Insulation Life Subcommittee - Unapproved Meeting Minutes
October 24, 2012 – Milwaukee, WI

5.8 Insulation Life Subcommittee – Bruce Forsyth, Chairman

The Insulation Life Subcommittee met in Milwaukee on October 24, 2012 at 8:00 AM.

A hand count of the members revealed that a quorum was present. David Harris proposed a motion to approve the minutes of our meeting in Nashville, TN on March 14, 2012 as written. Kent Miller seconded the motion. There was no discussion and the motion was unanimously approved.

The attendance rosters show that the meeting was attended by 197 people, 58 of 91 members and 139 guests. 10 guests requested membership.

5.8.1 Chair's Report

The Spring 2013 IEEE Transformers Committee Meeting will be held in Munich, Germany. The Fall 2013 meeting will be held in St. Louis, Missouri.

In order to ballot a standard, you must be a member of the Standard's Association. In addition, you will be notified of ballots based on your profile in IEEE MyProject. All members and guests are encouraged to check and update their profile in MyProject.

Working Group Chairs must be a member of the Subcommittee.

The minutes for Activity Groups should record:

- The attendance including the number of members, the number of guests, and if a quorum was present
- The Chair or Acting Chair
- The Secretary or Acting Secretary
- The name of the member who makes a motion, the name of the Member who seconds the motion, and if the motion carried or was defeated.
- A summary of the discussion and comments.

The Administrative Subcommittee is looking at the membership requirements for Subcommittees. Until they provide guidance on membership, this Subcommittee will use the following criteria:

- You must have attended at least 3 of the last 4 meetings in order to be considered for membership.
- Existing members will be moved to guest status if they miss three meetings in a row. Once moved to guest status, former members will need to meet the requirements for new members.
- Guests will be removed from the roster if they miss 3 meetings in a row.

The Transformers Committee is looking for tutorial topics. Please talk to your subcommittee Chair if you have any suggestions for technical presentations.

5.8.2 Project Status Reports

5.8.2.1 C57.100 IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution Transformers

C57.100 was recently approved. This standard is valid until 2021.

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

C57.119 is valid until 2018.

5.8.2.3 C57.154 Design, Testing and Application of Liquid-Immersed Transformers with High-Temperature Insulation

C57.154 has been approved and should be published by October 30, 2012. The existing PAR expires in 2013.

5.8.2.4 C57.91 IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators

C57.91 was recently approved. This standard is valid until 2012.

5.8.2.5 1276 Guide for the Application of High Temperature Insulation Materials in Liquid-Immersed Power Transformers

The 1276 PAR expires in 2016. The standard is valid until 2018.

5.8.2.6 1538 IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformers

1538 is valid until 2021.

5.8.3 Working Group and Task Force Reports

5.8.3.1 Task Force on Winding Temperature Indicators - Phil McClure

The meeting was called to order at 9:45 am. There were 7 members and 22 guests in attendance. There are now 8 members in the Task Force, so a quorum was achieved. Eight guests requested membership, but only two of these attended the Spring 2012 meeting.

The minutes of the Spring 2012 meeting in Nashville were emailed to the members before this meeting. The chair requested a motion for approval of the minutes and Dave Wallach made the motion. Juan Castellanos seconded the motion. The members voted approval and there were no dissenting votes.

Old Business

The Task Force membership has been reviewed and trimmed as was announced at the Nashville meeting. After the next meeting in Munich, the roster shall be reviewed again for the addition of new members.

New Business

The experiment was modified since the initial release and the changes were explained to the group. As a result of running the experiment's first section, which determines thermometer time constant, section 2 of the experiment – thermowell time constant - was found to be unnecessary. Section 2 and other sections which were dependent on it were removed. The requirement for multiple fluid circulation speeds when measuring WTI system time constants with low (25 °C) fluid temperature was simplified to a single (medium) speed, since fluid velocity is not zero nor very fast as a thermal head is developing. Later data indicated that fluid velocity does not make a significant difference in the time constant. The section on 200% thermowell excitation was also removed, since the thermowell manufacturers warned that their products would be damaged if they were taken beyond their full scale ratings. The recommendation is that any overload be considered within the full scale rating of the thermowell.

There is one more WTI system that needs to be tested and it will be done in a few weeks when a high power ballast resistor is obtained.

