

Annex H Insulation Life Subcommittee

March 27th, 2019

Hilton Anaheim, Anaheim, CA, USA

Chair: Sheldon Kennedy

Vice-Chair: Barry Beaster

Secretary: Jinesh Malde

The Insulation Life Subcommittee (ILSC) was called to order by the Chair in Anaheim, CA on March 27, 2018 at 8:00 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 date of upcoming Transformer Committee meetings as follow;

2019 Fall Meeting; October 27-31, 2019, Columbus, Ohio, 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: Bill Griesacker, Akash Joshi, Jose Salva, Brad Staley, Babanna Suresh, Alan Traut, and William Whitehead.

The Chair stated that the following members had been moved to guest status due to lack of attendance: Leonardo Gahardo, Mark Perkins, Trenton Williams, Sam Ojeda, Ismail Guner, James Cross, Jeffrey Golarz, and Joshua Herz.

The Chair also noted that no new guests were removed by request.

H.2 Secretary's Report

The Chair reported that according to the electronic check-in system, 87 out of 121 members were present in the meeting and that a quorum had thus been achieved. For the Spring meeting, both paper rosters and electronic check-in system were used. Going forward only electronic check-in will be used for the meeting and if a participant wants to request membership for the subcommittee, the person will have to meet the Chair, Vice-Chair or Secretary.

The Fall 2018 subcommittee meeting minutes had been provided to participants in advance of the meeting for review. Phil McClure made a motion to approve the minutes and the motion was seconded by Tom Prevost. Hearing no objections or abstentions, the motion carried by acclamation.

The Spring 2019 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. Sam Sharpless made a motion to approve the agenda and the motion was seconded by Kent Miller. Hearing no objections or abstentions, the motion carried by acclamation.

22 guests requested for membership via the membership roster and 11 met the membership criterion.

H.3 Project Status Reports. The Chair reported the status of each project as follows;

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

C57.91 is valid until December 31st 2021. The Working Group Chair is David Wallach.

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

C57.100 is valid until December 31st 2022. The Working Group Chair is Roger Wicks.

H.3.1.3 C57.119 IEEE Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Ratings

New revised standard published on October 18th 2018

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

C57.154 is valid until December 31st 2022. The Working Group Chair is Richard Marek.

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

C57.162 is a new document. The PAR for creating this document expires December 31, 2020. The working group Chair is Thomas Prevost.

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

1276 expires Dec 31, 2020. The working group Chair for this document is Roger C. Wicks.

H.3.1.7 C57.165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors

C57.165 is a new standard and the PAR expires December 31, 2021. The working group Chair is Phil McClure.

H.3.1.8 PC57.169 replacing 1538 - IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Filled Transformer

PAR valid till December 31st 2023. The working group Chair is Scott Digby

H.3.2 Working Group (WG) and Task Force (TF) Reports

H.3.2.1 Working Group on C57.162 Guide for the Interpretation of Moisture Related Parameters in Dry, Gas Insulated and Liquid Immersed Transformers and Reactors – Tom Prevost

The WG met on Monday at 1 pm. The Chair skipped introductions in order to save time and a quorum was established. Quorum was achieved by having 35 out of 60 members present in the meeting.

The Chair called for the approval of the Spring 2019 agenda. James Cross motioned and Scott Reed seconded the motion. The chairman called for approval of the Spring 2018 minutes. Don Doris motioned and it was seconded by Sam Sharp. The Chair then called for approval of the fall 2018 minutes. Don Doris motioned and James Cross seconded.

The Chair also provided information related to Essential Patent Claims, and none were noted.

The Chair proceeded to review the discussion from the Fall 2018 meeting. At this meeting changes to the scope of the document were agreed to. The changes were to remove the words “Dry and Gas Insulated” from the title and the scope and to focus on liquid insulation transformers. Task force 2, which covered moisture in gas insulation would be discontinued.

The new scope would remove gas and dry from the scope. The statement below reflected a motion to change the scope, as flows with crossed out information being removed:

“Guide for the Interpretation of Moisture Related Parameters in ~~Dry, Gas Insulated~~ and Liquid Immersed Transformers and Reactors”. Dave Wallace motioned for the change in scope and Jim Thompson seconded the change.

The next item was to edit the purpose statement to remove the words dry and gas. The motion was made by David Wallace and seconded by Rich Simonelli.

An additional change was brought by the Chair to change the title of the guide to remove dry and gas from the title. Motion was made by Bob Rasor and seconded by Steven Oaks.

The Chair will submit a PAR change request to Title, Scope and Purpose. The WG got a Par extension which will expire on Dec 31, 2020.

The draft for standard needs to be complete by the end of this year.

