Insulation Life Subcommittee

April 28th, 2021
Virtual Meeting

Chair: Sam Sharpless
Vice-Chair: Jinesh Malde
Secretary: Anastasia O'Malley

The Insulation Life Subcommittee (ILSC) was called to order by the Chair in the virtual meeting on April 28, 2021 at 8:01 AM CST. The Chair introduced the subcommittee officers. 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 emphasized the timely completion, technical accuracy, and usefulness of quality projects through the participation of working group leaders, subject matter experts and the general membership.

The Chair discussed the membership requirements and recognized the following new members: Juan Acosta, Onome Avanoma, David Calitz, Don Dorris, Michael Franchek, Anatoliy Mudryk, Kevin Rapp, Tim Raymond, Scott Reed, Oleg Roizman, Dinesh Sankarakurup, Pragnesh Vyas and Drew Welton.

The Chair also reviewed the people who requested membership, but did not respond to the verification email: Hakim Dulac, Kris Zibert, Parminder Panesar, Piotr Blaszcyk, Rainer Frotscher, Kuppuswamy Raja and Vijay Tendulkar. If you are requesting membership, please email the secretary and you will receive a verification email for the next meeting.

The Chair stated that the following members had been moved to guest status due to lack of attendance: Hamid Abdelkamel, Roger Fenton, Brian McBride and Joshua Yun.

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

The Chair encouraged working groups to conduct on-line meetings between the regular Transformer Committee Meetings to move projects along. Notice must be sent out to all members, attendance recorded and minutes taken. Any PAR extension requests need to be approved by the working group and documented in the minutes. 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 showed the essential patent claim notice and requested that any person with knowledge of an essential patent that meets the requirements of any subcommittee standard to bring the issue forward for discussion. No one responded to this request.

The Chair displayed the copyright policy and advised the subcommittee that permission would be required from the authors or organizations for use of information.

H.2 Project Status Reports. The Chair reported the status of each project as follows:

H.2.1.1 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.2.1.2 C57.100 IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution and Power Transformers

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

H.2.1.3 C57.119 IEEE Recommended Practice for Performing Temperature Rise Tests on Oil-Immersed Power Transformers at Loads Beyond Nameplate Rating

C57.119 is valid until December 31st 2028. The former Working Group Chair is Gael Kennedy.

H.2.1.4 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.2.1.5 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, 2022. The working group Chair is Thomas Prevost.

H.2.1.6 C57.165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors

PAR expires December 31, 2021 and will be making an extension request during today's meeting. The working group Chair is Mark Tostrud.

H.2.1.7 PC57.169 replacing 1538 - IEEE Guide for Determination of Maximum Winding Temperature Rise in Liquid-Immersed Transformer

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

H.2.1.8 1276 Guide for the Application of High Temperature Insulation Materials in Liquid-Immersed Power Transformers

1276 expires Dec 31, 2030. The former working group Chair for this document is Roger C. Wicks.

H.3 Secretary's Report

The attendance poll reported that 91 out of 149 members were present in the meeting along with 126 guests and that a quorum had thus been achieved. For the Spring 2021 virtual meeting, only the poll roster was used. Participants requesting membership for the subcommittee were advised to request in the poll to be a member and to email the Chair, Vice-Chair or Secretary. 29 guests requested membership. List of attendees is provided at the end of this report.

The agenda for the meeting had been provided to participants in advance of the meeting for review. Gary Hoffman made a motion to approve the agenda and it was seconded by Rogerio Verdolin. After hearing no objection from the attendees, the meeting agenda was approved. The Fall 2020 subcommittee meeting minutes had been provided to participants in advance of the meeting for review. Tom Prevost made a motion to approve the minutes. Markus Ferreira seconded the motion. The Fall 2020 meeting minutes were approved after hearing no objection from the attendees.

H.4 Working Group (WG) and Task Force (TF) Reports:

H.4.1.1 Working group on C57.91 IEEE Guide for Loading Mineral-Oil-Immersed Transformers – David Wallach

Working Group PC57.91 Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators Meeting Minutes

April 27, 2021, 3:45 PM – 5:00 PM (EST)

Virtual Webex Meeting

1. The Chair made his opening remarks and proposed a meeting agenda.
2. The chair requested unanimous approval of the Spring 2021 Meeting Agenda as emailed prior to the meeting by acclamation (subject to quorum being present later in the roll call). The agenda was approved unopposed.
3. **Call for Patents**: The chair asked if anyone was aware of any patents and there were none claimed.
4. **Copyright Policy**: The IEEE copyright policy was reviewed.
5. Establishment of quorum- Number of Current Members = 53; Number of Members Present in Meeting= 31; Quorum Present = 58.5 % and with a total number of 85 attendees (see attached list) at the meeting.
6. The chair requested unanimous approval of the Fall 2020 Meeting Minutes (as posted on the IEEE TC Website) by acclamation. The meeting minutes was approved unopposed.
7. Chair- David Wallach: The chair informed the group that on December 4, 2020 a Webex meeting was held (minutes emailed to working group) to discuss PAR extension and path forward. The minutes of the Dec 4, 2020 was approved by a subsequent electronic ballot send to the members of the working group. The chair stated that the members present in the December 4, 2020 meeting voted to submit a 2-year PAR extension. The extension request was submitted on March 29, 2021 for the June 15, 2021 NESCOM agenda. If approved, the PAR will expire on Dec 31, 2023. We will need to go for a straw ballot by Fall 2022 and then submit the revised guide for final approval in Oct 2023. The current draft 3 document of the PC 57.91 guide is posted on the TC.

The chair opened the floor to continue the discussion on interchanging Clause 7 with Annex G, a topic that was taken up in Fall 2020. In his opinion, he felt that Clause 7 should be retained in the guide since many utilities were still following Clause 7.

Discussion on interchanging Clause 7 and Annex G:

Tim Raymond felt that this was long overdue. The Annex G requires some revisions, but it is particularly useful for short duration over-load, but we need to keep Clause 7 in the existing document somewhere. The Annex G requires uses a bottom oil rise model developed in the late 1990s but in reality, the overload numbers are not changing much. When we have the data for bottom oil rise, it is advantageous to use Annex G model.

Chair: We need to rename Clause 7 like a classical model or something.
Tim R: My background is with PT Load software. We always called it bottom and top oil models.
Chair: We could consider calling Clause 7 as top and Annex G as bottom oil models.
Wally Binder: Will we run into copyrights issues with using PT Load terms?
Tim Raymond offered offer to get the copyright issue with EPRI clarified for our guide use if this working group had any concerns.
Jason Varnell wanted to know the basis behind swapping Annex G with Clause 7.
Chair: With the improvements being made to Annex G, it may be beneficial if we have bottom oil temperature.
Tim R: He stated that the bottom oil rise model in Annex G model considered two main improvements. It is recognized that duct oil temperature rises faster than the bulk oil temperature. Clause 7 was based upon winding rise over bulk oil temperature but did not include rapidly rising duct oil temperature. In reality, the hot spot temperature rises faster than what the Clause 7 model predicts. The bottom conductor temperature rises more rapidly than the top conductor when there is a step change in the loading. There are a couple of ancillary corrections that need to be made. Clause 7 assumes that increased resistance and losses is offset by decrease in viscosity and thereby more cooling. This applies to cooling in oil directed flow Transformers. There are significant improvements with the Annex G model.
Jason V pointed out that Annex G requires a lot more inputs to perform these calculations. His concern was that users will need to have many input values to perform these calculations. While it is true that oil temperature adjacent to the hot spot conductor in the winding is higher than the top oil temperature, in some models the hot spot temperature is calculated using hotspot gradient over top oil rise. He was concerned about making changes to the current methodology and the impact those changes will have in making overload calculations using Annex G.
Tim Raymond agreed that a lot more parameters were required while using Annex G. In reality, the only one piece of information you need in Annex G that you do not need in Clause 7 is the rated bottom oil rise. For everything else we can make equivalent assumptions like we already do for Clause 7. For example, in Clause 7 now, we calculate oil thermal time constant with an equation while we do not need to calculate that in Annex G. Annex G allows you to break load losses into eddy and stray losses. In reality, 90% of the time you cannot segregate eddy and stray losses. We have to assume losses to be all stray type and you will need to make some assumptions for which we could provide guidance. Annex G will provide answers for equivalent assumptions like the Clause 7 model, but it will have more flexibility,
Jason V: We focused mainly on eddy and stray losses while using Clause 7 and have used it for calculating hot spot rise for specific overload profiles while designing transformers. He felt that there may not be uniformity with OEMs using different values for inputs while using Annex G to get more desirable results.
Javier Ortega: There is an IEEE C57.169 guide that provides a procedure to determine hot spot rise and hotspot gradient. He added that C57.91 takes that information from the C57.169 guide to calculate the hot spot.
Jason V observed that Clause 7 hotspot gradient varies based upon load and the losses.
Oleg Roizman stated that Jason probably missed his presentation about Clause 7 in a previous C57.91 meeting. In that presentation, he had pointed out that Clause 7 is based upon a number of assumptions that are not valid. Annex G is based upon classical thermodynamics, heat transfer and the law of conservation of energy principals. Annex G is a classical thermal model. We need inputs like dynamic load, ambient temperature and some parameters that are fixed like losses. If we have all the parameters for the Annex G

