



2008 PROGRESS REPORT

STUDY COMMITTEE A2 (Transformers)

1. Highlights

A joint colloquium SC A2/D1 was organised in Bruges/BE on Oct. 198 experts, from 35 countries, gathered to discuss new developments in the field of insulating materials, reliability of transformers and shunt reactors. More than 50 papers were presented. The colloquium got a support from sponsors through a technical exhibition.

In 2007, activities were related to the preparation of the brochures in the field of Recommendations for condition monitoring facilities, Mechanical condition assessment of transformer windings and Moisture in transformer. The AG "UHV AC & DC Transformers" has been involved during the CIGRE/IEC Symposium in China on UHV in China. SC A2 is supporting A3-22 'Technical requirements for substation equipment exceeding 800kV' by a liaison to cover some specific aspects in relation with the development of 1000 kV equipments.

In 2007, three WGs have been created in the domain of: a) Guide for Transformer Procurement Process, b) Transformer Reliability Survey and c) Transformer Thermal Modelling.

An official liaison type A has been established in 2007 between IEC TC 10 and SC A2.

2. Status of SC reference model implementation

The strategic plan on the WEB site of SC A2 shows how the reference model for SC is fully implemented.

3. Main technical directions pursued

The two strategic directions of SC A2 have not been changed and are:

- To continue on transformer technology issues and to consider new information technologies (data, communication, web services)
- To provide services to CIGRE customers (reliability and availability including impact of accessories, life management, economical issues, tutorials, etc).

4. SC WG & TF

Full progress report, scope and membership of the different groups are on the WEB site of A2

4.1 Working groups disbanded or transferred to an other SC

WG A2-26 - Mechanical condition assessment of transformer windings (P. Picher) created in 2004. The CIGRE Working Group A2.26 main objective is to develop a guide on the mechanical condition assessment of transformer windings using the Frequency Response Analysis (FRA) method. The WG has delivered a final report end 2007 for a publication before the group session in August 2008. The WG is disbanded. UK will check with IEC TC 14 for a possibility to have a part of this document publish as an IEC document.

WG A2-27 - Recommendations for condition monitoring facilities (P. Jarman) created as a WG in 2005. A definite pattern and commonality to the requirements of the diverse monitoring systems has emerged. The WG has delivered a final report end 2007 for a publication in April 2008. The WG is disbanded. UK will check with IEC TC 14 for a possibility to have a part of this document publish in an existing IEC standard.

WG A2-30 - Moisture in transformer (V. Sokolov) was created in 2004. This WG has delivered a report on moisture in transformers to support the understanding of moisture mechanism in transformer. The WG has delivered a final report end 2007 for a publication before the group session in August 2008. The WG is disbanded.



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4.2 Activities of WG or TF

WG A2-24 - Thermal performances (J. Declercq) created in 2003. The WG is considering: fundamentals of thermal ageing of insulation system, thermal modelling of transformers (for monitoring system) and thermal testing of transformers (contribution to measuring uncertainties at heat run tests). We expect a closing of this group in 2008.

WG A2-32 - Copper sulphide in power transformer insulation (M. Dahlund) created in 2005. Corrosive oils have caused numerous failures in transformers and reactors. The main objectives of the working group are to achieve an understanding of the processes involved in the sulphide formation, finding methods for diagnostics and identifying units at risk, give recommendations for mitigation techniques, and propose necessary changes and new test methods to be used in oil specifications and maintenance guides. The method proposed by TF A2-32-01 has been adopted by IEC TC 10 under the reference IEC 62225. The working group will continue to work to find analysis methods for metal passivators and study their stability during service (TF2), to find methods for sulphur speciation (TF3). A TF 4 was recently set up to work on experiences registered by the various mitigation technique applied. We expect a closing of this group in 2008.

WG A2-33 - Fire Safety (A. Petersen/AU) was set in 2007. The aim is to prepare recommendations to minimise the risk of transformer fires and the collateral damage associated with such fires. The scope shall cover different parts, mainly: a) Avoidance of tank rupture, b) Precaution to fire victim and c) Precautions to fire origin.

