



Study Committee A2

## Working Group Form

**WG N°: A2.38**

**Name of convenor: J. Lapworth/UK**

**Title of working group:** Transformer Thermal Modelling

### **Context**

Transformer loading is often limited by the temperature of the winding hottest spot. Historically, as it was not feasible to measure directly the hottest spot in the winding, the standards defined a hot spot factor H to be applied as a multiplication factor on measured average temperature rises. IEC 60076 and IEC 354 suggested H factors of 1,1 for distribution transformers and 1,3 for medium and large power transformers. CIGRE WG 12-09 found a larger variation of H values (up to 2,1) without simple correlation with the transformer size and cooling. It should be borne in mind that a wide variety of winding geometries and cooling arrangements are in use: from long axial cooling ducts for layer wound windings to short radial ducts for disc type windings, with or without arrangements to direct the cooling oil flows in predetermined directions and with either forced or natural flow conditions. Recently, some manufacturers are using detailed thermal modeling and experience shows that the H factor is often very different from the values defined in the standards. Also, direct measurement of the winding temperature is increasingly being used to evaluate the thermal performance of the transformer and validate the thermal modeling. More recent concerns about the effectiveness of transformer cooling arrangements have arisen as a result of new manufacturers entering the marketplace, and suggestions that poor cooling may have been a significant contributing factor in some recent failures. WG A2.38 shall consider the work in progress within WG A2.34 'Thermal performances of power transformers' which will issue his final report before August 2008.

### **Scope and aim**

The aim is to describe the state of the art techniques in transformer thermal modeling to evaluate winding hottest spot as well as hot spots on other metallic parts (outside the windings). Examples of advanced transformer modeling 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 modeling to revise old transformer thermal performance will also be discussed with examples.

Specifically, the WG will:

- Define critical parameters that affect the accuracy of thermal modeling
- Describe practical examples of thermal modeling and its limitations
- Derive typical H factors for various common cooling arrangements
- Identify key factors for directed/non-directed and forced/natural cooling arrangements
- Describe the consequence of using erroneous H factor
- Identify good practices for direct measurement
- Make recommendation for standard improvement, if applicable
- Describe applications for new and old transformer

**Deliverables/time schedule**

- January 2009: Starting of the Working Group
- End of 2011 : Interim Report
- End of 2013 : Final Report

**Papers issued: TB, Summary in Electra****Approved by TC chairman: Klaus Fröhlich****Date: 13-02-2008**