

Protective Relay Maintenance, Solid-State

4.5 Days, 3.6 CEUs

Solid state relays require different test methodologies than electro-mechanical or numerical relays. NETA and NFPA 70B Maintenance and Testing standards recommend testing relays either every 2 years or at other regular intervals based on equipment condition and reliability requirements. There are no moving parts to adjust but they do have physical setting functions which must be properly applied. These functions include taps, time dials, range switches, target units and other switches and dials for relay setting and calibration. The relay may also have multiple built in time curves which must be properly selected and tested. Through proper maintenance and testing, technicians can help ensure the integrity of the protection system and ensure service continuity. The somewhat specialized testing procedures used to test and calibrate these relays will be fully addressed through valuable theoretical operating explanations and rigorous lab exercises.

The Protective Relay Maintenance Solid State course is an intensive, hands-on, lab oriented class covering:

1. Sync Check Relay (25)
2. Voltage Relays (27/59)
3. Directional Power (32R)
4. Overcurrent (50/51)
5. Directional Overcurrent (67)
6. Transformer Differential (87T)

The participant will learn the basics of substation protection combined with hands-on, realistic training on actual relays. Laboratory exercises will cover proper relay maintenance, specific test procedures, and detailed adjustment and calibration procedures utilizing state of the art relay test sets. 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.

Who Should Attend

This intensive hands-on course is designed specifically for test technicians responsible for the setting, testing, and calibration of solid-state protective relays. Learners should have basic knowledge of AC/DC electricity. Technicians who successfully complete this course will be certified to set, test, and calibrate the relays presented in the laboratories.

Learning Objectives:

Upon completion of this course the participant should be able to:

- Identify the type of relay and its functions.
- Interpret internal and external AC and DC schematics.
- Properly connect a relay test set to the relay for testing purposes.
- Perform the field tests and calibrate the tested relay as necessary
- Properly interpret test results and take corrective action if necessary
- Understand test forms and keep proper records.

SCOPE

Day 1

- I. **Class Introduction, Pre-Test, Paperwork**
- II. **Introduction**
 - A. Solid State vs. Electromechanical
 - B. Testing
 - C. Test Precautions
- III. **Solid-State Relay Fundamentals**
 - A. Basic Logic Circuits
 - B. Combined Logic Circuits
 - C. Basic Block Diagram Circuits
 - D. General Electric SFC
 - E. Packaging Characteristics
- IV. **Relay Test Equipment**
 - A. MPRT 8430
 - B. SMRT-36

V. Solid-State Overcurrent Relays

- A. Application
- B. Types of BE1-51 Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Testing
- G. Lab – BE1-51 Overcurrent Relay (3.5 Hours)
 1. Pickup Test
 2. Timing Tests
 3. Instantaneous Tests
 4. Adjustment Techniques

Day 2

VI. Solid-State Voltage Relays

- A. Applications
- B. Model and Style Number
- C. Controls and Indicators
- D. Functional Description of the BE1-27/59
- E. External Connection Diagram
- F. Internal Connections
- G. Testing
- H. Lab – BE1-27/59 Voltage Relay (2.5 Hours)
 1. Pickup Test
 2. Timing Tests
 3. Adjustment Techniques

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

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SCOPE (Cont)

VII. Solid-State Differential Relays

- A. Application
- B. Model and Style Number
- C. Controls and Indicators
- D. Functional Description of the BE1-87
- E. Restrained Trip Output
- F. External Connection Diagram
- G. Internal Connections
- H. Testing
 - I. Lab – BE1-87T Differential Relay (5 Hours)
 - 1. Minimum Pickup Tests
 - 2. Slope Tests
 - 3. Harmonic Restraint Tests
 - 4. Instantaneous Tests
 - 5. Adjustment Techniques

Day 3

VIII. Solid-State Directional Overcurrent Relays

- A. Application
- B. Model and Style Number
- C. Controls and Indicators
- D. Functional Description of the BE1-67
- E. Indicators
- F. Outputs
- G. External Connection Diagram
- H. Internal Connections
- I. Testing
- J. Lab – BE1-67 Directional Overcurrent Relay (5 Hours)
 - 1. Pickup Tests
 - 2. MTA Tests
 - 3. Timing Tests
 - 4. Adjustment Techniques

IX. Solid-State Power Directional Relays

- A. Application
- B. Model and Style Number
- C. Controls and Indicators
- D. Functional Description of the BE1-32
- E. External Connection Diagram
- F. Internal Connections
- G. Testing
- H. Lab – BE1-32R PWR Relay (2 Hours)
 - 1. Pickup Tests
 - 2. MTA Tests

Day 4

- Lab – BE1-32R PWR Relay (Cont) (3 Hours)
 - 3. Timing Tests
 - 4. Adjustment Techniques

X. Solid-State Synchro-Verifier Relays

- A. Application
- B. Types of BE1-25 Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Testing
- G. Lab – BE1-25 Synch Check Relay (3 Hours)
 - 1. Angle Tests
 - 2. Voltage Differential Test
 - 3. Timing Tests
 - 4. HBDL Test
 - 5. DBHL Test
 - 6. Adjustment Techniques

Day 5 (1/2 Day)

XI. Post-Test and Paperwork