Insulation Life Subcommittee - Un-Approved Meeting Minutes
March 22, 2006 - Costa Mesa, CA

7.4 Insulation Life Subcommittee – Don Platts, Chairman

The Insulation Life Subcommittee met in Costa Mesa, CA on March 22, 2006, at 8:00 AM. There were 37 members and 42 guests present, with 4 guests requesting membership in the subcommittee.

The minutes of our meeting in Memphis, TN on October 26, 2005 were approved as submitted.

7.4.1 Chair's Report

7.4.1.1 The Fall 2006 IEEE Transformers Committee Meeting will be held October 22 – 26, 2006 in Montreal, Quebec, Canada.

7.4.1.2 At this meeting, the Insulation Life Subcommittee was held at the same time as the Dielectric Test Subcommittee. A poll of the people in attendance revealed that the majority would like to attend both subcommittee meetings.

7.4.1.3 An IEEE Technical Committee has an opening for a Transformers Committee representative. The Transformers Committee is looking for a volunteer.

7.4.1.4 Metrification issues are still presenting problems to the Transformers Committee. However, the Insulation Life Subcommittee has very few problems with metrification.

7.4.1.5 The Transformers Committee organizers put in a lot of effort to minimize conflicts between Working Group and Task Force meetings. The Working Group and Task Force Chairs should avoid canceling their meetings at the last minute due to schedule conflicts.

7.4.2 Project Status Reports

7.4.2.1 Reaffirmation Ballot 1538, IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformers

The reaffirmation ballot was approved at RevCom. The guide is valid for five more years.

7.4.2.2 Reaffirmation Ballot 1276-1997, IEEE Guide for the Application of High-Temperature Insulation Materials in Liquid-Immersed Power Transformers

The reaffirmation ballot will be presented to RevCom next week.

7.4.2.3 Reaffirmation Ballot C57.119, IEEE Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Ratings

C57.119 needs to be reaffirmed by the end of 2006. Subhash Tuli will lead this effort.

7.4.3 Working Group and Task Force Reports

7.4.3.1 Working Group for the Revision to C57.91 Loading Guide - Tim Raymond

The WG meeting was called to order at 9:30 AM on Tuesday, March 21, 2006 by the working group Chair, Tim Raymond. There were 33 members present.

Approval of minutes from the October 25, 2005 meeting was requested. The minutes were approved as written.

The IEEE Patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. There were no responses to the request for disclosure.

Chair's Comments:

Draft 4 will be posted. We need to get back on track and wrap up the standard. All major technical changes are done. We need to clean up Draft 4 for preparation for ballot.

If anyone will be voting negative, this is the time to voice any concerns that they may have.

Specific discussions:

Clause 5.4 – Supplemental cooling of existing self-cooled transformers.

Does this clause belong where it presently is or should it be moved elsewhere? Tim made a motion to move this to a new annex, the motion was passed.

Affects of "Condition"

Include rough estimates of moisture and oxygen and apply multiplying factors to age acceleration factor for both thermally upgraded and non thermally upgraded paper. Tim calculated factors for both upgraded and non upgraded paper in a table based on Lundgaard, Emsley, and McNutt. The general question is should this be pursued, is it oversimplification, or is it about right? Tim also presented a graph from a Cigre working session comparing the aging rates for dry and wet papers.

Tim asked whether the WG feels the general concept is acceptable? Don Platts indicated he felt it was valuable, but perhaps with a caution note added regarding its use and some guidance on its use and risk associated with its use.

Comment from Tom Prevost, this needs to be the moisture at the hot spot. Moisture in bulk insulation would be different than at the hot spot.

Clause 6.4 – Normal Insulation Life

The 1995 revision avoided specifying normal life. The new revision, at some point, moved to specifying 180,000hrs as recommended normal life. Tim suggested that the guide be reverted back to the 1995 approach.

Equation 4 in the 1995 guide and Table 2 defined the normal insulation life for an insulation system. A vote was requested. Don Platts indicated that it may conflict with what has been done in C57.100. Tim indicated that we should revert back to the 1995 version and if there is a conflict with C57.100 when it comes out, it would have to be addressed on the next revision.