model, then we can go with it. If we do not have some information, then we need to provide guidance on what users need to do. We can use some formulae from Clause 7 to come with the parameters to address limitations of Annex G.
Jason V stated that it would be beneficial if guidance is provided to perform Annex G calculations so that there is uniformity on how OEM's perform this calculation.
Oleg R confirmed that we will provide that guidance in Annex G.
The Chair stated that the plan is to maintain present Clause 7 top oil model as many utilities will still use this information as reference.
Patrick Picher of Hydro Quebec started a discussion about whether IEC 76-6 equations will be added to this guide or whether there will be one set of equation from IEC and the other from IEEE. Thermal overshoot is covered in this IEC guide and is simpler to use than Annex G. IEC has constants for cooling that are better than IEEE for overshoot for a load duration of 30 minutes. Unlike Annex G, the IEC guide does not require as many parameters.
Oleg R stated that he has looked at the latest IEC edition. We should provide reference to the IEC model while discussing the classical the thermal model. IEC has attempted to solve a second-order dynamic model equation. We will refer to that but there are some problems with the IEC model which will be discussed in Annex G.
Tim Raymond expressed that he has concerns using the IEC model.
Oleg R stated not only Tim, but there are many others who have concerns about the IEC model. He invited Patrick to join the task force.
Patrick P offered Hydro Quebec's help with conducting overload tests in their Hydro Quebec lab using fiber optics. He thought that it may be interesting to perform these tests to compare Annex G & IEC-76-7 models and publish the results in this guide.
The Chair noted that Oleg R has been asking for fiber optic top, bottom oil temperature and load data to validate his model and use that information in the guide revision.
Oleg R confirmed examples, block diagrams and code will be provided to demonstrate the model and for everyone to use for free. Zach Draper of Delta-X has offered to write the code for the Annex G model. The HQ lab test can provide us with an opportunity to compare different techniques.
Tim Raymond: I had an Excel sheet about most of the parameters for Annex G back then.
Dan Blaydon: He agrees with maintaining Clause 7 as a user but would like to express concern that Annex G may require OEM's to have knowledge about various inputs required to perform the calculations. He wondered whether end users will have the data, additional parameters and assumptions to perform Annex G calculations like they do now for Clause 7 for validating the information they get from the OEMs.
Tim Raymond mentioned that information like rated bottom oil rise can be obtained from the OEM's. This has been required since 2000.
Dan Blaydon asked whether the parameters and exponentials will be available to the end user.
Tim R confirmed that the assumptions used in the Annex G document are not much different than the default ones we currently have in the Clause 7 model. We have more parameters because we are trying to address the over-simplification in the Clause 7 model. We cannot rule the possibility of overload ratings changing while using the Annex G model. We can possibly guard against the ratings being very vastly different, but we must never stop making improvements to the models in the guide. We need to come up with a model that is technically the best and not based upon past practices.
Oleg Roizman agreed with Tim Raymond.
Tim Raymond: For Annex G, values inputs can be determined during factory tests using test methods in current IEEE standards. There are certain assumptions on how certain exponents vary with losses of that system in Clause 7. But there is information available

out there which we could use to get equivalent results to Clause 7.
David Wallach stated that we do not want to discount the importance of Clause 7 but Annex G is a different way to approach overload calculation. We probably need to come up with a new nomenclature for Clause 7.

David Blaydon mentioned that by moving to Annex G you are making get the Clause 7 the alternate method.
The Chair mentioned that any member who may have information for improving Annex G and Clause 7 may please let him know. He mentioned that Oleg is leading a task force to revise Annex G. The Chair will swap the two sections physically in the guide. He emphasized the need for the WG members to stay engaged between TC meetings to get the guide finally done by end 2023. We probably need to have frequent TF meetings and WG meetings.
Oleg R mentioned that Tim Raymond, Patrick, Kayland Adams and Zach are part of this task force (Brad Staley has also volunteered to be on this task force subsequent to this meeting).

Discussion About Moving Bubble Evolution Temperature Annex A to C57.162:

The Chair mentioned that this topic was brought up at the end of the last meeting. The discussion was about whether the science behind this phenomenon belongs in C57.162 and the application part in this C57.91 guide or vice versa. It is possible that except for the example A4 in Annex A, the other parts will move to C57.162. And so, do we want to have discussion or have a motion to recommend moving parts A1 thru A3 of Annex A to C57.162 and keeping A4 in C57.91? The Chair mentioned that the C57.162 WG is supportive of this idea.
Sam Sharpless (Insulation Life Subcommittee Chair) mentioned that this was discussed in the C57.162 working group and they are supportive of this move.
The Chair added that the Insulation Life SC approval was not required if the two WGs agreed to the transfer. It seems that this transaction is a done deal.
Sam Sharpless agreed.
The Chair asked whether we now need a motion in this WG to release sections A1-A3 in Annex A to C57.162 WG, while keeping the application part in C57.91.
Oleg R: Annex A has only a couple of pages and a formula that needs correction. He agreed to handle the revision and submit it to this WG during the next meeting. But was fine with moving the science part to C57.162. We need to talk about the origins of the bubble equation in A2 of Annex A and correct that equation. The example in A4 should also be revised based on the revised equation. The equation correction will result in 10K difference at 2% moisture content.
The Chair asked if the Bibliography also needs to go to the C57.162 guide.
Oleg R agreed with that and added that there were a few additions made to it.
David Wallach again asked to hear a motion for moving the contents of Annex A to C57.162 after updating the equation and example in this guide.
Oleg R stated that no motion is required since both working groups have agreed to moving the science Annex A to C57.162. It was agreed in the C57.162 WG to add a dynamic angle to the Bubble Equation along with uncertainties and the science behind it. He stated that Tom Prevost the Chair of C57.162 was good with that and so we there is no need for a motion at all.
Sam S stated this topic was included as an item in the Fall 2020 minutes SC meeting and it was agreed that C57.91 will retain the equation and example while the science and theory will be moved to C57.162. This was discussed in the C57.162 WG yesterday.
Oleg R confirmed that the bubble equation with its assumptions will be covered in Annex

A of C57.91 while the section in C57.162 will be quite different.
Sam S stated he is good with not moving a motion as long as both the C57.91 and C57.162 WG chairs are coordinated about what their respective contents are going to be.
David Wallach mentioned that in the last WG meeting Tim R was hesitant to give the bubble equation to another Guide.
Tim Raymond stated that he was outvoted in many meetings on moving bubble evolution to C57.162. He feels that it is a natural fit for this guide, but he is OK if it is covered in a different IEEE document.
Oleg R remarked that Annex A was a normative and not an informative reference.
David Wallach confirmed that no motion is required, and we are going to revise Annex A, He will coordinate with Tom Prevost of C57.162 so that they can pick up more in-depth treatment of this topic.
Sam S summarized that he will report to the subcommittee that the bubble equation is being discussed by the C57.91 and the C57.162 WGs and the bubble equation topic will be split up between these two guides.

Discussion About Revising Annex I and Clause 5:

David Wallach mentioned in a previous WG meeting there was a discussion about Annex I and Clause 5 needing to be revised with respect to the presence of oxygen in oil like the latest IEC guide. He asked if there is going to be treatment of this topic elsewhere. Recent research indicated it's impact on DP / Tensile strength.
Oleg R stated that if C57.162 does not look into it, then we need to decide if we want to treat it in this guide. Clause 5 revision could be done by somebody else.
Tim R stated he could take a look at Clause 5 and Annex I and if there are specific things to be looked at then Oleg could provide that input.
Oleg R stated that we need to deal with terms like expected life, normal life, normal life expectancy, normal insulation life and life expectancy etc. in these sections. We need to get some consistent terminology defined and the life expectancy term should not be used. These are statistical terms and transformers are normally taken out of service before their end of life.
Tim R agreed that there are things that can be tightened up and brought in line with other standards and documents. This can be tricky since there is a lot of historical perspectives for many of these terms.
The Chair asked if there were volunteers to help Tim R clean it up. Zach and Kayland Adams offered to help Tim with revising Clause 5 (Kumar Mani subsequently volunteered after this meeting).
David Wallach: We should plan to have a WebEx working group meeting in June and October this year to see how the drafting is going and to iron out any possible conflicts.

8. Unfinished and New Business: There was none.

9. Adjournment

The meeting was adjourned at 11:53 AM[WD1]. The chair mentioned that a survey will be sent out in June regarding location preference for the Fall 2020 meeting whether it will be Virtual or in person at Milwaukee.

