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Panel Discussion on LTC Diagnostics

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1. Abstract

The science of analysis of gasses dissolved in transformer oil (DGA) to perform diagnostics as is useful for scheduling of maintenance or for knowledge of impending transformer failure has matured to the point that such is now common industry practice. There are many success stories derived from such diagnostics. Much less advanced is the application of DGA procedures to the load tap changer (LTC) of the transformer. The tools for applying equivalently relevant diagnostics to the LTC are still being developed and refined.

Much of the study remains in the chemistry lab, with field investigations directed to confirmation of the analytical results versus real world data. This tutorial will present the state of the art from the perspective of four researchers.

2. Learning Objectives

Transformer engineers must continue to update their knowledge of industry developments in the field of LTC oil DGA. Being so informed will permit difficult decisions, most dramatically such as that to remove a transformer from service, to be made based upon the best knowledge of the existing conditions.

Specific topics that will be addressed by the presenters include:

- Basics of oil chemistry. The fundamental difference in the oil-chemistry of the main transformer and the LTC.
- How fault gas patterns are significantly different in LTCs operating properly vs. those experiencing abnormal operation.
- Studies of the ratios of heating to arcing gases in the oil.
- Products introduced into the insulating fluid and their sources. Explanation of the components that produce gas under normal service conditions. The associated typical gassing pattern of each gassing source is shown.
- Particle size distributions and particle characterization methods as useful diagnostic tools.
- Impact of these mixtures on LTC operation.
- A few simple algorithms to demonstrate how results from dissolved gas analysis can be used to assess the status of an LTC.
- Why the analysis will require a comprehensive database of the history for a specific LTC design. Cautionary remarks regarding different behavior as a result of the specific design (make and model).
- Tools available for acquiring information.

3. Learning Outcomes

Attend will be acquainted with the state of the art of DGA of LTC oil. Specific identified outcomes include improved understanding of:

- The diagnostics related information available from insulating fluids.
- The impacts of new and in-service fluids on the operation of load tap changers.
- The analytical techniques useful for condition assessment.
- Using DGA as a diagnostic tool on LTC.
- Using ratios of heating to arcing gases and particle distribution and sizes as other means in the diagnoses of LTC problems.
- Using DGA for the successful predictive maintenance of load tap changers.
- The complications encountered with respect to interpretation of DGA on LTC.
- The interpretation of DGA results as applied to LTC compartment oil.

4. Presenter's Biographies

Dave Hanson: General Manager of TJ/H2b Analytical Services, Inc. He has been active in the field of insulating materials testing since 1978. He has been involved with the development of test methods and diagnostic criteria for high-voltage electric equipment. His involvement extends to the development of proprietary diagnostic programs for transformers (TCA™), load tap-changers (TASA™), oil-filled circuit breakers (BOA™) and gas-filled circuit breakers (BGA™). Dave Hanson has a master's degree in chemistry from California State University-Sacramento.

Fredi Jakob: Professor Emeritus at California State University where he taught for 36 years. He has been active in the testing field for the power industry since 1972. He was the founder of Analytical ChemTech International that is now a wholly owned subsidiary of the Weidmann Company. He is an active member of ASTM and IEEE. Dr. Jakob received a Ph.D in Analytical Chemistry from Rutgers University in 1961.

Hans Schellhase: Senior Research Chemist and Project Leader of Applied Chemistry (A.C.) at Powertech Labs Inc. in Surrey, British Columbia, Canada. This Business Unit 'A.C.' is responsible for applied research into insulating fluids, fuels and lubricants, new energy sources and environmental chemistry. Before joining Powertech Labs Inc., Mr. Schellhase taught as an instructor in the Chemistry Department of the Southern Alberta Institute of Technology, Calgary, from 1972 to 1981. Prior to this position he worked for the University of Calgary/Alberta, Imperial Oil, Calgary and Shell A.G, Hamburg, Germany. For the last five years he worked on maintenance-free load tap changers.

Dieter Dohnal: Director of Engineering and R&D at Maschinenfabrik Reinhausen. After joining Maschinenfabrik Reinhausen in Regensburg, Germany in 1981 as Manager of the Design Department, he was transferred in 1987 to serve as Engineering Manager at Reinhausen Manufacturing, Humboldt, Tennessee, USA for two years. In 1990, and until 1998, he served as Head of Research & Development. Dr. Dohnal received the M. Sc. degree in Electrical Engineering from the Technical University Carolo-Wilhelmina of Braunschweig, Germany in 1975 and his Dr.-Ing. degree in Electrical Engineering in 1981.