

Transformer Off-line Electrical Field Testing

Overview:

This interactive 3-5 day seminar combines theoretical background with practical field experience to provide engineers and technicians with the vital knowledge for off-line electrical testing of power transformers and other high-voltage electrical apparatus. For each test, there will be an in-depth discussion of each measurement, physics behind the measurement, setup and test methodology and acceptance criteria. In-depth discussion of each measurement, its purpose and expected results. Doble specialists will train you to review and decipher apparatus test results so that they are clear and easy to understand.

Learn from Doble's collection experience from working with 1,000's of transmission, distribution, generation and industrial clients globally.

Practical field testing demonstrations could extend training for a fourth and fifth day provided they can be coordinated well in advance along with information about objects to be tested.

Learning Outcomes:

Upon completion of this course, the participant will be able to:

- Understand the various off-line electrical tests at factory acceptance, transportation, installation and over asset life-cycle.
- Establish benchmark results to significantly increase diagnostic value of future tests.
- Understand when to perform specific off-line routine tests, off-line diagnostic tests and in-service diagnostic tests.
- Recognize different equipment test arrangements for different transformer designs.
- Correlate electrical test result with insulating test results.
- Interpret test results, case studies and numerous field examples.
- Improve asset management through accurate electrical asset condition assessment.
- Manage critical asset risk by learning to detect faults early.

Course Audience:

Electrical engineers, managers and technicians working in operations, maintenance, engineering, or other service field in which knowledge of electrical testing methods and evaluation is required part of job responsibility.

Duration:

Three to Five Days

Class Size:

8 - 15 Attendees

Credits:

Up to 2.4 CEUs or 24 Professional Development Hours

COURSE OUTLINE

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The course program contains the following training outline:

- **Dielectric Theory & Application** – Basic power factor theory will be presented. Topics will include basic measurements of current, capacitance, watts losses and power factor, and the role of each in insulation assessment. Basic test circuits as well as safety recommendations will be discussed.
- **Safety During Testing** – An overview of Doble recommended safety practices will be discussed. These include safety features of the M4100 as well as apparatus and personnel safety considerations.
- **Bushing Testing** – Basic bushing construction and design will be discussed. Recommended bushing tests including C1, C2, hot-collars, etc. and the role in determining the health and condition of a bushing will be discussed.
- **Power Factor & Capacitance Measurements** – Testing of bushings and main insulation to detect problems from aging, contamination, excessive moisture and mechanical issues.
- **Power Factor Tip-up** – How to perform the test and will review types of problems detected.
- **Excitation Current** – How to make good measurements, pattern recognition and variation based on transformer design.
- **Turns Ratio** – Both high-voltage and low-voltage test methods will be reviewed along with examples on how having both results can be of advantage.
- **Leakage Reactance** – Review of the physics behind the short circuit impedance measurement and its role in transformer field diagnostics. Discussion of test procedures as well as basic data analysis and expected results.
- **Sweep Frequency Response Analysis** – Discuss the role of frequency response analysis in a transformer condition assessment program. Review of theory, test procedures and expected results.
- **Winding Resistance** – Important test for detecting connection problems but can be subject to much variation unless care is taken in the measurements. The test method will be reviewed along with how to avoid common pitfalls in test technique. Best practice for interpretation of results and what are meaningful differences in results will be discussed.
- **Insulating Fluid Basics and How to Take a Proper Oil Sample** – Review the most common analytical tests performed on insulating fluids to assess transformer health. Important aspects of the sampling process will be covered to help ensure that a representative sample of the bulk insulating oil is obtained.
- **Interactive Case Studies** – Each day, field test results related to the material presented will be provided for seminar participants to discuss and analyze in small groups. Groups will be asked to identify the issues in their cases, recommend next actions to be taken, and present their findings and conclusions. Case discussion, problem solving techniques and solutions will be presented. This will be a practical exercise with real situations and decision-making which all field personnel encounter.

Presenter(s):

An experienced Doble Client Service Engineer or Technical Application Engineer.

Division of Responsibilities:

If the course is hosted at a customer location, to ensure smooth training course delivery, Doble requests the following division of responsibilities:

Doble will provide:

- Confirmed training dates upon receipt of a purchase order.
- Technical agenda for program.
- One experienced instructor including their travel/living expenses.
- Training manual (soft copy) to each participant.
- If applicable, all required measurement test equipment and tools for class and site training.
- All personnel safety equipment for Doble instructor.

Customer will provide:

- Confirmed training schedule at least 60 days in advance.
- Training coordinator through whom all contractor requests will be coordinated.
- Training facility, AV equipment, whiteboard and pens.
- Printing hard copy training material as required.
- If applicable, site access for any areas of the program outlined above for practical on-site training. Responsible for all safety issues before, during, and after the field demonstration.