Meeting Attendance and Membership Status gathered from the WebEx Quorum Poll:

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
James Dukarm	Delta-X Research Inc.		X	
Kayland Adams	SPX Transformer Solutions, Inc.		X	
Mickel Saad	Hitachi ABB Power Grids	X		
Zack Draper	Delta-X Research Inc.			X
Ismail Guner	Hydro-Quebec			X
Taylor Gray	Not known		X	
Dmitriy Klempner	Southern California Edison			X
Sebastien Riopel	Electro Composites ULC		X	
William Boettger	Boettger Transformer Consulting LLC		X	
J.Dennis Marlow	DenMar TDS Transformers		X	
Roger Hayes	General Electric	X		
Peter Zhao	Hydro One	X		
Gilles Bargone	FISO Technologies Inc.	X		
Afshin Rezaei-Zare	York University			X
Patrick Picher	Hydro-Quebec IREQ			X
YaquanBill Li	BC Hydro		X	
Brad Staley	Salt River Project	X		
Juan Castellanos	Prolec GE	X		
David Calitz	Siemens Energy	X		
Steve Jordan	Not known			
Matthew Mcfadden	Oncor Electric Delivery			

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Craig Colopy	Eaton Corporation	X		
Troy Tanaka	Burns & McDonnell		X	
Ryan Musgrove	Oklahoma Gas & Electric			
Emilio Morales-Cruz	Qualitrol Company LLC	X		
Eduardo Garcia	Siemens Energy	X		
Will Elliott	Prolec GE		X	
Eric Davis	Burns & McDonnell		X	
Jared Bates	Oncor Electric Delivery		X	
Kumar Mani	Duke Energy Inc.	X		
Javier Arteaga	Hitachi ABB Power Grids	X		
Bruce Webb	Knoxville Utilities Board	X		
David Wallach	Duke Energy Inc	X		
Anthony Franchitti	PECO Energy Company			
Kyle Stechschulte	American Electric Power			X
Gene Blackburn	Gene Blackburn Engineering		X	
Weijun Li	Braintree Electric Light Dept.	X		
Bruce Forsyth	Bruce Forsyth and Associates LLC	X		
Jeff Ray	JLR Consulting		X	
Evanne Wang	DuPont		X	
Timothy Raymond	EPRI	X		
Jason Varnell	Doble Engineering		X	
Jeff Schneider	Power Partners		X	
Daniel Blaydon	Baltimore Gas & Electric	X		

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Dinesh Sankarakurup	Duke Energy Inc		X	
Jeffrey Wright	Duquesne Light Co.	X		
Javier Del Rio	Siemens Energy		X	
John K John	VA Transformers	X		
Sam Sharpless	Rimkus Consulting Group	X		
Richard Marek	Retired		X	
Rogelio Martinez	Georgia Transformers	X		
Rod Sauls	Southern Company Services		X	
Suleman Khan	Ontario Power Corp.		X	
Sanjib Som	Pennsylvania Transformer		X	
Adam Smith	Commonwealth Associates Inc		X	
Susan McNeily	Xcel Energy		X	
Lee Matthews	Howard Industries	X		
Kent Miller	T&R Electric Supply Co		X	
Mike Warntjes	Not known		X	
Raymond Curtiss Frazier	Ameren		X	
Brian Penny	American Transmission Co.		X	
Alex Quispe	Eaton Corporation	X		
Barry Beaster	H-J Family of Companies		X	
Gary King	Howard Industries		X	
Stacey Kessler	Basin Electric Power Cooperative	X		
Megan Kell	Eaton Corporation		X	
Evgenii Ermakov	Hitachi ABB Power Grids			

Attendee Name	Affiliation	Member	Guest	Guest Requesting Membership
Radek Szewczyk	Specialty Products Poland			
Kerwin Stretch	Siemens Energy			X
Egon Kirchenmayer	Siemens Energy	X		
Paul Florida	Howard Industries		X	
Tom Prevost	Weidmann Electrical Technology		X	
Sukhdev Walia	New Energy Power Co.	X		
Aleksandr Levin	Weidmann Electrical Technology	X		
Tommy Eagle	SPX Transformer Solutions, Inc.		X	
Anthony Franchitti	PECO Energy Company			X
Mario Locarno	Doble Engineering			X
Anastasia O'Malley	Consolidated Edison Co. of NY		X	
Saramma Hoffman	PPL Electric Utilities	X		
Mark Tostrud	Dynamic Ratings	X		
Roger Wlcks	DuPont	X		
Sheldon Kennedy	Niagara Transformer	X		
Paul Morakinyo	PSEG		X	
Oleg Roizman	IntellPower Pty Ltd	X		
Valery Davydov	Mr Valery Davydov		X	

H.4.1.2 C57.100 IEEE Standard Test Procedure for Thermal Evaluation of Liquid-Immersed Distribution and Power Transformers – Roger Wicks

WG C57.100: IEEE Standard Test Procedure for Thermal Evaluation of Insulation Systems for Liquid-Immersed Distribution and Power Transformers

Spring 2021 "Virtual" Meeting – 27 April 2021, 3:20 p.m. – 4:35 p.m. CDT, Webex
Chairman: Roger Wicks, Secretary: Kevin Biggie

The Chair called the meeting to order at 3:20 p.m. and welcomed attendees. The meeting agenda, Essential Patent Claims information (none were noted), and copyright information were reviewed. A quorum poll was then taken indicating 34 members were present (of 69), thus a quorum was not achieved (35 needed). Full attendance details were provided separately by the Encore virtual meeting service.

Subsequently, attendance was confirmed to be a total of 112 attendees, with 38 members and 74 guests present. There were 11 guests requesting membership, with 8 meeting the membership requirement of attending the last two consecutive, or three of the last five meetings of an existing WG. The WG welcomes new members: Erich Buchgeher, Eric Doak, Samragni Dutta Roy, Saramma Hoffman, Chao Li, Ashmita Niroula, Pragnesh Vyas, and Daniel Weyer. The other 3 guests requesting membership will be reconsidered upon achieving the meeting attendance membership requirements. In addition, a review of participation identified 21 current members not at either of the previous two, nor three of the last five meetings. Thus, to keep membership current, they were reverted back to Guest status and will be contacted accordingly. Given these changes, the new total number of members is 56, including the Chair and Secretary. Final attendance was recorded in AMS, and rosters are listed at the end of the minutes.

The Chair then proceeded with a review of a prepared meeting presentation, beginning with an overview of the recently completed draft, which was distributed with the meeting agenda last week. The bulk of the work on the draft was completed by the Sealed Tube Test Task Force (TF 3). The chair thanked TF3 for all the hard work on updating the draft, and Jinesh Malde, TF3 leader added his thanks to his team of Brad Greaves, Kevin Biggie and Stu Chambers who have done the bulk of this work.

Slides summarizing the changes included in the latest draft proposed by TF 3 were reviewed by TF 3 Leader, Jinesh Malde, and TF 3 contributors, with highlights as follows:

- Jinesh - the order of the sections of the document were revised to improve layout and flow.
- Kevin Biggie - the sealed tube test procedures were adapted from the active Liquids Aging Task Force in C57.154, and are currently being used by five labs in the ongoing TF lab aging studies.
- Roger – the dual temperature test section was also expanded and clarified.
- Jinesh – the 3-point aging test sections were carried over from the 2011 version and clarified.
- Kevin – reviewed the proposed new Annex for a modified sealed tube aging test for enameled wires in liquids, as an adaptation of a recently published paper on the topic. Sasha Levin added that end of life criteria for enameled wires in liquids is a key topic for further discussion to improve the proposal in the annex. Radek Szewczyk asked about the apparent large amount of wires in the material ratio, and Sasha responded that it was taken from an analysis of actual transformer designs, and is explained in the draft annex.
- Jinesh – introduced that a new single set of material ratios is proposed, vs. the separate distribution and power transformer ratios in the 2011 version. Sasha provided a detailed

explanation of the analysis and examples used to develop the new single set of ratios proposed, including a review of the tables in a new annex with the analysis and recommendation. Sasha explained the main drivers for the single set of ratios as follows:
    - The power ratio has shown to have much faster and different aging than the distribution ratio, which does not reflect real world experience.
    - The current power ratio included a portion of "cooler" board materials outside of windings, which are not representative of the hot spot, to which the test relates. Removal of such a cool board portion would bring it closer to the distribution ratio.
    - The current power ratio has a very small amount of paper. As the paper to board ratio has been shown to be important to aging results, thus a new paper to board ratio is proposed.
- Jinesh – there is a new thermal screening test annex used to provide an initial indication for expected thermal class of a candidate system, which is used to help choose candidate system aging temperatures.
- Jinesh – additional clarifications about testing in cases of changes to an already qualified candidate system were put in a new annex also.

Alan Sbravati commented that he would like to introduce a different additional method of analyzing aging test data, involving data fitting of all available data to unit life. Jinesh proposed that such a method could perhaps be discussed in the continuing work of TF 3. Roger requested that Alan develop and make a proposal for consideration.