WG A2-34 Guide for Transformer Maintenance (C. Rajotte/CA) created in 2007. The aim is to prepare a guide for transformer maintenance that will help transformer users to define and apply best practices for transformer maintenance. The intent is to include transformers rated 69 kV and above, and larger than 25 MVA. The activity is partly a response on a request of IEC TC 14. The Scope shall be accomplished in the three following parts: a) define a best practices list of periodic actions applied in service or with outage, for checking and testing in order to evaluate transformers condition, b) address advanced maintenance activities, usually referred as condition based maintenance, such as oil additives, oil filtering, oil regeneration, and insulation drying and c) human and material aspects of transformer maintenance, with maintenance planning, maintenance tasks tracking, maintenance resources, cost references, level of competences required for different tasks, training, on-site repair, etc.

WG A2-35 Experiences in service with new liquids (R. Martin/UK) created in 2007. The aim is to collate and review the in-service experience of using the new fluids in a way which is relevant and beneficial to the electrical industry. The work has been split in the following manner: a) Physical, Chemical and Electrical properties of alternative fluids in comparison with Mineral oil, b) How the use of the alternative fluids impinges on equipment design, c) Gather and review in service uses of the new fluids - Where and how used - Power and distribution transformers - Review in-service - concerns/needs, d) Review relevance of in service tests (Lab and field) to the new fluids as opposed to mineral oil, e) Maintenance and refilling and f) Reliability, longevity and the interaction of fluids with solid insulation.

4.3 New working Groups and Task Force

WG A2-36 Guide for Transformer Procurement Process (T. Breckenbridge / UK). The aim is to carry out a full review and update of the existing CIGRE A2 documents on procurement, taking into account the current market conditions and the new commercial pressures that customers operate under, and also to prepare a new guide for assessing the capability of transformer manufacturers that evaluates technical competence and experience and can be integrated to and supported by the aspects of process control covered by existing quality assurance procedures, e.g. ISO 9000. Simultaneously, an article will be produced for publication in Electra to try and get the message over to the senior managers of the purchasers that if good engineering practices are abandoned in the procurement process, then poor reliability of transformers in the future will be the likely price.

WG A2-37 Transformer Reliability Survey (S. Tenbohlen/DE). The aim would be to prepare a brochure describing international transformer reliability survey practices. A new survey will not be conducted but data and information already in the public domain and usually available only locally will be presented in a comprehensive manner. The differences in contexts like failure definition, transformer usage and transformer specification that may influence survey results will be discussed and best practices identified. Finally, where applicable, the



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brochure should include recommendations to improve the compatibility of the data compiled in the different countries and propose a uniform way of collecting, compiling and presenting data. Specifically, the WG will: a) Review all existing national surveys and study different practices (data collection, compilation, etc.), b) Discuss the differences and identify best practices, c) Compile and present the information available in these national survey reports and d) Make recommendations to improve the situation.

WG A2-38 Transformer Thermal Modelling (J. Lapworth/UK). The aim is to describe the state of the art techniques in transformer thermal modelling to evaluate winding hottest spot as well as hot spots on other metallic parts (outside the windings). Examples of advanced transformer modelling tools will be included. Examples of application of hottest spot direct measurement should also be included and best practices will be described. Advantages and limitations of these technologies will be discussed. If applicable, recommendation will be made for standard improvement. The applicability of thermal modelling to revise old transformer thermal performance will also be discussed with examples.

4.4 Advisory Groups (AG) within A2.

Actually SC A2 has 7 AG's to support the management of A2. They are related to : a) transformer technology, b) use of the equipment, c) relation with other SC's, d) tutorial, e) A2 customers, f) development of UHV transformers and g) A2 strategy.

5. Joint WG & TF

5.1 Joint working Groups

JWG A2/B4-28 - HVDC Converter Transformers (M. Saravolac) created in 2004. The JWG is working in the following directions: Reliability Survey Update, Design Review, Guide for HVDC Converter Transformers and Test Specification.

The JWG activities are currently focusing on the issue of a brochure as guide for design review and a Tutorial on Reliability of UHVDC Converter Transformers to be issued by the CIGRE 2008 Conference.

JTF B3/A2/A3/B2/C2.19 - Dynamic Loading (Dale Douglass /US). This JTF has been disbanded in 2007 due to a lack of activities.

