Annex H Insulation Life Subcommittee

November 1, 2017
Marriott Hotel, Louisville, Kentucky, USA

Chair: Sheldon Kennedy
Vice-Chair: Barry Beaster
Secretary: Sam Sharpless

The Insulation Life Subcommittee was called to order by the Chair in Louisville, Kentucky on November 1, 2017 at 8:10 AM. Due to the size of the group, general introductions were not made. The Chair requested that each person state their name and affiliation when addressing the subcommittee.

H.1 Chair's Report/Remarks

The chair provided the dates of upcoming Transformer Committee meetings as follows;

2018 Spring Meeting; March 25-29, 2018, Pittsburgh, Pennsylvania, USA

2018 Fall Meeting; October 14-18, 2018, Jacksonville, Florida, USA

The Chair requested that any person with knowledge of a patent essential to meet the requirements of any subcommittee standard to bring the issue forward for discussion. No one responded to this request.

The Chair requested the following items be included in all activity group minutes;

- The name of the activity
- The date and time of the meeting
- The number of members and guests in attendance. Full attendance should be recorded in the AMS system
- The presence or absence of a quorum
- Any essential patent issues raised during the meeting.
- A summary of discussion. Intricate detail not required. Use a separate document to explain decisions that are made.
- A record of the decisions made in the meeting
- If there will be another meeting. If so, state the time and place.
- Submit minutes as soon as possible, but no more than 15 days after the meeting.

The Chair reminded everyone that working groups must achieve a two-thirds majority to submit a document for Sponsor Ballot. The subcommittee must achieve a simple majority to submit a document for Sponsor Ballot.

The Chair discussed the membership requirements and recognized the following new members; Jose Gamboa, Saurabh Ghosh, Jinesh Malde, Mickel Saad, Robert Thompson, Jason Varnell, and Michel Veilette.

The Chair discussed the requirements for continued membership and stated that the following members had been moved to guest status due to lack of attendance; Dieter Dohnal, Kenneth McNeish, Hasse Nordman, Oscar Pinon, Rakesh Rathi, Subhas Sarkar, Charles Simmons

The Chair noted that the following guest had been removed from subcommittee rolls by request; Keith Ellis

The Chair reported on the status of subcommittee Projects;

- C57.91 - IEEE Guide for Loading Mineral Oil-Immersed Transformers; C57.91 is valid until 2021.

- C57.100 - IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution Transformers; C57.100 is valid until 2021.

- 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. The working group chair for revision of this document is Gael Kennedy.

- C57.154 - Design, Testing and Application of Liquid-Immersed Transformers with High-Temperature Insulation; C57.154 is valid until 2022.

- C57.162 – Guide for the Interpretation of Moisture Related Parameters in Dry, Gas Insulated and Liquid Immersed Transformers and Reactors; The C57.162 PAR expires December 31, 2017. The standard is valid until 2018. A PAR extension has been requested. The working group chair for revision of this document is Thomas Prevost.

- 1276 – Guide for the Application of High Temperature Insulation Materials in Liquid-Immersed Power Tranformers; The 1276 PAR expires December 31, 2016. The standard is valid until 2018. A PAR extension has been requested. The working group chair for revision of this document is Roger C. Wicks

- 1538 – IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformers; 1538 is valid until 2021. An amendment was approved September 2015. The working group chair for revision of this document is Richard P. Marek.

H.2 Secretary's Report

The Secretary reported that according to the electronic check-in system, 90 members were present at the start of the meeting and that a quorum had thus been achieved.

The Spring 2017 subcommittee meeting minutes had been provided to participants in advance of the meeting for review. Hem Shertukde made a motion to approve the minutes, the motion was seconded by John John and carried by acclamation with no objections.

The Fall 2017 subcommittee meeting agenda was provided to participants in advance of the meeting for review and they were also presented on a screen at the meeting. Don Platts made a motion to approve the agenda, the motion was seconded and carried by acclamation with no objections.

Consolidation of the electronic check-in records and the written attendance rosters after the meeting showed that 214 total members and guest were present at the meeting.

Eleven guests requested membership via the membership roster and all met the membership criterion; Jason Attard, Kevin Biggie, Roger Fenton, Gael Kennedy, Neil Kranich, Kumar Mani, Shankar Nambi, Anastasia O'Malley, Pugazhenthi Selvaraj, Robert Stinson, and Peter Zhao.

