

# ELECTRICAL TRANSFORMER TESTING AND MAINTENANCE



November 27-28, 2017	Richmond, BC
November 29-30, 2017	Edmonton, AB
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Transformer Life Extension Strategies - The Latest Engineering and Testing Techniques!

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# ELECTRICAL TRANSFORMER DESIGN, TESTING AND MAINTENANCE

Perhaps one of the most important electromagnetic systems today is the electrical transformer. The robustness, range of operation energy density and simplicity associated with the relatively long life make the transformer a unique component in the Electrical Power Transmission and Distribution Systems.

As an owner of transformers you are faced with the challenge of how to minimize downtime and maximize life expectancy of your valuable asset. With budget restraints, knowing how to prioritize your transformer testing and maintenance expenditures is crucial. This transformer testing and maintenance course will review what traditional and new maintenance testing procedures should be utilized by transformer owners. We will also look at the latest developments in transformer design, construction, testing, diagnostics, oil sampling techniques, interpretation of results and transformer asset planning.

Many electric utilities and large industrial, commercial and institutional owners of medium and large power transformers are beginning to develop their own "Life Cycle Transformer Management" programs.

Our 2016 Electrical Transformer design, testing and maintenance course will deal with many of the technical and economic issues such as a) The Screening Process to prioritize the transformer fleet; b) Transformer Condition Assessment of individual transformers, and c) Life Cycle Decisions: retire, refurbish, replace, relocate.

Students will learn safe and proper maintenance and testing procedures on power transformers. The course covers transformers used in commercial and industrial power distribution systems, including oil and dry-type units. Larger power transformers used in utility applications are also covered.

## Students will learn:

- The principle of operation of the transformers
- Types of transformer core: one phase; 3 phase; Autotransformer
- Most important and typical applications;
- Sizing of a transformer for a specific application;
- How to calculate the main parameters based on equivalent schematic
- Factors that affect the proper operation of the Power and Distribution Transformers
- Connection Diagrams of primary and secondary winding; Y; Delta and Zigzag
- Special transformers for low power: Current and Voltage-Autotransformers; Special Core construction and special winding diagrams
- Relay Protection for Power and Distribution Transformers
- Buckholtz Gas relay Protection and indication
- Paralleling Backup Power transformers
- Voltage transients during operation
- Surge arrestors required
- Coordination of the BIL with the rest of the System
- Thermal Stress and normal limits
- Forced ventilation and oil circulation
- Overload Capability of Power transformers
- Installation conditions for specific application
- Off Load and On Load tap changer
- Testing the dry type Power Transformers
- Testing Oil Cooled Power transformers
- On Power and Off Power Oil Test

## AGENDA - DAY 1

### PART 1. RISK ASSESSMENT & ASSET MANAGEMENT

- This presentation will show how to identify, assess and mitigate the risks associated with distribution and power transformers. Transformers and other electrical equipment are assets that have ongoing maintenance needs or are at risk for failure. The presentation will assist participants in developing an intelligent maintenance program that will evaluate risks and consequences of failure and prioritize maintenance needs according to our data and standards, industry standards and best engineering practices.
- Learn how to develop or improve a risk-based asset management program.
- Identify categories of assets within an organization.
- Define risk-based asset management and why it is important in managing the life cycle.
- Perform an analysis of an electrical system equipment with an emphasis on transformers.
- Identify advantages of various maintenance programs and the benefit of on-line monitors.
- Students will learn the causes of failures and how to assess the risk of failures.
- Develop or improve a risk-based asset management program for your company.
- Assess and implement proper maintenance practices to prevent unplanned and unscheduled outages.
- Understand test results and perform an analysis of your company's electrical system in order to improve operating conditions.
- Students will be able to perform a transformer assessment to determine the condition and risk of your transformer investment.

### PART 2. INTRODUCTION TO TRANSFORMER TESTING

- Solid Insulation
- Transformer Oil
- Testing Transformer Oil
- Moisture in Transformers

- Dissolved Gas Analysis
- Analysis for Furanic Compounds and Non-Routine Oil Tests
- Electrical Testing Principles
- Interpreting Oil Test Results and Maintenance Options

### PART 3. INCREASE TRANSFORMER RELIABILITY AND LIFE CYCLE THROUGH PROPER MAINTENANCE OF LOAD TAP CHANGERS

- Brief History of Load Tap Changing
- Basic Electrical Theory
- Components and Configurations
- Operating Principles
- Monitoring and Testing
- Internal Inspections and Maintenance
- Developing a Detailed Maintenance Program

### PART 4. DISSOLVED GAS ANALYSIS (DGA)

- How dissolved gas analysis (DGA) results are interpreted – an important tool in the overall transformer maintenance program. Includes hands-on break out groups. This session is intended to identify fault gases and what causes their formation; explain and provide examples of qualitative and quantitative interpretation of dissolved gasses. This class will also evaluate the condition of cellulose insulation and other non-routine tests, and how to determine if a transformer is at risk for failure due to presence of corrosive sulfur, and how to mitigate the risk.
- Maintenance and Sampling Oil
- Introduction to Oil Testing
- Dissolved Gas Analysis
- Non-Routine Oil Analysis
- DGA Case Studies

complete course details:

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#### PART 5. IN-SERVICE INSPECTION & SAMPLING OF FLUID-FILLED TRANSFORMERS