5.2 Activities with other Study Committee

- WG D1-01: Impregnated insulation (L. Lundgaard / NO)
- TF D1-01-12: Oil maintenance - Insulating oil reclamation and dechlorination (B. Pahlavanpour / UK)
- TF D1-01-13: Furans for diagnostics (Marie-Claude Lessard / CA)
- TF D1-01-14: Dielectric response diagnoses for transformer windings (S. Gubanski / SE).
- TF D1-01-15: Progress in DGA techniques and diagnoses (M.Duval / CA)
- TF D1-01-17: Oxidation Stability of Transformer Insulating Oils (I. Atanasova Höhle / DE)
- WG C1-10: CIGRE Glossary (A. Popescu /RO & W. Reinke / US)
- WG A3-22: Technical requirements for substation equipment exceeding 800kV (Dr. Hiroki Ito / JP)

6. SC Publications and publication plan

- State-of-the-art report on 'Fire Avoidance in Transformer Substation', prepared by Prof. D. Allan with the support of J. Declercq and A. Petersen – April 2007.
- Report prepared by the SC A2 Advisory Group – Transformer Technology with the title "Power Transformers Technology Review and Assessments" – February 2008
- Final report/brochure of WG A2-27 "Recommendations for condition monitoring facilities" - to be published in April 2008
- Short Report on Joint Colloquium A2/D1 2007 in Bruges/BE – to be published in June 2008
- Final report/brochure of WG A2-30 "Moisture in transformer" - to be published before August 2008
- Final report/brochure of WG A2-36 "Mechanical condition assessment of transformer windings" - to be published before August 2008



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7. SC Website

The new CIGRE format is fully implemented and a lot of relevant reports for the branch of the transformers have been put on this important interface. The last updating has been performed on 6.3.2008. Under the part 'Publication', multiple important reports dealing with the current activities of SC A2 are available. For members only, papers presented at the six last SCA2 Colloquium are also available.

8. SC Strategic plan & Action plan

SC A2 has fully implemented the reference model for SC (see strategic plan on the WEB site of A2). The strategic & action plans are available on the WEB site of A2. They have been updated in Sept. 2007.

9. SC meetings

The committee met on Oct 11, 2007 in Bruges/BE. 47 persons were present: regular members (22), substitute (1) and observer members (5), WG convenors (8) and guests (11) were present.

SC A2 has presently 24 regular members and 15 observers.

SC A2 has received an invitation from South-Africa to hold the 2009 SC meeting and invitations from Japan for 2011 and Switzerland for 2013.

10. Tutorial and SC participations to regional meetings, Colloquium and Symposia

SC A2 has prepared a group of tutorial in the field of Short-circuit, Economic of transformer management, Life management, Condition assessment, Design review, Overload and Thermal aging of Transformers, Copper sulphide in power transformer insulation, Recommendations for condition monitoring and condition assessment facilities for transformers, Transformer lifetime data management, Partial discharge application in factory and in the field (with support WG D1.01), Ageing of cellulose insulation in transformers (with support WG D1.01), Diagnostics of oil-paper insulation by means of dielectric response methods (with support WG D1.01).

Other tutorials are in preparation in various domains. These tutorials have been, or will be, presented in conjunction with the events listed hereafter.

- Support to the Conf. on Transient Phenomena in Large Electric Power Systems in Zagreb/Croatia (April 2007).
- International Conference on Power Transformers, May 30-31, 2007 - Torun, Poland
- Workshop on Variable Frequency Diagnostics Dielectric response and FRA, Stockholm, Sweden, Sept. 2007
- Conf. on Tfo Technology in Serbia and Rumania, Sept 2007
- Joint Colloquium SC A2/D1 in Bruges, Belgium, October 2007
- International Advanced Research Workshop on Transformers, Vigo, Spain, October 2007
- Matpost 07, Lyon/France, November 2007
- CMD2008 – Int. Conf. on Condition Monitoring and Diagnostics, Beijing, China, April 2008

11. Relation with other organisation

- Good relations are established with IEC TC 14 and IEEE Transformers as delegates are reporting regularly to SC A2.
- An official liaison type A has been established in 2007 between IEC TC 10 and SC A2.

P. Boss