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## Substation Maintenance Training

Contact us Today for a FREE quotation to deliver this course at your company's location.

<https://www.electricityforum.com/onsite-training-rfq>

Electrical Substation maintenance is a key component of any substation owner's electrical maintenance program. It has been well documented that failures in key procedures such as racking mechanisms, meters, relays and busses are among the most common source of unplanned outages. Electrical transmission, distribution and switching substations generally have switching, protection and control equipment and one or more transformers. Our electrical substation maintenance course focuses on maintenance and testing of switchgear, circuit breakers, batteries and protective relays.

This course will cover the maintenance and testing requirements for common substation devices, including power transformers, oil, air and vacuum circuit breakers, switchgear, ground grid systems, batteries, chargers and insulating liquids. This course focuses on what to do, when to do it and how to interpret the results from testing and maintenance. This Substation Maintenance course will deal with all of these important issues

### LEARNING OBJECTIVES

- Substation types, applications, components and safety procedures
- Maintenance and testing methods for medium-voltage circuit breakers
- How to perform insulation resistance, contact resistance on air, oil and vacuum breakers, and tank loss index on oil circuit breaker and vacuum bottle integrity tests on vacuum breaker
- Switchgear arrangement, torque requirements, insulation systems and maintenance intervals
- How to perform switchgear inspection and maintenance

### WHO SHOULD ATTEND

This course is designed for engineering project managers, engineers, and technicians from utilities who have built or are considering building or retrofitting substations or distribution systems with SCADA and substation integration and automation equipment.

- Substation operation and planning Managers
- Transmission maintenance engineers
- Distribution maintenance engineers
- Substation Design Engineers
- Consulting Engineers
- maintenance Engineers & technologists
- Substation network maintenance engineers
- Substation operation/maintenance engineers & technologists
- Substation protection & control engineers & technologists

### STUDENTS RECEIVE

- **FREE** T&D Automation and AMR/AMI Systems Handbook Vol. 2 (Value \$20)

- **\$100 Coupon** Toward any Future Electricity Forum Event (Restrictions Apply)
- 1.4 Continuing Education Unit (CEU) Credits
- **FREE** Electricity Today Magazine Subscription (Value \$25.00)
- Forum Presentations in Paper Format

## **COURSE OUTLINE**

### **Electrical Substation Maintenance**

#### **DAY ONE**

##### **Session 1: Substation Overview**

- Purpose of a Substation
- Components of a Power System
- Types of Substations
- Substation Switching Configurations
- Distribution Substation Configurations
- Substation Components
- Metering in Substations
- Relaying in Substations
- Substation SCADA

##### **Session 2: Air and Disconnect Switches**

- Maintenance and Testing
- Components
- Interlocking

- Motor-Operated Mechanism
- Vacuum Interrupters
- Maintenance Requirements
- Testing

### **Session 3: Circuit Breaker Maintenance and Testing**

- Overall Maintenance
- Electrical Testing
- High-Potential Testing (Hi-Pot)
- Principles of Power Factor Testing
- Operation and Timing Tests

### **Session 4: Switchgear Maintenance and Testing**

- Arrangement of Components
- Maintenance Intervals
- Maintaining the Insulation System
- Maintaining Auxiliary Components
- Torque Requirement for Switchgear Assemblies
- Electrical Testing of Switchgear

### **Session 5: Transformer DC and AC Testing**

- General Safety Precautions
- DC Testing
- Insulation Resistance
- Winding Resistance Testing
- AC Testing
- Power Factor Testing Fundamentals
- Transformer Winding Testing
- Typical Tests Performed Using Power Factor/Dissipation Factor Test Sets
- Transformer Bushing Testing
- Liquid Insulating Power Testing

- Core Excitation Current Testing

## **DAY TWO**

### **Session 6: Transformer Oil Testing**

- Insulating Liquids
- Liquid Sampling
- Sampling for Power Factor Testing
- Sampling for Gas-In-Oil Analysis ASTM D-3613
- Silicone Insulating Fluid
- Dielectric Breakdown Voltage Test
- Color Testing (ASTM D-1500)
- Visual Examination (ASTM D-1524)
- Neutralization Number Test (ASTM D-1534)
- Interfacial Tension Test
- Moisture Content Test (ASTM D-1533)
- Evaluation of Test Data
- Other Insulating Liquids

### **Session 7: Transformer Gas Testing**

- Gas Detection
- Oxygen Testing
- Combustible Gas Testing
- Gas Analysis Interpretation

### **Session 8: Current and Voltage Transformers**

- Elementary Connections

- Instrument Transformers
- Types of Current Transformers
- Understanding CT Ratios
- Determining CT Polarity
- Measuring Current
- Shorting CT Secondary
- Current Circuits
- Operation of Current Transformers at Excessive Burden
- Open-Circuit Voltage
- Understanding CTs in a Schematic
- Voltage Transformers
- Coupling Capacitors Voltage
- Transformer Design Fundamentals
- Application: High-Voltage
- Transmission (115 kV – 500 kV)
- Understanding Voltage Transformers in a Schematic

### **Session 9: Ground Testing**

- Types of Connections
- Applications
- Reasons for Special Treatment
- The Hazard
- Surface Resistivity
- Bulk Soil Resistivity Measurement
- Design of Grid
- Operating Handles
- Fences
- Principles Involved in Earth Resistance Testing
- Basic Test Methods for Earth Resistance
- Effects of Different Reference Probe Locations
- Tests at a Large Substation
- General Comments
- Other Tests
- Maintenance

### **Session 10: Battery Maintenance and Testing**

- Battery In-Service Operation
- Temperature and Battery Life
- Battery Safety Factors
- Safety Hazards
- Safety Equipment
- Safety Precautions
- Battery Inspections
- Corrective Actions
- Equalizing Charge (Lead-Acid Only)
- Battery Measurement Techniques

### **Session 11: Overview of Protective Relays**

- Classification of Relays
- Protective Zones
- Fundamentals of Electromechanical Design
- Relay Construction
- Time Characteristics
- Protective Relay Maintenance and Testing
- Mechanical and Visual Inspections
- Preventive Maintenance Testing
- Acceptance Testing
- Testing Techniques
- General Tests
- Relays in Substations

### **COURSE TIMETABLE**

Start: 8:00 a.m.

Coffee Break: 10:00 a.m.

Lunch: 12:00 noon

Restart: 1:15 p.m.

Finish: 4:30 p.m.

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