

# Substation

## Engineering Course



**Sargent & Lundy conducts four days of training in substation design for our clients in the utility industry. Training is offered to utility personnel as an onsite presentation by Sargent & Lundy engineers engaged in utility substation design and engineering.**

### What You'll Learn

This four-day course provides a comprehensive treatment of the fundamentals of substation physical design, protection and control systems, civil/structural design, telecommunications, and electrical testing, and commissioning. The course is tailored to address specific tasks and applications of substation design. Throughout the course, attendees will complete calculation and design exercises, applying the principles learned.

Throughout each session, new information is derived from recent experience on a wide variety of projects, including enclosed GIS substations in urban locations and extensive upgrades to existing facilities.

### Who Should Attend?

Utility engineers, project managers, and other professionals involved with substation projects as well entry level engineers or experienced who are new to this area of the electric utility business.

### Course Fees

The four-day course is offered at a price of \$2,050 per person. The price is reduced to \$1,950 if payment is received by Sargent & Lundy one week prior to the course start date. Credit card payment is accepted via PayPal through our website.

The course is available to utilities looking to provide an onsite presentation exclusively for their employees. Exclusive onsite presentations require a minimum of 15 students. Please call for information and pricing.

### 32 Professional Development Hours

Participants receive a certificate of completion and one professional development hour (PDH) for every hour of classroom instruction. Refer to specific state requirements for applicable PDH credits.

FOR INFORMATION CONTACT:

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# Substation Engineering Course Details

## Day 1: Power System Analysis and Electrical Design

Session 1 introduces students to electric power systems and factors influencing substation design. Session 2 introduces students to functions and design of various substation components.

### Session 1 – Electric Power Systems

- Electricity basics
- Power grid operation
- Types of studies
- Power grid configuration

### Session 2 – Substation Components

- Substation types
- Substation equipment
- Equipment standards and ratings
- Substation material

## Day 2: Substation Electrical Design

Session 3 reviews the fundamentals of relay protection, as well as introducing attendees to the principles of protection schemes for major substation equipment. Session 4 covers the single line development process and includes in-class development of a single line.

### Session 3 – Protective Relaying Principles

- PLC components
- Transformers
- Buses
- Lines
- Breaker failure

### Session 4 – Single Line Development

- Bus arrangements
- One-line diagram
- Protection zones

## Day 3: Substation Physical Design, Grounding, and Communications

Session 5 presents design inputs, layout options and selection, and air and gas insulated substation design. Session 6 covers grounding principles and substation grounding design. Sessions 7 and 8 present SCADA concepts and telecom methods. Session 9 discusses the use of voltage control and power flow equipment in power grid operation.

### Session 5 – Substation Layout

- Design inputs
- Substation layout selection
- Air insulated substations
- Gas insulated substations

### Session 6 - Substation Grounding

- Purpose of the grounding system
- Touch and step potentials
- Grounding system design

### Session 7 – SCADA Concepts

- Typical network
- Equipment
- Communication protocols

### Session 8 - Telecom

- Telecommunications network functions
- Main types of communication
- Substation telecom networks and components

### Session 9 – Voltage Control/ Power Flow Equipment

- Capacitors and reactor
- Phase shifting transformers
- Synchronous condensers
- Static VAR compensators and STATCOMs

## Day 4: Civil/Structural/Commissioning, and Testing

Sessions 10 through 14 covers the principal elements of tasks performed by civil/structural engineers in the design of a substation. Session 15 identifies the steps required to verify the functionality of equipment, demonstrate that equipment is ready to be energized, and enable safe energization and commissioning of newly installed equipment.

### Session 10 – Site Development

- Grading and drainage

### Session 11– Foundations

- Soil Types
- Foundation Types

### Session 12 – Bus Structural Design

- Strain bus
- Rigid bus

### Session 13 – Structures

- Types
- Loadings

### Session 14 – Substation Buildings

- Construction alternatives
- Cost factors

### Session 15 – Commissioning and Testing

- Objectives of commissioning and testing
- Testing and commissioning caveats
- Coordination and support requirements
- Equipment and component testing
- Equipment and circuitry functional testing
- In-service testing/commissioning

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