H.3 Project Status Reports

H.3.1.1 C57.91 IEEE Guide for Loading Mineral-Oil-Immersed Transformers

C57.91 is valid until 2021.

H.3.1.2 C57.100 IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution Transformers

C57.100 is valid until 2021.

H.3.1.3 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 and the working group is Chaired by Gael Kennedy.

H.3.1.4 C57.154 Design, Testing and Application of Liquid-Immersed Transformers with High-Temperature Insulation

C57.154 is valid until 2022.

H.3.1.5 C57.162 - Guide for the Interpretation of Moisture Related Parameters in Dry, Gas Insulated and Liquid Immersed Transformers and Reactors

The C57.162 PAR expires December 31, 2017. The standard is valid until 2018 and the working group is Chaired by Tom Prevost. A PAR extension has been applied for.

H.3.1.6 1276 Guide for the Application of High Temperature Insulation Materials in Liquid-Immersed Power Transformers

The 1276 PAR expires December 31, 2016 and a PAR extension has been approved through 2018. The standard is valid until 2018 and the working group is chaired by Roger C. Wicks.

H.3.1.7 1538 IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformer

The 1538 guide is valid until 2021 and the working group is chaired by Richard Marek. An amendment was approved in September 2015.

H.3.1.8 165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors

The 165 guide has just been started and the working group is Chaired by Phil McClure. The PAR is valid until 2021.

H.3.2 Working Group and Task Force Reports

H.3.2.1 Working group on PC57.162 – Guide for the Interpretation of Moisture Related Parameters in Dry, Gas Insulated and Liquid Immersed Transformers and Reactors – Tom Prevost

The meeting was called to order at 11:00 am.

Attendance:

Members:	46 of 90 , 51%, (Quorum was achieved)
Guests:	112

Following the establishment of a quorum, the following business was completed:

- Approval of Agenda
- Approval of Minutes from Spring, 2017
- Call for Patents
- Review of PAR
  - Project Scope
  - Project Purpose
- Chair's Remarks
  - PAR Extension request; The chair informed the meeting attendees that the PAR for this project expires at the end of 2017. A request had been submitted to NesCom for a three year extension.
  - Project Timeline; Assuming that we will be granted the extension for the project we will need to complete the document in two years (by the end of 2019) in order to complete balloting by the end of 2020.
  - Document Status; The document is approximately 50% complete. Several chapters are finished while there are other chapters that have very little complete. The chair reiterated the need for all chapters to have a draft before the next meeting,

Task Force Reports

Task Force 1 – Terminology and Definitions
Task Force Leader (Jeff Golarz)
First draft is complete. Still looking for additional input from task forces.

Task Force 2 – Measurement and evaluation of moisture-in-gas insulation parameters.
Task Force Leader – Tom Melle
Working on first draft.

Task Force 3 – Measurement and evaluation of moisture -in – liquid insulation parameters.
Task Force Leader – Claude Beauchemin
Working on first draft. Due to huge amount of effort to complete the revision of C57.104, for which Mr. Beauchemin is chair, the chair is looking for a new task force leader.

Task Force 4 – Measurement of moisture in solid insulation.
Task Force Leader – Ron Hernandez
Draft is complete.

Task Force 5 – Estimation of moisture in solid insulation
Task Force Leader George Frimpong
Draft is complete.

Task Force 6 – Inferring of moisture in solid insulation from measurements conducted in liquid or gaseous medium.
Task Force Leader – Valery Davydov
First draft is complete.

Task Force 7 – evaluation of aging and end of life of solid insulation parameters
Task Force leader – Roger Wicks
Waiting on first draft.

Task Force 8 – Factory/workshop application of knowledge on moisture; establishing baselines
Task Force leader – Poorvi Patel
First draft is complete

Task Force 9 – Field application of knowledge on moisture
Task Force leader – Jim Thompson
Waiting on first draft.

Task Force 10 – Moisture equilibrium charts
Task Force leader – Tom Prevost
Waiting on first draft.

