CIGRE Study Committee A2 & C4

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

JWG* N° A2/C4.52	**Name of Convenor : Bjørn Gustavsen (NO)** **E-mail address: Bjorn.Gustavsen@sintef.no**
Technical Issues # (2): 8	**Strategic Directions #(3): 1, 2**
The WG applies to distribution networks (4) : Yes	
Title of the Group: High-frequency transformer models for non-standard waveforms	

Scope, deliverables and proposed time schedule of the Group :

Context

A recent JWG A2/C4.39 "Electrical transient interaction between transformers and the system" has completed its work. The JWG performed a review of the overvoltages that a transformer can be subjected to in service, focusing on shape of impinging overvoltages and pertinent modeling techniques. The JWG brochure includes the following findings:

- A transformer subjected to a voltage transient waveform with an oscillating component and /or a very high rate of rise may suffer dielectric failure due internal resonances or unpredictable withstand of the insulation to very fast transients.
- The manufacturer's white-box models are able to predict the maximum overvoltage stresses due to standard test voltages with fairly good accuracy. However, the accuracy deteriorates when the model is subjected to oscillating overvoltages and/or aperiodic impulses with a very high rate of rise.
- Black-box models based on measurements can accurately predict the transformer terminal behaviour also during resonant conditions up to a certain frequency range, but they do not provide information about the internal overvoltages.

The manufacturers do not in general supply the customer with a model of the transformer, neither a black-box model nor a white-box model. This prevents the customer from including the transformer in network studies.

In this context, the focus of the proposed JWG is to continue the work of A2/C4.39 in the direction of transformer modeling with the objective of providing the customers with useful models of the transformer for application in system transient studies.

Scope and aim

- Provide guidelines and recommendations for the generation of transformer models for simulation of high-frequency transient overvoltages that can occur in actual service.
- Define minimum requirements that models supplied by manufacturers to customers must comply with for including the transformer model in network studies.

White-box models:

- Assess the most suitable model formulations.
- Compare and recommend procedures for model parameter determination.
- Propose measurement procedures for model/parameters validation.
- Application to actual transformers, if possible.
- Define the level of detail of white-box models for their future use in network studies, including, as outputs, adequate calculated information on external and internal overvoltages.
- Propose model specifications and data formats for inclusion in common circuit simulators.
- Inclusion of 50/60 Hz initial conditions.
- Interpretation of results considering model uncertainties.

Black-box models:

- Assess the most suitable measurement principles and types of frequency sweep setups, including the setup/procedure outlined in IEC 60076-18.
- Propose modeling approaches and accuracy validation procedures.
- Propose simplified measurement procedures.
- Inclusion of 50/60 Hz initial conditions.
- Propose model specifications and data formats for inclusion in common circuit simulators.
- Application to actual transformers.

Besides these more complex models, discuss simplified models which take into account some physical parameters of the transformer together with information from frequency sweep measurements.

Application examples:

- Provide benchmark examples of models applied in simulation of transformer-network transient interactions using white-box and black-box models.

Deliverables/time schedule

- August 2014: Starting of the Joint working group
- End of 2016 : Interim Report
- August 2018 : Final Report

Comments from Chairmen of SC concerned: C4

Approval by Technical Committee Chairman: M. Wald

Date : 26/02/2014

(1) Joint Working Group (JWG) - (2) See attached table 1 – (3) See attached table 2
(4) Delete as appropriate

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