Thermal Analysis of Dry Type Power Transformer Under Effect of Linear and Nonlinear Loads

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Abstract

The thermal performance of the dry type power transformers is directly connected to the internal heat source caused by electrical losses. Thus, it is necessary to evaluate the temperatures reached by the transformer core to ensure optimum operation. This paper presents a detailed experimental and numerical study of the heating of a 5 Kva three-phase power transformer operating with linear and non-linear loads. The cooling of this transformer is made with free or forced convection. An analysis of the best types of sensors used to measure temperature was also performed. Computer simulations using the COMSOL Multiphysics® software were carried out to determine the temperature field in the transformer core and their hot spots. As main results, it is observed that the maximum temperatures numerically obtained by the program were close to the experimental. The nonlinear loads generates higher heat sources not envisaged in the project, in which core temperatures reach the limit of 130 °C of the core insulation. Fact that results effectively in reducing the life of the transformer.

Reference

Comsol AB, Comsol Multiphysics-Heat Transer Module, User's Guide, Version 5.1, (2015).
. M. A. TSILI, A. KLADAS, E. I. AIMOIRALIS, T. SOUFLARIS, Power transformer thermal analysis by using an advanced coupled 3D heat transfer and fluid flow FEM model. International Journal of Thermal Sciences. January 2011.
A. C. DELAIBA, J. C. OLIVEIRA, A. L. A. VILAÇA, J. R. CARDOSO, "The Effect of Harmonics on Power Transformers Loss of Life", 1996.
IEEE Std C57.110-2008. "IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents", 2008.
E. F. FUCHS, M. A. S. MASOUM, Power Quality in Power Systems and Electrical Machines, 1e, 638 pp, ISBN.

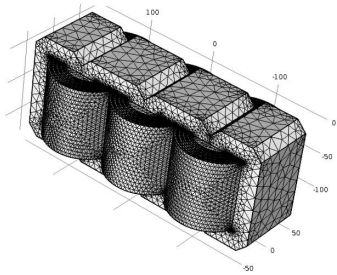# Figures used in the abstract

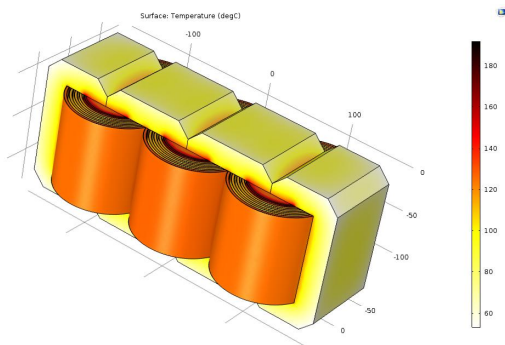Figure 1: Core photo

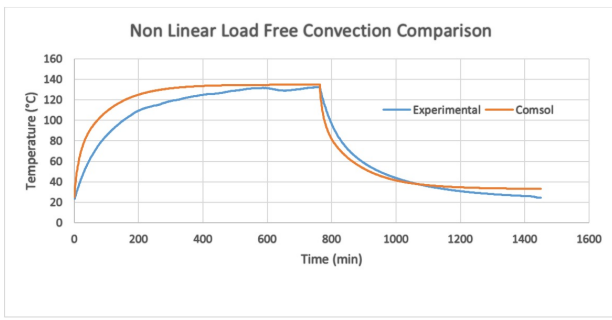Figure 2: Mesh 546566 elements

Figure 3: Temperature Field

Figure 4: Comparison between Experimental and Numeric results.