

Sunday Tutorial Session: “Guidelines for Forensic Examination and Tear-Down of Transformers”

Sponsored by the Transformers Committee

Sunday, March 21, 2010

1:30 pm – 5:30 pm

America Center & South

TUTORIAL: Guidelines for Forensic Examinations and Tear-Down of Transformers Tutorial

Sunday, March 21st, 1:30 pm - 5:30 pm

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The aim of this tutorial is to provide Doble Clients with information and practical experience on how to get the most out of tear-downs. Transformer tear-downs and the associated forensic examinations, provide a unique opportunity to learn about how different designs perform in service. Tear-downs can be used to investigate how and why transformers fail or develop problems in service. Tear-downs on redundant transformers can also provide useful information on incipient faults or design defects so that transformers can be rebuilt to lengthen their service life.

This tutorial will describe the transformer tear-down process in detail. It will describe how tear-downs are carried out, both in the field and at factories or repair shops. The tutorial will also address what can be learned and how this knowledge can be used to improve the management of other transformers in service. Tear-downs also allow materials to be recovered for investigation and testing, to investigate ageing of the solid insulation or other possible problems.

The tutorial will include a large number of case studies from Doble Clients, giving field experience on how they have carried out tear-downs and what they have learned from them. The tutorial will also include insights from the insurance industry. Sometimes it is advantageous to rebuild failed, faulty or aged transformers. The tutorial will include insights from a manufacturer on when to do rebuild and how it is accomplished.

The Featured Speakers for this Tutorial are:

Bill Griesacker; Doble, United States

Bill Griesacker is a member of Doble Global Power Services, employed as a transformer engineer working on projects that include forensic analysis, factory inspections, condition assessment, design reviews and general consulting. He previously worked for Pennsylvania Transformer Technology Inc., where he held various positions including Engineering Manager. His work included high voltage insulation design, transient voltage modeling of power transformer windings and various LTC and DETC switch development projects. Prior to this, he was employed by the Westinghouse Electric Company, working on synchronous generator projects as a member of the Generator Engineering Department. Bill started his career with Cooper Power Systems in large power transformers and later worked in the Kyle Switchgear, Vacuum Interrupter Department. He has earned a M.S. degree in electric power engineering from the Rensselaer Polytechnic Institute and a B.S. degree in electrical engineering from Gannon University. Bill is an active member of the IEEE, PES Transformers Committee where he holds positions in several working groups and subcommittees.

Abel J. Pereira; Bonneville Power Administration, United States

Abel J. Pereira is the manager for Substation Maintenance and High Voltage Engineering at Bonneville Power Administration. This department is responsible for all substation equipment application, maintenance and proper operation. Before assuming this position Abel was a Technical Specialist on Substation Equipment for mainly power transformers, reactors and capacitors. Equipment related issues were resolved in this office from installation to disposal. After graduation Abel became a Design Engineer for protection and control of the power system at BPA. Abel earned a B.S. degree in Electrical Engineering from the University of Portland, Oregon in 1985.

Harry A. Ruggles; American Electric Power Service Corp., United States

Harry Ruggles is a graduate of Michigan Technological University. He is a member of the Doble Engineering Company Client Committees on Transformers, Bushings, Insulators and Instrument Transformers, and a past chair of the Transformer Committee. Harry has written papers and presented seminars to the Doble Client Conferences.

Harry has worked for American Electric Power and its subsidiary companies throughout his utility career. He has been a Station Engineer, Electrical Station Projects Engineer, and Transformer Specialist.

Harry has ongoing responsibility for investigation of transformer failures in the field and in factories and repair shops for the AEP system; contracts for remanufacture of failed equipment and follows the redesigns through manufacture and factory test. Experience includes High Voltage, Extra High Voltage and Ultra High Voltage equipment.

Harry's other duties include transformer problem solutions on in-service equipment and technical instruction and support of AEP employees and specialists.

David Grant; Manitoba Hydro, Canada

David was trained in Chemical and Materials Engineering in Ontario in the 60s. He has worked in a variety of industries, from brewing to Uranium refining, for 15 years in Michigan and Ontario, primarily in process troubleshooting, with some years spent in project management and retrofit design. In the 24 years with Manitoba Hydro, David has taken on a variety of research and method-development tasks. A few of David's original test methods have evolved into methods used by ASTM and IEC. David has been a regular presenter at the Doble Client Conference.

David has been taking part in transformer dissections for quite a few years, eventually suggesting that this topic would be of use to other Doble clients and their engineers. He has a few techniques and pieces of apparatus that are unique and useful in the forensic dismantling of oil-filled equipment.

David's other interests have involved engineering and volunteering. He has been a racetrack flagger and autocrosser for over 40 years. In 2008, he won the Porsche Club's top award, Enthusiast of the Year, for his volunteer efforts, winning out over 100,000 (mostly very enthusiastic) Porsche owners across Canada and the US. He restores old Porsches and race cars in his spare time, and expects to drive one of these classics to Boston for the 2010 DCC.

Simon Ryder, Doble, United Kingdom

Simon Ryder was born in England in 1973. He studied engineering science at St John's College Oxford, graduating in 1996. He joined GEC Alsthom the following year working in transformer design, development and eventually research. He left to join Doble PowerTest in 2003, where he has worked on transformer condition assessment and failure investigations. More recently he has also become involved with transformer procurement for various utilities. He is a fellow of IET, a member of IEEE-PES and a member of CIGRE working group A2.36 on transformer procurement.