This meeting adjourned at 12:15pm

H.3.2.2 Working Group for Application of High-Temperature Materials IEEE P-1276 – Roger Wicks

A. Welcome & Chairman's Remarks R. Wicks

Roger opened the meeting at 3:15 pm with a brief description of the status of the Working Group.

B. Circulation of Attendance Rosters J. Arteaga

Circulated

C. Attendance for Quorum J. Arteaga

24 members were in attendance meeting the quorum requirement a minimum of 19 members. 47 guests were presented and 8 requested membership.

D. Approval of Spring 2017 Meeting Minutes – New Orleans, LA J. Arteaga

Marion Jaroszewski made a motion to approve the minutes and Bruce seconded it. The group unanimously approved the minutes.

E. Approval of agenda

Alan Sbravati made the motion to approve the agenda and Marion Jaroszewski seconded it. The group unanimously approved the agenda.

F. Patent Disclosure R. Wicks

There were no issues related to Patent Assurance brought up by attendees in the meeting.

G. Discussion R. Wicks

Chair presented the results of testing using the sealed tube method with a pressure relief device rated at 10PSI, and a 3 point evaluation as outlined in std. C57.100. It was noted that the ratio of materials utilized for the test has an impact in the results. The ratio of materials for distribution transformers results on a tensile strength retention of 16% to 20%, as with ratio of materials for power transformers this value is between 11% and 13%. The results showed that the thickness of the material used for insulation does not have as much of an effect on the results.

Alan Sbravati indicated that in his experience the sealed tube without a pressure relief device represents better the condition of degradation due to the catalytic effect under pressure, which has a large effect, and suggested that the use of bellows can compensate for the changes in pressure. The chair mentioned that in the transformers there is a pressure relief device making the use of the relief device in the sealed tubes more representative of the conditions of the transformer in operation. Also, the use of bellows make the test more difficult to conduct.

John Luksich and Roger Wicks will provide examples for Clause 8, loading guidelines, using the methodology described in C57.100 to provide the loading guidelines for other fluids and insulation systems.

It was commented that the material compatibility of materials, like gaskets, made need to addresses similarly as in standard ASTM D3455. Roger Wicks indicated that this standard addresses the chemical compatibility of the insulating materials with mineral oil at lower temperatures (100˚C), but does not cover their performance at higher temperatures. Tom Golner mentioned that these materials are already covered in this document.

Alan Sbravati requested to include overload guidelines for the performance of de-energized tap changer and bushings. Roger Wicks indicated that due to time constrains this requirement may not be include now if the material is not already available.

Marion Jaroszewski made the motion to made a straw ballot within the WG starting by November 17 using the current document with the changes discussed today. David Sundin seconded the motion and the group approved it unanimously. The significant changes discussed included combining Clause 4 and 7, incorporating a generic loading guide method using the aging example from IEEE C57.100 and incorporating the loading guide from IEEE 1276-1997 (aramid in mineral oil) and an updated version of the loading guide on natural esters into an informative annex linked to this method described in the main body of the document. Additionally, some of the information in the Annex on materials in the Annex will be condensed as no work has been done on this section.

A ballot resolution group formed by Roger Wicks, Marion Jaroszewski, Clair Clairborne and Alan Sbravati will review and resolve the ballot results and present the resolution the WG for approval and proceed to have a vote at the subcommittee level to allow us to proceed to have a sponsor ballot.

It is expected to complete this process before October of next year, before the current guide expires.

David Sundin made a motion to adjourn the meeting, Bruce Forsyth seconded the motion, all members approved it, and the meeting adjourned at 4:30 PM.

H.3.2.3 Working Group on C57-119 IEEE Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Ratings – Gael Kennedy

The document continues to undergo ballot resolution. It is still on track to be completed prior to the end of 2018. This working group did not meet during the Louisville Conference.

Submitted by: Gael R Kennedy

H.3.2.4 Working Group on C57-91 IEEE Guide to Loading Mineral-Oil-Immersed Transformers– David Wallach

A. Welcome & Introductions

B. Rosters were handed out for attendance. The AMS membership contains the roster from the prior PAR (244 names). All prior members have been rolled back to guest status and attendees can request membership. Attendance at this meeting was 96 signing in on rosters (118 on RFID) with 44 attendees requesting membership.

