

Hands-On

# Electrical Testing and Maintenance



## Course Description

This Hands-On course will teach you how to prioritize your electrical maintenance strategy, stretch your electrical maintenance budget and at the same time maximize the life and condition of your equipment.

Cost-effective electrical preventive maintenance is the best way to reducing accidents, saving lives, and avoiding costly breakdowns and work stoppages. Our Electrical Testing and Maintenance course is an in-depth examination of electrical testing and predictive maintenance methods and teaches how to maximize the effectiveness of your electrical maintenance investment. Our course introduces students to NETA (North American Electrical Testing Association) "Standard for Maintenance Testing Specifications" and NFPA 70b, "Recommended Practices For Electrical Equipment Maintenance".

These standards apply to preventive maintenance for electrical, electronic, and communication systems and equipment installed in industrial, commercial and institutional power systems.

This course will alert electrical maintenance personnel in utility, industrial, commercial and institutional facilities to the latest North American Electrical Maintenance and Testing Standards and Specifications that cover the suggested field tests and inspections that are available to assess the suitability for continued service and reliability of electrical power distribution equipment and systems. The purpose of NETA and NFPA 70b testing and maintenance specifications is to assure that tested electrical equipment and systems are operational and within applicable standards and manufacturer's tolerances and that the equipment and systems are suitable for continued service.

This course will also deal with the important subject of troubleshooting electrical systems and choosing the proper preventive maintenance testing equipment and procedures.

## Students Will Learn

- **Learn How to design and implement a cost-effective "Recession-Friendly" electrical maintenance program.**
- **Learn the essential procedures for the safe operation, repair, testing, and maintenance of major power equipment.**
- **Learn how to establish what electrical maintenance work can be done in-house and what must be contracted out.**
- **And more...**

## Target Audience

This comprehensive two-day course is designed to benefit those working in maintenance that desire to increase their practical knowledge of electrical maintenance standards and practices. The course is open to industrial, commercial and

institutional electrical engineering and maintenance professionals, plant electricians, electrical maintenance supervisors, field and plant personnel.

## Prerequisites

A basic understanding of Electricity.

## Course Outline

### Module I. What is an EPM and what are its benefits?

- Planning an EPM Program
- Personnel Safety
- Equipment Loss
- Production Economics
- Main Parts of an EPM Program
- Programmed Inspections
- Recordkeeping
- Training for Safety and Technical Skills

### Module II. Planning and developing a program

- Survey of Electrical Installations
- Data Collection
- Single Line Diagrams and Data
- Electrical Equipment Installation Change
- Lighting System Diagrams
- Ventilation
- HVAC
- Control and Monitoring
- Emergency Procedures
- Test and Maintenance Equipment
- Identification of Critical Equipment
- Establishment of a Systematic Program
- Inspection Frequency
- Forms, Planning, Records

### Module III. Electrical Testing and Maintenance Standards

- Review of NETA's Latest Electrical Maintenance Testing Specifications
- NETA's ANSI Standards for Transformer maintenance
- NETA Critical Switchgear maintenance
- Review of NFPA 70b Electrical Maintenance Standard

#### **Module IV. Test Equipment Overview**

- Insulation Resistance Test Sets (Hipot, Meggar, VLF)
- Contact resistance Testing (Ducter)
- Power Factor Sets (Cap Bridge, Doble)
- Transformer Sets (Winding Resistance, TTR)
- Relay Test sets and AC Current Sources

#### **Module V. Personal Safety**

- Qualification, Tools, Equipment, Training, Arc Flash, NFPA 70e, PPE

#### **Module VI. Fundamentals of Electrical Equipment Maintenance**

- Scheduling, cleaning, environmental concerns, equipment additions and retrofits

#### **Module VII. Substations and Switchgear Assemblies**

- Insulators
- Conductors
- Air-Disconnecting Switches
- Grounding Equipment
- Enclosures
- Switchgear Assemblies
- Air Circuit Breakers
- Arc Interrupters
- Oil Circuit Breakers
- Interrupter Switches
- Gas-Insulated Substations and Gas-Insulated Equipment
- Maintenance and Repair of the GIS and GIE
- Surge Arresters
- Instrument Transformers and Auxiliary Transformers
- Protective Relays, Meters, and Instruments
- Ground-Fault Indicators
- Network Protectors