- **TF 1 Terminology and Definitions**
Jeff Golarz has retired and Oleg Roizman volunteered to take over and complete the work
- **TF2 has been dissolved**
Tom Melle
- **TF3 Measurement and evaluation of moisture-in-liquid insulation parameters**
Ron Hernandez has completed the content and is in second revision. He gave a short report on the content of the chapter.
- **TF4 Measurement of moisture in solid insulation**
Paul Griffin and Ron Hernandez have completed this chapter.
- **TF5 Evaluation of moisture in solid insulation using dielectric response methods**
George Frimpong has completed this chapter.
- **TF6 Inferring of moisture in solid insulation from measurements conducted in liquid or gaseous medium**
Valary Davydov has completed this chapter.
- **Task Force 7 Evaluation of aging and end of life of solid insulation parameters**
Bob Rasor is now Task Force chair. He has completed a first draft for this chapter.
- **Task Force 8 Factory/workshop application of knowledge on moisture; establishing baselines**
Poorvi Patel has completed this chapter.
- **Task Force 9 Field application of knowledge on moisture**
** Note: This section lists the risks associated with moisture*
Jim Thompson has completed this chapter.
- **TF10 Moisture Migration, Distribution and Moisture Equilibrium Charts**
Oleg Roizman will take over the chairmanship of this chapter.

The chairman went over the table of content and the meeting was adjourned at 12:15 PM

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

The WG for P1276 did not meet as the document is in comments resolution. The ballot was successful, with an 82% response rate (above 75%) and an 87% approval rate (with an additional 5% abstention rate). Of the 306 comments received the vast majority of them are easily accepted (as editorial changes), leaving around 80 comments (many of which are similar in nature) to be resolved by the comments resolution group (CRG). Work on the editorial changes has begun, and the first meeting of the CRG was intended for the Spring 2019 meetings week, but one of the members was on vacation, so the group will do a phone conversation within the next few weeks to complete the work. The goal is to have a document ready for recirculation by the end of June. WG Chair requested and received a PAR extension to the end of 2020 to allow for time to complete the work.

H.3.2.3 Working group on C57.100 IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution Transformers – Roger Wicks

The Chair called the meeting to order at 9:15 a.m. and welcomed attendees. As the PAR to revise the standard was approved after the last meeting, a WG has been formed, based on requests at the last two meetings, with 42 members. After introductions, attendance was taken, and of the 42 WG members, 28 were present, achieving a quorum to conduct business.

The meeting agenda was reviewed, and a motion was made for approval by Mike Shannon, seconded by Bruce Forsyth. The agenda was approved unanimously. The minutes of the last (Fall 2018) meeting were distributed previously, and a motion was made to approve the minutes by Tom Prevost, seconded by Rick Marek. The minutes were approved unanimously. The Chair also provided information related to Essential Patent Claims, and none were noted.

The Chair then reviewed the status of the standard, noting that the PAR was approved with an expiration date of December 2022, and that the document has an expiration date of December 2021. He then also quickly reviewed the previously agreed title, scope and purpose from the PAR submission.

There were 106 total attendees at the meeting, 29 members, and 77 guests. Since this was the first meeting of the WG, guests from the meeting who requesting membership were added as members. With 17 additional guests requesting membership, the total number of members (for the next meeting) will be 59 (including the task force Chair and Secretary).

Reminder of key items identified during last fall's meeting

The key items identified in the Fall 2018 meeting as potential updates to the standard, which were reviewed by the Chair include:

- Industry Proven System Definition
 - Addition of PVF Enamel and Pressboard
- Location of tests within document (main body vs. Annex)
 - Sealed Tube, Dual Temperature, Lockie Test
- Clarity around sealed tube test
 - Pressure Relief
- Ratios (volume, weight) – applicability of one test vs. other applications, etc.
- Time duration to correlate to in the test
 - 180,000 (current) or shorter durations
- End of life of materials test

- Correlate to IPS (at time above or shorter)
- Correlate to minimum value (how to determine)

Discussion that followed included:

