Minutes of Core Over-excitation Task Force

Chairman: Craig Stiegemeier Secretary: Tim Raymond

The sixth meeting of the Core Over-Excitation Task Force authorized by the Performance Characteristics Subcommittee took place at 3:15pm on October 23, 2006. This Task Force is charged with the identification of limits for core over-excitation and coming up with suggestions for modification of appropriate standards. There were 64 total attendees, of which 20 were members and 44 were guests. Nineteen (19) of the 64 attendees were first time attendees to this task force meeting. Two (2) attendees requested membership and will be added to the Task Force membership roster.

The following agenda for the meeting was reviewed with the attendees.

- Participant introductions – sign attendance roster
- Patent reminder
- Approve Minutes of Costa Mesa Meeting
- Task Force Charter & Scope:
  - Charter – Performance Characteristics Subcommittee
  - Scope – The impact of excitation overvoltage on the transformer core
- Review Suggested Modifications to Standards based on discussion at the Costa Mesa meeting
- Discuss suggested text for Surface Temperature Limit
- Action item review

At the beginning of the meeting, attendees were reminded of the need to adhere to the IEEE patent policy was stressed and the chair asked for anyone aware of patentable situations to bring it before the group. No one offered the chairman suggestions during or after the meeting of patentable work or identified any inappropriate topics covered during the meeting.

A discussion was opened to review the minutes from the Costa Mesa meeting published on the Committee website. A vote was taken and the Costa Mesa meeting minutes were approved as reported.

The changes to C57.12.00 (IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers), Section 4.1.6 (Operation above rated voltage or below rated frequency) suggested at the Memphis (Fall 2005) meeting and discussed again at the Costa Mesa meeting were reviewed in detail. The following suggestion was made for the re-write of C57.12.00, with the text in blue being the additions to the standard suggested at the Memphis meeting:

4.1.6 Operation above rated voltage or below rated frequency

4.1.6.1 Capability

Transformers shall be capable of:

a) Operating continuously above rated voltage or below rated frequency, at maximum rated kVA for any tap, without exceeding the limits of observable temperature rise in accordance with 5.11.1 when all of the following conditions prevail:

1) For distribution transformers:

1a) Secondary voltage and volts per hertz do not exceed 105% of rated values.

1b) Load power factor is 80% or higher.

2) For generator step-up transformers, the primary voltage is equal to the highest generator voltage at full load as specified by the user.

3) For system tie transformers, the primary and secondary voltages are equal to the highest levels specified by the user.

4) Frequency is at least 95% of rated value.

b) Operating continuously above rated voltage or below rated frequency, on any tap at no load, without exceeding limits of observable temperature rise in accordance with 5.11.1, when neither the voltage nor volts per hertz exceed 110% of rated values.

In the case of multiwinding transformers or autotransformers, 4.1.6.1 applies only to the specific loading conditions used as the basis of design. These loading conditions involve simultaneous coordination of kVA input and output, load power factors, and winding voltage combinations [see item j) of 4.3.3]. Differences in loading and voltage regulation for various output windings may prevent simultaneous achievement of 105% voltage on all output terminals. In no case shall the kVA outputs specified for any loading condition require continuous loading of any input winding in excess of its rating.

4.1.6.2 Maximum continuous transformer operating voltage (unchanged)

4.1.6.3 Core hotspot temperature limit

To avoid the generation of gasses in the core, the core hot spot temperature should be limited to 130ºC for the condition of highest core over-excitation, full load, and the highest ambient temperature for transformers filled with mineral oil. It should be noted that the calculation for the hotspot is unique and different from the core surface temperature. The location of the core hotspot is typically in the center, or between cooling ducts, of the upper part of the core. Gas generation in this area is caused by overheating of a thin film of mineral oil.

The following comments were made during general discussions of the suggested text:

- (Pete Balma) For GSUs, are we specifying that the highest generator voltage at full load is the overexcitation voltage requirement?
    - Craig indicated yes. Additional comments along same line.
- (Dan Perco) Discussion of core hotspot vs. surface hotspot. Leakage flux could result in core hotspot temperatures on the surface vs. in the center.
- (Harold Moore) Should discuss capability of core (and adjacent) materials at elevated temperatures.
- (Ramsis Girgis) Core hot spot limit is related to oil thin film gassing. Other materials would be more related to surface temperatures.
- (Harold Moore) Spacers made of materials such as pressboard are only good for 95°C, and therefore are a valid concern.
- (Hasse Nordman) Same temperature limits for metallic hot spots adjacent to insulation materials would apply.

The following comments were made during the discussion of the suggested Surface Temperature Limit text:

- (Tim Raymond) What are we trying to say? If we are trying to put a requirement on the core surface temperature limit, this should be clarified by stating that the 130°C core temperature limit applies to internal temperatures and that the core surface temperature should be limited to the maximum allowable temperature for metallic hot spots in contact with solid insulation.
- Several participants further discussed the 125°C surface temperature limit. The origin of the limit and appropriateness were discussed.
- Harold suggested wording it such that any materials in contact with the core surface must be compatible with the maximum expected temperatures, such as 95°C for pressboard.

- Craig was asked to summarize the comments, noting that the specific surface temperature limits should be removed and text included to reflect the limitation based on the core insulation material. He agreed to come up with suggested text, which follows:

  > Core surface temperatures, including interior cooling ducts, shall be limited by the temperature capability of the insulation materials in contact with the core surface. For non-thermally upgraded pressboard, this limit would be 95°C.

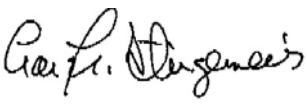
Craig will communicate the information that has been compiled to date to the appropriate Working Groups that have responsibility of revising standards that are impacted by the suggestions of this task force. A summary of those communication follow:

- Performance Characteristics SC (Ramsis Girgis, Chair)
  - WG revising C57.12.00 (Steve Snyder, Chair)
    - Recommend that the wording for 4.1.6.1 be modified and an addition (4.1.6.3) is included that aids in the clarification of overvoltage capability and hotspot limits.
    - The inclusion of a specific temperature should note that the limit applies only to mineral oil insulated transformers.
    - Capacity limits or capabilities should be included on the nameplate that makes the transformer design unique.
- Insulation Life SC (Don Platts, Chair)
  - WG revising C57.91 (Tim Raymond, chair)
    - Suggest inclusion of core hotspot temperature limit in C57.91.
    - Provide the suggested addition of 4.1.6.3 for consideration,
- Insulating Fluids SC (Rick Ladroga, Chair)
  - WG revising C57.104 Gas Guide (Rick Ladroga, Chair)
    - Suggest that text should be included to note that moderate core overheating doesn't place the transformer at risk.
    - A guideline for low levels of gas generation with a H_2/CH_4 ratio in the range of 6-8 should be considered for incorporation into a future revision of C57.104.

If meaningful responses to these communications are received prior to the Dallas meeting next spring, a session will be scheduled to review those comments. It is expected that the individual working groups will need some time to consider the comments, so it is likely that the work of this task force is over until such time as a response to questions or modification suggestions are received.

The meeting was adjourned at 3:55 pm.

Respectfully submitted,



Craig L. Stiegemeier, Task Force Chairman