IEEE/PES Transformers Committee
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"Effects of DC Currents on Transformers Under Service Conditions"

-- Technical Presentation --
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1. Abstract

In today's current climate, environmental compliance requires almost noiseless transformer designs. There is also a drive to utilize transformers with low core losses in order to satisfy the aim of minimized carbon dioxide related greenhouse gasses.

In order to achieve these objectives, the most optimal solution is the use of highly efficient grain oriented electrical core steel and the application of the most advanced core stacking techniques. In addition, transformer cores are usually operated at low flux densities and relatively low excitation currents.

However, recent investigations into transformers that have unusually high noise levels in service, when compared to the values which were measured during factory acceptance testing, have revealed that as a result of the techniques employed above, low DC currents may be the source of this phenomenon.

Presently, the origins of low DC currents have not been fully investigated, but the following sources have been identified: power electronics from large drives or wind farms, railroad or subway systems and galvanic corrosion protection of pipelines. There is even the possibility that system transient behavior or frequent energization and de-energization of transformers in networks may also contribute to low DC currents and as a result unusually high noise levels in service.

In order to combat this phenomenon, there are currently two possibilities, namely; the use of mitigation techniques which reduce or prevent low DC currents from impacting on the transformer, or by ensuring that the transformer design is less susceptible to low DC currents.

This tutorial will discuss the possible sources of low DC currents, its effect on transformers in service and the ways in which both the manufacturer and end user can deal with this phenomenon.

2. Learning Objectives

This tutorial will help individuals involved with transformers to:

- Recognize the changing environment for transformers in transmission systems regarding disturbances.
- Understand the impact of low magnitude DC currents on the performance of transformers.
- Accept the need to explore the current conditions in their transmission system and the future trends.
- Specify any unusual system conditions not covered by international standards.
- Investigate possible mitigation solutions.

3. Learning Outcomes

As a result of attending this tutorial session, participants will gain an understanding and will then be enabled to:

- Evaluate the impact of low magnitude DC currents in their area of responsibility.
- Understand the influence of design parameters on the susceptibility to low magnitude DC currents.
- Adapt acceptance test requirements in the specification for future projects if necessary.
- Introduce the newest mitigation technologies in up-coming projects.

4. Presenters' Biographies

Alfons Schrammel is Engineering Manager of SIEMENS Global Technology Center for Large Power Transformers. After graduation at the Technical University of Graz in the field of high voltage engineering, he started in 1986 as a Design Engineer for large power transformers in ELIN factory in Weiz, Austria. In 1990 he changed to technical project management and was responsible for special projects as the first 500 kV phase shifting transformers ever built. In 1996 he became head of the electrical design department and was involved in the technology harmonization program within the VATECH Transformers group and since 2007 within the SIEMENS Transformers group. He is IEEE member and currently active in the working group for development of the Dual Logo IEEE/IEC Standard for "Liquid Immersed Phase Shifting Transformers".

Ron Sharp is a Principal Engineer in the Substation Engineering Services Department of Pacific Gas and Electric Company. After graduating at the University of California-Berkeley in 1972 with an electrical engineering and computer science degree, he began working at PG&E. He has worked in various activities at PG&E including substation construction-design-maintenance and underground transmission. He is an IEEE member and has taken part in various working committees. At PG&E he currently is involved in addressing substation issues in insulator/bushing failures, animal mitigation, energy storage, EHV reactive equipment maintenance/repairs and equipment noise.