Tim asked if it would be worth pulling some of the background information on life expectancy into the guide. Tim requested a volunteer to do this. Tom Prevost volunteered to take this on.

TV Oommen commented on the End of Life Criteria. He will look into reinserting this table into the Guide. Need to determine if the testing that was done to determine the 65,000 at 50% tensile strength and the 180,000 value are correct with newer information that is available.

Temperature Calculations

Annex G model was moved into the main body of the guide. The old Clause 7 was then moved to the Annex instead for cases in which the bottom oil rise is not available. Tim indicated that he knows this will generate some negatives. Rather than discuss at this time, he requested that any individuals that may be voting negative on this point to contact him to discuss.

Life expectancy

Is there anything, or what should be done to make this guide more useable for distribution transformer users? Should there be simple charts or tables? A group of volunteers will look at the issue concerning distribution transformers.

Cold Load Pickup

This was formerly in an Annex and was moved to the main body. Should this be left in the main body or moved back into an Annex. It was decided that it would be moved to an Annex.

Annexes

Annex B – Question as to whether this should be in the body of the guide since it is addressed in the scope. Ruling was that it needs to be in the body of the guide and will have to therefore, be moved.

Annex E – some of this will be moved back into the main body of the guide.

Annex F – Background on gas evolution. Suggested taking relevant portions out and moving back to the main body and removing the annex.

Annex H – Hot spot temperature indicators and fiber optic detectors. Does this really belong in the guide? Tim suggested that it be struck. Comment that a reference be made to the paper being written. The information is valuable, the question is whether this is the appropriate location for the information.

Tim has requested more participation from the WG members in working on the guide. He has set up a distribution list for work to be done between now and the next meeting. Members that wish to remain members of the WG are expected to sign up and participate in discussions and provide feedback.

Meeting adjourned at approximately 10:40 am.

Tim Raymond, Chair

Glenn Swift, Vice Chair

7.4.3.2 Working Group On Thermal Evaluation Of Power And Distribution Transformers (C57.100) – Roger Wicks

7.4.3.2.1 Introduction and Rosters
The working group met on Monday, March 20, 2006 at 11:00 AM with 14 members and 50 guests attending. One guest requested membership in the working group.

7.4.3.2.2 Approval of minutes from October 24, 2005 meeting
The minutes of the October 24, 2005 meeting in Memphis were approved as written.

7.4.3.2.3 Patent Disclosure
The chairman asked if anyone knew of any patents which could pertain to this project. There were none.

7.4.3.2.4 Discussion of two methods in existing C57.100 document – Lockie Tests and Sealed Tube Tests.

Patrick McShane provided a short summary of their Aging work recently conducted which utilized the Lockie Tests and Sealed Tube Tests, which will be reviewed in more detail on the 21st, in the Tutorial titled "Aging Rate of Kraft Paper Insulation Immersed in Natural Ester

Based Dielectric". This overview solicited some questions from the audience related to the makeup of the cells, as well as the moisture content of the papers in the cell. Patrick addressed the questions, and noted that they obtained a very good correlation between historical values and their testing for thermally upgraded kraft (within 2ºC).

Patrick also noted that their testing showed longer aging than predicted from the classic aging curves, especially for the ester-based fluids. Their Lockie tests were conducted with hot spot temperatures at 168, 175 and 183ºC, all of which ran significantly longer than the required aging times at these temperatures (up to 3 to 4X).

7.4.3.2.5 Discussion of DuPont-Weidmann test of Model using Thermally Upgraded Kraft

The chair and secretary then reviewed the joint work being conducted by their companies to utilize the new IEC test method (62332) which involves model cells designed to simulate the thermal performance of a power transformer. To date, this testing has been conducted with non-upgraded kraft insulation, and life curves are being generated which look to show longer life for this material than seen in either of the existing C57.100 methods.

In this testing, the bulk oil temperature is controlled at 115ºC, and the conductor temperature is independently controlled at higher temperatures. This current set of aging is being conducted with a Nitrogen blanketed cell and well-dried paper-oil insulation system, which may explain the superior life. The chair noted that subsequent work will be conducted with air blanketing and also to look at the effect of moisture.

