

Substation Maintenance II

4.5 Days, 3.2 CEUs

This course provides an overview of electrical power system substations including bus and switching configurations and grounding. It offers training on the components of power and distribution type transformers, including common insulating and cooling mediums, and explains common transformer configurations. It offers training on substation earth testing, transformer testing, and transformer oil testing.

This course is designed to provide an in-depth study to aid skilled qualified substation maintenance technicians in the safe performance of substation component preventive maintenance. This hands-on course is intended for apprentices, technicians and engineers responsible for the maintenance and testing of industrial and utility substations.

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 and lab practice, the participant will demonstrate that he/she is able to:

- Explain the configuration and function of common equipment found in a substation.
- Identify components of power and distribution type transformers, including common insulating and cooling mediums.
- Summarize the importance of proper grounding requirements in a substation.
- Perform and interpret results of required tests performed on transformers.
- Calculate temperature corrections.
- Summarize ASTM requirements for testing and sampling gas and oil in transformers.
- Demonstrate and interpret results of earth resistance tests.

SCOPE

Day 1* (7 contact hours)

- I. Introduction (0.5 hr)
- II. Introduction to Safety (0.5 hr)
 - A. Lab Safety Rules
 - B. On-the-Job Safety
- III. Substation Overview (0.5 hr)
 - A. Components of a Power System
 - B. Substation Switching Configurations
 - C. Substation Components

- D. Metering in Substations
- E. Relaying in Substations
- IV. Substation Grounding (0.5 hr)
 - A. Functions of Substation Grounding Systems
 - B. Grounding Methods for Electric Supply
- V. Substation Earth Testing (1 hr)
 - A. Safety
 - B. Earth Resistivity

- C. Determining a Good Electrode Location
- D. Earth Resistance Testing Principles
- E. Direct Method
- F. Fall of Potential Method
- AM BREAK
- G. Intersecting Curves Method
- H. Slope Method
- I. Maintenance

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

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SCOPE (cont'd)

VI. Components and Indicators .. (0.5 hr)

- A. Major Components
- B. Indicators and Alarms
- C. Instrument Transformers

VII. Nameplate Data (1 hr)

- A. Transformer Nameplate
- B. Operating Principles
- C. Nameplate Data Exercise

LUNCH

VIII. Inspections (0.5 hr)

- A. Visual (Routine) Inspections
- B. Diagnostic Inspections
- C. Recommendations for Testing and Maintenance

IX. Transformer DC Testing (2.5 hrs)

- A. General Safety Precautions

PM BREAK (15 min)

- B. DC Testing
- C. Insulation Resistance

Day 2 (7 contact hours)

IX. Transformer DC Testing (cont'd) (1 hr)

- D. Winding Resistance Testing

X. Transformer AC Testing (2 hrs)

- A. AC Testing
- B. Power Factor Testing Fundamentals
- C. Transformer Winding Testing

AM BREAK

D. Liquid Insulating Power Testing

E. Core Excitation Current Testing

XI. Transformer Oil Testing (1 hr)

- A. Insulating Liquids
- B. Liquid Sampling

LUNCH

XI. Transformer Oil Testing (cont'd) (3 hrs)

- C. Sampling for Gas-In-Oil Analysis
- D. Dielectric Breakdown Voltage Test
- E. Color Testing
- F. Visual Examination
- G. Neutralization Number Test
- H. Interfacial Tension Test

PM BREAK

- I. Moisture Content Test
- J. Insulating Liquid Power Factor Testing
- K. Evaluation of Test Data
- L. Other Insulating Liquids

Day 3 (7 contact hours)

XII. Transformer Gas Testing (2 hrs)

- A. Gas Detection
- B. Oxygen Testing
- C. Combustible Gas Testing
- D. Gas Analysis Interpretation

AM BREAK

XIII. Labs

- A. Earth Resistance Testing (2 hrs)

LUNCH

- B. Insulation Resistance Testing (1.5 hrs)

PM BREAK (15 min)

- B. Insulation Resistance Testing (cont'd) (1.5 hrs)

Day 4 (7 contact hours)

XIV. Labs (7 hrs)

- A. Winding Resistance Testing

AM BREAK (15 min)

- B. Turns Ratio Testing

LUNCH

- C. Power Factor/Dissipation Factor Testing

PM BREAK

- D. Oil Dielectric Testing (Optional)

Day 5 (Half Day) (4 contact hours)

XV. Conclusion

- A. Review (3 hrs)

AM BREAK

- B. Final test (1 hr)