The data for the static accuracy and response times of the thermometers was presented along with graphical plots of the data for the WTI systems. A discussion of the results and conclusions ensued. This information essentially answers the question that had been asked as the charter for the Task Force.

A discussion was had on how to introduce the results of the experiment, in order that they can be used as a reference for future documents and existing documents in the future. The suggestions that were made at the prior meeting were reiterated and some new ideas were presented. These will be pursued with greater urgency now that the experiment has nearly been completed.

The next discussion dealt with what to do with the existing paper, which has been written over a period of many years, while we attempted through several avenues to get data to answer the charter question. During these years Task Force members thought that the

paper should also include descriptions of the types of WTI systems that were being investigated, how they are used and applied, how they are calibrated and maintained, what the consequences are of failure to accurately measure winding temperatures and what more recent or new technology might be applied to supersede the older technologies, in the event they are found to be problematic. These sections were added and as a result the paper contains many of the properties of a guide. The members of the Task Force and several guests expressed their opinions that the experiment should be published and the existing paper be completed to the level of a guide.

As a result of this discussion, the Chair requested a motion to bring the recommendations of the Task Force to a vote. Dave Wallach made the motion to complete and publish the experiment, then recommend to the Insulation Life Subcommittee that a working group be formed to write an IEEE guide for Winding Temperature Indicators. The motion was seconded by Josh Herz and all members present voted in favor of the motion.

The assignment to complete the experiment and remaining minor editorial work was accepted by the Chair. Guests Bruce Forsyth and Don Platts were asked to investigate persons they were acquainted with to help with ideas to get the paper published. Further assignments were held pending action of the Insulation Life Subcommittee.

The meeting was adjourned at 11:00 am.

Respectfully Submitted

Phil McClure
Chair
Task Force on Winding Temperature Indicators

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

Monday, October 22nd, 2012 11:15 a.m.
Approximately 65 in attendance

11 Members – 6 in attendance

1. Valery Davydov
2. Don Platts
3. Tom Prevost
4. Jin Sim
5. Brian Sparling
6. Barry Ward

Task force scope was reviewed and Jin pointed out that it does not align with the document (revision 13). He thought the goal was to define the moisture in the insulation at or near the

hot spot, but that is not clear in the approved TF scope. Don Platts pointed out that the scope said at a minimum there are bullets to be addressed. Tom Prevost said that the recently revised draft 14 does not include the methodology of finding moisture in the insulation at the hot spot.
Oleg Roizman is the only member to provide written comments of Revision 14 so far
Jin stated that the TF failed as there is no information of moisture content for end users to apply to calculate the bubble evolution or thermal ageing. He asked for comments and opinions.

- Hasse Nordman – Oleg's point is very clear and he thinks we need clear figures in order to give the industry anything useful.
- Tom Prevost said that Draft 14 does not address this issue directly. Despite all the work on the document, it should have been clear to align with the scope. From what he can tell, there is no measurement that directly correlates to moisture in the paper at the hot spot in Draft 14. Maybe the document can be expanded a chapter to address how close current methodologies can come.
- Claude Beauchemin asked if the recent paper from a moisture study in Germany has been reviewed. Tom Prevost confirmed that the study is in revision 14.

Jin proposed to 'wrap this up' and hand over to the TF Moisture in Insulation Systems. Bruce Forsyth stated that he did not see it as a failure but that it gave valuable information for the new group. Tom Prevost said there will be much discussion at the next TF Moisture in Insulation Systems meeting, but it does not address the scope and would not be right to combine the two. The document does not need much additional work to have published and it can be done between now and the next conference.
Don Platts stated that the document falls so short, it is not worth publishing. Logic is faulty and it needs many editorial corrections. It does not give guidance of how to use the information in the document.

Valery Davydov stated measuring the hot spot is difficult on its own and it may change depending on load. Brian Sparling stated the loading guide already has a method to determine the hot spot temperature. It is estimation.

Jin restated again that the TF failed because there is nothing for end user. The goal was to be plus or minus 50 percent on moisture content estimation. So the TF is not close to estimating moisture. The TF has a good collection of what the industry has, and can wrap up the next draft in six more months without addressing the scope. Bruce Forsyth would like to see the document finished with the current scope and will not personally support changing direction.

Jin stated that several groups that address moisture. Tom and Brian should produce revision 15 without increasing scope. Tom Prevost then suggested it should not discuss how moisture is removed in the field since it is not already in the document. Barry Ward suggested it be added but then refer to other documents that cover it in detail. Don Platts offered to provide his written comments on the document.