Roger reviewed comments about the proposal for initial water content of the solid insulation at the start of aging in the latest draft, being 0.1 % – 0.3 %, which is a change from the 0.25 % - 0.5 % in the 2011 version. A concern is that such a level may be lower than what is observed in practice. Sasha commented that such lower water content is a practical level for lab testing, but that an expanded range compromise of 0.15 % - 0.4 % could be considered if needed. Alan commented the term should be "water content" and not "moisture content." Tom Prevost added that although 0.5 % is mentioned in industry as a target starting water content level, that this number represents the entire insulation system, including thicker, e.g. laminated material, "cool" insulation, and that actually the "hot" insulation, e.g. wire insulation paper and winding spacer pressboard would be much drier than 0.5 %. Luiz Cheim asked if the recommendation could just be simply less than 0.5%. Sasha recommended not, in that a narrow range of starting moisture is needed to get consistent results. Tom added that practically you can't achieve such "higher" water contents (approaching 0.5%) in actual lab conditions, and requested to stick with the 0.1% - 0.3% original recommendation. Roger concluded that he will send out the meeting slides, which have additional comments on this topic also.

Regarding next steps on the draft, Jinesh said that TF 3 would need perhaps a couple more months to complete all final recommendations on the draft before presenting a version that could be considered by the WG for a ballot. Roger requested that anyone in the WG with comments on the latest draft should submit them to Jinesh for consideration by TF 3.

Roger also noted, that since we had run out of time to conduct a second quorum poll, that he would send out an email survey to the working group members requesting approval of the minutes from the fall's virtual meeting.

The virtual meeting was adjourned at 4:35 p.m. Next planned meeting is in the Fall of 2021.

Annex H

Respectfully submitted,

Kevin Biggie
Secretary

Roger Wicks
Chair

Attendance WG C57.100 Spring 2021 Virtual Meeting:

Members (38)

Robert	Ballard	DuPont
Gilles	Bargone	FISO Technologies Inc.
Kevin	Biggie	Weidmann Electrical Technology
Edward	Casserly	Ergon, Inc.
Juan	Castellanos	Prolec GE
Stuart	Chambers	Powertech Labs Inc.
Luiz	Cheim	Hitachi ABB Power Grids
Solomon	Chiang	The Gund Company
Bruce	Forsyth	Bruce Forsyth and Associates LLC
George	Frimpong	Hitachi ABB Power Grids
Rob	Ghosh	GE
Attila	Gyore	M&I Materials Ltd
Kurt	Kaineder	Siemens Energy
Jon	Karas	SDMyers, LLC.
Sheldon	Kennedy	Niagara Transformer
Stacey	Kessler	Basin Electric Power Cooperative
Aleksandr	Levin	Weidmann Electrical Technology
Jinesh	Malde	M&I Materials Inc.
Richard	Marek	Retired
Rogelio	Martinez	Georgia Transformer
Emilio	Morales-Cruz	Qualitrol Company LLC
Tom	Prevost	Weidmann Electrical Technology
Ion	Radu	Hitachi ABB Power Grids
Kevin	Rapp	Cargill, Inc.
Jimmy	Rasco	Rasco Consulting LLC
Timothy	Raymond	Electric Power Research Institute (EPRI)
Tony	Reiss	Custom Materials, Inc.
Afshin	Rezaei-Zare	York University
Dinesh	Sankarakurup	Duke Energy
Amitabh	Sarkar	Virginia Transformer Corp.
Alan	Sbravati	Cargill, Inc.
Steve	Schappell	SPX Transformer Solutions, Inc.
Sam	Sharpless	Rimkus Consulting Group
Dave	Stankes	3M
Paul	Su	FM Global
Radek	Szewczyk	Specialty Products Poland Sp. z o.o.
Evanne	Wang	DuPont
Roger	WIcks	DuPont

Annex H

Guests (74)

Juan	Acosta	Ergon, Inc.
Juan Pablo	Andrade Medina	Olsun Electrics Corporation
Javier	Arteaga	Hitachi ABB Power Grids
Jean-Noel	Berube	Rugged Monitoring Inc.
Gene	Blackburn	Gene Blackburn Engineering
William	Boettger	Boettger Transformer Consulting LLC
Josh	Bohrn	PacifiCorp
Jeremiah	Bradshaw	Bureau of Reclamation
Erich	Buchgeher	Siemens Energy
Valery	Davydov	Mr. Valery Davydov
Brandon	Dent	Memphis Light, Gas & Water
Eric	Doak	D4EnergySolutions LLC
Zack	Draper	Delta-X Research Inc.
Samragni	Dutta Roy	Siemens Energy
Megan	Eckroth(Kell)	EATON Corporation
Marco	Espindola	Hitachi ABB Power Grids
Joseph	Foldi	Foldi & Associates, Inc.
Michael	Franchek	Retired
Rainer	Frotscher	Maschinenfabrik Reinhausen
Orlando	Giraldo	H-J Family of Companies
Shawn	Gossett	Ameren
Tim	Gradnik	Elektroinsitut Milan Vidmar
Jim	Graham	Weidmann Electrical Technology
Thomas	Hartmann	Pepco Holdings Inc.
Saramma	Hoffman	PPL Electric Utilities
David	Holland	ExxonMobil
Derek	Hollrah	Burns & McDonnell
Paul	Jarman	University of Manchester
Marion	Jaroszewski	Delta Star Inc.
Toby	Johnson	Pacificorp
Gael	Kennedy	GR Kennedy & Associates LLC
Gary	King	Howard Industries
Ken	Klein	Grand Power Systems
Dmitriy	Klempner	Southern California Edison
John	Lackey	PowerNex Associates Inc.
Donald	Lamontagne	Arizona Public Service Co.
Fernando	Leal	Prolec GE
Yaquan(Bill)	Li	BC Hydro
Chao	Li	EATON Corporation
Lee	Matthews	Howard Industries
Zach	Millard	Great River Energy
Kent	Miller	T&R Electric Supply Co.
Paul	Morakinyo	PSEG

Martín	Muñoz Molina	Orto de Mexico
Ryan	Musgrove	Oklahoma Gas & Electric
Shankar	Nambi	Bechtel
Aniruddha	Narawane	Power Distribution, Inc. (PDI)
Brady	Nesvold	Xcel Energy
Ashmita	Niroula	Ergon, Inc.
Anastasia	O'Malley	Consolidated Edison Co. of NY
Parminder	Panesar	Virginia Transformer Corp.
Patrick	Picher	Hydro-Quebec IREQ
Jarrod	Prince	ERMCO
John	Reagan	Oncor Electric Delivery
Tim	Rocque	SPX Transformer Solutions, Inc.
Josue	Rodriguez	Prolec GE
Hakan	Sahin	Virginia and Georgia Transformers
Albert	Sanchez	Knoxville Utilities Board
Rod	Sauls	Southern Company Services
Eric	Schleismann	Southern Company Services
Pugal	Selvaraj	Virginia Transformer Corp.
Adam	Smith	Commonwealth Associates, Inc.
Muhammad	Sohail	Trench Limited
Mauricio	Soto	Hitachi ABB Power Grids
Brad	Staley	Salt River Project
Dervis	Tekin	Meramec Instrument Transformer Co.
Pragnesh	Vyas	Sunbelt-Solomon Solutions
Daniel	Weyer	Nebraska Public Power District
Bill	Whitehead	Siemens Energy
Helena	Wilhelm	Vegoor Tecnologia Aplicada
Trenton	Williams	Advanced Power Technologies
Mana	Yazdani	Trench Limited
Malia	Zaman	IEEE
Kris	Zibert	Allgeier, Martin and Associates

H.4.1.3 C57.154 IEEE Standard for Liquid Immersed Transformers Designed to Operate at Temperatures Above Conventional Limits Using High-Temperature Insulation Systems – Richard Marek

PC57.154 – IEEE Standard for Liquid-Immersed Transformers Designed to Operate at Temperatures Above Conventional Limits Using High-Temperature Insulation Systems

Minutes of S21 Virtual WG Meeting (originally planned in Toronto, ON, Canada)
Monday, April 26, 2021

The meeting was called to order at 12:55PM (CDT) by Chair, Richard Marek. Vice-

Chair, Anastasia O'Malley and Secretary, Ewald Schweiger (writer of Minutes) were also present. This was the fifth meeting as a WG.

A total of 101 people connected to the virtual meeting.
7 of the total 90 attendees requested membership: Juan Acosta, Waldemar Ziomek, Robert Harper, vbaniroula (assumed to be Niroula Ashmita), Fabian Durand Stacy, Tim Gradnik and Balakrishnan Mani.

Data from the online poll provided by the meeting host:

Number of Members in WG = 59
Number of Members Present = 36
Quorum was met with 61% of membership present

Ten members had been changed to guest status. These are Craig DeRouen, William Elliott, Peter Heinzig, Brian McBride, Barry McGlew, Paul Morakinyo, Masaharu Murata, Jimmy Rasco, Jeff Valmus, Kwasi Yeboah

Five members, who requested membership had been changed to member status. These are Nitin Adiseshadrirao, Piotr Blaszczyk, Antoine Lecomte, Daniel Sauer, Timothy Tillery

Introductions of the Chair, Vice Chair and Secretary were made. Due to the large number of attendees and the virtual format for this meeting, no individual introductions were made.