C. The meeting agenda was reviewed and approved.

D. The call for patents was made and no applicable patents were identified.

E. The chair informed the group that the PAR for this guide was valid until Dec 31, 2021. The plan was work on draft revisions in 2018 and 2019 with a view of keeping 2020 free for finalizing draft and going for a start ballot.

F.There was good deal of discussion and suggestions to include transformer rating, condition based approach and include moisture and DGA scoring factors in the C57.91 guide.

G. There was discussion about including other liquids like esters. One member suggested the WG consider including other liquids like esters but the overall majority of members felt that we keep the guide restricted to mineral oil only.

H. Jason Varnell of SPX and Javier Arteaga of ABB suggested we include overloading guidance on major components like leads, DETC and bushings.

I. Alan Sbravati of Cargill suggested we provide guidance on use of fiber optic based hot spot temperatures to the guide .

J. One member suggested we remove 200% overload capability from the guide.

K. One member felt that Table 8 includes transformer design information and should not be in guide and cautioned to look for similar data in the guide that needs to be removed while revising the guide.

L. Sasha suggested we look at distribution loading guidelines of utilities by conducting a survey.

M. One member suggested we harmonize loading with C57.163 guide.

N. Action Items:

1. We are looking for a WG vice chair. Five attendees offered their names for this position and the chair will make a selection.

2. The chair will request the present document in Word format to begin editing before the next meeting.

3. The request was made for volunteers to consider the list of proposed focus areas discussed this meeting to begin work at the next meeting.

O. Meeting was adjoined.

P.The next meeting of this WG will be held in Pittsburgh, PA.

H.3.2.5 Working Group on C57-165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors – Phil McClure

The Chair called the meeting to order at 9:30 am and welcomed the attendees to the inaugural meeting of the working group. A brief summary of the mission of the group was given.

The attendees were asked if any of them were aware of any patents that may be essential to any aspect of the work we will be doing and if so, that they must inform one of the officers in order that IEEE may be notified.

The rosters were circulated. Prior to the meeting six persons expressed interest in the group and those persons were given membership. A roll call of those persons was made, but only two members, including the Chair, were in attendance. Since there were no plans to conduct

business, it was not necessary to have a quorum. There were 61 total attendees comprised of 2 members, 32 persons requesting membership and 27 interested persons.

The Chair called for volunteers to serve as the Vice Chair and Secretary, which resulted in four persons expressing interest.

A summary outline of the Guide was presented by the Chair and a good discussion was had. It was explained that much of the work that had been done by the Task Force on Winding Temperature indicators will be updated if necessary and used in this guide. It was further proposed to put the reasons and recommendations for particular temperature measurements in the normative sections and put more tutorial instruction in the annexes.

The group then discussed the scope of its mission. The Chair thought that the only potentially contentious term in the paragraph related to the meaning of measurements. The debate revolved about the tense of measurements; whether only measurements that are presently being made, or had been made in the past would be a limiting factor, or whether projections of future measurements, often referred to as predictive valuation or dynamic ratings, should be included. One attendee thought it was important that the group consider including it. While acknowledging that predictive valuation has considerable merit, the consensus of the group was that it should not be included in our work. It was pointed out that the loading guide contains equations that had been used for predicting load response for many years and that may be best left to other groups to include in their work.

Having no more business to discuss, the Chair adjourned the meeting at 10:40 am.

H.3.2.6 Task Force for Annex B of C57.154 for High Temperature Insulation Systems – Robert Thompson.

Meeting was called in order by chairman Bob Thompson at 3:15pm

Members in attendance: Robert Thompson- Chair, Jinesh Malde – secretary, Bruce Forsyth, Sheldon Kennedy, Tom Prevost, Alan Sbravati, Patrick McShane, Sam Sharpless, Jeff Valmus, Alonso Castillo

Guests: John Luksich, Rick Marek, Brian McBride & Barry Menzies

Prior to the meeting, minutes from the previous meeting was forwarded to the group.

Scope: This TF was tasked to evaluate the content of C57.154 Annex B, Temperature Limits and to specifically recommend the disposition of Clause B.5 to the Insulation Life Subcommittee. The TF was not authorized to make any changes to Annex B or to take any other action.

