



Content  
Community  
Connection

United States  
The Electricity Forum Inc.  
742 Pre Emption Road  
Geneva, NY 14456  
Tel 289-387-1025

Canada  
The Electricity Forum  
1885 Clements Rd, Unit 218  
Pickering, ON L1W3V4  
Tel 905-686-1040  
Fax 905-686-1078  
Toll Free 855-824-6131

---

## Substation Training

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

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

This 12-Hour Live Online Substation Training course give an overview of substations, primary breaking device, transformer, secondary switching devices, switchgear lineup, instrument transformers, relays, meters & instruments, lightning arresters, transducers, cables & bus ducts, control & communications wires/cables, SCADA, capacitors and static VARs, and how they all interact. The course will also cover the application, design & testing and maintenance of low, medium and high voltage circuit breakers as well as disconnect switches. It will also cover also protective relays, how they operate vs. how they protect. The course will cover the communication networks, topology and communication media. Utility oriented as well as industrial oriented communication protocols will be given.

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 Electrical Substation training 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.

## **LEARNING OBJECTIVES**

- The typical structures of a substation,
- The most important components of a substation
- Typical substation protection parameters
- Substation grounding system requirements.
- Substation safety and safety operation
- Best substation maintenance practices

## **WHO SHOULD ATTEND**

- Utility and Industrial Electrical Engineers and Engineering Technicians
- Transmission planning engineers
- Distribution planning engineers
- Substation Design Engineers
- Consulting Electrical Engineers
- Substation network management engineers
- Substation maintenance and construction engineers & technologists

## **STUDENTS RECEIVE**

- **FREE** 100-Page Digital Electrical Testing and Maintenance Handbook (Value \$20)
- **\$100 Coupon** Toward any Future Electricity Forum Event (Restrictions Apply)

- 1.4 Continuing Education Unit (CEU) Credits
- **FREE** Magazine Subscription (Value \$25.00)
- Course Materials in Paper Format

## **COURSE OUTLINE**

### **Substation Training**

#### **DAY ONE**

##### **1. Introduction to Substations**

- Substations Practical Examples (Updated Pictures to reflect Several styles)
- General Overview Of The Substation Characteristics (Transmission, Distribution, Industrial)
- Substation Typical Documentation
- Common Voltages throughout Canada and US High/Medium/Low class

##### **2. Ultra High Voltage; High Voltage; Medium Voltage and Low Voltage substation definition**

- American Standards And Definitions For Substation
- Canadian Utility Standards And Voltage Levels For Utility
- Substation Design Requirements And International Standards

##### **3. Functions and Topologies of Substations**

- Transfer Substation
- Step Up Substation
- Step Down Substations
- Breaker And A Half; Single Buss; Double Buss; Ring Buss And Other Topologies, Advantage And Disadvantages
- Typical Substation Schematics (single lines, Control wiring, protective devices and wiring)
- Layout of typical industrial/Commercial Substation with onsite Generation

#### **4. Power Circuit Breakers; Power Switches; Power Fuses**

- Indoor/outdoor style Substations
- New Arc proof Switchgear and advantages
- Switchyards And Overhead Lines
- SF6 Switchgear-GIS (Gas Insulated Switchgears)
- SF6 Circuit Breakers For High And Medium Voltage, Insulated And Life Tank
- Air Insulated Switchgear Limitations
- Replacement And Maintenance Of Oil Circuit Breakers
- Vacuum Circuit Breakers
- Vacuum Breakers In SF6 Enclosed Switchgear
- Resin-Encapsulated Switchgear - Advantage And Limitations
- How To Select The Best Switchgear For The Application
- Surge Arrestors Point Of Installation
- Feeders And Re-Closures
- Use of Ground carts and features
- Load And No Load Power Switches
- Different types of fusing and Characteristics
- Meggering; Hi-Pot And PI Measurements And Interpretation Based On NETA Standard

#### **5. Power Transformers Equipment and Maintenance**

- Transformer Spill containment systems

- Power Transformer Construction
- Oil Power Transformers and cooling methods
- Bushing System and Bushing Tap monitoring
- Buchholtz Relay 63
- Overpressure Protection Systems
- Gages And Measurement On An Oil-Cooled Transformer
- RTD Devices for Monitoring real time Temperature
- Tap Changing System
- DGA-Dissolved Gas Analysing System
- Sampling The Oil And Results Interpretation
- Online Monitoring System (Qualitrol/SEL)
- SFRA of Power Transformers
- Doble Test Equipment
- Winding Resistance Testing
- Ratio Testing of Transformer

## **6. Substation Battery systems**

- Substation Batteries and Charging systems
- Typical Voltages and setups
- Examples of different manufacturer and monitoring
- Examples of alarms and settings within charger software
- Maintenance of Batteries

## **7. Substation Grounding Requirements**

- Soil Resistivity Measurements
- Grounding Model And Evaluations
- Sizing The Grounding System
- Safety Equipment Grounding In Substations
- Grounding System Interconnections
- Grounding System Maintenance Requirements
- Potential Drop Test And Interpretation

- Testing Equipment For Grounding Systems, Ground Potential Rise; Step And Touch Potential
- IEEE 80 Requirements For Substation Grounding

## **DAY TWO**

### **8. Smart Grids**

- Understanding the equipment and how it will impact the changing Electrical Grid
- Use of Auto sensing equipment
- Impacts to electrical distribution equipment
- Stray currents
- Maintenance of Ground grids and bonding of non-electrical equipment

### **9. Typical Protection Relays used in Substation**

- Selecting The Proper Protection Relays
- Selecting The CT And PT
- Performing Protection Coordination
- Generating Preliminary Settings
- Use of Remote Tripping and Checks of System
- Selecting The Final Circuit Breakers And Protection, Using The Model And Electrical Calculation Software
- Generating Protection Setting Sheets
- Performing ARC FLASH Study And Generating Equipment Labels
- NFPA 70E And IEEE 1584; CSA 462
- Typical Protection For Substations Transformers And Feeders
- Listing of Various Manufacturer of Relaying
- Transformer monitoring Relays and newer monitoring features

- Example Of A Relay Protection Settings For GE 750, Using EnerVista,
- Arc flash sensors and uses
- Partial discharge monitoring
- Current injection Testing and Equipment

## **10. Substation Power Factor Correction**

- Capacitor System For Substation Power Factor Correction
- Static System For Power Factor Correction
- Condenser Systems
- Maintenance Of Power Factor Correction Systems
- DC Subsystems

## **11. Remote SCADA Systems and Remote Substation Control**

- Network Communications For Power Systems
- SCADA System Requirement
- Cellular Modems
- Radio controlled devices and Repeater towers
- Installing SCADA Systems On Existing Substations
- Monitoring And Control
- Procedures For Handling SCADA In Power Systems
- Example Of SCADA Systems
- Prioritization of alarm points in SCADA

## **12. Other Requirements to be considered**

- Substation Installation
- Safe Operation Of The Substation
- Safe Work Area; PPE; In Hand Procedures
- Maintenance Of The Substation grounds/landscapes

- Testing And Commissioning Of A Substation
- Meggering; High Pot And Very Low Frequency Test
- Bus Bars Testing Using Micro Ohmmeter/insulation tester
- Power Transformer Testing
- DGA Testing, Alternative Methods
- Test Results And Approvals
- NETA Standard, And Qualifications Of Personnel

### **13. Pad mounted and Over Head Remote controlled switches**

- Installation and uses to assist with substation feeds
- Commissioning of switches
- Examples of various manufacturers

**4:00PM - Wrap up and Q&A**

### **COURSE TIMETABLE**

**Both days:**

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.



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

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