- Question was asked if ASTM has standards or guidance about aging, and ASTM liaison Tom Prevost replied that ASTM only covers the test methods themselves, and not how to apply them to aging.
- Alan Sbravati commented that 180,000 hours is transformer life, but sealed tube testing looks at material life, and Roger Wicks agreed that the challenge is how to relate materials life testing to transformer life. For example, IEC likes to use 20,000 hours, but the problem is how to extrapolate to 180,000.
- Luiz Cheim echoed the challenge to correlate end of life of an insulation material to transformer life, mentioning that he has never seen a transformer operate at 110 C (temperature index of current industry proven insulation system) for 20 years. He also discussed his experience with very old transformers with extremely brittle insulation that were still operational when taken out of service.
- Alan mentioned a study by Duval that dielectrics are still OK when mechanical strength of cellulose insulation material was very low. Thus, perhaps having movement of the material, representing for example movement from a short circuit could be considered in the test.
- Question was asked what defines end of life. Roger mentioned that it is defined relative to the Industry Proven System. Patrick McShane added that there are lots of ways to evaluate end of life, including lightning impulse, short circuit, switching surge, etc. Rogerio Verdolin mentioned end of life of surge arrestors, as an example, and suggested perhaps a 'fingerprint' of a transformer that could be tested new and over lifetime.
- Patrick mentioned another 'pothole' with aging testing is moisture, and that high moisture in an aged unit can cause failure, and thus would like moisture to be included as part of the test. Alan added that regarding moisture and PRDs, that PRDs are usually set higher than the vapor pressure at test temperatures, and thus if this test procedure has PRD pressure that is lower, then moisture and other degradation products are lost, which these should be kept inside as much as possible.

Path Forward

The Chair then reviewed his proposed path forward, as follows:

- Need to work on items discussed from these presentations for creating a draft revision.
- Need volunteers for leading work in the areas mentioned:
 - #1 - Update Industry Proven System listing
 - #2 - Outline Location of test methods for draft
 - #3 - Sealed tube method improvement
 - Ratios, Pressure, Sample treatment, etc.
 - #4 - End of Life
 - Correlate to C57.12.00 curve, life requirement, EOL criteria

Discussion that followed included:

- Bruce Forsyth proposed that 4 task forces be formed to address these 4 work areas.
- Luiz added that it is important that end-users / utilities be involved in these task forces as well. Roger added that he & Kevin Biggie would review the roster & propose potential end users for participation.
- Bruce made a motion to form the 4 task forces as proposed. Casey Ballard seconded the motion, but added a friendly amendment to set a deadline for the Task Forces to provide their recommendations at the next meeting. The motion as amended was approved unanimously.
- Radoslaw Szewczyk suggested the life criteria of the liquid should be considered, as the standard currently focuses on the solid insulation. Roger added that the IEC test that is similar to this document (62332) attempts to discuss evaluation of the liquid as well as the solid in aging. Alan added that work is being done on aging of liquid as part of a task force under WG C57.154.

- Jinesh Malde cautioned that the testing in this test standard has to be practical to do, and that it should recognize testing that has been done in the past as valid.

Full list of task force volunteers collected during the meeting is as follows:

#1 - Update Industry Proven System listing

Task Force Lead – Roger Wicks

Volunteers – Kevin Biggie, Israel Barrientos

#2 - Outline Location of test methods for draft

Task Force Lead – Alan Sbravati

Volunteers -

#3 - Sealed tube method improvement (Ratios, Pressure, Sample treatment, etc.)

Task Force Lead – Jinesh Malde

Volunteers – Evanne Wang, Mike Shannon, Jon Karas, Radek Szewczyk, Ed Casserly, Kevin Biggie, Andy Holden

#4 - End of Life (Correlate to C57.12.00 curve, life requirement, EOL criteria)

Task Force Lead – Luiz Cheim

Volunteers – Mario Alonso, Eric Doak, Rogerio Verdolin, Darrell Mangubat, Sasha Levin

The Chair concluded by mentioning that he will distribute the existing standard as a Word document to serve as Draft 0 prior to the task forces making recommended changes. With a motion from Alan, seconded by Vinay Mehrotra, the meeting was adjourned at 10:40 pm.

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

Introductions

Establishment of quorum- quorum narrowly missed based upon the RFID system roll call- Number of Members in Activity = 73; Number of Members Present = 35; Quorum Present = 47.9% with Number of attendees = 89 at the meeting. The chair mentioned that we may have to review the member list based upon 2 out of three 3 last meetings attended.

Meeting Agenda Review

The meeting agenda was reviewed and not approved due to lack of quorum

Previous Meeting Minutes Approval Status

- a. Louisville, 2017 Fall – was approved by electronic vote prior to meeting
- b. Pittsburgh, 2018 Spring – still needs approval
- c. Jacksonville, 2018 Fall – still needs approval

Call for Patents:

A call for patents was made and there were none claimed.

