance
- Relationship of Improperly Maintained Electrical Equipment to the Hazards of Electricity



- Hazards Associated with Electrical Maintenance
- The Economic Case for Electrical Maintenance
- Reliability Centered Maintenance (RCM)
- Impact of RCM on a Facilities Life Cycle
- The Eight Step Maintenance Program
- Frequency of Maintenance
- Substations, Switchgear Assemblies,
- Switchboards, Panel-boards, Motor Control
- Centers, and Disconnect Switches
- Premises Wiring
- Controller Equipment
- Fuses and Circuit Breakers
- Rotating Equipment
- Hazardous (Classified) Locations
- Batteries and Battery Rooms
- Portable Electric Tools and Equipment
- Personal Safety and Protective Equipment

## **Review of General Work and Plant Safety Rules**

### **Substations and Switchgear Rooms**

- The basic rules for substations and switchgear rooms
- Requirements for identification.

### **Access to High Voltage Enclosures and Equipment**

### **Responsibilities for Power Systems**

## **Responsibilities for Operations in Power Systems**

### **Electrical Safety Documents**

### **Switching of Power Systems under Normal Circumstances**

- Switching Under Emergency Conditions

### **Circumstances Requiring Isolation and/or Earthing**

#### **Isolation**

#### **Other Earthing Methods on High Voltage Electrical Equipment**

#### **Earthing of Low Voltage Electrical Equipment of an Earthed System**

#### **Recording of HV and LV Earth**

#### **Work on Electrical Equipment**

- Work on High Voltage Electrical Equipment
- Work on High Voltage Transformers.
- Work on High Voltage Switchgear
- Work on Low Voltage Electrical Equipment
- Work on Cables
- Work on Low Voltage Power Cables
- Work on High Voltage Power Cables
- Spiking of Cables for Identification
- Work on Pilot Cables Adjacent to Live Circuits

**Work on Overhead Lines**

**Work on Electrical Equipment Operated by or Containing Compressed Air**

**Work on Electrical Protection Relays**

**Work on Remotely or Automatically Controlled Electrical Equipment**

**Physical Danger**

**Precautions**

**Work on Enclosures Protected by Fixed Fire Fighting Equipment**

**Automatic Control**

**Ventilation after a Discharge**

**Testing**

**Use of Safety Locks, Key Safes and Other Safety**

**Switching, Working or Testing in Potentially Flammable Atmospheres Hazardous Areas**

- Additional Precautions

**Non Electrical Work in the Vicinity of Live Parts**

- Caution Notices
- The Use of Portable; (Hand-Held) Electrical Apparatus

## **Safety-Related Work Practices**

- Definitions
- General Requirements for Electrical
- Safety-Related Work Practices
- Establishing an Electrically Safe Work Condition
- Work Involving Electrical Hazards
- Selection and use of work practices
- Use of equipment
- Safeguards for personnel protection

## **Regulatory and Legal Safety Requirements and Standards**

- The Regulatory Bodies
- The American National Standards Institute (ANSI)
- The Institute of Electrical and Electronic Engineers (IEEE)
- National Fire Protection Association (NFPA)
- American Society for Testing and Materials (ASTM)
- American Society of Safety Engineers (ASSE)
- The Occupational Safety and Health Administration (OSHA)
- Other Electrical Safety Organizations
- The National Electrical Safety Code (NESC)—ANSI C-2
- The National Electrical Code (NEC)—ANSI/NFPA 70
- Electrical Equipment Maintenance—ANSI/NFPA 70B
- Standard for Electrical Safety in the Workplace—ANSI/NFPA 70E
- The American Society for Testing and Materials (ASTM) Standards
- Occupational Safety and Health Administration (OSHA) Standards

## **Safety Requirements for Special Equipment**

- Safety-Related Work Practices for :
- Safety-Related Work Requirements: Research and Development Laboratories
- Limits of Approach
- Incident Energy and Flash Protection Boundary Calculation Methods
- Electrical Safety Program
- Hazard/Risk Evaluation Procedure
- Sample Lockout/Tag-out Procedure
- Simplified, Two-Category, Flame-Resistant (FR) Clothing System
- Job Briefing and Planning Checklist
- Energized Electrical Work Permit
- General Categories of Electrical Hazards
- Typical Application of Safeguards in the Cell Line Working Zone
- Layering of Protective Clothing and Total System Arc Rating
- Example Industrial Procedures and Policies for Working Near Overhead
- Electrical Lines and Equipment
- Safety-Related Design Requirements

### **Electrical Equipment In Hazardous Areas**

#### **Properties of hazardous / Flammable Materials.**

- Fire Triangle , Source of ignition, Static Electricity, Static protection, Flash point, Ignition temperature, Explosive limits, Gas / apparatus grouping, Area classification.

**Methods of Making Electrical Equipment Safe for use in Hazardous Environments (EX p, EX m, EX o, EX d, EX e, EX i , EX n, EX q).**

- Exclusion of hazardous gas
- Exclusion of heat.
- Exclusion of air.
- **Selection of electrical apparatus according to zone of risk**

### **Installation, Inspection & Maintenance.**

### **International Standards Related To Hazardous Area**

### **New classification of group/categories (Directive ATEX 94/9/EC)**

### **Recommendations For Electrical Safety**

- Essential Requirements For Electrical Safety
- Responsibilities For Electrical Power Systems
- Authorization of personnel
- Switching, isolating and earthing procedures
- Electrical safety documents
- Precautions before working on or testing high voltage electrical Equipment
- Precautions before working on low voltage electrical equipment
- Additional precautions to be taken on specific types of electrical Equipment
- Electrical work at construction sites
- The use of portable/transportable electrical equipment

### **Electrical Incident and Hazard Prevention**

- Electrically safe work condition

- Shock hazard and flash hazard analysis
- Approach boundaries for shock protection
- Flash hazard analysis
- Method 1: NFPA 70E tables
- Method 2 NFPA 70E formulae
- Method 3 IEEE 1584
- Arcing fault currents in the long time characteristic of over-current protective devices
- Other considerations
- Personal protective equipment (PPE)
- Lockout/Tagout
- Stored energy systems
- IP2X (finger-safe) ratings
- Grounding

### **Electrical Safety Program**