The patent slides and the copyright policy had been provided by email before the meeting. A reminder of these slides was given and a call for patents was made, with no response.

Alan Sbravati gave a report on TF1 as shown in the presentation slides in Annex 1.

Kevin Biggie gave a report on TF2 as shown in the presentation slides in Annex2.

The chair mentioned that a motion made at a previous ILSC meeting to add new information to IEEE Std 1276 was not valid, since there was no active project for this document. Bruce Forsyth explained that another WG can only make proposals and this is only possible if this WG is actively working on this standard. Therefore, a revised motion will be presented in the ILSC meeting to include a PAR for the proposed TF to amend Annex B in IEEE Std 1276.

The chair expressed his appreciation for the work which was achieved in the three meetings held by each TF. The very good progress on the standard would not have been possible without these efforts.

A quorum was established via the online poll (details see above).

The agenda was approved unanimously as well as approval of the minutes from the previous meeting in the fall of 2020.

The chair opened a discussion requesting comments on Draft 4 which was previously sent out via email before the meeting took place.

Rainer Frotscher brought up two topics on Draft 4. The first concerned the definitions in chapter 3 which were removed during the development of the document. He felt that definitions should be brought back into the document since these are important to the application of the standard. After some discussion the conclusion was to leave the current version Draft 4 as it is, since reference is made to these definitions in IEEE Std 1276.

Phil Hopkinson suggested making a list of definitions that are used in the document, but are defined in IEEE Std 1276. The chair will consider this suggestion and will come back to the WG.

Shankar Nambi offered that some of the definitions could be moved to C57.12.80 if the WG would like to do so. Since he leads this WG he is willing to consider these wishes.

The second topic Rainer suggested, was to remove annex C since this is already part of IEEE Std 1276 and duplications should be avoided. Only the clauses C4 & C5 should be kept since this information is not documented in any other standard.

Rainer Frotscher brought up another topic, that the standard needs to provide typical tap changer contact temperature profiles, requirements for tap changer life, number of operations and values of temperature rise of contacts.

The chair stated that C57.154 is a transformer standard and the tap changer information is valuable as an important accessory. However, if much more R&D is needed to complete the guide information, this standard cannot be postponed until these long-lasting R&D efforts are finished. If there is a strong need for these values, a separate guide should be considered. Alan Sbravati stated that some of the values are considered in the table proposed by TF2 for IEEE Std 1276.

Bruce Forsyth suggested a vote on the next steps and therefore Rainer Frotscher made the motion to remove Annex C from Draft 4 and to propose shifting clauses C4 & C5 from Annex C to C57.166. Alan Sbravati seconded the motion.

<u>Data from the online poll provided by the meeting host:</u>

Number of Members voted for = 29
Number of Members voted against = 1
Abstained = 8
The motion carried since 29 of the 36 members present voted in favor of the motion

The chair outlined the intention to go out for ballot in order to get a bigger group to look at the document and receive additional valuable feedback and input. The chair will update Draft 4 removing Annex C and will consider incorporating the comments received from Alan via email during the meeting. Draft 5 will then be circulated within the WG. If there are no significant comments after about 30 days for the review of the document, the chair will ask the WG for approval to go for ballot. If this vote is positive the chair will request approval from the ILSC.

There was no additional new business and the meeting was adjourned at 2:10PM (CDT).

Annex H

Richard Marek
WG Chair

Anastasia O'Malley
WG Vice-Chair

Ewald Schweiger
WG Secretary

Annex 1

Task Force 1
Thermal Class of Liquids

- TF Chair: Alan Sbravati
- Active members:
  - Aleksandr Levin
  - Kevin Biggie
  - Brad Greaves
  - Kevin Rapp
  - Roger Wicks
  - Nikola Lukenda
  - Ed Casserly
  - Attila Gyore
  - Chao Li
  - Helena Wilhelm
  - Anastasia O'Malley
  - Phil Hopkinson
  - Muhammad Ali Masood Cheema
  - Paul Su
  - Radek Szewczyk
  - Jon Karas
  - Dan Sauer
  - Mary Slovachek
  - Stu Chambers

Second Round of Tests

- During the week of April 12th, 5 laboratories started another accelerated aging
- Two sets of "metal options" were defined the testing of the three liquids x metal option were sorted among the labs

	Mineral oil	Natural Ester	Synthetic Ester	Extra Vessels
Weidmann	Metal Options 1	Metal Options 1	Metal Options 1	2 liq (MO + NE) Metal Options 2 / 2 temp x 3 dur
Cargill	Metal Options 2	Metal Options 2	-	-
Vegoor	Metal Options 2	Metal Options 2	Metal Options 2	1 liq (SE) / Metal Options 1 / 1 temp x 3 dur
Eaton	-	Metal Options 1	Metal Options 1	-
Powertech	Metal Options 1	-	Metal Options 2	-

Metal Option # 1:
copper enameled wires;
non-insulated copper strip
non-insulated aluminum strip
strip of transformer steel

Metal Option # 2:
non-insulated copper strip.

Second Round of Tests

- The two different sets of "metals" are:
  - Metal Option # 1:
    - copper enameled wires;
    - non-insulated copper strip
    - non-insulated aluminum strip
    - strip of transformer steel
  - Metal Option # 2:
    - non-insulated copper strip.
- Test duration x temperatures are:

165 °C		180 °C	
Vessel#	Time, h	Vessel #	Time, h
1	Control		
2	432	5	336
3	840	6	672
4	Tbd	7	Tbd

Additional texts suggested by TF#1

- Section 6.3 of the current draft of C57.154 already includes some information for considering the impacts of the hotspot temperature on the liquid.
- From C57.154 (partial): The temperature of the liquid in the winding cooling duct being higher than that of the liquid in the top of the tank.
- From C57.154 (partial): The liquid needs to withstand the **maximum surface temperature without accelerated aging, unacceptable gas generation or bubble generation**.
- To be added in Std. 1276: The liquid's flash point subtracted of 10°C can be used as the limit for the surface temperature($T_{coil\ surface} = T_{hotspot} - \Delta T_{solid\ insulation}$)

Additional texts suggested to Std. 1276

- Additional table with some typical temperature rise limits. Main question was the top liquid limits. The new table proposed in TF#2 may address this:

	High-temperature insulation systems [b]			
Insulation system thermal class	130	140	155	180
Top liquid temperature rise[c], (°C)	75	85	95	115
Average winding temperature rise, (°C)				
Cooling classes: KN, KF, LN, LF,	75	85	95	115
Cooling classes: KD, LD	80	90	100	120
Hottest spot temperature rise, (°C)	90	100	115	140

Annex H

Annex 2

Task Force 2 - Comment Review Overview

- TF Chair: Kevin Biggie
- TF Members: Aleksandr Levin, Alan Sbravati, Stuart Chambers, George Frimpong, Roger Wicks, Ewald Schweiger, Anastasia O'Malley, Rick Marek, Attila Gyore, Jinesh Malde, Radek Szewczyk, Paul Su, Jon Karas, Kwasi Yeboah
- TF Scope: Review submitted comments received to date on PC57.154 and consolidate changes agreed by consensus as a recommendation back to the WG
- Approach: Consolidate agreed changes onto working copy of Draft 3, as TF input to Draft 4

Task Force 2 - Comment Review Activities Summary Since F20 (1 of 2)

- Held 3 TF meetings: 10 DEC, 4 FEB, 25 FEB
- Remaining submitted changes to Draft 2 and new changes to Draft 3 were consolidated into a single comments summary table for discussion
- Over the 3 meetings, the group proceeded through the comments summary table and achieved decisions on all remaining comments
- The decisions were added to a markup copy of D3, which was submitted to the WG Chair as input for D4

Task Force 2 - Comment Review Activities Summary Since F20 (2 of 2)

- Notable change regarding input to Draft 4:
  - Clarified top liquid temperature rise limits in Tables 3 & 5 (e.g. from general ">= 65°C" statement to specific temperatures based on average winding temp. rise
- Other clarifying content & editorial changes input also
- Work of the Task Force has been completed, and no future meetings planned
- However, in case of a requirement to review future Draft change recommendations, this TF could be considered for such work

Task Force 2 - Comment Review Next Steps

- In Section 5.1, Atilla and Jinesh recommended to add an additional table with some typical temperature rise limits as was proposed for IEC 60076. The Task Force decided to propose to the Working Group that such a table be considered for the next revision of IEEE 1276.