Discussions on Draft Document D2 (circulated before the meeting)

- A. Distribution Transformer loading: This topic is being discussed by the Transformer Efficiency and Loss Evaluation SC under SC Distribution. The chair will continue to maintain contact with Phil Hopkinson for input if made available.
- B. Table 8 Maximum Loading Multiplier (9.2.1)

- Mickel Saad suggested changing it based upon transformer size like in IEC with an insulation life of 180,000. He and Jeffrey Wright agreed to work on studying the IEC guidelines.
 - Don Platts suggested we make changes to temperature limit tables.
 - Daniel Blaydon mentioned that many utilities may not agree in to doing that.
 - Jeff Wright was inclined to limit maximum loading to less than 200% due to increased stray flux heating at the load.
 - Anastasia O'Malley stated that she was not in favor of changing limits since their 93-300 MVA transformers are designed on that basis.
 - Weijun Li mentioned that 200% overloading is used in the operating procedures of many utilities.
 - Daniel Blaydon wanted to know why there is reluctance to make changes to the limits.
 - Mickel Saad felt that utilities should be specifying a load profile during the overloading conditions in their purchase specifications.
 - Thomas Spitzer cited that Texas Utilities had a 150 % limit for overloading large power transformers.
 - Shibao Zhang commented that bushings did not have a short time overload rating
 - It was decided that Jeff Wright / David Wallach / Mickel Saad will work on a proposal for Table 8.
- C. Updates to Ancillary Component loading (9.2.2) – Weijun Li
- Weijun commented that we should revise 9.2.2 to state that design reviews should be held to ensure that the ancillary components are selected appropriately to withstand the overloading. It should also be called out in clause 9.7
 - Juan Castellanos felt that the clause 9.2.2 is not meant for the transformer OEMs but rather for the users.
 - Bruce Forsyth felt that the design review intent is already conveyed in clause 9.2.2.
 - Thomas Spitzer felt that the OEM should be responsible to ensure the ancillary component capabilities.
 - Amitabh Sarkar felt that the user should specify the overloading requirements in the purchase specification.
 - Weijun Li mentioned that the intent was to make the user to take into consideration that the components will not be hot spot during the overloading cycle.
 - It was decided to leave the clause 9.2.2 as it was for now.
- D. Updates to Effect of Loading Above Nameplate – Bushing (B.1.1)– Shibao Zhang
- The temperature limits for overloading C57.19.100-2012 have been removed since bushings have zero overload capability. Based upon this, he proposed revision of Annexure B.1.1 of the guide to let the OEM / User decide the rating of the bushings based upon the specified overload.
 - Daniel Blaydon suggested we coordinate changes with the bushing overload TF. Peter Zhao mentioned that the concerned TF is getting ready to conclude its findings. They are working on PD / bubbling of condenser bushings due to overloading.
 - Robert Thompson requested that the guide only indicate that the users need to specify the current rating of the bushings.
 - Cihangir Sen stated that a number of design factors will change if overloading is specified.
- E. Other Updates – A new/updated Abstract and Keywords were proposed by Barrie Kokanos via correspondence with the chair. Barrie was unable to attend but requested to participate with the WG.

Abstract: The contents of this guide describe the assumptions, techniques and methods for estimating the effects of loading above nameplate of 65 °C rise mineral-oil-immersed power transformers and step voltage regulators. Consequences due to loading above nameplate ratings are discussed including damage to insulation, production of gases in oil, and ultimately loss of life effects. In addition, effects of loading on auxiliary equipment is presented. Different types of loading scenarios as well as variations in ambient temperature and altitude are described. Effects due to different cooling techniques and their impacts on transformer capacity are reviewed. Transformer temperature criteria are also provided. Finally, two calculation methods with and without consideration to duct oil effects are provided and with sample temperature calculations.

Keywords: distribution transformer, step-voltage regulators, IEEE C57.91, loss-of-life, short-term overloads, long-term overloads, loading, mineral-oil-immersed, insulation aging, power transformer.

The sub-committee could not discuss this topic for want of time.

- A. Differential Equation Presentation in Clause 7 and Annex G – Oleg Roizman made an excellent presentation on the history of this differential equation. He mentioned that there is a Cigre Publication # 659 for thermal modelling. Oleg will work on some suggested wording, perhaps an appendix, to propose at the next meeting. He recommended that a numerical solution today is more appropriate, using finite differences, to reflect better the performance of the transformer.

Additional notes from subcommittee meeting:

Jim Graham asked if the presentation done by Oleg Roizman on Differential Equation would be available and the WG Chair mentioned that it would be posted on the website.

Sanjib Som asked if the presentation could be made to a tutorial and Oleg was interested in making it into a tutorial. Tom Prevost would consider it for the Fall 2019 meeting if Oleg can contact Tom.

