

Protective Relay Maintenance, Generation

4.5 Days, 3.2 CEUs

Mechanical relays that are designed to monitor and protect generators from damage are unique from other protective relays. NETA and FERC Maintenance and Testing standards recommend testing relays at regular intervals based on equipment condition and reliability requirements. While they use time proven protective functions, those functions are modified or enhanced for the specialized requirements of generator protection. Special training is required to understand, test, calibrate, and maintain generator relays. Proper relay maintenance procedures will ensure that the generator and prime mover are protected from damage and are operating within prescribed boundaries. Understanding generator protective zones and their associated protective relays will assist the technician to effectively troubleshoot generator events, so that service interruptions are minimized and system integrity is preserved. The Protective Relay Maintenance Generation course is an intensive, hands-on, lab oriented presentation covering:

1. Voltage controlled and voltage restrained overcurrent Relays (27/51)
2. Reverse Power Relays (32)
3. Loss of Field or Loss of Excitation Relays (40)
4. Negative Sequence Relays (46)
5. Generator Differential Relays (87G)

The participant will learn the basics of generator 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.

This course is developed to challenge test technicians who want to thoroughly understand generator and unit protection and the testing, calibration, and maintenance of generator protective relays. Participants should have basic knowledge of AC/DC electricity and basic generator functions. Those technicians who qualify will be certified to test, maintain and calibrate the relays presented in the labs.

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:

- Identify generator relay components and explain their operation
- Interpret AC and DC relay schemes.
- Perform tests and calibrate the following relays (ANSI device numbers):
 - Voltage Controlled/Restrained Overcurrent Relays (27/51)
 - Directional Power Relays (32)
 - Loss of Field/Excitation Relays (40)
 - Generator Differential Relays (87G)
 - Targets and Indicators
- Summarize the application of the relays.
- Perform direct injection testing and evaluate results.

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

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SCOPE

Day 1* (7 contact hours)

- I. Introduction (0.5 hr)
 - A. Types of Generators Rules
 - B. Schemes for Generators
- II. Relay Test Equipment (0.5 hr)
 - A. SMRT Quick Start
 - B. Power DB Demo (instructor led)
- III. Protective Relay Maintenance/ Testing (1 hr)
 - A. Mechanical and Visual Inspections
 - B. Preventive Maintenance Testing
 - 1. Visual Check
 - 2. As-Found and As-Left Tests
 - C. Acceptance Testing
 - D. Testing Techniques
 - E. General Tests

AM Break

All relays:

- A. Application
- B. Types of Relays
- C. Components
- D. Operating Principles
- E. Protection Scheme
- F. Testing
- G. Types of Tests
- H. Adjustments
- I. Time Settings

- IV. ABB/Westinghouse Overcurrent Relay (COV) (2.5 hrs)

- J. Lab
 - 1. Pickup Test
 - 2. Timing Test

Lunch

- 3. Seal-In Test

- V. General Electric Overcurrent Relay (IJCW) (2.5 hrs)

- J. Lab
 - 1. Pickup Test

PM Break

- 2. Timing Test
- 3. Seal-In Test

Day 2 (7 contact hours)

- VI. Introduction to Generator Differential Relays (0.5 hr)
 - A. Application
 - B. Operating Principles

- VII. ABB/Westinghouse Differential Relays (CA) (2 hrs)

- J. Lab
 - 1. Minimum Pickup Test
 - 2. Timing Test
 - 3. Slope Test

AM Break

- 4. Seal-In Test

- VIII. General Electric High-Speed Differential Relays (CFD) (2 hrs)

- J. Lab
 - 1. Minimum Pickup Test
 - 2. Timing Test
 - 3. Slope Test
 - 4. Seal-In Test

Lunch

- IX. Introduction to Power Relaying (0.5 hr)

- X. ABB/Westinghouse Reverse Power Relay (CW) (2 hrs)

- J. Lab
 - 1. Pickup Test

PM Break

- 2. Timing Test
- 3. MTA Test
- 4. Seal-In Test

Day 3 (7 contact hours)

- XI. General Electric Power Relays (ICW) (2 hrs)

- J. Lab
 - 1. Pickup Test
 - 2. Timing Test
 - 3. MTA Test
 - 4. Seal-In Test

AM Break

- XII. ABB/Westinghouse Negative Phase Sequence Relays (COQ) (2.5 hrs)

- J. Lab
 - 1. Filter Test
 - 2. Pickup Test
 - 3. Timing Test

Lunch

- 4. Seal-In Test

- XIII. General Electric Negative Phase Sequence Relays (INC77) (2.5 hrs)

- J. Lab
 - 1. Filter Test
 - 2. Alarm Pickup Test

PM Break

- 3. Trip Pickup Test
- 4. Trip Timing Test
- 5. Seal-In Test

Day 4 (7 contact hours)

- XIV. ABB/Westinghouse Loss of Excitation Relays (KLF/KLF-1) ... (4 hrs)

- J. Lab
 - 1. Reach Test
 - 2. MTA Test
 - 3. Fwd Characteristic Test
- AM Break
- 4. Offset Reach Test
 - 5. Directional Unit Pickup Test
 - 6. Directional Unit MTA Test
 - 7. Undervoltage Unit Dropout Test
 - 8. "X" Relay Pickup and Dropout Tests
 - 9. Seal-In Tests

Lunch

- XVI. General Electric Loss of Excitation Relay (CEH51A) (3 hrs)

- J. Lab-CEH Loss of Excitation
 - 1. Reach Test
 - 2. MTA Test
 - 3. Fwd Characteristic Test

PM Test

- 4. Offset Reach Test
- 5. "A" Relay Pickup and Dropout Test
- 6. Seal-In Test

Day 5 (1/2 day) (4 contact hours)

- XVII Conclusion (4 hrs)

- A. Review

AM Break

- A. Review (cont'd)
- B. Final exam



STANDARD EQUIPMENT LIST

Protective Relay Maintenance, Generation

REVISED: 03/03/2014

BY: DENNIS MOON

DAYS: 4.5 DAYS

TEXT (PER 1 STUDENT)	
1	PROTECTIVE RELAY MAINTENANCE - GENERATION COURSE #9913, JULY 2000

MATERIALS NEEDED (PER CLASSROOM)	
QUANTITY	ITEM
*1	PROJECTOR OR TV WITH PROJECTION CAPABILITIES
*1	DRY ERASE BOARD WITH MARKERS AND ERASERS
*10	STUDENT TABLES
*10	STUDENT CHAIRS

EQUIPMENT (PER 1 STUDENT)	
1	CALCULATOR
1	NEUSES BURNISHING TOOL
1	MULTI BIT SCREWDRIVER

EQUIPMENT (PER CLASS)	
1	TOOL BOX (SEE ATTACHED SHEET)

DEVICES (PER 1 STUDENT)	
2	GE TEST JACKS
2	STATES TEST JACKS
2	WEST COV-7, 8, 9
2	GE IJCV-51
2	WEST CA GEN DIFFERENTIAL
2	GE CFD-22B
2	WEST CW 0 DEGREES OR 30 DEGREES
2	GE ICW-51A
2	WEST COQ
2	GE INC-77
2	WEST KLF, KLF-1
2	GE CEH-51

TEST EQUIPMENT (PER 1 STUDENT)	
2	SMRT 36 TEST SETS

TEST EQUIPMENT (PER TEST SET)	
1	25' EXTENSION CORD 14 GA MULTI-OUTLET

FOR VIRTUAL CLASSES:
CONTENT MATERIAL WILL BE PROVIDED IN DIGITAL FORMAT