

---

# Power Systems Engineering Seminar Series

## Industrial/Commercial Distribution Power Systems

---

**TOPICS COVERED:** This seminar is divided into 3 parts, which can be presented individually or together.

### 1. Basic Power Systems Analysis

#### Summary

- This module covers basic concepts and calculations necessary for the analysis of a distribution power system.

#### Course Overview

- Basic components of a power system: generators, transformers, transmission lines, loads, and protective elements
- Review of the per-unit system for power system calculations
- Three-phase power triangle: real power, reactive power, apparent power, and power factor
- Studies for distribution power systems: load flow, voltage regulation, ANSI short circuit, protective device coordination, and arc flash hazard analysis

### 2. Basic Power System Protection

#### Summary

- This module covers basic concepts and calculations for protection of high, medium, and low voltage power systems.

#### Course Overview

- Review of short circuit calculations for a power system: three-phase fault, phase to phase fault, and single line to ground fault
- Effects of fault currents on a power system
- Sources of fault currents in a power system
- Computer demonstration of a short circuit study and a discussion of the results
- Objectives of a protective device coordination study
- Protective device ratings: voltage, continuous current, interrupting, and momentary

- Purpose of protective device evaluation: high and medium voltage circuit breakers, LVPCBs, ICCBs, and MCCBs and fuses
- Time current curves (TCCs) for protective devices
- Protection of electrical equipment: conductors, transformers, rotating machines, and capacitors
- Electro-mechanical and digital protective relays: overcurrent, under voltage, over voltage, directional, differential
- Instrument transformers: current transformers (CTs) and potential transformers (PTs)
- Typical phase and ground fault protection schemes
- Computer demonstration of a protective device coordination study and a discussion of the results

### 3. Arc Flash Hazard Analysis

#### Summary

- This module covers basic concepts and calculations for performing an arc flash hazard analysis for a power system.

#### Course Overview

- Understanding the difference between a bolted and an arcing fault
- Arc flash standards: NFPA 70E and IEEE 1584
- Equipment issues relating to arc flash hazards
- Introduction to arc flash calculations
- Specification of proper labeling for electrical equipment in a power system
- Specification of proper protective clothing and personal protective equipment (PPE) for plant personnel
- Computer demonstration of an arc flash analysis study and a discussion on the results

**LENGTH:** This seminar can be presented in a 3 full-day version or can be presented in a 1 week half-day version. Shorter customized versions (1-2 days) can also be presented on a subset of the listed topics.