



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

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# Substation Design Course

Course details: <https://electricityforum.com/electrical-training/substation-design-training>

## COURSE DATES AND TIMES

This comprehensive 12-hour, two-day live online Substation Design course provides in-depth training for professionals involved in the design, operation, and maintenance of electrical substations. Tailored for engineers and designers working within the utility industry, this course offers a complete understanding of the role they play in electric power transmission and distribution. Covering essential aspects of T&D engineering, the course explores substation equipment, design methodologies, and the integration of modern technologies to ensure reliable and efficient power systems.

The course delves into all stages of substation design, from concept development to detailed engineering, and includes critical considerations such as equipment selection, system layout, safety standards, and maintenance practices. Participants will learn how to optimize for performance and reliability, while also adhering to industry regulations and best practices. The course also covers the electrical principles behind substations, system protection, grounding, and automation.

### What Students Will Learn

Participants in the Substation Design course will gain a thorough understanding of the engineering principles and technical skills required to design and operate modern substations. Key learning outcomes include:

- Mastering the technical aspects of engineering and understanding how they fit into broader electric power networks.
- Learning how to specify and select appropriate equipment for different operational needs.
- Developing expertise in substation design layouts that maximize efficiency and safety.
- Understanding protective relaying, automation, and control systems used in substations.
- Gaining insights into the integration of advanced technologies, such as digital subs and SCADA systems, to enhance grid reliability.
- Becoming familiar with industry standards, codes, and best practices that govern engineering and electrical utilities.

- Acquiring practical knowledge of power systems analysis, troubleshooting, and maintenance practices to ensure the longevity and performance of subs.

By the end of this course, participants will be well-prepared to contribute to the design, operation, and maintenance of electrical substations, making them valuable assets to the utility industry and other sectors that rely on electric power infrastructure.

### **Key topics covered include:**

- Introduction to electrical fundamentals and their role in power systems.
- Detailed study of equipment, including transformers, circuit breakers, switchgear, and protective relays.
- Best practices in the design and layout of subs.
- Electrical grounding and protection schemes.
- The role of substation design in ensuring grid reliability.
- Integrating automation and modern technology into distribution systems.
- Maintenance strategies and safety considerations.

### **WHO SHOULD ATTEND**

This course is ideal for professionals working in electrical engineering and the utility industry who are responsible for the design, implementation, or management. It is particularly beneficial for:

- Engineers and designers tasked with substation design and development.
- Professionals involved in the planning and operation of electrical utilities.
- Technicians and consultants who oversee equipment and maintenance.
- Project managers and planners working on power systems and infrastructure projects.

### **STUDENTS RECEIVE**

- **FREE** 100-Page Digital Electrical Safety Handbook (Value \$20)
- **\$100 Coupon** Toward Any Future Electricity Forum Event (Restrictions Apply)
- 1.2 Continuing Education Unit (CEU) Credits (12 Professional Development Hours)
- **FREE** Magazine Subscription (Value \$25.00)
- Course Materials In PDF Format

### **COURSE OUTLINE**

#### **DAY ONE**

##### **Section 1: Basic Design Parameters – Single Line Diagram**

**Objective:** Understand the key design considerations, including environmental and regulatory factors.

##### **Single Line Diagram (SLD) Overview**

- Introduction to SLD, its role in substation design, and interpreting SLDs for various configurations.

### **Design Influencing Factors**

- Environmental considerations: Altitude, wind, ambient temperature, and seismic areas.
- Site-specific requirements and constraints.
- Impact of these factors on equipment choice and configuration.

### **Industry Standards and Practices**

- Overview of domestic and international standards for substation design (e.g., IEEE, IEC).
- Understanding how these standards guide the safety, efficiency, and sustainability of substation designs.

### **Substation Configuration Variations**

- Why subs are configured differently based on their function, environmental factors, and grid requirements.
- Case studies highlighting different configurations for similar functions.

## **Section 2: Power Transformers**

**Objective:** Explore transformer types, applications, and their role in substations.

### **Overview of Transformer Types**

- Step-up vs. step-down transformers and their specific roles in distribution systems.
- Autotransformers and their application in voltage regulation.

### **Cooling Methods for Transformers**

- Understanding ONAN, ONAF, OFAF, OFWF cooling methods and how they impact transformer ratings and performance.
- The role of cooling in extending transformer life and ensuring operational efficiency.

### **Transformer Configurations and Components**

- Discussion of transformer winding configurations: Delta-Wye, Wye-Wye, etc.
- Components: core, windings, tap changers, bushings, cooling fans, and radiators.
- General arrangement of a power transformer.

## **Section 3: Switchgear**

**Objective:** Understand the function and types of switchgear used in subs.

### **Introduction to Switchgear**

- Definition and purpose of switchgear in electrical engineering and substation design.
- Difference between Low Voltage (LV), Medium Voltage (MV), and High Voltage (HV) switchgear.

## **Types of Switchgear and Their Applications**

- Overview of LV switchgear and typical industry applications.
- Explanation of components such as circuit breakers, fuses, isolators, and relays.

## **Safety Features**

- Discussion of the critical safety features employed in switchgear, including arc flash protection, grounding, and interlocks.

## **Section 4: Lightning Protection Systems**

**Objective:** Learn about lightning protection systems and their importance in substations.

### **Introduction to Lightning Protection**

- Overview of how lightning strikes affect power systems and the role of protection systems in mitigating risk.

### **Components of a Lightning Protection System**

- Components such as lightning rods, surge arresters, ground wires, and grounding systems.
- Design considerations to protect equipment from high-voltage surges caused by lightning.

### **Best Practices for Lightning Protection**

- International standards and best practices for designing effective lightning protection systems.

## **DAY TWO**

## **Section 5: Control System Components**

**Objective:** Gain familiarity with control system components.

### **Standard Components and Applications**

- Overview of critical components such as Push Buttons (PB), TNC control switches, selector switches, time delay relays, and indicating lamps.
- Discussion of terminal blocks and how they help in wiring and control.

### **Applications and Functions**

- How these control components are integrated into operations for safe and efficient performance.
- Real-world examples of control system setups.

## **Section 6: Substation AC/DC Auxiliary Power Systems**

**Objective:** Understand the role of auxiliary power systems and how they are configured.

### **Introduction to AC/DC Aux Power Systems**

- Overview of the auxiliary systems required for the proper functioning of a sub.

### **Classification of Loads**

- Categorization of loads into vital, essential, and non-essential.
- How to prioritize and supply these loads based on their importance.

### **AC and DC Power Distribution**

- Basics of AC and DC auxiliary power systems, including distribution methods and load management.

### **Auxiliary Transformer Sizing**

- Practical case study on transformer sizing, considering factors like load requirements, system capacity, and redundancy.

## **Section 7: Substations and the Smart Grid**

**Objective:** Learn about the role of subs in modern smart grid technology and challenges in connectivity.

### **Smart Grid Overview**

- Definition of the smart grid and its significance in modern electrical utilities.

### **Integration of Substations into the Smart Grid**

- How substations are connected to smart grids for enhanced monitoring, control, and performance.
- Role of digital subs and automated systems in supporting smart grids.

### **Challenges in Connectivity and Performance**

- Key issues related to integrating subs with smart grids, including communication protocols, cybersecurity, and data management.

### **Solutions for Improved Performance**

- Best practices for ensuring the reliability and efficiency of smart grid-connected subs.

## **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.

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<https://electricityforum.com/onsite-requestforquote>