

Insulation Life Subcommittee - Unapproved Meeting Minutes
April 22, 2009 – Miami, Florida

8.1 Insulation Life Subcommittee – Don Platts, Chairman

The Insulation Life Subcommittee met in Miami, Florida on April 22, 2009 at 8:00 AM.

The minutes of our meeting in Porto, Portugal on October 8, 2008 were approved as written.

8.1.1 Chair’s Report

The Fall 2009 IEEE Transformers Committee Meeting will be held in Lombard, Illinois in October. The Spring 2010 meeting location has not been determined..

Tim Raymond has resigned as the Task Force Chair for the Loading Guide. Don Duckett will be the new Chair.

8.1.2 Project Status Reports

8.1.2.1 C57.91 Loading Guide

C57.91 and its PAR expire at the end of this year.

8.1.2.2 C57.100

The PAR for C57.100 expires the end of 2010.

8.1.3 Working Group and Task Force Reports

8.1.3.1 Working Group for the Revision to C57.91 Loading Guide – Tim Raymond

The working group was called to order by the Insulation Life Chair Don Platts for the absent Chair and Vice Chair at 9:32 AM on Tuesday, April 21, 2009. Secretary Susan McNelly was also present.

There were 41 of 134 members present and 51 guests with 7 guests requesting membership to the WG. Guests requesting membership were:

Rick Dong	Said Hachichi
Prem Patni	Sanjib Som
Sandhu Surinder	Ajith Varghese
Baitun Yang	

Agenda:

- 1. Introductions**
- 2. Minutes approval and patent announcement**
- 3. Comments to latest revision**

4. Plans for Completion

5. Adjournment

Introductions of members and guests were made.

Approval of minutes from the Fall 2008 meeting in Porto, Portugal 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 – The Chair, Tim Reynolds has stepped down from his position. The Vice Chair Carlo Arpino has indicated a desire to continue, but not to take over the WG. We are looking for someone to step forward to take the Chair position to see this guide through to ballot.

Draft 5.2 of the Guide has been posted. This draft has cleaned up formulas and moved symbol definitions into an Annex. There have been many changes and reversals of changes to the Guide. At this point, it is uncertain whether the present draft represents all of the votes taken in the past. Don Duckett volunteered to review the Guide and compare to past minutes documenting decisions. However, after the meeting, Don agreed to take over as WG Chair, and will likely be looking for someone to help with this task.

There are some oversights in the document that need to be resolved and found before the Guide is sent to ballot. At some point it was decided to take the cooling classes definitions and put in the Guide. The equations need to be reviewed to make sure they are in the correct location and have the correct definitions and terms.

Juan Castellanos volunteered to review Annex G. Kurt Robbins volunteered to review the Clause 7 equations.

Plan to meet the year-end deadline – The WG members will receive an e-mail regarding review of the document in a very short time. Those members not responding may be removed as members of the WG.

Barry Beaster, Jin Sim, Rick Marek, and Dave Wallach volunteered to help go through comments received to resolve any issues identified.

The question of gas evolution during overloads raised

Loading recommendations based on loading – Jin Sim indicated that at one time there was a plan to add something to the Guide to address this. Clause 12.2, Limitations, has some information on this subject. There is no background material to support the information in the document, only what is thought to be values due to prudent practice. Don Platts indicated that he thought that we had decided to take this out since there is no background data to support the numbers. Jin Sim asked if by show of hand, how many members would vote negative if this was left as shown. There were a few more users present that did not vote to take the

information out than negatives, however, there were enough that would vote negative that it would be difficult to resolve during ballot.

Dave Wallach suggested possibly revising the section to take out the tables, but provide some language discussing the issue. Dave Wallach volunteered to take on rewriting this section.

Clause 7.1 item 2) – Don Platts asked if there were any recommendations on whether the thermal decomposition of insulation during overload really generates bubbles in the oil. There were no comments.

The meeting was adjourned at 10:05 am.

Respectfully Submitted

Don Platts for Tim Raymond (WG Chair) and Carlo Arpino (WG Vice Chair)
Susan McNelly – WG Secretary

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

8.1.3.2.1 Introduction and Rosters

The working group met on Monday, April 20, 2009 at 11:00 AM with 24 members and 100 guests attending, with 9 guests requesting membership. This brings the number of members to 84.

8.1.3.2.2 Approval of minutes from October 6, 2008 meeting

The minutes of the October 6, 2008 meeting in Porto, Portugal were approved as written.

