

Protective Device Coordination for Utilities

3 Days, 2.1 CEUs

For a utility, inadequate protective device coordination can cause widespread outages affecting millions of customers. The goal of protective device coordination is to allow for normal equipment operation, ensure circuits open before equipment is damaged and limit outages to the smallest area through selectivity. This helps reduce the quantity of customers affected by outages. These studies are used to verify correct equipment ratings and settings as well as assist in the selection of new equipment. A properly coordinated power system can prevent equipment damage and lost productivity.

This course is intended for engineers, supervisors and relay technicians that are responsible for the protection of utility power systems.

Lab and Classroom Attire

AVO Training Institute is committed to the personal safety of each participant and require long pants and ANSI rated "safety-toe" work shoes for lab activities. Lecture courses may involve a tour of a work or shop area and for this reason open-toe shoes and shorts are not considered appropriate attire for the classroom.

Pre-Requisites

Students must bring a PC running Windows 7 or newer desktop operating system, w/8 GB of RAM, 120 GB+ hard drive with administrative rights to install SKM PTW 30-day trial software.

Learning Objectives

To receive 2.1 CEUs, participants must attend 3 days of class (21 contact hours) and attain a minimum grade of 80% on the final exam. Upon completion of this course the participant will demonstrate that he/she is able to:

- Evaluate a protection system for reliability, selectivity, speed, simplicity and economics.
- Utilize leading engineering software to create and modify one-line drawings and time current curves (TCCs).
- Interpret TCCs and damage curves.
- Explain the application of directional, impedance (distance), differential, carrier, pilot wire, underfrequency and ground overcurrent protective relays.
- Calculate CT burden impedances.
- Coordinate protective relays for ground fault and line protection, using leading engineering.
- Identify common protection schemes for generators, transmission lines, and distribution lines.

SCOPE

Day 1* (7 contact hours)

- I. Introduction (0.5 hr)
 - A. Schedule
 - B. Course Outline
- II. Introduction To Protective (1 hr) Device Coordination for Utilities
 - A. Protective Devices Application Concepts
 1. Circuit Configuration
 2. System Voltage

3. Type of Conductor
4. Construction Methods
5. Load Type
6. Time-Current Coordination
7. Grounding Methods
- B. Evaluation of Protection System
 1. Reliability
 2. Selectivity

3. Speed
4. Simplicity
5. Economics
- C. Standards 141, 242, 399
- AM Break
- III. Computer Methods (1.5 hrs)
 - A. PTW – Captor™
 - B. Creating a TCC
 - C. Creating a Report

*Class scheduling times may vary based on discussions and size of class

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SCOPE (cont'd)

- D. Creating a One-Line Drawing
- E. Printing/Plotting Time-Current Curves
- F. Creating a TCC from a One-Line Drawing
- G. Deleting or Removing a Component
- H. Example Problem

Lunch

- IV. Ground Fault Protection (1 hr)
 - A. General Concepts
 - B. Grounding Methods
 - 1. Overview
 - 2. Solid Grounding
 - 3. Low- and High-Resistance Grounding
 - 4. Ungrounded Systems

PM Break

- C. Ground Fault Protection Options
 - 1. Voltage Sensing
 - 2. Current Unbalance
- D. Coordinating Ground Over-current Devices
 - 1. Basic Principles
 - 2. Pickup Settings
 - 3. Time Settings
 - 4. Examples

Day 2 (7 contact hours)

- V. Protective Relay Applications (4 hrs)
 - A. Current Transformers
 - 1. Ratings
 - 2. Principles of Operation
 - 3. Selection Methods
 - 4. Optical Current Transformers
 - B. Other Relay Types
 - 1. Modern Protective Relays
 - 2. Directional Overcurrent Relays
 - 3. Directional Power Relays

AM Break

- 4. Impedance (Distance) Relays
- 5. Power System Impedances
- 6. Schweitzer Engineering Laboratories SEL-321
- 7. Carrier and Pilot Wire Relays
- 8. Frequency Relays

C. Automatic Reclosing

- 1. Introduction
- 2. Distribution System Applications

Lunch

- VI. Generator Protection (3 hrs)
 - A. Generator Protection Schemes
 - 1. Components
 - 2. Typical Protection Schemes

- B. Voltage-Controlled and Restrained Overcurrent Relays

PM Break

- 1. Voltage-Restrained Overcurrent Relays
- 2. Voltage-Controlled Overcurrent Relays
- C. Negative Sequence Relays
- D. Loss of Excitation Relays

Day 3 (7 contact hours)

- VII. Software Exercise (6.5 hrs)
 - A. Load SKM PTW Software

AM Break

- B. Present PTW Basic Procedure

Lunch

- C. Hands-On PDC Exercise Using PTW Software

PM Break

- VIII. Conclusion (0.5 hr)
 - A. Review
 - B. Final Exam