

Protective Relay Maintenance, Basic

4.5 Days, 3.2 CEUs

The Protective Relay Maintenance Distribution course is an intensive, hands-on, lab oriented presentation covering overcurrent, bus differential, and transformer differential protective relays. The participant will learn the basics of distribution protection combined with hands-on, realistic training on actual relay. Laboratory exercises will cover proper relay maintenance, specific test procedures, and detailed adjustment and calibration procedures utilizing state-of-the-art relay test sets. Class participants will understand applicable NETA testing standards, what test result information should be recorded, and what hand tools are necessary for proper relay adjustment and calibration.

This course is intended for electricians, technicians and engineers responsible for the testing, maintenance and calibration of relays that protect distribution feeders, transformers, buses, and loads. The participant should have basic knowledge of AC/DC electricity.

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.

Learning Objectives

To receive 3.2 CEUs, participants must attend 4.5 days of class (32 contact hours) and attain a minimum average grade of 80% (overall grade will consist of 50% lab practice and 50% final exam). Upon completion of this course the participant will demonstrate that he/she is able to:

- Explain the application of these relays.
- Identify critical relay components.
- Interpret AC and DC relay schemes.
- Practice standard tests to be performed on the relays.
- Perform as found/as left tests and calibrate relays with the following functions (ANSI device numbers):
 - Instantaneous and Time Overcurrent (50/51)
 - Undervoltage (27)
 - Overvoltage (59)
 - Bus Differential (87B)
 - Transformer Percentage Differential with Harmonic Restraint (87T)
 - Targets and Indicators
- Use the provided relay test set to perform direct injection testing and evaluate results

SCOPE

Day 1* (7 contact hours)

- I. Introduction (0.5 hr)
- II. Introduction To Basic Relays (1 hr)
 - A. Purpose of Protective Relays
 - B. The Art and Science of Protective Relaying
- III. Current and Voltage Transformers (1 hr)
 - A. Elementary Connections of Instrument Transformers
 - B. Types of Current Transformers
 - C. Understanding CT Ratios
 - D. Determining CT Polarity
 - E. Measuring Current
 - F. Shorting CT Secondary Current Circuits

AM Break

- G. Operation of Current Transformers at Excessive Burden or Open Circuit Voltage
- H. Effect on Accuracy of Open-Circuit Saturation of Iron
- I. Understanding CTs in a Schematic
- J. Voltage Transformers
- K. Coupling Capacitors Voltage Transformer Design Fundamentals
- L. Application: High-Voltage Transmission (115 kV – 500 kV)
- M. Understanding Voltage Transformers in a Schematic
- IV. Introduction To Relaying (1.5 hrs)
 - A. Classification of Relays
 - B. Protective Zones

- C. Fundamentals of Electro-mechanical Design
- D. Relay Construction
- E. Time Characteristics
- F. Protective Relay Maintenance and Testing
- G. Mechanical and Visual Inspections
- H. Preventive Maintenance Testing
- I. Acceptance Testing
- J. Testing Techniques
- K. General Tests
- Lunch
- V. Relay Test Equipment (3 hrs)
 - A. SMRT Quick Start
 - B. Power DB Demo (Instructor Led)

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

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4.5 Days, 3.2 CEUs

SCOPE (cont'd)

Day 2 (7 contact hours)

VI. Westinghouse Type Overcurrent Relay (CO) (2.5 hrs)

- A. Applications
- B. Types of CO Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments
- H. Timing
- I. Lab
 1. Pickup Test
 2. Timing Test
 3. Instantaneous Test
 4. Seal-In Test

AM Break

VII. General Electric Overcurrent Relays (IAC) (2.5 hrs)

- A. Applications
- B. Types of IAC Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments

Lunch

- H. Lab
 1. Pickup Test
 2. Timing Test
 3. Instantaneous Test
 4. Seal-In Test

VIII. Westinghouse Voltage Relays (CV) (2 hrs)

- A. Applications
- B. Types of CV Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments

PM Break

- H. Lab
 1. Pickup Test
 2. Timing Test
 3. Seal-In Test

Day 3 (7 contact hours)

IX. General Electric Voltage Relays (IAV) (4 hrs)

- A. Applications
- B. Types of IAV Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Types of Tests
- G. Adjustments for IAV 51A Overvoltage Relays
- H. Adjustments for IAV 51E Undervoltage Relays

AM Break

- I. Lab (2 Hours)
 1. Pickup Test
 2. Timing Test
 3. Seal-In Test

Lunch

X. Introduction To Transformer Differential Relays (0.5 hr)

- A. Applications
- B. Operating Principles
 1. Basic
 2. Transformer Differentials
 3. Transformer Differentials with Harmonic Restraint

XI. General Electric Bus Differential Relay (PVD) (2.5 hrs)

- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments

PM Break

- G. Lab
 1. Minimum Pickup 87L
 2. Minimum Pickup 87H
 3. Thyrite Leakage Test
 4. Seal-In Test

Day 4 (7 contact hours)

XII. Westinghouse Differential Relays (HU) (2 hrs)

- A. Applications
- B. Components
- C. Operating Principles

- D. Protection Scheme
- E. Types of Tests
- F. Adjustments
- G. Lab
 1. Minimum Pickup Test
 2. Slope Test
 3. Harmonic Restraint Test
 4. Instantaneous Test
 5. Seal-In Test

AM Break

XIII. General Electric Type Transformer Differential Relay with Percentage and Harmonic Restraint (BDD) (2 hrs)

- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments
- G. Lab (4 Hours)
 1. Minimum Pickup Test
 2. Slope Test
 3. Harmonic Restraint Test
 4. Instantaneous Test
 5. Seal-In Test

Lunch

XIV. General Electric Type Transformer Differential Relay with Percentage and Harmonic Restraint (STD) (3 hrs)

- A. Applications
- B. Components
- C. Operating Principles
- D. Protection Scheme
- E. Types of Tests
- F. Adjustments

PM Break

- G. Lab
 1. Minimum Pickup Test
 2. Slope Test
 3. Harmonic Restraint Test
 4. Instantaneous Test
 5. Seal-In Test

Day 5 (Half day) (4 contact hours)

XV. Conclusion (4 hrs)

- A. Review and Exam