Jin asked for a time commitment to complete the document. Tom P suggested the following schedule:

1. All comments received by Dec 15th
2. Tom and Brian will finish and have it to Jin by the end of January
3. TF members will have it by February and can review until March end.

No additional comments were given and the meeting was adjourned at 11:55 a.m.

Minutes recorded by Hali Moleski for the chairman Jin Sim

5.8.3.3 Task Force on Moisture In Insulation Systems – Tom Prevost

Chair: Tom Prevost
Vice-Chair: Valery Davydov

The TF on Moisture in Insulating Systems met on Monday, October 22, 2012 at 1:45 PM with 152 people attending. 69 individuals attending this meeting indicated that they would be willing to serve as members of this task force.

This was the first meeting of this task force.

Introductions and statement of affiliation.

Introduction of goals of the task force- Tom Prevost

- Create membership
- Develop Title, Scope ad Purpose of document
- Create PAR for potential WG to be presented to Insulation Life Subcommittee Chair

Introduction of need for document- Valery Davydov

- Proposal
  - To develop a new reference document tentatively titled *"Moisture Phenomena in Insulating Systems of Dry, Gas Insulated and Liquid Immersed Transformers and Reactors"*
  - To consider an IEEE/IEC dual logo status of the document proposed

- Statement of the Problem
  - The current approach is that each existing IEEE standard or guide contains its own solution to the moisture related phenomena it is dealing with
  - The current approach is lacking benchmarking of the moisture state of insulation of transformers and reactors
  - The proposed approach is unprecedented in the series of IEEE/PES Transformers Committee standard documents

- It has been Proposed:
    - To consider the issue of Moisture in Insulating Systems of Transformers and Reactors as a whole
    - To develop a new document that would serve as a single knowledge base document for IEEE (and IEC?) standards and guides dealing with moisture
    - To consider the Insulation System of a transformer or reactor as one of the following physical complexes:
        - Solid-Gas (dry type, gas insulated & vacuum insulated units)
        - Solid-Liquid (liquid immersed units without headspace), or
        - Solid-Liquid-Gas (liquid immersed units with headspace)
    - To use the physical laws and mathematical equations for the Solid-Gas Physical Complex as the basis for all the three above listed physical complexes

- Sections of New Document Proposed:
    1. Terminology and definitions
    2. Measurement and evaluation of moisture-in-gas insulation parameters
    3. Measurement and evaluation of moisture-in-liquid insulation parameters
    4. Measurement and evaluation of moisture-in-solid insulation parameters
    5. Evaluation of aging and end of life of solid insulation parameters
    6. Factory/workshop application of knowledge on moisture; benchmarking
    7. Field application of knowledge on moisture

The title, scope and purpose will be circulated in a survey ballot to the membership. During the meeting the following drafts for title, scope and purpose were developed:
Title:

(Recommended Practice) (Guide) (Trial-Use Guide) for the Interpretation of Moisture and Moisture Assessment Related Parameters in Dry, Gas Insulated and Liquid Immersed Transformers and Reactors

Scope:

This document applies to dry, gas insulated and liquid immersed transformers and reactors and addresses:

1. The theory of moisture dynamics and methods of assessment of moisture and moisture assessment related parameters in solid-gas, solid-liquid and solid-liquid-gas insulating physical complexes
2. The interpretation of measurements and evaluations of moisture and moisture related parameters
3. The risks associated with moisture in operating transformers and reactors, and approaches to mitigate the risks
4. The benchmarking of moisture and moisture assessment related parameters
5. Trending (tracking) the changes against the benchmarks through the life of the transformer or reactor
6. A bibliography of related literature

Purpose:

- There is a need for a new reference document, written in a proper scientific and engineering manner, which would serve as a single knowledge base for other standards and guides dealing with moisture and moisture related phenomena in dry, gas insulated and liquid immersed transformers and reactors.
- After such a reference document is developed, each existing guide or standard could refer to it and, if needed, build a higher level moisture related application on the basis of the comprehensive and up-to-date information presented in it.
- This document, therefore, recommends the ways of comprehensive assessment of moisture and moisture related parameters of transformers and reactors, their benchmarking at the factory or workshop, tracking the changes against the benchmarks throughout the life of the units in the field.