8.1.3.2.3 Patent Disclosure

The chairman asked if anyone knew of any patents that could pertain to this project. There were none.

8.1.3.2.4 Historical overview of insulation system testing for liquid immersed transformers

- Discussion of original Lockie test program conducted starting in 1957
- Discussion of power transformer model tests conducted in the late 70's/early 80s.
- Review of the completed Dual Temperature test conducted by DuPont and Weidmann to validate this test method as a thermal model for transformers.

8.1.3.2.5 Discussion of Issues related to the test methodology uncovered during the historical investigation as well as the dual temperature test program

- Number of test points required for life curves (depending on the amount of extrapolation)

- How to meet the life requirement (full life curve, vs. provisional rating based on reduced testing with safety margin, vs. three point test of short duration with 5X safety margin to allow extrapolation.
- Discussion of life curves – finite number vs. separate life curve for each possible combination.
- Blended materials (such as upgraded kraft, wire enamels etc.) how to deal with minimum requirements in testing.
- Test duration discussion (accuracy of testing)
- Oil Temperatures/Oil preservation
- Other issues, such as end-of life criteria, how to evaluate other types of materials thermally (such as bonded CTC, etc.). This section provided the most feedback, as there was a spirited discussion whether the end of life (for non-kraft materials) should be 50% tensile or some lower number – since 200DP for kraft seems to correlate to a lower number than 50% tensile (based on testing and our own standards requirements).

8.1.3.2.6 “Industry Proven System”

The chair mentioned that the more precise the method, potentially the more complicated, and the more doubtful the method would be used. He offered a “carrot” to the group, that perhaps, due to the 40+ years of successful use of thermally upgraded kraft papers, one could develop a “Industry Proven System” which was by definition defined as meeting our 65C rise curve, assuming all of the conditions of the system were met, such as nitrogen content of the paper, type of processing, maximum operating temperature, etc. This could then allow all manufacturers to have access to a system without testing, and then our job would be to then perhaps define under what conditions a new test would be required and/or a reduced set of tests (one or two point comparison test).

8.1.3.2.7 Comments

The chair then finished up the discussion by soliciting comments (one more time). After receiving little comments, the chair described the process. He will send the working group these minutes and the presentation, and then ask for feed back on the issue areas and proposals, and to have the feed back by the end of May. Once this has been received, the chair will develop a draft for submission to the working group in June.

8.1.3.2.8 The meeting adjourned at 12:20 PM.

8.1.3.3 Working Group for Temperature Rise Test Procedures Section 11 of C57.12.90 - Paulette Powell

The Working Group met at 11:00am April 20, 2009 in Symphony 1 meeting room of the Hilton Miami Downtown Hotel, Miami, Florida. In attendance there were fifteen members and fifty-eight guests. There were no patent disclosures.

The minutes of the October 7 2008 were distributed prior to the meeting and approved as written. There were no introductions due to time constraints from a full agenda.

Projects:

TF – Sub-clause 11.2.2e

The TF is addressing two scenarios that could possibly result in hot-resistance time data not being suited to fit an exponential decay curve:

1. The time constant of small distribution transformers may be short due to transformer thermal characteristics and measuring equipment
2. The mean oil temperature surrounding the winding and the actual location of the winding may result in top and bottom oil temperatures not giving the intended average winding oil temperature.

Juan Castellanos shared an example wherein the radiator configuration resulted in a decay curve that was not an exponential decay when related to measured average oil temperature. Barry Beaster applied the Blume methodology to Juan's data determining hot-resistance at time zero. Juan commented that the average temperature of the oil at time infinity can be varied from 36.6 to 49.6 °C and still get a good data fit, but the resulting average winding temperature would be significantly different. He also commented that the 2nd order polynomial approximation would give only one possible solution when using the least squares regression method. Bertrand Poulin commented he will share with the WG an iteration method not subject to human manipulation - in order to run again same data.

Marcel Fortin gave a presentation on "Transformer Coil Average Temperature." From examples of distribution transformers, Marcel concluded that measurement of the oil temperature surrounding the coils cannot be done sufficiently precise to serve as an extrapolation reference for the coils cooling curves. Correct interpolation of coils temperatures at time zero requires approximation of the coil and bulk oil time constants, and coil resistances measured in a short period compared to the coil time constant. Marcel proposes first measurements be taken in less than half the coil time constant and measurements extend to not much less than the coil time constant. Actual loading or the back to back method would be the preferred way to perform the heat run tests. Multiple interpolations are required to determine the best fit first order exponential coil cooling curve. Sanjib Som proposed coordinating efforts with IEC and will provide the Chair documents for cooling curve methodology.