Background: C57.154 Annex B Clause B.5, titled Temperature Limits, proposed equations and alternative tables to the body of the C57.154 standard based on curves composed of historical test data, which are incorporated in the annex. A presentation was made at the WG for the revision of IEEE Std 1276 in the Fall of 2016 that presented these curves without the mineral oil comparison data points. The claim was made that this data was insufficient to define such equations and alternative tables. The presentations further recommend the removal of Clause B.5 from the annex. In consideration of this request, the Chair of the

Insulation Life Committee requested that a taskforce be formed to evaluate this request and make a recommendation to the Subcommittee.

The chair opened the meeting restating the purpose of the meeting and possible outcomes from the meeting being:

1) Recommend that C57.154 Annex B be flagged for review at the next revision of the standard.

2) Recommend no action

3) Any other recommendation from the meeting.

Rick Marek was invited to present the issue that forms the basis for the taskforce. He wanted the technical amendment to remove clause B.5 in Annex B of C57.154 and associated references. The reasoning for this was that the tables in the document were based on the procedures of the IEEE C57.100-1999 and some of the data was estimated through extrapolation. A claim was made that the information from the Annex was being used as normative rather than informative. A copy of his presentation is attached to the minutes of the Working Group meeting.

John Luksich made the counter reasoning that the data was good because it was based on several ageing tests and the tests were done in same procedure as mineral oil. There was no requirement at the time when the data was generated to follow 2011 revision of IEEE C57.100 standard.

Tom Prevost wanted to know why the taskforce was not in the main schedule of the IEEE transformer working group meetings. Sheldon Kennedy mentioned that Greg Anderson had it off schedule but the taskforce meeting was announced during Monday's opening session of the transformer committee meeting. The intention was to have one TF meeting to come to a decision on the recommendation to the subcommittee.

Alan Sbravati and John Luksich presented on "Validation of Annex B Ester Liquid and Insulation". The presentation was focused on aging test done in natural ester and mineral oil insulation system with thermally upgraded Kraft paper and non-thermally upgraded Kraft paper. Unit life equation and normal life endpoints were used to plot the tensile strength and DP graphs of data from various aging tests. Alan mentioned that new data available to be added to the current data. The new data will be published next year in the EIC 2018 conference. Addition of the new data will show that the current natural ester curves in Annex B are more conservative. A copy of the presentation is attached to the minutes.

Additional discussions:

Rick Marek mentioned the life curve of thermally upgraded Kraft and non-thermally upgraded Kraft was different. John Luksich said that by using the unit life equation, the slopes of non-thermally upgraded Kraft and thermally upgraded Kraft were parallel.

Barry Menzies inquired whether the natural ester ageing curves apply to all natural esters to which Alan responded that it applies to all natural ester liquids but not synthetic ester liquids.

Because the current version of C57.154 expires in December of 2022, a PAR was going to be opened in the near future so a consensus was formed that the Annex B should be discussed when the PAR opens.

Motion was made by Bruce Forsyth that: "Annex B of IEEE C57.154 standard should not be opened for amendment and recommendation is for the subcommittee to take steps to open the IEEE C57.154 standard for revision".

Motion was seconded by Jeff Valmus.

In favor: 9

Opposed: 0

Abstained: 0

Chairman Thompson adjourned the meeting at 4:30pm.

H.4 Old Business

Mr. Robert Thompson presented the work of the "C57.154 Annex B Clause B.5 Recommendation" working group. Mr. Rick Marek provided a presentation explaining his concern that thermal class data in C57.154-2012 Annex B regarding cellulose in ester was based upon insufficient data. Mr. Alan Svarti provided a presentation supporting the C57.154-2012 Annex B data. Mr. Thompson provided the working group's recommendation; "Annex B of IEEE C57.154 standard should not be opened for amendment and recommendation is for the subcommittee to take steps to open the IEEE C57.154 standard for revision".

Robert Thompson made a motion to open IEEE C57.154 for revision. The motion was seconded by Bruce Forsyth. After an extended discussion, the motion was called for a vote and it carried with 0 against and 1 abstention. Mr. Marek will submit the PAR application as called for in the motion.

H.5 New Business

There was no new business

H.6 Adjournment

Hem Shertukde made a motion for Amendment. Sanjib Som seconded the motion and it carried by acclamation with no objections.

Respectfully submitted,

Samuel L. Sharpless
Secretary, Insulation Life Subcommittee