H.3.2.5 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

New revised standard published on October 18th 2018

H.3.2.6 Working group on C57.169 Maximum Winding Temperature Rise in Liquid-Filled Transformers (PC57.169 replacing IEEE 1538) – Scott Digby

The WG for Revision of the Guide for Determination of Maximum Winding Temperature Rise in Liquid-Immersed Transformers met on Tuesday, March 26, 2019. This new standard will be replacing the existing Std. 1538 that will be expiring in 2021. The PAR for this WG has been approved in March 2019 and will expire on December 31, 2023. This was the first meeting of the WG. The Chair Scott Digby called the Group to order at 1:46 PM. Two rosters were passed to obtain the membership requests from the attendees. According the rosters, there were total of 62 individuals present. 38 participants requested membership and became members since this was the first meeting of the WG.

The Chair initiated the meeting with presenting the Agenda. No approval required for the Agenda since this was the first meeting of the WG.

The Chair made the requisite Call for Patents and there were none noted by those present. An overview of the scope and the purpose of the WG were also reviewed.

Some background information was provided to the attendees on the current IEEE Std. 1538 document and the Amendment-1 that was published in 2015. The Chair also shared the comments that were received from the ballot resolution group during the reaffirmation of the standard during 2011. Some of the items were also reviewed and discussed during this meeting.

The Chair opened the floor for discussion about the content of the Std. 1538 and the Amendment-1.

Below topics were discussed during this session:

- 1) The Section 4.1 of the Amendment-1 is reprinted with the permission of CIGRE. Scott Digby (Chair) questioned if we should renew the permission from CIGRE to use the same section in the new standard C57.169. Gary Hoffman (APT) mentioned that any copyrighted material should go to the permission process before it goes in the draft. The Chair will contact Malia Zaman to start the permission process with CIGRE.
- 2) Peter Heinzig (Weidmann) commented about the similarities between C57.165 (Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors) and C57.169 scopes. Some of the attendees also agreed that the direct winding temperature measurement methods are planned to be a part of the C57.165 guide. It was agreed to ask the subject to the other group's Chair (Phil McClure) and make sure the subject is not a part of both WGs. The Chair volunteered for the task of contacting the other WG and discuss the similarities between both.
- 3) "Direct temperature measurement by fiber optic detectors" section does not include shell type transformer applications. Scott Digby (Chair) volunteered for contacting some of the shell type manufacturers to ask about their direct hot spot measurement methods (how many probes, how to install, where to install the fiber optic probes, etc.) and the need to add such content to the document.
- 4) Gary Hoffman (APT) suggested that a latest version of the Std. 1538 and the Amendment-1 to be submitted to the members of the WG. The Chair will be submitting the documents to the members.
- 5) Juan Castellanos (Prolec GE) mentioned that the new IEC Loading Guide has an Annex regarding direct hot spot measurement by fiber optic probes written by Hasse Nordman. WG will review this section and discuss if there is any information that could be implemented in the new standard.
- 6) The Chair asked the WG if there are any volunteers who are willing to review the current standard and provide their feedback. Below attendees have volunteered for reviewing and assessing the content of the document related to direct measurement by fiber optic probes (section 4.1 and Amendment-1):
 - Surinder Sandhu (Consultant)
 - Peter Heinzig (Weidmann)
 - Suresh Babanna (Southwest Electric Company)
- 7) The Chair asked for other volunteers who could help with reviewing some of the sections of the Std. 1538.
 - Jason Varnell (SPX) has volunteered for reviewing the Section 3 "Definitions" to make sure the definitions are matching the other IEEE documents.
 - Juan Castellanos (Prolec GE) has volunteered to review the below sections
 - i. Section 4.3 "Prototype test data"
 - ii. Section 4.4 "Test windings"

iii. Section 6 “Determination of hottest spot rise...” with Annex-C

- 8) A question was asked if the new standard will be including only the oil filled transformers. The Chair presented the scope of the WG and verified that the standard will be only for the oil filled transformer applications.
- 9) Juan Castellanos (Prolec GE) mentioned that the average winding rise shouldn't be in this WG's scope since it is already covered in C57.12.90. The Chair agreed to that comment and there was general consensus to that viewpoint. It was further clarified that our work can include up to what is stated in the scope.
- 10) Several attendees from transformer manufacturers mentioned that the direct measurement method by thermocouples is used for special applications and not being used for measuring the temperature during the acceptance tests of the transformers.

Don Platts (Chair of Std. 1538) has provided some background information about Section 4.2 “Direct measurement by thermocouples”. Prior to the development of testing with fiber optics, all the thermal evaluations were done on models with thermocouples. He said that section about thermocouples is a carryover from the traditional methods before measurements with fiber optics so WG might want to consider eliminating this section.

Juan Castellanos, Gary Hoffman and Craig Stiegemeier shared some special applications that were performed by using thermocouples such as prototype bushing and winding temperature measurements.