Task Force 2 -1276 Proposed Table

Insulation system typical materials	Insulation system thermal class	Maximum continuous operation liquid temperature (°C)	Typical top liquid temperature rise (°C)
Cellulose Kraft paper and mineral oil [a]	105	105	60
Thermally upgraded and mineral oil [b]	120	105	65
Cellulose Kraft paper and natural ester [c]	120	130	65
Cellulose Kraft paper and synthetic ester [d]	120	130	65
Thermally upgraded and natural ester [c]	140	130	85
Thermally upgraded and synthetic ester [c]	140	130	85
Elevated Temperature Solid Insulation and mineral oil [c]	130	105	65
Elevated Temperature Solid Insulation and ester [c]	140	130	85
High Temperature Solid Insulation and mineral oil [a]	155	105	65
High Temperature Solid Insulation and ester [a]	155	135	95
High Temperature Solid Insulation and ester [a]	180	135	95
High Temperature Solid Insulation and silicone [a]	180	155	115

[a] Historical thermal parameters for the conventional insulation system
[b] Typical thermal parameters for some countries, especially in North America
[c] With suitable liquid manufacturer's test evidence of thermal class since the combination of Kraft or thermally upgraded paper and the many different ester liquids does not necessarily result in the same thermal performance
[d] Additional support information to be included in Annex B of IEEE Std. 1276

Annex H

Role	First Name	Last Name	Company	Country
Guest	Juan	Acosta	Ergon, Inc.	USA
Guest	Donald	Ayers	Ayers Transformer Consulting	USA
Guest	Suresh	Babanna	SPX Transformer Solutions, Inc.	USA
Member	Gilles	Bargone	FISO Technologies Inc.	Canada
Guest	Claude	Beauchemin	TJH2b Analytical Services	Canada
Guest	Jean-Noel	Berube	Rugged Monitoring Inc.	Canada
Member	Kevin	Biggie	Weidmann Electrical Technology	USA
Member	Piotr	Blaszczyk	Specialty Transformer Components LLC	USA
Member	William	Boettger	Boettger Transformer Consulting LLC	USA
Member	Mike	Bonn	Soltex Inc.	Canada
Guest	Jeremiah	Bradshaw	Bureau of Reclamation	USA
Member	Edward	Casserly	Ergon, Inc.	USA
Member	Juan	Castellanos	Prolec GE	Mexico
Member	Stuart	Chambers	Powertech Labs Inc.	Canada
Guest	Huan	Dinh	Hitachi ABB Power Grids	USA
Guest	Jeffrey	Door	H-J Family of Companies	USA
Guest	ANDY	DOWNEY	SPX TRANSFORMER SOLUTIONS	USA
Guest	Hakim	Dulac	Qualitrol Company LLC	Canada
Guest	William	Elliott	General Electric	USA
Guest	Marco	Espindola	Hitachi ABB Power Grids	USA
Member	Bruce	Forsyth	Bruce Forsyth and Associates LLC	USA
Guest	Michael	Franchek	Retired	USA
Member	George	Frimpong	Hitachi ABB Power Grids	USA
Member	Rainer	Frotscher	Maschinenfabrik Reinhausen	Germany
Guest	Jose	Gamboa	H-J Family of Companies	USA
Guest	Rob	Ghosh	GE	USA
Guest	Orlando	Giraldo	H-J Family of Companies	USA
Guest	Tim	Gradnik	Elektroinsitut Milan Vidmar	Slovenia
Member	Attila	Gyore	M&I Materials Ltd	UK
Guest	Robert	Harper	Soltex Inc.	Canada
Guest	Thomas	Hartmann	Pepco Holdings Inc.	USA
Guest	David	Holland	ExxonMobil	USA
Member	Philip	Hopkinson	HVOLT Inc.	USA
Guest	George	Jalhoum	PPl	USA
Guest	Paul	Jarman	University of Manchester	UK
Member	Marion	Jaroszewski	Delta Star Inc.	USA
Guest	Toby	Johnson	Pacificorp	USA
Guest	Laszlo	Kadar	Hatch	Canada
Member	Kurt	Kaineder	Siemens Energy	Austria
Member	Jon	Karas	SDMyers, LLC.	USA
Member	Sheldon	Kennedy	Niagara Transformer	USA

Guest	Gary	King	Howard Industries	USA
Member	Krzysztof	Kulasek	Hitachi ABB Power Grids	Canada
Guest	Michelle	Kutzleb	TJH2b Analytical Services	USA
Guest	Xose	Lopez-Fernandez	Universidade de Vigo	Spain
Guest	Tiffany	Lucas	SPX Transformer Solutions, Inc.	USA
Member	Nikola	Lukenda	Petro-Canada Lubricants Inc.	Canada
Guest	Nigel	Macdonald	Trench Limited	Canada
Member	Jinesh	Malde	M&I Materials Inc.	USA
Guest	Balakrishnan	Mani	Virginia Transformer Corp.	USA
Chair	Richard	Marek	Retired	USA
Guest	Rogelio	Martinez	Georgia Transformer	USA
Guest	James	Mciver	Siemens Energy	USA
Guest	Randolph	Mullikin	ABB Inc.	USA
Guest	Shankar	Nambi	Bechtel	USA
Guest	Ashmita	Niroula	Ergon, Inc.	USA
Guest	Rodrigo	Ocon	Industrias IEM	Mexico
Vice-Chair	Anastasia	O'Malley	Consolidated Edison Co. of NY	USA
Guest	Monil	Patel	Pacific Gas & Electric Company	USA
Guest	Patrick	Picher	Hydro-Quebec IREQ	Canada
Guest	Christoph	Ploetner	Hitachi ABB Power Grids	Germany
Guest	Tejasvi	Prakash	Schweitzer Engineering Labs	USA
Member	Thomas	Prevost	Weidmann Electrical Technology	USA
Member	Kevin	Rapp	Cargill, Inc.	USA
Guest	Jeffrey	Ray	JLR Consulting, Inc.	USA
Guest	Larry	Rebman	EMLS, Inc.	USA
Guest	Samuel	Reed	EATON Corporation	USA
Member	Clemens	Reiss IV	Custom Materials, Inc.	USA
Guest	Tim	Rocque	SPX Transformer Solutions, Inc.	USA
Guest	Josue	Rodriguez	Prolec GE	Mexico
Guest	Mahesh	Sampat	EMS Consulting Inc.	USA
Guest	Anil	Sawant	Virginia Transformer Corp.	USA
Member	Alan	Sbravati	Cargill, Inc.	USA
Secretary	Ewald	Schweiger	Siemens Energy	Germany
Member	Jaber	Shalabi	VanTran Industries, Inc.	USA
Member	Samuel	Sharpless	Rimkus Consulting Group	USA
Guest	Adam	Smith	Commonwealth Associates, Inc.	USA
Guest	William	Solano	Instrument Transformer Equip Corp	USA
Guest	Mike	Spurlock	Spurlock Engineering Services, LLC	USA
Guest	Fabian	Stacy	Hitachi ABB Power Grids	USA
Member	David	Stankes	3M	USA
Guest	Christopher	Steineman	Delta Star Inc.	USA
Guest	David	Stockton	Stockton Consulting	USA
Member	Paul	Su	FM Global	USA

Member	Radoslaw	Szewczyk	Specialty Products Poland Sp. z o.o.	Poland
Guest	Dervis	Tekin	Meramec Instrument Transformer Co.	USA
Member	Alan	Traut	Howard Industries	USA
Guest	Kannan	Veeran	Georgia Transformer	USA
Guest	Dejan	Vukovic	Hitachi ABB Power Grids	Germany
Chair	Loren	Wagenaar	WagenTrans Consulting	USA
Guest	Dieter	Wagner	Hydro One	Canada
Member	Evanne	Wang	DuPont	USA
Member	Bruce	Webb	Knoxville Utilities Board	USA
Guest	William	Whitehead	Siemens Energy	USA
Member	Roger	Wicks	DuPont	USA
Guest	Helena	Wilhelm	Vegoor Tecnologia Aplicada	Brazil
Guest	Mana	Yazdani	Trench Limited	Canada
Guest	Joshua	Yun	Virginia Transformer Corporation	USA
Guest	Malia	Zaman	IEEE	USA
Guest	Michael	Zarnowski	Carte International	Canada
Guest	Waldemar	Ziomek	PTI Transformers	Canada

H.4.1.4 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

Working Group: Moisture in Insulation PC57.162
Monday, April 26, 2021
10:45AM – 12:00 PM
Virtual Web-Ex meeting

Chairman: Tom Prevost
Vice Chair: Valery Davydov
Secretary: Stephanie Denzer

The meeting was called to order at 10:45 am by Chair Tom Prevost.

38 members out of 42 were present. A membership quorum was achieved.
Total attendees including guests 134 attendees

Agenda:

1. Introduction of attendees
2. Establishment of Quorum
3. Approval of Agenda
4. Approval of Minutes from Fall 2020 and Fall 2019
5. Call for Patents
6. Copyright Policy
7. Chair's Remarks
8. Project Timeline
9. Membership Review
10. Document Status

11. Task Force Activities
    a. TF 9
        i. Bubble Equations and Discussion
        ii. Dielectric Risk- Maximum Moisture Value in Solid

Update on Task Force Activity
TF1: Terminology and definitions
TF2: Moisture migration, distribution and equilibrium charts
TF3: Measurement and evaluation of moisture-in-liquid insulation parameters
TF4: Measurement of moisture in solid insulation using sample of insulation
TF5: Evaluation of moisture in solid insulation using dielectric response methods
TF6: Inferring of moisture in solid insulation from measurements conducted in liquid or gaseous medium
TF7: Evaluation of aging and end of life of solid insulation parameters
TF8: Factory/workshop application of knowledge on moisture; establishing baselines
TF9: Field application of knowledge on moisture

Minutes:
A call for patents was completed and there were NO responses.

