



Understanding the Value of Electrical Testing for Power Transformers

Canada Protection Symposium Tutorial

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Description

The electric power industry is always looking for the best approach to better determine and continually track the condition of power transformers. It is important to understand the need for and value of comprehensive testing of power transformers.

Through careful selection, hierarchical value, and appropriate times of use, today transformer diagnostics generally consists of a comprehensive suite of basic or standard electrical field tests including:

- > Power Factor
- > Exciting Current
- > Turns/Voltage Ratio
- > Leakage Reactance
- > DC Winding Resistance
- > Sweep Frequency Response Analysis (SFRA)

These specific diagnostic tests have been selected as the primary focus for this training and discussion.

Learning Objectives

- > Identify power transformers properties essential for comprehensive diagnostic testing.
- > Become familiar with best practices, test preparation, and influencing factors.
- > Understand the basics steps in testing power transformers.
- > Learn basic analysis strategies.

A comprehensive list of power transformer topics will be presented including:

1. Introduction to Power Transformers/Bushings/Surge Arresters
2. Best Practices
3. Application of Electrical Measurements
4. Advanced Diagnostic Test Methods
5. Analysis and Interpretation Results

Introduction to Power Transformers

- > Transformer Types (2-Winding, 3-Winding, Autos)
- > Winding Configurations (Delta, Wye, Auto, Zig-Zag)
- > Conservator Types
- > Insulating Material
- > Fluid Types
- > Construction Forms (Core, Shell)
- > Nameplates
- > Cooling Modes
- > Life Expectancy
- > Tap Changers (OLTC, DETC)
- > Failure Modes
- > Transformer Testing (Factory, Field)
- > Analysis and Interpretation of Test Results (Using Standard Limits, Using Nameplate Values, Identifying Trends, Confirming the results of Other Diagnostic Tests)

Introduction to Bushings

- > Bushing Theory
- > Bushing Types (OIP, RIP, and non-condenser)
- > Bushing Tap Adapters (Test and Potential)
- > Bushing Nameplates and Ratings
- > Failure Modes
- > Bushing Testing (C1, C2, Energized Collar)
- > Analyzing Results
- > Field Experience

Introduction Surge Arresters

- > Surge Arrester Theory
- > Surge Arrester Types (Metal-Oxide, Silicone-Carbide)
- > Failure Modes
- > Surge Arrester Testing
- > Analyzing Results
- > Field Experience

Best Practices

- > Test Preparation
- > User Error
- > Temperature/Humidity
- > External Contamination
- > Lead Placement and Contact
- > Electro-Static/Electro-Magnetic Interference
- > Grounding

Application of Electrical Measurements

- > Power Factor and Capacitance
- > Exciting Current
- > Ratio (TTR)
- > Impedance: Leakage Reactance
- > DC Winding Resistance
- > SFRA

Advanced Diagnostic Testing Methods

- > Tip-Up PF/CAP
- > Variable Frequency PF/CAP

Analysis and Interpretation of Results

- > Interpretation Strategies
- > Limits and Trending
- > Failure Modes
- > Assessment to Industry Standards
 - > IEEE C57.152
- > DGA/Oil Screen
- > Moisture Estimation
- > Residual Magnetization (DEMAG)

Pre-Requisites

- > Basic knowledge and understanding of power transformers and substation components