- Learn how to properly inspect and safely obtain fluid samples from energized electrical transformers. This session is designed for substation personnel whose responsibilities include sampling and monitoring the overall condition of fluid filled transformers.
- Safety
- Special Care Transformers
- Transformer Part & Visual Inspection
- Inspection Forms/Nameplates/Gauges
- Sampling Containers
- Proper Sampling
- Nitrogen Blanket
- Packaging
- Why Oil Test
- The importance of monitoring the insulation

## AGENDA - DAY 2

#### TRANSFORMER FIELD DIAGNOSTICS TESTS AND TECHNIQUES

##### TRANSFORMER FAILURES

- Misapplication, overload and stress
- Vibration, and vibration monitoring
- High operating temperature
- Lightning or line surges
- Overloading types and effects
- Care of control equipment
- Lack of cleanliness
- Care of idle or spare equipment
- Improper lubrication
- Careless or negligent operation

#### TRANSFORMER FIELD DIAGNOSTIC TESTING AND MAINTENANCE TECHNIQUES

- WINDING RESISTANCE
- Testing techniques
- Voltmeter – Ammeter method
- Bridge technique
- Micro ohmmeter

#### TRANSFORMER RATIO/POLARITY

- Testing Techniques
- Inductive kick (DC method) polarity
- Alternative voltage (AC method) polarity
- Turn ratio test set
- Double voltage meters

#### EXCITATION CURRENT MEASUREMENT

- Hysteresis
- Eddy currents
- Copper losses

#### SHORT CIRCUIT IMPEDANCE MEASUREMENT

- Testing techniques
- Voltmeter – Ammeter method

#### SWEEP FREQUENCY RESPONSE ANALYSIS

- Testing techniques
- Problems detected
- Shifted winding/core
- Deformed windings
- Loose windings

#### INSULATION RESISTANCE

- Testing techniques
- Megger
- Polarization index test (PI)
- Can detect the following problems
  - Insulation dryness
  - Insulation contamination
  - Sensitive to temperature

#### INSULATION CAPACITANCE AND POWER FACTOR

- Testing techniques
- Capacitance bridge method – DF Dielectric Factor
- AC Dielectric loss method - PF Dielectric Power Factor or Tangent Delta

#### PARTIAL DISCHARGE MEASUREMENT

- Can detect the following problems
- Insulation defects
- Insulation contamination
- Air bubbles trapped in insulation
- Localized high electrical stress
- PD is the “cancer” of insulation system
- PD detector
- RIV - Radio Induced Voltage, as supplementary test,

#### TRANSFORMER CORE TESTING

- Typical Core Problems
- Insulation resistance
- More grounding points
- Meggering the Core to tank
- Separate external core ground lead from 250 resistor
- Measure core

#### INSULATING OIL

- Sulphur in transformer oil solutions
- Resolving moisture in transformer oil
- Proposed federal PCB transformer regulations
- Transformer on-line oil monitoring techniques
- Various tests performed on insulating oil
- Properties and parameters of insulating
- Oil sample quality
- Dielectric breakdown
- Water content
- Power factor
- DGA “key” fault gasses
- Benchmarks
- Rating system

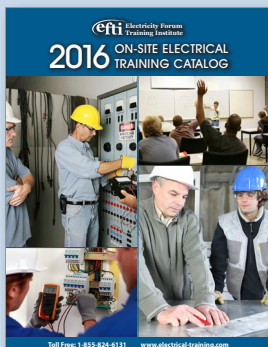
#### BUSHING VISUAL CHECK

- Oil Level
- Leaking
- Chipped porcelain
- Fractured flange
- Poor gaskets
- Peeled painting
- Terminal connection
- Corrosion

#### TAP CHANGERS MAINTENANCE

- DETC
- Contact resistance increase
- Loose contact pressure
- Misalignment
- Electrical and mechanical centers
- LTC
- Contact continuity
- Arcing switch and tap selector
- Drive mechanism operation
- Motor, system
- Timing of the LTC change
- Oil compartment
- Protection and control

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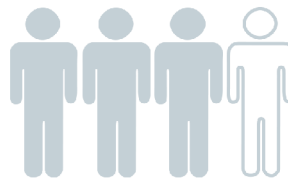
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Sawridge Hotel Edmonton South

4235 Gateway Blvd N

Tel: 780-438-1222

**Winnipeg, MB - December 4-5, 2017**

Hampton Inn Winnipeg Airport

730 Berry Street

Tel: 204-772-3000

**Toronto, ON - December 6-7, 2017**

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3279 Caroga Drive, Mississauga, ON

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**ATTENDEE INFORMATION**

To receive registration fee discounts, you must **REGISTER AND PREPAY** prior to the course date.

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The registration fee to attend the 2016 Electrical Transformer Training course is \$799.00 + Tax. Register and prepay 14 days before forum date and receive an early bird registration fee of \$749.00 + Tax. The fee includes Course presentation materials, refreshments, **Complimentary Lunch Included.**

**Register and prepay 14 days before forum date and receive an early bird discount of \$50.00**

**CANCELLATION AND REFUND POLICY**

Registration fees are refundable only upon receipt of written notification 10 days prior to the conference date, less a 10 per cent service charge. Substitution of participants is permissible.

The Electricity Forum reserves the right to cancel any conference it deems necessary and will, in such event, make a full refund of the registration fees.

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