IEEE/PES Transformers Committee
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"Transformer Life Extension for Better Asset Management"

– Technical Presentation –
(Part 2 of 2)
Tuesday, 13 March, 4:45 p.m.

By William Bartley, Craig Stiegemeier and David Woodcock

1. Abstract

This presentation is the second part of a two-part presentation on Transformer Life. In the first session, we will discuss transformer mortality models. In this session on Tuesday afternoon, we will discuss, transformer condition assessment, and life cycle management.

Transformer Risk/Life Assessment has received a lot of attention in the past few years due to the aging fleet of transformers in the industry and high profile system outages caused by transformer failures. Due to advanced aging of transformers throughout the electric power industry, many electric power companies are faced with the possibility of increased failure of these important assets in upcoming years. The purpose of a Condition and Risk Assessment is to provide the transformer owner with a unit-specific, rigorous and detailed assessment of selected units, aimed at assisting in day-to-day problem resolution or as part of effectively managing the overall transformer fleet.

A two-tiered approach has been found to the most reliable and economical method for assessing selected units:

- A macro or high-level phase one assessment can systematically rank the condition, failure probability and associated financial risk for selected units as a group and to choose critical transformer candidates requiring further detailed examination.
- Individual or problem units can be analyzed in a more detailed engineering (micro) assessment, wherein more focused unit-specific maintenance and operational recommendations are developed and reported.

Risk Assessment Screening – The Macro Approach
Although difficult to precisely predict the likelihood of failure of any single transformer over time, methodology for ranking condition and failure probability for selected groups of units, utilizing such tools as risk models and Monte Carlo simulation, can be combined to provide an impartial and systematic evaluation toward this end. Results of the assessment can provide T&D managers with insight into vital technical and financial issues, including unit-specific failure probability and associated risk-cost, along with potentially 5, 10, or 15 year forecasts of the impact on future capital reinvestment for aging and problematic transformers in the fleet.

Analytical Assessment – The Micro Approach
The individual-based design evaluation and condition assessment process is a paramount step in the transformer life assessment and asset management approach. It requires rigorous, state-of-the-art analysis methods/rules, typical of the design, testing, and quality assurance tools presently used by designers in the manufacture of new power transformers. The assessment combines input from the design assessment, historical loading, operational history, and also routine and advanced diagnostic data.

Meeting the growing demand of the grid and at the same time maintaining system reliability may require significant changes in the way the utility operates and cares for its transformers. One conservative strategy suggests that the industry start a massive capital replacement program that duplicates the construction profile of the 60's and 70's. But this would cause many transformers to be replaced needlessly and cost the utility industry billions of US dollars.

Another strategy suggests that we leave all the transformers in service until they fail, and let the insurance pay for it. But most insurance programs have high deductibles, and probably don't cover all the costs. Additionally, the cost of an unexpected failure can be several times the cost of the original transformer installation, when you consider system outages, lost power sales, replacement power expense, and possible environmental clean up costs. The presenters believe that the presentations will help the audience to better understand the risk ranking and condition assessment process. This technical presentation aims to provide a definition, means of measurement, way of standardization, test procedure and applications of the new concept of risk assessment and life cycle management in transformers.

2. Learning Objectives

The presentation will provide:

- Discussion on methods available today to conduct a risk assessment screening of a fleet of transformers and a more rigorous condition assessment of specific individual units.
- Introduction of risk ranking concepts
- Discussion of design and operating parameters that affect the life cycle.
- Review of advance diagnostic tests to help assess current conditions.

3. Learning Outcomes

As a result of attending of this presentation session members will gain:

- An understanding of "risk ranking" (a concept of frequency and severity) for a fleet of aging transformers.
- An appreciation of the parameters that affect the operating risk of a fleet of transformers.
- A recognition of different design issues and operating history that contribute to the life assessment.
- A better understanding of means for solution of the life management problems related to the maintenance of transformers.

4. Presenter's Biographies

William H. Bartley P.E.: Mr. Bartley is an Assistant Vice President and the Principal Electrical Engineer in the Engineering Department of The Hartford Steam Boiler Inspection and Insurance Company. Mr. Bartley earned a B.S. degree in Electrical Engineering from University of Missouri at Rolla, and has been employed by Hartford Steam Boiler since 1971. He is responsible for developing standards, OEM relations, fleet problems, repair procedure development, and new testing technologies. He is a Senior Member of IEEE and serves on both the Transformers Committee and Electric Machinery Committee. He is currently Vice Chair of the Generator Subcommittee /EMC, and holds leadership positions in several generator and transformer Working Groups. He lives in Newington, Connecticut.

Craig L. Stiegemeier: Mr. Stiegemeier is the Engineering Solutions Manager for the Transformer Remanufacturing and Engineering Services Department of ABB Inc. in Saint Louis. His group is responsible for engineering solutions and studies that assist customers in reliably operating aging power transformers. He began his career with ABB (then Westinghouse) in 1979, as a shell form transformer development engineer, at the Muncie Indiana power transformer manufacturing facility. He has been a member of IEEE/PES since 1977, and is actively involved in the work of the Transformers Committee. He received BS and MS degrees in Electrical Engineering from the University of Illinois (Urbana/Champaign) in 1979 and 1981, and did graduate work in the MBA programs at Ball State University and the University of Pittsburgh. He lives in St. Charles, Missouri.

David J. Woodcock: Mr. Woodcock is Vice President of Business Development for Weidmann Systems International Inc. in St. Johnsbury, Vermont. He has over twenty-five years of experience in design, field service, power engineering and business development projects in the power equipment field. At both Weidmann and Dupont, he has been involved in the development of thermally enhanced insulation technology for high voltage transformers. Mr. Woodcock received the Diploma of Mechanical Engineering in England and attended the graduate program in Business Administration at the Wharton School of Business. He is a member of the ASME Power Engineering Society; a member of the IEEE/PES Transformers Committee; a member of CIGRE WG 12-20 Guide for Economic Management of Transformers and WG A2.27 Transformer Monitoring. He lives in Lyndonville, Vermont.