IEEE Copyright policy was reviewed and there were no questions or comments.

A quorum was established. This allowed the chair to conduct official business.

The agenda was approved unanimously.

A motion was made by Mike Spurlock and seconded by David Wallach to approve the minutes of the Fall 2019 meeting of PC57.162. There were no comments and the motion passed with unanimous approval.

A motion was made by Luiz Chiem and seconded by Oleg Roizman to approve the minutes of the Fall 2020 meeting of PC57.162. There were no comments and the motion passed with unanimous approval.

Chairs Remarks:

Project Timeline:

- Original PAR was approved on August 23, 2013
- A Two Year PAR extension was approved by NESCom in December 2020.
  - Project approved until Dec 31, 2022
- PAR revision to revise title, scope and purpose to address only liquid immersed transformers was approved by NESCom in January 2021.
- Balloting has to be completed by the end of 2021.
  - This means that we need to complete the document by July 2021 latest.

Document Status:

- Draft 6 has been compiled and edited by editor- Stephanie Denzer
- A Two-Year PAR extension was approved by NESCom in December 2020.
  - Project approved until Dec 31, 2022
- Balloting has to be completed by the end of 2021.
  - This means that we need to complete the document by July 2021 latest.
- Remaining chapters:
  - Chapter 7, Evaluation of aging and end of life of solid insulation parameters
    - Chapter written, Needs to be put into IEEE template style
    - Chair to review with chapter owner, Bob Raser
  - Chapter 9, Field application of knowledge on moisture
    - This chapter includes discussion on risks of moisture

Bubble equations and discussion:

The chair reviewed a motion that was prepared for the Insulation Life Subcommittee meeting stating that the detailed explanation of the bubble evolution phenomenon should be in C57.162, not C57.91, the loading guide. Bruce Forsyth, chair of the IEEE Transformers Committee stated that this motion was out of order because one working group cannot decide what another working group can put in their document. After discussion the working group agreed that C57.162 should included detailed discussion on bubble evolution. Dave Wallach, chair of the revision of C57.91 was present at this meeting. He stated that this topic will be discussed at the meeting of C57.91. Sam Sharpless, chair of the Insulation Life Subcommittee (ILSC) was present for this discussion as well. He will discuss the decision at the ILSC, and remove the motion prepared by Chair Prevost from the agenda.
Oleg Roizman has agreed to work with Tom Prevost to add information on bubble evolution phenomenon as a risk of moisture in chapter 9.

Dielectric Risk, - Maximum Moisture Value in Solid

Chair Prevost presented three graphs which showed the relationship between the dielectric strength of the liquid, the solid surface and the solid paper (turn to turn). Jinesh Malde and Claude Beauchemin have offered help to find the source of the technical paper that these graphs came from. There was discussion on the limits suggested by chair Prevost of 4% moisture in the solid insulation and 50% rH for the liquid. Oleg Roizman suggested that we consider relative saturation of the solid insulation rather than percent moisture. Emilio Morales questioned whether we need to consider the temperature of the solid insulation. There was consensus that this chapter SHOULD give maximum levels for moisture for risks of dielectric integrity of the insulation system.

New Business:
None

The meeting was adjourned at 12:15 pm.
Next meeting is scheduled for October 18, 2021

Respectfully Submitted,

Tom Prevost	Valery Davydov	Stephanie Denzer
Chair	Vice-Chair	Secretary

Meeting Attendees:

Name	Email	
Diego Robalino	diego_robalino@ieee.org	member
Stephan Brauer	sbrauer@morganschaffer.com	member
Ronald Hernandez	rhernandrz@doble.com	member
Dieter Wagner	dieter.wagner@hydroone.com	
Sanjay	s.patel@smitusa.com	
Mauricio Soto	mausotog@hotmail.com	
Nick Perjanik	nick.perjanik@weidmann-group.com	member
Ramon Benedict	ramon.benedict@spx.com	
Jeff Gragert	jeffrey.a.gragert@xcelenergy.com	
Cihangir Sen	cihangir.sen@duke-energy.com	
555217	rogelio.martinez@gatransformer.com	
vinay	patelvin@coned.com	
Jimmy M Rasco	jimras7952@bellsouth.net	member
Paul Morakinyo	paul.morakinyo@pseg.com	
elise.arnold@sgb-smit.group		

Deniss Villagran	deniss.villagran@ge.com	
Kannan Veeran	kannan.veeran@gatransfirmer.com	
Nitesh patel	nrpatel@hhiamerica.com	
Florin Faur	florin.faur@spx.com	
Joe Nims	jnims@allenhoshall.com	
Peter Zhao	peter.zhao@hydroone.com	
Martín Muñoz	martin.munoz@orto.mx	
Thomas Hartmann	dr.thomas.hartmann@ieee.org	
Jayme Nunes	jayme.nunes@nynas.com	
Paul Boman	paul_boman@hsb.com	member
Ewald	schweiger.ewald@siemens.com	
Daniel Blaydon	dblaydon@ieee.org	
Bill Whitehead	bwhitehead@h2scan.com	
Thomas (Tom) Dauzat	thomas.dauzat@ge.com	
Zack Draper	zhdraper@deltaxresearch.com	
Kurt Kaineder	kurt.kaineder@siemens.com	
Drew Welton	dwelton88@live.com	
Bob Kinner	bkinner@firstpowergroupllc.com	member
Valery Davydov	valery.davydov@ieee.org	member
bob rasor	bob.rasor@sdmyers.com	member
Afshin Rezaei Zare	rezaei@eecs.yorku.ca	
Zan Kiparizoski	zkiparizoski@ieee.org	member
Luiz Cheim	luiz.v.cheim@us.abb.com	member
Jonathan Sinclair	jjsinclair@pplweb.com	
Alvaro Portillo	acport@adinet.com.uy	
Robert Harper	rharper@soltexinc.com	
George Frimpong	george.k.frimpong@hitachi-powergrid	member
Mark Tostrud	mark.tostrud@dynamicratings.com	member
Anastasia O'Malley	o'malleya@coned.com	
Claude Beauchemin	beauchemin@tjh2b.com	member
David Murray	dbmurray@tva.gov	
David Wallach	david.wallach@ieee.org	member
Leon White	lwhite@h2scan.com	
vinay mehrotra	vinay.mehrotra@spx.com	
ISMAIL GUNER	guner.ismail@hydro.qc.ca	member
Loren Wagenaar	lbwagenaar@ieee.org	
John Reagan	john.reagan@oncor.com	
Piotr Blaszczyk	pblaszczyk@transformercomponents.	
Jim Thompson	jim@svtv.com	
Chris Steineman	csteineman@deltastar.com	
bill griesacker	bgriesacker@verizon.net	
Orlando Giraldo	orlandog@h-j.com	
Anthony Natale	anatale@hicoamerica.com	
Tom Prevost	tprevost78@gmail.com	member
Brian Sparling	sparlibr@gmail.com	member
David Hanson	hanson@tjh2b.com	

Sheldon Kennedy	skennedy@niagaratransformer.com	
Erich Buchgeher	erich.buchgeher@siemens.com	
Gilles Bargone	gilles.bargone@gmail.com	
Axel Kraemer	a.kraemer@reinhausen.com	
Roger Fenton	roger.a.fenton@gmail.com	member
Mike Bonn	mbonn@soltexinc.com	
Oleg Roizman	oleg.roizman@ieee.org	member
jharley	jack.harley@firstpowergroupllc.com	
Tiffany Lucas - SPX	tiffany.lucas@spx.com	
John Lackey	johnlackey@pnxa.com	
Hakim Dulac	hdulac@qualitrolcorp.com	
Dharam Vir	dharam.vir@spx.com	
Balakrishnan	balaee07@gmail.com	
George Jalhoum PPL EU	gjalhoum@pplweb.com	
Ed	ed.g.tenyenhuis@hitachi-powergrids.c	
solomon chiang	schiang@thegundcompany.com	member
William Boettger	weboettger@aol.com	
Paul Su	pocheng.su@fmglobal.com	member
Suleman Khan	suleman.khan@opg.com	
Samragni Dutta Roy	samragni.dutta_roy@siemens.com	
Olle Benzler	olle.benzler@megger.com	
Michael Spurlock	mspurlock@ieee.org	member
Adrian Silgardo	adrian.silgardo@ifdcorporation.com	
Ronnie Minhaz	rminhaz@tc-servicesinc.com	
Roger Hayes	roger.hayes1@ge.com	
Rodrigo Ocon	rocon@condume.com.mx	
Don Dorris	ddorris@nespower.com	member
Bruce Forsyth	bruce.forsyth@ieee.org	member
Saramma Hoffman	shoffman@pplweb.com	
Jeremiah Bradshaw	jeremiah.l.bradshaw@ieee.org	
Hali Moleski	hali.moleski@sdmyers.com	member
Roger WIcks	roger.c.wicks@dupont.com	member
Josue Rodriguez	Josue.rodriguez@prolecge.com	
Eric Doak	ericdoak@d4energysolutions.com	
James Dukarm	j.dukarm@ieee.org	
Ryan Thompson	rthompson@burnsmcd.com	
evanne	evanne.wang@dupont.com	member
Jon Karas	jon.karas@sdmyers.com	member
Kurt Kaineder	kurt.kaineder@siemens.com	
Tim Gradnik	tim.gradnik@eimv.si	
AnatoliyMudryk	a.mudryk@camlinpower.com	
Jinesh Malde	jineshmalde@mimaterials.com	
Marco Espindola	mespindola@ieee.org	
Aleksandr Levin	aleksandr.levin@weidmann-group.co	member
Juan Castellanos	juangonzalo.castellanos@prolecge.co	
vbaniroula	ashmita.niroulaa@ergon.com	

