CIGRE Study Committee A2

PROPOSAL FOR THE CREATION OF A NEW WORKING GROUP (1)

WG N° A2.53	**Name of Convenor : Patrick Picher (CA)** **E-mail address**: picher.patrick@ireq.ca
Technical Issues: 8	**Strategic Directions: 2**
The WG applies to distribution networks: No	
Title of the Group: Objective interpretation methodology for the mechanical condition assessment of transformer windings using Frequency Response Analysis (FRA)	

Scope, deliverables and proposed time schedule of the Group

Context

Measurement of the frequency response is now commonly used in the industry to assess the mechanical condition of transformer windings. The analysis of the results, the so-called Frequency Response Analysis (FRA), is based on comparison with a reference measurement which is either a previous measurement on the same unit, a measurement on an identical transformer or a measurement on another phase of a three-phase transformer.

In 2008, CIGRÉ published a guide (Brochure #342) on the assessment of the mechanical condition of transformer windings using Frequency Response Analysis (FRA). This guide covers the various measurement techniques available in the industry and makes recommendations on the standardisation of good measurement practices. One chapter is dedicated to FRA interpretation and several examples of FRA measurements and diagnostics are reported.

After the CIGRÉ working group had completed their work, an IEC project team was initiated to develop a standard on the measurement of frequency response. The standard, published in 2012 (IEC 60076-18 Ed. 1), widely based on the previously published CIGRE guide, specifies the measurement method (connection and configuration), the measuring equipment and the measurement records.

In parallel with the CIGRÉ and IEC working bodies, another working group was active in the IEEE organization. The measurement configurations presented in the IEEE guide (IEEE Std C57.149-2012) are similar to those presented by IEC but there are a few differences in the recommended configurations for a new set of measurements.

Even if the method has recently been studied at the international level in various working groups under the umbrella of CIGRÉ, IEC and IEEE organizations, there is still a need in the industry to obtain more guidance on the interpretation of the results. In fact, the usual way to interpret the result is to visually and subjectively compare the frequency response curves and make an interpretation based on previous experience. The ultimate goal would be to develop an internationally agreed objective interpretation algorithm that can be applied to condition assessment (input to health index), troubleshooting (diagnosis after incident) and ultimately as pass-fail criteria for transformer short-circuit testing.

Scope and aim

The working group will focus on the development of an objective methodology for the interpretation of frequency response measurements. It is anticipated that the measurements will be based on the

methods given in IEC 60076-18.

The proposed scope of work will be divided as follow:

- Review of the state-of-the-art of quantitative interpretation methodologies.
- 'Explain' typical responses and common features, e.g.: generic differences between HV and LV responses, effect of delta connections, effect of internal leads between terminals and ends of windings, effect of capacitive coupling between phases, effect of the core magnetization, differences between core and shell form transformers, etc.
- Collect frequency response signatures for typical mechanical failure modes using high frequency transformer modelling, real case studies or a combination of both.
- Compare the performance of selected interpretation methodologies for typical failure modes.
- Discuss the applications for such methodologies (short-circuit testing, diagnostics and maintenance, end-of-life criteria, etc.)
- Make recommendations for best practices and possible standardisation.

Deliverables/time schedule

Start of the Working Group: September 2015

Brochure and Workshop: December 2019

Comments from Chairmen of SC concerned :

Approval by Technical Committee Chairman : M. Wald

Date : 09/10/2015

Table 1: Technical Issues of the TC project "Network of the Future" (cf. Electra 256 June 2011)

1	Active Distribution Networks resulting in bidirectional flows within distribution level and to the upstream network.
2	The application of advanced metering and resulting massive need for exchange of information.
3	The growth in the application of HVDC and power electronics at all voltage levels and its impact on power quality, system control, and system security, and standardisation.
4	The need for the development and massive installation of energy storage systems, and the impact this can have on the power system development and operation.
5	New concepts for system operation and control to take account of active customer interactions and different generation types.
6	New concepts for protection to respond to the developing grid and different characteristics of generation.
7	New concepts in planning to take into account increasing environmental constraints, and new technology solutions for active and reactive power flow control.
8	New tools for system technical performance assessment, because of new Customer, Generator and Network characteristics.
9	Increase of right of way capacity and use of overhead, underground and subsea infrastructure, and its consequence on the technical performance and reliability of the network.
10	An increasing need for keeping Stakeholders aware of the technical and commercial consequences and keeping them engaged during the development of the network of the future.

Table 2: Strategic directions of the TC (cf. Electra 249 April 2010)

1	The electrical power system of the future
2	Making the best use of the existing system
3	Focus on the environment and sustainability
4	Preparation of material readable for non technical audience