Content Community Connection

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Substation Relay Protection Training

View Course Details

COURSE DATES AND TIMES

May 4-5 , 2026

10:00 am - 4:30 pm ET

November 9-10 , 2026

10:00 am - 4:30 pm ET

Our Substation Relay Protection Training is a 12-hour, instructor-led live online course designed for utility and industrial professionals involved in protective relay design, installation, testing, or maintenance. This course is ideal for electrical engineers, substation technicians, and system protection personnel who need a deep, practical understanding of relay protection principles across key substation assets.

Participants will gain applied knowledge of how relay protection systems safeguard transmission and distribution lines, transformers, buses, generators, and motors. You'll explore the function, coordination, and implementation of relay types such as overcurrent, directional, impedance (distance), differential, underfrequency, and generator protection relays. Real-world considerations and common challenges will be discussed, helping learners apply protection strategies effectively in the field.

This training emphasizes the theoretical foundations of relay protection and the practical tradeoffs, constraints, and modernization trends, including the growing role of data communications and substation networking technologies like IEC 61850.

Course Learning Objectives – Substation Protection

By the end of this course, participants will be able to:

- ?? Explain core system protection concepts and their importance in maintaining grid reliability
- ?? Understand the operation and role of batteries, battery chargers, trip/close circuits, and DC control systems
- ?? Apply protective relays to critical substation components, including transmission/distribution lines, transformers, generators, and motors
- ?? Identify and describe the operation of key relay types: overcurrent, directional, impedance, differential, underfrequency, and generator relays
- ?? Recognize the design tradeoffs and system constraints involved in protection system coordination
- ?? Evaluate the benefits of modernizing substation protection using digital relays and data networking technologies

Related Training and Resources

To enhance your understanding of electrical infrastructure, see our related courses and guides:

- Substation Training
- Electrical Substation Design Training
- Substation Automation Training
- Substation Maintenance Training
- Substation SCADA Monitoring Training
- Substation Grounding Training

WHO SHOULD ATTEND

This Substation Relay Protection Training course is recommended for engineers and technicians from utilities or industries who participate in the design, installation, or maintenance of protective relays and substation controls. Job classifications include:

- System Protection Engineers
- Substation Design Engineers
- Relay Technicians
- Substation Construction Technicians
- Control System Engineers
- Consulting Engineers
- Testing & Commissioning Engineers
- Maintenance Engineers & Technologists
- Substation Operation/Maintenance Engineers & Technologists
- Transmission & Distribution Engineers

STUDENTS RECEIVE

- This Course Includes Our Latest Protection And Control Electrical 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 $50.00)
- Course Materials In PDF Format

COURSE OUTLINE

SUBSTATION RELAY PROTECTION TRAINING – COURSE OUTLINE

DAY ONE

What is a protection system?

- What is being protected and why? NERC definition
- Protective relays
- Instrument transformers (VT’s and CT’s)
- DC Protection and control circuits

Substation DC Systems

- Purpose for DC systems in substations
- Batteries, different types and comparison
- Battery capacity, battery installation
- Battery chargers
- Trip circuits

- Close circuits
- DC circuit monitoring

Voltage Transformers

- Electro-magnetic Voltage Transformers (EMVT)
- Capacitive Coupled Voltage Transformers (CCVT)
- VT accuracy

Current Transformers

- Types of current transformers
- CT ratios & polarity
- CT accuracy, burden, and saturation
- Shorting CT secondary circuits
- Open-circuit CT voltage and safety considerations
- CT magnetization
- CT Connection in ring bus / breaker & a half schemes

Protective Relay Types

- Dependability, security, selectivity, speed
- IEEE device numbers
- Electromechanical, Electronic, & Microprocessor
- History, Comparison of types

Transformer Protection

- Fuses - Good for small transformers, difficulties coordinating with downstream devices
- Overcurrent – simplicity but limited mainly as backup protection
- Differential – single & multiple slope, harmonic inrush restraint
- Delta-wye transformer connection considerations
- Sudden Pressure & Bucholz relays
- Voltage controller (90)

DAY TWO

Bus Protection

- Bus differential
- Bus configurations and CT connections
- Breaker failure protection

Distribution Line Protection

- Fusing
- Reclosers & sectionalizers
- Overcurrent relays
- Directional, negative sequence settings

Transmission Line Protection

- Directional Overcurrent

- Distance (Impedance) and mho characteristic
- Load encroachment settings
- Pilot Relaying (communications assisted)
- DCB - Directional Comparison Blocking
- POTT - Permissive Overreaching Transfer Trip
- Line Current Differential

Reclosing (79)

- Pros and cons of reclosing on line faults
- Distribution circuits, reclosing considerations
- Transmission circuits, reclosing considerations

Underfrequency Load Shedding

Generation Protection

- Stator grounding, high resistance or low resistance
- Stator protection, generally differential
- Accidental energization - generator acts as a motor and produces high current in the rotor
- Start-up protection
- Loss of field
- Out-of-step protection and pole slip

Relay Data Communication

- Digital communication concepts
- Protocols, DNP, IEC 61850
- Relay event reports & COMTRADE
- Data concentrator
- SCADA communication

COURSE TIMETABLE

Both days:
Start: 10:00 a.m. ET
Finish: 4:30 p.m. ET