Oleg Roizman gave a presentation on "Temperature Rise Tests" illustrating some of the factors that affect winding temperature rise of power transformers. His findings supports some of the proposals the WG has completed for 11.2.2 such as recording hot resistance-time data points at 15-second intervals for power transformers and taking the first hot resistance data point no later than 4 minutes after shutdown. Other conclusions such as a longer data collection period for power transformers as for some cases with low time constant measurement at 4 minutes may be too long wait, and measuring one winding phase differ than the WGs completed proposal. He also gave recommendations for when using fiber optics temperature sensors inside windings.

TF – Modified Temperature Test

The TFs objective is to specify the parameters for a loading test, sometimes referred to as a quality control heat run, to check the transformer when a full temperature test has not been performed. Mark Perkins gave the following report.

The Task Force met Sunday April 19, 2009 at 1:30 pm with Subhash Tuli, Paulette Payne Powell, Don Platts and the Chairperson, Mark Perkins present. The TF discussed different ways that this modified temperature test might be included in the standards:

1. The modified temperature test could be listed as an "other" test in C57.12.00 and described in a sub-clause of Section 11 of C57.12.90
2. A working group paper could be written describing the test and it could be included as a reference to C57.12.00 or C57.12.90
3. C57.119 could have the title and scope changed to include the test in that guide.
4. The test could be included as an informative Annex to C57.12.00 or C57.12.90 or C57.12.10.

The TF was in favor of alternative 1. Don Platts agreed to take it forward to the Administrative Subcommittee for guidance.

The TF reached consensus on what would be included in the modified temperature test:

The modified temperature test is an "other" test used to verify the performance of the transformer when a full temperature test is not performed. Only one test is performed and that is done at the maximum nameplate MVA rating. The selection of tap changer positions, measurement points and setup parameters is made on the same basis as the normal temperature test at the tap position giving the highest average winding temperature rise as specified in C57.12.90 sub-clauses 11.1-11.6.

The current in the transformer shall be the total loss current as defined in C57.12.90 sub-clause 11.5. This current shall be held for a minimum of eight hours, of which a minimum of six hours must be at a top oil temperature rise above 80% of the calculated value. After this minimum duration, the top oil rise, bottom oil rise and average oil rise are to be calculated prior to shutdown. The average winding temperatures are to then be measured after shutdown as described in C57.12.90 sub-clause 11.3, only at the total loss current.

The average winding temperature gradients of additional windings are to be measured by circulating current corresponding to the maximum nameplate ratings of the windings for one hour followed by the average winding temperature measurement as described in sub-clause 11.3. The measured winding temperature rise values are to

be adjusted for the maximum nameplate currents and for any other adjustments per clauses 11.2 - 11.6.

Oil samples for dissolved gas in oil analysis are to be taken before and after the modified temperature test.

The estimated top oil rise and average winding rise (based on readings taken immediately before the shutdown) are to be determined. If any of these values exceed the 65 degree limit, then a full temperature test is required.

After the working group approves the proposed wording, a survey will be sent to the sub-committee. The next meeting of the TF will be Fall 2009 in Chicago at 1:30 pm on Sunday.

The meeting adjourned at 2:40 pm.

Unfinished Business:

There were no items discussed.

New Business:

11.2.2b - Juan Castellanos proposes for power transformers that a series of hot resistance measurements made on "all terminal pairs" only apply to the maximum capacity heat run. For the minimum capacity heat run just one phase per winding would be required as there is no value added in testing all three phases at minimum or intermediate capacities. This proposal will be drafted and sent to the WG for straw ballot.

11.2.2d Steve Snyder gave a presentation on "10- Minute Cooling Curve" for which measurements were made on both a 50kVA and 250kVA single phase distribution transformers using the short circuit and loading back methods.

Steve said that as the coils are of small mass, the winding temperature rapidly approaches the surrounding oil temperature, and then the heat release rate declines as this temperature differential is reduced. Performing regression analysis on the entire 10-minutes of data can result in the constant-slope portion of the curve significantly influencing the time zero intercept producing less accurate results. The curve slope is much greater in the first time interval (0 – 3 minutes), which he believes most accurately reflects the winding temperature decay, and hence leads to the most accurate projection of the "time zero" value. Steve proposes for the distribution class transformers, that it is more appropriate to specify a minimum number of points e.g. 10 points collected over a certain time interval e.g. no longer than 30-second intervals.