Proposed Next Steps:

1. Establish TF membership – today (October 22, 2012)
2. Establish working Title, Scope and Purpose – today
3. Survey Ballot TF – by November 30, 2012:
    a. Finalize the Title, Scope and Purpose
4. Prepare and submit PAR to IL SC Chair – by December 28, 2012
5. PAR reviewed at AdCom – on Sunday, March 17, 2013 (S13 Mtg)
6. PAR submitted to NesCom – before May 3, 2013
7. PAR is approved:
    a. New WG is formed – June 14, 2013 (Standards Board Mtg)
8. Establish WG membership – Monday, October 21, 2013 (F13 Mtg)
9. Four years to complete the new document

The meeting adjourned at 3:00 PM

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

The Working Group met in the Crystal Ballroom of the Hilton Milwaukee City Center Hotel in Milwaukee, WI on Tuesday October 23, 2012 at 11am. Present were thirteen (13) members and fifty-seven (57) guests. We had a quorum.

The minutes from the previous meeting in Nashville were approved as written.

The meeting focused on the revised loading-back-method proposal, section 11.1.2.2. The revised version included the comments received during the straw ballot. After some discussion, the following changes to the proposal were agreed:
1.- To delete the last sentence of second paragraph regarding correction of liquid temperature rises due to losses differences. Proposed by Mr. Tom Holifield.

2.- To change last sentence of first paragraph on second page to express that the excitation and loading power sources may be in phase or 120° out of phase. Proposed by Mr. Bertrand Poulin.

3.- To remove average voltage meter from figure 28. Proposed by Mr. Bertrand Poulin.

4.- To revise figure 29 in order to include metering equipment, similar to figure 28. A volunteer from the audience was asked to perform this task, but without response. After the meeting, Mr. Mohamed Diaby (mohamed.diaby@efacec.com) volunteered to do the changes. The modified proposal will be sent for a straw ballot within the working group.
In response to Mr. Holifield request, the latest draft of section 11 including all changes so far will be sent to the working group. This is for information purposes.

Under new business, Mr. Hakan Sahin (hakan.sahin@us.abb.com) commented about the possibility of performing the heat run test at a different OLTC position than the anticipated highest temperature rise or highest losses, but with the preventive auto at a bridging position. The test results would be corrected based on losses. He will send a proposal for consideration by the working group.

Having no other new business, the meeting adjourned at 11:45am.

Respectfully submitted,
Paulette Powell, Chairperson
Juan Castellanos, Vice-Chair

5.8.3.5 Working Group for Application of High-Temperature Materials IEEE P-1276

October 23, 2012
Walker Room, Milwaukee Hilton
Milwaukee, WI
Mike Franchek, Chairman
Roger Wicks, Secretary

5.8.3.5.1 Introduction and Rosters

The working group met on Tuesday, October 23, 2012 at 3:15 PM with 18 attendees requesting membership and 30 guests attending.

5.8.3.5.2 Chairman's Remarks on WG Task

The chair reviewed the document history as well as some of the recent history of documents that have been developed since this document was last revised.

History - first in 1994 there was a background paper developed which outlined the current state of the art (at that time) for the use of higher temperature materials in transformer

applications. At this time there were no industry standards, so this document contained some technical guidance like information and examples.

After completion of the background paper, a trial-use guide was developed in 1996 which covered the use of high temperature materials in power transformers. This document because an IEEE Guided in 1997. There were discussions regarding broader coverage, but the group agreed to limit to a narrow scope based on what was broadly in use at the time.

Then the chair detailed this scope and where a subsequent IEEE document that was just approved (IEEE C57.154). This standard covers subjects including limits, a variety of ways transformers are used (mixed hybrid, full hybrid, high temperature transformer, etc.) and it includes high-temperature dielectric fluids.

5.8.3.5.3 Discussion on History and Adjacent Documents

Sam Mehta asked a question related to test methods discussed in this document. Roger Wicks provided a feedback related to current methods described in IEEE C57.100 and IEC 62332. Note – in looking back over the document after the meeting – Sam may have been discussing the note in the 1276 document which describes sealed tube testing and a dual-temperature like test (62332 was not available at this time).

Hasse Nordman – commented that the more standard like the document the more useful. He also expressed concerns related to the purpose of this document vs. IEEE C57.154 and IEC 60076-14.

The Chair then noted that he will solicit additional options from other attendees either during the rest of the week or via email.