Jason Varnell (SPX) pointed the last paragraph of Section 4.2 that clarifies the thermocouples to be installed temporarily in the distribution transformers: “*Due to the voltage hazard, the thermocouples must not remain if the transformer is placed in service*”.

As section 4.2 seems apply mainly to distribution transformers but there did not appear to be representation present with the current, relevant involvement, the Chair noted the need to reach out to the Distribution Subcommittee. Gary Hoffman volunteered to announce such during New Business at the Distribution Transformers Subcommittee meeting.

The subject will be discussed with other groups and will be clarified in the Fall 2019 meeting.

The Chair requested to receive the feedback from all volunteered members for reviewing the document until **early August 2019** to make sure all are captured in the Fall 2019 meeting in Columbus, OH.

The next meeting of this WG will be during the Fall-2019 IEEE Transformers Committee Meetings in Columbus, OH.

The meeting was adjourned at approximately 2:48 p.m.

H.3.2.7 C57.165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors – Phil McClure

Meeting Date and Time: 3/26/2019 at 9:30am

Meeting was called to order at 9:30am

Call for essential patents

The patent slides were projected on screen and a request for any known patents that were essential to the work of the Working Group was made. There were no responses to the request.

Chairs remarks

The Chair discussed the challenges the working group has experienced achieving a quorum the past couple of meetings. Meeting minutes for the 18-01 and 18-02 meetings were distributed via email but approval of the minutes using email was not successful due to a lack of response.

Attendance

- Introduction of Members and Guests
- Roll Call of Members for Quorum – 16 of 35 members were present.
- We were informed during the roll call that one member had switched industries and will no longer be attending. That makes attendance 16 of 34 members present.
- RFID system indicated agreement with initial roll call; 16 of ~~35~~ (34) members were present (Quorum not achieved)
- Attendance Rosters were distributed as a backup to RFID. Roster attendance indicated 52 total in attendance.
- One member showed up after the RFID session had closed so he is not documented in the RFID system but was documented in the meeting attendance
- Members – 17, Guest – 12, New Guests – 23
- Quorum was achieved about 45 after the meeting was called to order. See agenda and minutes paragraph below.

Old business

The Chair asked for volunteers for sections that weren't previously covered:

- 1) Annex A Sensors. Gilles Bargone volunteered.
- 2) Annex B. Winding temperature indicators - Zan Kiparizoski volunteered.
- 3) Sections Still Needing Authors
- 4) Section 4.8 Bushing Temperature Measurement. No volunteers were identified during the meeting.
- 5) Section 4.9 Tie Plate Temperature Measurement. No volunteers
- 6) Section 4.10 Tap Changer Lead & Contact Temperature Measurement. No volunteers
- 7) Section 4.11 Bolted Connection Temperature Measurement. Hakim Dulac volunteered
 - Comment was later that this was raised more as a design test than something to monitor in service

New business

Review of section drafts that have been completed

- 1) Definitions: Oleg Roizman - Not present to discuss.
- 2) Winding temperature section 4.3
- 3) Reviewed proposed changes to the draft of this section. No objections. Changes will be accepted as written.
- 4) Core Temperature Section 4.4
- 5) Reviewed proposed changes to the draft of this section. No objections. Changes will be accepted.
- 6) Additional areas for improvement were identified for the core temperature measurement section.
 - Recommendation was made to add information on how to install fiber sensors in the core. Gilles Bargone volunteered
- 7) Sections that don't have volunteers – we will need to consider dropping sections that do not have adequate support.
- 8) One member commented that the word “shall” should not be used in this document since this is a guide and not a standard. Instances where “shall” is used should be reviewed.
- 9) Request was made to have a fiber manufacturer present to the group on best practices for what to measure and how to install fiber probes.

- Cigre has a guide for installation of fiber probes – this could be a start.
- 10) The chair requested a fiber optic temperature user review the section on fiber temperature measurement – Jamil Kahn volunteered

Approval of the agenda and minutes

- 1) Review of the attendance rosters 45 minutes after the meeting was called to order indicated that a quorum had been achieved.
- 2) The Chair requested a motion for approval of the agenda for this meeting:
 - Received 1st and 2nd motion
 - Unanimous approval
- 3) The Chair requested a motion for approval of the minutes from the 18-01 meeting
Received 1st and 2nd motion
Unanimous approval
- 4) The Chair requested a motion for approval of the minutes from the 18-02 meeting
 - Received 1st and 2nd motion
 - Unanimous approval

Next Scheduled Meeting

October 27-31, 2019 Columbus, OH

Adjournment

A motion for adjournment was requested, made and seconded. Unanimous approval for adjournment was accepted. Meeting was adjourned at 10:45am

Minutes

The minutes were recorded by Mark Tostrud – Secretary

The minutes were reviewed and submitted by Phil McClure - Chair

ILS Chair mentioned that some of the measurement points need to be looked at on tap changer contacts and connections.