Marcel Fortin agreed to merge his and Steve Snyder's presentation proposals into one proposal for a straw ballot by the WG.

Being no other business, the meeting adjourned at 12:05pm.

Respectfully submitted,

Paulette Payne Powell, Chair
Juan Castellanos, Co-Chair

8.1.3.4 Task Force on High Temperature Transformers – Richard Marek

The second meeting of the WG took place on Monday, April 20, 2009 in Concerto C/D Meeting Room at 3:15 pm, at the Hilton Downtown Miami; Miami, Florida, USA

There were 16 members and 30 guests present. Introductions were made and attendance sheets were circulated. The IEEE patent policy was discussed and there were no concerns regarding patents.

Vice-Chair Waldemar Ziomek was introduced.

The Chairman informed the group that the PAR request was approved by NESCOM on 18 March 2009, and is valid until December 2013. The project has been assigned the number PC57.154. The approved title, scope and purpose were shown to the group. There were no comments concerning the title or purpose.

The Chairman noted that draft 2 incorporates comments by members Bill Henning and Patrick McShane and he reported briefly on the outside working meeting which was held on Sunday, April 19. He noted that there will be a second working meeting on Thursday, after the normal meetings are finished. The purpose of these meetings was to allow time to review and modify the draft which had been proposed as a starting point at the previous meeting in Porto. This draft was similar to an IEC document, modified to fit the IEEE template. During this Sunday meeting, modifications to the scope were suggested. It was also decided that section 4 should be moved to an informative annex, since it was considered tutorial.

Discussion about the scope in the WG meeting triggered a question as to which transformers are excluded from the scope or does it include all units? The Chair stated that his intention was to include all transformers, but that the WG should make this decision. The members were requested to provide comments to the chairman concerning revision to the scope, after which a decision on the request for revision will be made before the next meeting.

Marion Jaroszewski stated that the mobile transformers do not always conform to the requirements of the C57.91 loading guide and that some care is needed to avoid confusion.

Don Platts expressed concern about the status of the proposed document, questioning whether it was really a guide rather than a standard. He suggested that maybe it would be better to use IEEE C57.12.00 as a template, modifying as necessary to make sure it was a standard. The Chairman disagreed stating that the WG should be able to modify the draft to comply with the PAR.

Under new business, Hasse Nordman reported on some special applications of high temperature transformers and difficulties in locating high temperature accessories.

Claude Beauchemin asked the WG if anyone has any information or study results concerning bubble generation with high-temperature insulation. Mike Franchek said he thought Weidmann had performed some research many years ago and that he would try to make it available to the WG.

Draft 3 is expected to be circulated before the fall meeting. The WG was requested to review the draft 2 document and make comments or suggestions which would be incorporated into draft 3.

The meeting adjourned at 4:30

8.1.3.5 Task Force on Moisture Estimation in Transformer Insulation – Jin Sim

The Task Force on Moisture Estimation in Transformer Insulation did not meet during the Spring 2009 Transformer's Committee meeting.

8.1.3.6 Task Force on Furan Testing – Kent Haggerty

The task Force met Monday April 20, 2009. Tom Prevost and Don Platts substituted for the Chair, Kent Haggerty, who could not attend.

They reviewed the status of the technical paper that has become the primary focus of the task force. The group producing the paper has hopes to get it published in 2009.

Tom repeated his request for Furan test data from the users and laboratory companies in attendance. Tom reported that his company has a large number of data records. Bob Rasor from SD Myers gave Tom disks with thousands of additional records. These will be added to the database the task force is developing.

There was no new business, and no other old business.

Don Platts
Acting Secretary

8.1.3.7 Task Force on Winding Temperature Indicators - Phil McClure

The Task Force on Winding Temperature Indicators did not meet during the Fall 2008 Transformer's Committee meeting.

8.1.3.8 Task Force on Quality Control (Accelerated) Heat Runs – Mark Perkins

8.1.3.9 The Task Force on Quality Control (Accelerated) Heat Runs did not meet during the Fall 2008 Transformer's Committee meeting.

8.1.3.10 Task Force on Tie Plate Temperature Limits – Jeff Ray

The Task Force on Tie Plate Temperature Limits did not meet during the Fall 2008 Transformer's Committee meeting.

8.1.4 Old Business:

There was no Old Business.

8.1.5 New Business:

There was no New Business.

8.1.6 The meeting adjourned.

Don Platts
Chair, Insulation Life Subcommittee