

Development of a Combined, Empirical and Analytical Tool for Real-Time Estimation of Emergency Loading Capability of Power Transformers

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ABSTRACT

Oil immersed power transformers are very critical components in electric power systems of any kind; besides their high acquisition costs, lead times range from a few, to more than 15 months. Even though these components have a naturally high resistance to thermal overloads, which would make them suitable to participate supporting emergency conditions, and help sustain continued service to critical users, the fact is that other than thermal concerns limit their service capabilities.

As a matter of fact, moisture is always present in transformers insulation, at a level that depends on initial installation dry up control, equivalent service age and maintenance practice. Hence, depending on initial temperature and moisture level, there are constraints to the maximum emergency loads that particular transformers can safely take. The equipment reliability is given by the bubble evolution temperature threshold, and the many variables involved deter most users from any

In this work, the authors present the results of a multigenerational research project between Prolec GE and Instituto de Investigaciones Electricas, carried out to develop a combined, two stage model for determination of the capability of a specific transformer to sustain a given overload profile. In a first stage, the moisture distribution profile in the windings insulation is estimated, and in the second stage the bubbling evolution threshold is calculated with consideration of all critical contributing variables. Important variables for this models are: moisture saturation level of circulating oil, temperature profile on the windings before and during the emergency overload event, transient thermal performance of the windings design, gas saturation level of oil, moisture in insulation distribution profile, aging conditions of oil and paper insulation, hydrostatic pressure profile.

The model is programmed in a computer code that can be interfaced with M&D systems and protection schemes.