The testing has just started with upgraded papers as well (2.74% Nitrogen) and based on a limited sample base, the incremental benefit of these papers vs. the non-upgraded papers is in the range of 10 to 15ºC. Due to the lengthy aging periods (in some cases a factor of 10 over historical sealed tube work), an original test plan to have completed this work with four different nitrogen content papers was not accomplished prior to the meeting. This testing will continue, and the other variations mentioned above will be considered as well.

The working group dealing with the gas guide expressed interest in some of the oil data from this testing, as well as the working group dealing with the loading guide. The chair will finish updating the information in the presentation, and then send it out to members of the working group. He expects to receive data on 4 or 5 additional cells during the next couple of days.

The working group seemed pleased with this work, and some good discussion points were provided, especially around the need to evaluation moisture and oxygen effects. Patrick McShane offered to help the chair understand methods to provide a controlled amount of moisture content for the start of the aging cycles. Haase Nordman provided some insight into a Finnish study which looked at moisture content vs. transformer life.

7.4.3.2.6 Work Going Forward

The aging work from the IEC Model aging will continue. Additionally, the secretary will work with IEEE (Jodi Haasz) to obtain permission to distribute copies of IEC 62332 to the working group members to help our efforts in developing a power transformer model.

The chair also noted, that as a group we need to evaluate both the existing model as well as the proposed model to understand test criteria for evaluation. During the meeting, it was noted that DP is a much more predictable indicator of remaining life than tensile strength, but the chair cautioned that not all materials can use this method (non-cellulosic as an example). We also need to consider how one qualifies a system – do all parameters have to pass, or only the solid. Is there two sets of criteria – one if the fluid is good, one if not so good, etc. Perhaps these decisions can only be made after more extensive aging is completed.

7.4.3.2.7 Adjournment

The meeting adjourned at 12:15PM.

7.4.3.3 Task Force on Winding Temperature Indicators - Phil McClure

1. The meeting convened at 9:30 AM, with seven members and 29 guests in attendance. Three persons requested to be added as members.

2. The patent instructional slides were displayed and a request for disclosure of knowledge of patent applicability to the group's work was made. There were no affirmative answers to the inquiry.

3. The Members and Guests introduced themselves.

4. The minutes of the March 13, 2005 meeting in Jackson, MI had been sent to the members and posted on the TC website and they were approved and seconded as written.

Old Business

At the last meeting in Jackson, review of the glossary of the technical paper had begun, but had not been completed. Draft 9 of the paper has been distributed to the members with the glossary completed to the point where we left off, and it was decided that further action to complete it will be done through email. Remaining action is limited to comparing our definitions to other IEEE documents, primarily IEEE 100.

New Business

1. In the ongoing review of the group's direction, and in conversations with group members it was made clear that there was a renewed urgency to expedite the completion of the paper and move along to whatever is next.

The chair explained to the group that determining the time constant of electro-mechanical ISS WTI system is all that is required to complete the investigative portion of the paper. This step is required to answer a question that was the original impetus for the group's formation. Previously we had proposed testing transformers using step inputs to highly loaded conditions. This test plan is very costly and disruptive to insert into a normal heat-run test plan. It was suggested by the chair that we could apply proportional overload current to the heater of the thermowell during the stabilization portion of the heat run and simulate the same conditions. It was further suggested by Don Chu that applying the overload current to the heater of the thermowell from cold conditions would produce another valuable data set. The group was very receptive to both suggestions. The chair will create a test plan and circulate it to the members for comment.

The chair then brought up suggestions from recent and past history regarding where the group should go after the paper is finished. There were four suggestions; do no further work, or produce a recommended practice, or a guide or a standard. The chair pointed out that in previous discussions a guide had been preferred, and further explained that the paper, from all previous revisions, probably had enough information to produce a guide in short order. These options were discussed, and the group seemed to favor producing a guide.

The chair then opened discussion on how to complete the paper. Two options were discussed; take the paper private, using existing contributors as authors, or continue under the auspices of the task force. The chair explained that if it was decided to produce a guide, completion of the paper might delay that effort.

Dave Wallach then made a motion proposing to produce a guide and to complete the paper aside from the activities of the Task Force. The motion was seconded by Phil McClure. By vote of 7 in favor and 2 opposing, the members approved producing a guide and taking the paper private.