Patrick McShane noted that work on standards is has benefits/costs – how does this document measure against that. The Chair noted that one concern about not working on this document would be to lose a lot of good tutorial information. He noted that there is a lot of work needed, but that this would be worth the effort. Examples of some work needed including gassing tendencies, addition of new fluids/solids, and other improvements.

John Luksich then asked about loading guides – The Chair noted that this document should address this issue, how to apply existing loading guide separately.

There was an additional input (Jitendra Mamtora) related to transformer that operates at normal temperatures but allowing 30% overload.

3.8.3.5.4 Discussion of Scope for the Revised Document

The Chair reviewed the introductory parts of the 1997 version of the document (Overview, Scope) and then a revised Scope that was part of the revised PAR submission to begin this work (revised from the original scope to address input from NESCOM).

Areas of significant difference included removal of the overview, adding a specific comment related to average winding rise (75C to 115C rise units), and then removal of a note that limited the scope of the document to mineral oil.

Patrick McShane noted that lower rises might be needed for units like wind where the units are normally lightly loaded, but which allow a much higher overloads than typical.

Joe Foldi commented that it might be important to list higher hottest spot vs. higher rise as part of the scope (as the hottest spot limits the life typically).

Input (Jitendra?) related to reduced size needed in wind/solar applications – where loading is on average only 20 to 25% and the NL losses then become very important. For wind – the maximum load typically is concurrent with higher cooling capability. These types of units (broaden scope beyond power) would be useful.

Question related to strength of copper conductor under short circuit stresses.

Discussion related to core insulation (which could depend on maximum fluid temperature which would depend on fluids allowed in this document).

Joe Foldi mentioned that the life is based on hottest spot temperature – much more important than average (winding rise).

Question from audience related to allowing alternative fluids which allow higher top oil temperatures – scope wider – which would allow a broader range of applications to be discussed. The use of new fluids would benefit users.

Input related to higher gradients used with these high temperature materials and how to best take advantage of these materials in designs.

Sam Mehta mentioned it should include other fluids and many in the audience echoed this comment (David Sundin, Patrick McShane, etc.).

Patrick McShane noted that higher temperature fluid operation would require more detail on a number of other items (gaskets, bushings, LTCs, etc.). The Chair noted this was discussed in minor degree in our existing document and in more degree in IEEE C57.154. Will have to see to what extent this needs to be discussed when we finalize scope.

Joe Foldi mentioned that the scope needs to address evaluation of high temperature solid materials (just states high temperature materials in scope as submitted for the PAR).

Sam Mehta asked a question related to the use of high molecular weight hydrocarbons (mineral oil variation) operating at higher oil temperatures and the Chair noted this would be within the current scope.

The Chair then finished the discussion regarding the need to change the scope to include high temperature fluids – and that he would get a consensus of the group (new working group) as the document moves forward.

3.8.3.5.5 The meeting adjourned at 4:15 PM.

5.8.4 Old Business:

No old business.

5.8.5 New Business:

5.8.5.1 Moisture in Insulation Systems – Discussion

There was a discussion about the goal of the Moisture in Insulation Systems Task Force along with the number of task forces dealing with moisture? Key points of the discussion were:

- Moisture in transformers crosses the boundaries between subcommittees. Moisture in solid insulation is covered by the Insulation Life Subcommittee while moisture in oil is covered by the Insulation Fluids Subcommittee.
- The Moisture in Insulation Systems Task Force will try to pull the information together and create a reference for the other documents.

Jin Sim asked if the Task Force will produce a method for the utility to estimate the moisture in the transformer and apply it to aging and bubbles around the paper and hotspot. Tom Prevost replied that it was one of the goals along with providing a method for benchmarking.

5.8.5.2 Winding Temperature Indicator – Discussion

There was a discussion about taking the Winding Temperature Indicator (WTI) Task Force information and turning it into a Guide. Key points of the discussion were:

- The history of the Task Force was reviewed. The original scope dealt with WTI time constants with the goal of producing a guide. A few years later, the Task Force and Subcommittee agreed with changing the goal from creating a guide to writing a private paper.
- The main thrust of the Task Force is to capture the information gained on WTIs.
- A guide traditionally provides a procedure. The information on the WTI sounds more like a tutorial.

A straw poll of the subcommittee revealed that was not strong interest in creating a guide on WTIs.

The Chair directed P. McClure to complete the paper on the WTI tests and results.

5.8.6 The meeting adjourned at 9:15 AM.

Bruce Forsyth
Chair, Insulation Life Subcommittee