#### **Module VIII. Power and Distribution Transformers**

- Liquid-Filled Transformers
- Regular Inspections
- Current and Voltage Readings
- Temperature Readings
- Liquid-Level Indicator and Pressure/Vacuum Gauges
- Special Inspections and Repairs
- Liquid Maintenance and Analysis
- Fault-Gas Analysis
- Dissolved-Gas-in-Oil Analysis
- Dry-Type Transformers
- Regular Inspections
- Current and Voltage Readings
- Temperature Readings

#### **Module IX. Power Cables**

- Visual Inspection
- Aerial Installations
- Raceway Installations
- Cable Testing

#### **Module X. Motor Control Equipment**

- Motor Control Preventive Maintenance Guide
- Components and Maintenance of Motor Controls
- Enclosures
- Bus Bar, Wiring, and Terminal Connections
- Disconnects
- Molded Case Breakers
- Fuses
- Contactors
- Motor Overload Relays Thermal Types
- Pilot and Miscellaneous Control
- Devices
- Mechanical Interlocks

#### **Module XI. Molded-case Circuit Breakers**

- Types of Molded-Case Circuit Breakers
- Phase-Fault Current Conditions
- Ground-Fault Tripping
- Special-Purpose Breakers
- Inspection and Cleaning
- Loose Connections
- Mechanical Mechanism Exercise

#### **Module XII. Ground Fault Protection**

Personal and Equipment Protection

#### **Module XIII. Fuses**

- Fuses Rated 1000 Volts or Less
- Fuses Rated over 1000 Volts
- Installing and Removing Fuses
- Inspection, Cleaning and Servicing
- Replacement

#### **Module XIV. Rotating Equipment**

- Maintenance, cleaning, Testing
- Stator and Rotor Windings
- Brushes, Collector Rings, and Commutators
- Bearings and Lubrication

## **Module XV. Testing and Test Methods**

- Acceptance Tests and Maintenance Tests
- Frequency of Tests
- Special Precautions and Safety
- Qualifications of Test Operators
- Insulation Testing
- Dielectric Absorption
- Protective Device Testing
- Circuit Breaker Tests
- Transformer Turns-Ratio and Polarity Tests
- Impedance Testing of Equipment Grounding Conductor
- Infrared Inspection
- Meggaring, Continuity, Hi-Pot testing of equipment

## **Module XVI. Uninterruptible Power Supply (UPS) Systems**

- UPS System Maintenance Procedures General
- System Tests, Routine Maintenance, Special Tests

## **Module XVII. Power Quality**

- Harmonics
- Transients (Surges)
- Voltage Sags and Swells
- Long-Duration Undervoltages
- Sustained Voltage Interruptions
- Unbalanced Voltages and Single Phasing
- Symptoms Grounding
- Voltage Fluctuations and Flicker

## **Module XVIII. Grounding**

- Symptoms and Causes of Inadequate Grounding
- Grounding System Inspection, Testing, and Monitoring
- Solutions to Inadequate Grounding

## **Module XIV: EPM from Commissioning (Acceptance Testing) Through Maintenance**

- Commissioning Planning Stages
- Submit Functional Performance Tests (FPTs)
- Costs of Commissioning, New Construction
- Suggestions for Inclusion in a Walk-Through Inspection Checklist

## **Module XX: Single Line Diagrams and Symbols**

## **Module XXI. Forms to Document all Tests and Inspections**

- Battery inspections
- Breaker Inspections
- Test Results

- Transformer tests, inspections,
- Ground System Tests
- Long-Term Maintenance Guidelines

## **Delivery Method**

Instructor-Led with numerous Hands-On labs and exercises.

## **Equipment Requirements**

**(This apply's to our hands-on courses only)**

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

## **Course Length**

2 Days