

Advanced Transformer Maintenance and Testing

4.5 Days, 3.2 CEUs

Aging transformers require a higher level of inspection and maintenance to extend their useful service life. If maintaining these devices is your responsibility, this course provides the necessary tools to succeed. Power and Instrument Transformers are critical and expensive components of the electric energy system, maintaining safe and reliable operation is essential.

Technology has made the fundamental principles of energy transfer a complex set of mathematical algorithms used to improve the four main areas of a transformer's design: mechanical, electromagnetic, dielectric, and thermal.

Pre-Requisites

Before attending the Advanced Transformer Maintenance and Testing training course it is recommended the attendee has:

- Completed the basic Transformer Maintenance and Testing training course
- Previous knowledge of the different types of transformers, components, and their operation.
- Familiarity with fundamental transformer testing.

Lab and Classroom Attire

AVO is committed to the personal safety of each participant and requires safety glasses, 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, the participant 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:

- Outline the service life of a transformer and the importance of transformer testing to ensure its integrity and estimate its age.
- Demonstrate the various tests used to diagnose the condition of a transformer and how to analyze results.
- Apply the SFRA fundamentals and its guidelines for interpretation.
- Summarize the importance of the condition of the insulation system and how to evaluate it.
- Illustrate the Dissolved Gas Analysis test to determine the presence of active fault conditions.
- Explain the Power Factor test and what results may indicate.
- Describe the Dielectric Frequency Response technique and its importance.
- Paraphrase the definition of a current transformer, its features and applications for measurement and protection.

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

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SCOPE

Day 1* (7 contact hours)

- I. Introduction to Advanced Transformer Training
- II. International Standards and Guidelines

AM Break

- III. Electromechanical Condition Assessment

Lunch

IV. Labs (3 hrs)

- 1. LV Turn Ratio & Polarity Test Excitation Current Winding Resistance and Demagnetization

PM Break

- 2. Leakage Reactance
- 3. HV Turn Ratio Test and Excitation Current

Day 2 (7 contact hours)

- V. Advanced Electromechanical Diagnostics
Sweep Frequency Response Analysis (SFRA)

AM Break

- VI. Simulation of SFRA Testing and Instrument Verification

- VII. Transformer Insulation: Solid and Liquid

Lunch

- VIII. Physical, Chemical, and Electrical Analysis

PM Break

- IX. Liquid Insulation Analysis-Dissolved Gas Analysis

Day 3 (7 contact hours)

- X. Special Topics of Insulation Diagnostics by the Power Factor Method

AM Break

- XI. Dielectric Frequency Response Frequency Domain Spectroscopy

- XII. Simulation of DFR Testing and Instrument Verification

Lunch

XIII. Labs

- 4. Insulating Liquids - Electrical Testing
- 5. Lab Power Factor - ITC, VDF, and Tip-Up

PM Break

- 6. Sweep Frequency Response Analysis

Day 4 (7 contact hours)

- XIV. Transformer Dry-Out Process Advanced Monitoring

- XV. Loading of Oil-Immersed Power Transformers Life Estimation

AM Break

- XVI. Instrument Transformer Testing Advanced Current Transformer Diagnostics

- XVII. Transformer Test Data Management

Lunch

XVIII. Labs (3 hrs)

- 7. Transformer DFR
- 8. CT Multi-Tap Testing

PM Break

- 9. Instrument Transformer and Bushing DFR

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

XIX. Labs

XX. Conclusion

- A. Evaluation of Results - Group specific work
- B. Preparing presentations of evaluations

AM Break

- C. Final written examination
- D. Group specific work - presentation (each group presents results in 20 minutes)



STANDARD EQUIPMENT LIST
Advanced Transformer Maintenance and Testing
 Course Number: 149, REV. 3

REVISED: 08/30/2017

BY: Mike Carter

DAYS: 4.5 DAYS

TEXT (PER 1 STUDENT)	
QUANTITY	ITEM
1	ADVANCED TRANSFORMER MAINTENANCE AND TESTING , COURSE #149 REV 3, AUGUST 2017

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 CLASS)	
QUANTITY	ITEM
3	PERSONAL COMPUTER W/LISTED SOFTWARE: POWER DB 10.5 X PROFESSIONAL OR LITE FRAX 2.5 MLR10 3.6.00 DELTA CONTROL 2.0 IDAX 5.0 X
1	FREQUENCY RESPONSE ANALYZER FRAX 101 OR FRAX 150
1	FDB 101 TRANSFORMER SIMULATOR DEMO BOX
1	FTB 101 FIELD VERIFICATION BOX
1	TTR310 THREE PHASE TURN RATION TEST SET
1	MTO 300 THREE PHASE WINDING RESISTANCE TEST SET
1	MLR10 LEAKAGE REACTANCE TEST SET
1	12 kV CAPACITANCE & DISSIPATION FACTOR (POWER FACTOR) TEST SET DELTA 4310
1	10 KV HV TTR 10nF CAPACITOR
1	ACCESSORY KIT INCLUDING %RH AND TEMPERATURE SENSOR
1	OIL TEST CELL
1	INSULATION DIAGNOSTIC ANALYZER IDAX 300S
1	IDB 300 TRANSFORMER DEMO BOX

1	INSULATION RESISTANCE TEST SET SI SERIES 5 OR 10 kV (2,4, OR 8 mA NOISE REJECTION)
1	OIL DIELECTRIC BREAKDOWN TEST SET OTS 60PB INCLUDING ALL ACCESSORIES FOR ASTM AND IEC TESTING
1	RELAY & CURRENT TRANSFORMER TEST SET MRCT

FIXED EQUIPMENT TO BE TESTED	
QUANTITY	ITEM
	OIL IMMERSERD TRANSFORMERS: OUTDOOR SUBSTATION UNIT INDOOR SUBSTATION UNIT REQUIRED ONE UNIT MECHANICALLY DAMAGED REQUIRED ONE UNIT DIELECTRICALLY DAMAGED
1	HV MULTI-TAP CURRENT TRANSFORMERS
2	LV MULTI-TAP CURRENT TRANSFORMERS
	LV OR MV INDUCTIVE POTENTIAL TRANSFORMER
	OIL SAMPLES FOR TESTING

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