H.3.2.8 Working group on C57.154 Design, Testing and Application of Liquid-Immersed Transformers with High-Temperature Insulation – Richard Marek

125 signed in, 136 recorded on RFID. Had quorum 50 of 90, 5 requested membership. Agenda and meeting minutes from last meeting approved. A TF was formed to evaluate “Thermal Class of Insulating Liquid” since 3 meetings. A test was presented. David Stankes revised the definitions. Definition of reference temperature needed to be aligned to 1280. Kurk Kr suggested to provide cooling stages for hybrid insulation. Radik proposed for content for information Annex for guidance for high temperature applications. Phil Hopkinson provided information on contents. Brough discussion of connection made on bolt or crimp. Rainer Froscher brought questions on tap changers. A tap changer for high temperature application should meet exact same requirements for mineral oil. There should be no derating.

The meeting was called to order at 4:45PM on Monday March 25th by Chair Richard Marek. Vice-Chair Anastasia O’Malley and Secretary Ewald Schweiger (writer of Minutes) were also present.

This was the second meeting as a WG. There were **5** of the **total 125 attendees** that requested membership. There were a total of 125 people that signed in on the paper roster and 136 on the RFID list. The chair stated at the beginning of the meeting that the paper roster will lead since there have been previous issues with RFID system in this room.

Data from the RFID system: (versus paper roster)

Number of Members in Activity = 90

Number of Members Present = 49 (50)

Quorum Present = 54.4%

Number of attendees = 136 (125)

The following participants indicated interest to be a member:

Frotscher	Rainer	Maschinenfabrik Reinhausen
Galhardo	Leonardo	DuPont
Kazmierczak	Jerzy	ABB Inc.
Sankarakurup	Dinesh	Niagara Transformer
Bradshaw	Jeremiah	Bureau of Reclamation

Introductions of the Chair, Vice Chair, and Secretary were made. Due to the large number of attendees no individual introductions were made. Attendees were asked to indicate their affiliations when making comments or asking questions.

The patent slides were shown with no response.

The chair presented the agenda and a motion was made and seconded to approve the revised minutes of meetings (Samuel Sharpless, Phil Hopkinson). There were no objections.

The chair stated that the previously mailed minutes of meetings were re-arranged to Rev 2 and some administrative additions were added, including the list of names of participants. A motion was made and seconded to approve the revised minutes of meetings (Robert Thompson, Kurt Kaineder). There were no objections.

In the last meeting a TF was formed under the leadership of Alan Sbravati to investigate the thermal class of liquids. This TF have met via web meeting three times and the result was reported by Alan in this meeting.

Alan reported the outcome of these meetings and presented a proposal for screening tests which could be performed with different types of liquids (mineral oil, natural and synthetic esters) at different temperatures.

Tom Prevost shared his experience made in WG Moisture in Insulation PC57.162 and suggested that IFT (interfacial tension) be added to the list of tests as well.

Dave Stankes (supported by Jose Silva) presented the result of the comparison of definitions in IEEE C57.154 with those in C57.12.80 (also under revision) to determine if there are any conflicts.

Only one minor conflict was found with the definition of reference temperature. A motion was made by David Stankes to align the reference temperature definition of C57.154 with the one found in C57.12.80. This motion was second by Phil Hopkinson and it was approved by the members.

Radoslaw Szewczyk reported on the “Precision Needed for High Temperature Insulation System Description” and made suggestions to unify the notes of table 4 and to add a clarification for such case in the document, in section 4.2.4

Kurt Kaineder presented a slide with suggestion to add the cooling stages to table 3 - Maximum continuous temperature rise limits for transformers with hybrid insulation systems, to show the effect of cooling type (ON, OF, OD, the effect of liquid temperature class and the effect of combination of Insulation systems, cooling type and liquid thermal class.

Radoslaw Szewczyk proposed content for an informative annex: “Guidance on High Temperature Transformer Applications” and will send a draft before the next meeting.

On the topic Phil Hopkinson shared his findings of different behavior of contacts made out of different materials (e.g. silver and tin plating) and he reported the findings of his investigations on the behavior at high temperature in different liquids. This information is found in an annex in C57.157.

The chair asked Phil to send a proposal for a wording as reference to this annex.

Phil brought up another topic in regard to how the connections are done – bolted vs crimped – and the behavior at high temperatures.

The chair asked for volunteers to share their experience on crimped connections under high temperature.

Rainer Frotscher presented questions a tap changer manufacturer needs to get answered to develop appropriate equipment. In coincidence with the floor the chair stated that the life of a high temperature transformer is assumed to be the same as for conventional mineral oil applications (180 000 hrs). The other questions remain as subjects for further discussion..

