CIGRE Study Committee A3

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

WG* N° A3.36	**Name of Convenor :** Martin Kriegel (Switzerland) **E-mail address**: martin.kriegel@ch.abb.com	
Technical Issues # (2): 8		**Strategic Directions # (3): 1, 2**
The WG applies to distribution networks (4): Yes		
Title of the Group: Application and Benchmark of Multi Physic Simulations and Engineering Tools for Temperature Rise Calculation		

Scope, deliverables and proposed time schedule of the Group :

Background :

Recognizing an increasing role of simulation technologies in the development and performance verification of MV and HV switchgear, Study Committee A3 established WG A3.20 in 2004 to evaluate existing simulation tools and the extent to which they can be used as verification tools to enhance understanding of equipment performance, to extrapolate test results, to provide an alternative to testing, or to replace some of the tests.

As a result a new Working Group, built upon the activities of WG A3.20, was proposed in 2008. The new WG A3.24 continued the analysis of the use of simulation as a verification tool with a specific focus on internal arc testing of SF6 filled equipment.

Another benchmark performed in WG A3.20 was related to temperature rise analysis. WG A3.20 stated that although a full analytical approach can be possible, e.g. extrapolation from data found by partially type-tested assemblies (IEC TR 60890), it is limited to very simple configurations, obtaining quick and quite good results for average temperature values but no accuracy for hot spots. WG A3.20 advised to use a 2D or 3D numerical approach to achieve an improved accuracy by means of commercial multi-physics simulation tools, including the hot-spots calculation, but without giving any further insight about its suitable use and implementation.

On the other hand, WG A2.38 "Transformer Thermal Modeling" was established in 2008 to describe the state of the art techniques in transformer thermal modeling and to evaluate winding hottest spot as well as hot spots on other metallic parts by means of network models and advanced CFD tools. However, there is no specific WG for temperature rise calculations in MV and HV switchgears.

As a conclusion, WG A3.20 stated that the temperature rise test seems to be the most straight-forward to be predicted by simulations, because both the temperature distribution at steady-state and the time evolution of the hot spots seem quite possible. However, multi-physics require expertise in different physical domains and the time to set up a reliable coupled model. Any temperature rise simulation/calculation has to take into account: the joule effect (electromagnetic), the temperature field in busbars and panels (thermal) and the heat transfer coefficient calculation (CFD). Although multi-physics can be a more accurate way to reproduce a temperature rise test, the chances of making a modeling mistake are higher, and therefore some guidance would be advisable.

Finally, environmental concerns related to the greenhouse effect of SF6 are promoting a new generation of power products based on more environmentally friendly insulating gases. Given that any of the "green" alternatives (e.g. dry air) show as good thermal properties as SF6, the optimization of the thermal design will be a must to develop competitive solutions.

Scope :

The WG will study a benchmark of multi-physics simulation and simplified engineering tools to predict temperature rise tests, describing the state of the art techniques regarding MV and HV switchgears and defining the critical parameters that affect the accuracy of thermal modelling.

The outcome of the working group will show the benefit of those simulations for manufacturers like:

- Enhanced understanding of processes in the equipment
- Guidance to replacement development tests by multi-physics simulation
- Guidance to reduction of verification tests
- Impact on development time

The benchmark of more simplified tools, which can be used by non-experts and are adjusted by tests or advanced simulation techniques, give the following advantages to users:

- Additional information to the test results like temperature of non-accessible parts
- Temperature calculation of equipment stressed with non-tested duties, e.g. for temporarily overloading.
- Streamline the learning curve by means of a reduction of the time-to-experiment.

Deliverables : Electra summary report. Technical brochure. Tutorial.

Time Schedule : start : January 2014 **Final report** : 2017

Comments from Chairmen of SCs concerned :

Approval by Technical Committee Chairman : M. Waldron
Date : 09/05/2014

(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