Wednesday Tutorial Session: “Visual Inspections of Rotating Machinery”

Sponsored by the Rotating Machinery Committee

Wednesday, March 24, 2010

1:30 pm – 5:30 pm

America Center & South

TUTORIAL: Visual Inspections of Rotating Machinery

Wednesday, March 24th, 1:30 pm - 5:30 pm

America Center & South

Physical Inspection of Generators

To ensure reliable operation and to reduce the possibility of forced outage of a generator requires periodic evaluation. This involves conducting various tests, i.e. electrical, mechanical and thermal evaluations. However, some types of deterioration and failure modes are best detected and confirmed with a physical inspection. An example of such a failure mode is shown in the photograph below of a core failure in the step iron of a turbine-generator.



Failure due to Loose Step Iron

This tutorial will help define the various stator failure modes common to hydro-generators and turbine-generators. Both air-cooled and hydrogen-cooled turbine-generators will be discussed.

It is the intent of this tutorial to also help identify test and inspection evidence that substantiates the presence of deterioration that may progress to failure modes versus acceptable conditions that will not result in failure.

Session 1 – Physical Inspection of Turbine-Generators

Failures Modes of Turbine-Generators

Clyde Maughan; Maughan Engineering Consultants

Physical Inspection of Turbine-Generators

James Timperley; Doble Engineering Company, USA

Session 2 - Physical Inspection of Hydro-Generators

Failures Modes of Hydro-Generators

Eric Eastment; U.S. Bureau of Reclamation

Physical Inspection of Hydro-Generators

John Linn; Portland General Electric

Presented by James Timperley; Doble Engineering Company USA

Training Track

TRAINING TRACK

TRAINING: POWER FACTOR AND APPARATUS TESTING

Monday, March 22nd

America North

Theory, 7:30 am – 9:15 am

Keith Hill, Doble

Bushings, 10:30am – 12:00pm

Don Prien, Doble

Transformers 1:30pm – 4:30pm

Jill Duplessis, Doble

Circuit Breakers and Instrument Transformers, 4:30 –6:00pm

Gary Heuston, Doble

The classes on power factor testing continue to be popular. To begin, the fundamentals of why the power factor tests are so valuable will be covered in the theory portion of this series of classes. The application of these tests will be explained for transformers, bushings, circuit breakers and instrument transformers. Case studies are included to show how apparatus problems have been found by applying the fundamentals of the theory.

TRAINING: DTAWeb

Tuesday, March 23rd

7:30 am – 9:45 am

America North

Marshall Turley, Doble

Doble Engineering has implemented a system where Clients may store Doble Test Assistant data sets in a Doble Engineering database called DTAWeb. This system allows controlled access to the stored information over the World Wide Web. This system of data storage has become very popular. At this time, there are over 700,000 tests for more than 300,000 apparatus from the Doble Client companies using the system. In this class the user of the system learn the benefits of this new system and how to maximize the features of DTAWeb.

TRAINING: SWEEP FREQUENCY RESPONSE ANALYSIS

Tuesday, March 23rd

10:00 am – 12:00 pm

America North

Long Pong, Doble

This year there will be training on the use of the Sweep Frequency Response Analysis technique. A review of the fundamentals will be covered and examples of apparatus problems will be shown.

TRAINING: PARTIAL DISCHARGE TESTING

Tuesday, March 23rd

2:45 pm – 5:30 pm

America North

Matt Kennedy, Doble

Alan Wilson, Doble

Introduction to the basics- what are partial discharges why are they important?

- Partial discharges, causes, consequences
- Examples of failures concentrating on Transformers, Machines, GIS, Cables

How a partial discharge develops physical changes that allow detection

- Indirect methods using heat, light, sound, vibration, chemical changes and radiated electromagnetic waves

Applications of PD techniques

- Measuring the electrical signals on line- using traveling waves and capacitance coupling in cables, machines and transformers and using electromagnetic probes to detect UHF radiation in transformers and GIS.
- Off-line techniques used in the field

TRAINING: FUNDAMENTALS AND DIAGNOSTICS OF TRANSFORMER LOAD TAP CHANGERS

Wednesday, March 24th

1:30 pm – 5:00 pm

America North

Steve Larson, Manager

Snohomish Public Utility District

The Load Tap Changer (LTC) Fundamentals class will aid the participant in understanding how LTC's are constructed and operate. Components of the LTC such as moving/stationary contacts, reversing switch, collector ring, preventive autotransformer, leads and barrier board are identified and discussed. The various designs, such as arcing tap switch reactive & resistive, diverter switch resistive, transfer switch reactive, and vacuum bottle will also be explained, as well as comparing high and low side LTC configurations and series transformer types. Tap changer diagnostic testing (both on-line and off-line) and maintenance of LTC's will be discussed. This class will also describe how LTC controllers work, the meaning of settings, how to choose appropriate settings, test and troubleshoot them.

TRAINING: BASIC PROTECTIVE RELAYING

Thursday, March 25th

7:30 am – 12:00 pm, 1:30 pm – 5:00 pm

St. George

Ed Khan, Doble

The Basic Protection Relaying course is geared towards entry level engineers making their way into the field of relay protection and for technicians who like to obtain the theory and practices of protective relaying. The course is intended to provide a conceptual level of knowledge without the vigorous mathematical details.

The course will cover the following topics:

- Introduction to Relays.
- Differences between Electro-Mechanical, Solid State and Microprocessor Relays.
- Current and Voltage Transformers
- Basic Overcurrent Protection
- Distance Protection
- Transformer Protection.
- Basics of Communication Assisted Protection
- Reclosing of Circuits
- Remote and Local Backup Protection