2. Discussion then turned to revisions to draft 8 which were incorporated into draft 9.

   The chair thanked Gary Hoffman for his editing of section 1.2 sensor descriptions and asked if he thought that it might need to be reorganized. He agreed, and volunteered to do the reorganization.

   Comments on section 1.5 adherence to national standards were sought. Some areas of this section, pertinent to the creation of a guide were discussed, but it was clear that the section was not read by many of the group. Gary Hoffman pointed out that mention of two EMI / RFI standards needed to be added.

3. It was decided not to discuss any of the other sections needing authors, since those tasks will be passed on to the private authors.

4. The group was asked if there were any transformer manufacturers who would be willing to sponsor the new heat run test and two answered favorably.

The meeting was adjourned at 10:35 am.

Respectfully Submitted,

Phil McClure
Chair

7.4.3.4 Working Group for Temperature Rise Test Procedures Section 11 of C57.12.90 - Paulette Payne

The Task Force met March 21, 2006 at 8:00am in the Emerald 1 Room of the Costa Mesa Hotel in Costa, Mesa California. There were 16 members and 32 guests present. Messrs Barry Beaster and Tom Harbaugh were announced as new members; membership is now 39.

Members were provided the opportunity to identify or disclose any patents believed to be essential for the use of Clause 11.0; no patents were identified or disclosed.

The minutes from the October 24, 2005 meeting were approved.

Presentations were made on the following and are identified by the section cited in PC57.12.90/D2 12 April 2002.

11.2.2 - Mr. Bob Ganser presented a proposal for a cooling standard curve format requiring a 10 minute data collection interval starting at time zero (when the power is taken off the system) with data points taken every 15 seconds up to 4 minutes, then every 30 seconds from the 4 to the 10 minute mark. This would generally result in 20 – 24 data points. Discussion ensued regarding the 15 second interval and if the shutdowns and data collection should be done for all three phases. Mr. Ganser suggested at least one measurement be made on all windings within 4 minutes of shutdown and that a minimum of 4 measurements be made on all windings as B-phase may not necessarily give the highest temperature rise.

11.2.2.e – Mr. Barry Beaster presented the Blume method as an example of data fitting and regression using least squares. Mr. Thang Hochanh analyzed the same data as Mr. Beaster using the IREQ method for data regression obtaining practically the same results. Calculation spreadsheets for both methodologies will be made available to the membership.

11.1.2 - Mr. Jerry Corkran presented results from temperature rise tests varying the time to re-energize. The basis for data collection was stabilization on total winding watts, testing the primary winding first; subsequently, a similar test was performed testing the secondary winding first. The winding rises obtained for both tests were similar for each winding. Mr. Don Platts addressed the proposal for time to re-energize as at the previous meeting, consensus was to return the transformer to the stabilized top oil temperature for continuing data collection when resistance measurements can not be completed in the specified time

interval. Mr. Corkran stated that it is not necessary to hold the stabilized temperature at constant current for one hour in order to take additional readings. He stressed stabilization of the winding gradient (resistance measurements) and correction of the oil temperature at the time of shutdown as essential.

Old Business – Mr. Subash Tuli presented a proposal for top oil rise correction to adjust for difference in calculated and actual total losses when performing the temperature rise test with constant current.

Having exhausted allotted time, New Business could not be addressed. The meeting was adjourned at 9:15am.

Vice Chair – Juan Castellanos
Chair – Paulette Payne Powell

7.4.3.5 Task Force: on Moisture Estimation in Transformer Insulation – Jin Sim

Schedule conflicts have prevented this task force from meeting.

7.4.4 Old Business:

IEEE Standards C57.12.00 and C57.12.90 were balloted in 2002 and received many comments. Don Platts and Barry Beaster are getting editable documents and will begin addressing the comments.

7.4.5 New Business:

Don Platts and Barry Beaster discussed the effects of core over-excitation on the temperature of the core. The loading guide does not address non-current carrying parts and there is no method to calculate of hot spot temperature in the core and the core surface temperature when doing overload calculations. The core surface temperature can be important since it is generally in contact with insulation. The Subcommittee will address this issue sometime in the future.

7.4.6 The meeting adjourned at 9:15 AM

Don Platts
Chair, Insulation Life Subcommittee