IEEE/PES Transformers Committee
Fall 2002 Meeting, October 20-24, 2002
Oklahoma City, Oklahoma, USA

H2 Generation in Mildly Overheated Transformer Cores

-- Presentation, Tuesday, October 22, 4:45 p.m. --

by Ramsis Girgis and Ed teNyenhuis

1. Abstract

The phenomenon of hydrogen gassing in power transformers, due to moderately overheated cores, was first discovered in 1996. Results of experimental investigations performed in the laboratory and on an actual large power transformer were reported in CIGRE and Doble. Subsequent to those reported investigations, this phenomenon was identified in a number of other power transformers where the core hot spot temperature exceeded identified limits and where H2 gassing was experienced. With the realization of the consequences of this phenomenon, a number of large US utilities are presently including in their transformer specifications limits on the magnitude of the core hot spot temperature such that hydrogen generation is minimized under worst operating conditions of over-voltage at full-load.

This session presents the phenomenon and case studies where hydrogen gassing due to overheating of thin oil film in the core was experienced in the field. The session also presents field & factory measurements as well as analysis of field data collected on a large power transformer, where hydrogen generation was experienced and where modifications were made to the transformer cooling system to significantly reduce the rate of hydrogen generation in the future. Calculated and measured results were found to be in an excellent agreement, which further confirms this hydrogen gas generation phenomenon and confirms that additions are needed in the respective industry standards on gas-in-oil analysis interpretation methods and core hot-spot temperature limits. The session also describes the location and calculation of the core hot spot temperature, which is now becoming ever so important due to the hydrogen-gassing phenomenon. Suggested changes to the over-excitation criteria in the ANSI standards related to the core hot spot calculation are described.

2. Learning Objectives

- Understand the new phenomena of hydrogen gassing and why it raises the importance of the core hot spot temperature calculation and limits on its magnitude.
- Learn about location and method of calculations of the core hot spot in different core types
- Understand the rationale for proposed changes to industry standards, particularly the gas in oil analysis guide, introducing core hot spot temperature limits, and transformer over-excitation.

3. Learning Outcomes

- Be able to identify this new phenomenon to possibly explain long term hydrogen gassing of units in the field.
- Be able to actively contribute to the effort and discussion on revisions to IEEE and other industry standards that are impacted by the hydrogen gassing phenomena as will be explained in detail in the session.

4. Presenter's Biographies

Ramsis Girgis: Dr. Ramsis S. Girgis (F'93) is presently Manager of the Development Engineering Department in the Power Transformer Division of ABB Power T&D Company located in St. Louis, Missouri, USA. He is also the leader of the global ABB R&D activities in the transformer core performance area. Ramsis received his Ph.D. degree from the University of Saskatchewan, Canada, in Electrical Power Engineering in 1978. Dr. Girgis has over 35 years of R&D experience in the area of power, distribution, and high frequency transformers, rotating machines, and pulse-power components. His main areas of interest are electro-magnetics and noise of electric power equipment. He has published and presented over 60 scientific papers in IEEE, IEE, CIGRE, SMM, and other international journals. He is a member of several working groups and subcommittees in the IEEE/PES Transformers Committee and is presently Chairman of the Performance Characteristics Subcommittee within that organization. He has co-authored chapters in two electrical engineering handbooks on transformer design and transformer noise. He is the past Technical Advisor representing the US National Committee in the IEC Power Transformer Technical Committee 14.

Ed teNyenhuis: Ed G. teNyenhuis (M'97) was born in Barrie, Canada in 1966. He received his B.A. Sc. degree from the University of Waterloo, Canada, in 1990 and his M. Eng. degree from North Carolina State University, USA, in 2000; all in electrical engineering. Mr. teNyenhuis has worked in the power transformer industry for 10 years and is presently a design manager at ABB Transformers in Guelph, Canada. His past experience includes positions at ABB Power Transformers Division in Ludvika, Sweden and ABB Electrical Systems Technology Institute in Raleigh, North Carolina, USA. He has published several technical papers in IEEE, SMM and 2DM pertaining to power transformers, magnetics, and electrical steel. He presently chairs the Working Group on Loss Measurement and Tolerances of power and distribution transformers within the IEEE/PES Transformers Committee.