The chair announced that he will distribute all the presentations and suggestions shown in the meeting.

The WG plans to meet at the Fall 2019 Transformers Committee Meeting in Columbus, OH. The meeting was adjourned at 5:45PM.

H.3.2.9 Taskforce on Temperature Rise Test Procedures (C57.12.90 Clause 11) – Ajith Varghese

TF meeting on Temperature Rise Test Procedure C57.12.90, Clause 11 started at 8:00 AM on Tuesday, March 26 in El Capitan room of Hilton Anaheim Hotel, Anaheim, California.

This was the first meeting of this task force and hence there were no official member registered for this task force.

TF chair asked for volunteer to work as Secretary for this TF and Arup Chakraborty from Delta Star agreed to work as Secretary for this TF.

There were 78 participants, 64 requesting membership and all were granted. Attendance was recorded in AM System.

Jerzy Kazmierczak of ABB presented test data showing the difference of tested winding gradients with respect to time to hot resistance shutdown, which shows no significant difference in winding gradient measurement for hot resistance shutdown taken at 30mins, 45mins & 60mins.

Egon Kirchenmayer of Siemens presented theoretical estimation of winding time constant and suggested that time to hot resistance shutdown can be set at 2-3 time of estimated winding time constant.

Ajith Varghese from SPX also presented measured winding gradient data from hot resistance shutdown taken at different time, which also shows insignificant difference in measured winding gradient taken within reasonable time e.g. 30mins, 45mins & 60mins.

The group agreed that work should be done to review the requirement of the time to hot resistance shutdown based on winding time constant in order to reduce temperature rise test duration and accordingly a draft will be prepared to present on the next meeting.

Meeting adjourned at 9:10 AM

H.4 Old Business

There was no old business

H.5 New Business

- 1) Jin Sim forward the following proposal to the Chair electronically:
C57.12.90-2015 Clause 11.1.2.2 d) and e) requires holding the current constant for 1 hour. This work was taken over by TF Chaired by Ajith Varghese

In the Standards meeting, Steve Antosz mentioned that ILSC continues working on reviewing the Temperature measurement in the C57.12.90. Ajith will complete the work for the TF looking at C57.12.90-12 Clause 11.2.2 d) and e) and once the work is complete, Bob Thompson will Chair the TF for continuous revision of the temperature rise test in C57.12.90. Bruce Forsyth made the motion to “form TF for continuous revision of temperature rise test in IEEE C57.12.90 upon completion of the TF currently reviewing the C57.12.90-12 Clause 11.2.2 d) and e)” .The motion was seconded by Jim Graham.

- 2) Alan Sbravati suggested that a TF be formed to determine if a guide is required for retrofilling mineral oil transformers with alternative liquids.

ILSC Chair did not believe that the guide would belong to the ILSC. It would be more suited for Insulating Liquid SC. Tom Prevost mentioned that there is an active PAR for C57.166 (Acceptance and Maintenance of Insulating Liquids) that will look at mixing of liquids. He believes that it should be Insulating Liquid Subcommittee and looked at by the WG in C57.166. It was concluded that this discussion be brought forward in the Insulating Liquid Subcommittee meeting.

New Topics

- 1) Joe Watson representing Volts/Hz TF in the Power Subcommittees had new business. 2 years ago transformer committee was asked if there were recent V/Hz curves for relays. An investigation took place to look at what information was there. The outcome from the investigation was that one curve used by everyone was not valid anymore. The TF intends to develop new processes to establishing V/Hz capability curves for transformers. These transformers would be directly connected to generators. The group is talking about 10s to 2 min period of time where there would be load rejection or abnormal conditions where there would be high V/Hz. The TF need support from this subcommittee to get expertise in damage on insulation. The TF want to make sure that there is coordination. Joe mentioned that the TF on V/Hz can report back to ILSC.
- 2) Jim Graham who was speaking as Vice Chair of Terminology Standard PC57.12.80 is looking for volunteers to review the standards to align definitions. Looking for people from ILSC to review the standards and guides under ILSC for definitions that need to be added, deleted or modified. If anyone is interested, they should contact Clair Clairborne and Jim Graham. Shankar Nambi volunteered on behalf of ILSC to look at the standards and aligning the definitions to PC57.12.80 document.

H.6 Adjournment

With all business completed, the Chair called for a motion to adjourn. Hemchandra Shertukde moved for adjournment and the motion was seconded by Phil Hopkinson. The meeting was adjourned at 9:03 AM.

Respectfully submitted,

Jinesh Malde
Secretary, Insulation Life Subcommittee