László Kádár	laszlo.kadar@hatch.com	
sam sharpless	slsharpless@rimkus.com	member
Mike Waldrop	mwaldrop@mlgw.org	
Timothy Raymond	traymond@epri.com	member
Toby Johnson	toby.johnson@pacificorp.com	
Nicholas Jensen	nbjensen89@gmail.com	
Stuart Chambers	Stuart.chambers@powertechlabs.com	member
greg Steeves	greg@baronusa.com	
Rainer Frotscher	r.frotscher@reinhausen.com	
Mike Warntjes	mwarntjes@atcllc.com	
Mani KUMAR	kumar.mani@duke-energy.com	member
ANIL SAWANT	anil_sawant@vatransformer.com	
Eduardo Garcia	eduardo.garcia@ieee.org	
Ed	efeloni@ligconsultants.com	
Trenton Williams	tlwilliams@advpowertech.com	
Edward Casserly	Edward.Casserly@ergon.com	member
Emilio Morales-Cruz	emorales@qualitrolcorp.com	member
Michelle Kutzleb	kutzleb@tjh2b.com	
Brian Penny	bpenny@atcllc.com	
Juan Acosta	Juan.Acosta@ergon.com	
Attila Gyore	attilagyore@mimaterials.com	
Richard Marek	rick.marek@gmail.com	member
James Gardner	jmgardner@compuserve.com	member
Mickel Saad	mickel.saad@hitachi-powergrids.com	
Rakesh Patel	rakeshrameshpatel@gmail.com	
suresh babanna	suresh.babanna@spx.com	
HELENA	helena@vegoor.com.br	
Rob	sghrob@gmail.com	
Anand Zanwar	anand.zanwar123@gmail.com	
Sukhdev Walia	SDEV.WALIA@GMAIL.COM	
ray54162	rayjl@bv.com	
Rob Ghosh	sghrob@gmail.com	
Tony Reiss	treiss@custommaterials.com	

H.4.1.5 Working group on C57.165 IEEE Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors – Mark Tostrud

Officers:
Chair – Mark Tostrud
Vice Chair – Vacant
Secretary – Zan Kiparizoski

Approved Meeting Minutes
PC57.165 WG Guide for Temperature Measurements for Liquid Immersed Transformers and Reactors
Minutes from Fall 2020 Virtual Meeting

Officers

Chair – Mark Tostrud
Vice Chair/Secretary – Zan Kiparizoski

1. Meeting Date and Time: 10/22/2020 at 9:25-10:20am CST

Meeting was called to order at 9:30am

2. 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.

2. Reviewed IEEE-SA Copyright Policy

The copyright policy slides were projected on screen and a request for any known copyright issues was made. There were no responses to the request.

3. Officer changes

Officer changes - Phil McClure (Chair) retired in September, 2020. Robert Thompson (Vice-Chair) retired in February, 2020. The secretary, Mark Tostrud, has moved to the Chair position. A volunteer was requested to fill the secretary position. Zan Kiparizoski volunteered to serve as secretary. At this time, the vice-chair position will not be filled.

4. Chairs remarks

The PAR for this project expires on 12/31/2020. A schedule to complete the guide was proposed to the working group to complete the guide early in 2021 so we can begin the ballot process by the spring of 2021. Sheldon Kennedy commented that it is important to start the ballot process by Spring, 2021. A PAR extension will probably not be granted if we are not in ballot.

5. Attendance

There were 41 attendees in the meeting
- 13 members
- 28 guest

7 guests requested membership
- 6 were added as guests since it was their first meeting
- 1 was attending his second consecutive meeting and will be added as a member for the spring meeting

Quorum check
- The first electronic poll showed 12 of 25 members were present
- The second electronic poll was performed about 10 minutes into the meeting. 10 of 25 members were present for the second poll.

A manual poll was performed using the chat box. 13 of 25 members were present so a Quorum was achieved

6. Approval of the agenda and minutes

There was no objection to the unanimous approval of the meeting agenda
There was no objection to unanimous approval of the fall, 2019 meeting minutes after minor corrections were made

7. Old Business

Chair requested updates from the volunteers for various sections in the guide:

Purpose – A purpose statement was drafted and emailed to the former chair late in 2019. The volunteer will try to find the email but is not sure if he will be able to locate the email since his computer failed and he may not be able to recover it. If the original proposal cannot be found, a new purpose statement will be drafted. Since the Scope doesn't specify whether design measurements will be considered in the guide, the purpose statement will address whether R&D measurements and type test measurements are included.
Purpose statement will clarify whether the guide will include R&D measurements and other test measurements.
Section 3 - Definitions: Section was recently reviewed. The section is in pretty good shape. A final review will be performed once the document is further along to minimize the number of revisions required.
Section 4.4 – Core Temperature Measurements: Review of this section will be completed by December 2020.
Section 4.6 – OLTC temperature measurements - The methods to monitor OLTC temperatures are identical to the methods used to monitor top oil and bottom oil temperature. Recommendation is to include OLTC oil temperature measurements in section 4.2.
Section 4.8 – Bushing temperature measurement – Volunteers from the bushing committee provided guidance on this section in an email to the previous chair in January/February, 2020. The email will be forwarded to the current chair for his consideration.
A motion passed in fall, 2019 to remove sections 4.5 to 4.10 from the guide since the measurements in these sections were R&D measurements. Since we don't have content for these sections, we will proceed with removing those sections. If viable methods to monitor bushing temperatures are identified, a motion will be made to add section 4.8 back into the document.
During the fall 2019 new business discussion, a proposal was made to reorganize the document by measurement type rather than by component. The proposal was tabled until this meeting since the former chair was not present in the meeting. The current chair indicated he was not considering reformatting the document since we are in the final stages of completing the document.

8. New Business

The chair proposed the following timeline to allow us the move the guide towards ballot:

December, 2020 – Complete all sections discussed in old business above
January, 2021 – Update the guide to include the content submitted in December and send the draft out for comment
February/March, 2021 – resolve all comments and update the guide

April, 2021 – Begin the ballot process

9. Motion to adjourn

10. Minutes

The minutes were recorded by Mark Tostrud – Chair and reviewed by Zan Kiparizoski – Secretary

WG PC57.165 – Participation List, Virtual Fall 2020 Meeting			
Role	First Name	Last Name	Company
Member	Gilles	Bargone	FISO Technologies Inc.
Member	Jean-Noel	Berube	Rugged Monitoring Inc.
Member	Juan	Castellanos	Prolec GE
Member	Hakim	Dulac	Qualitrol Company LLC
Member	Sheldon	Kennedy	Niagara Transformer
Secretary	Zan	Kiparizoski	Howard Industries
Member	Martin	Munoz Molina	Orto de Mexico
Member	Ryan	Musgrove	Oklahoma Gas & Electric
Member	Steven	Schappell	SPX Transformer Solutions, Inc.
Member	Samuel	Sharpless	Rimkus Consulting Group
Member	Babanna	Suresh	Southwest Electric Co.
Chair	Mark	Tostrud	Dynamic Ratings, Inc.
Member	Trenton	Williams	Advanced Power Technologies
Guest	Kayland	Adams	SPX Transformer Solutions, Inc.
Guest	Onome	Avanoma	Transformer Consulting Services Inc.
Guest	Jean-Noel	Berube	Rugged Monitoring Inc.
Guest	Thomas	Blackburn	Gene Blackburn Engineering
Guest	Nicolas	Blais	Nomos Systems
Guest	Jeremiah	Bradshaw	Bureau of Reclamation
Guest	Darren	Brown	Howard Industries
Guest	Solomon	Chiang	The Gund Company
Guest	Scott	Digby	Duke Energy
Guest	Samragni	Dutta Roy	Siemens Energy
Guest	Daniela	Ember Baciu	Hydro-Quebec IREQ
Guest	Shamaun	Hakim	WEG Transformers USA Inc.
Guest	Ronald	Hernandez	Doble Engineering Co.
Guest	John	John	Virginia Transformer Corp.
Guest	Tiffany	Lucas	SPX Transformer Solutions, Inc.
Guest	Jinesh	Malde	M&I Materials Inc.
Guest	Anatoliy	Mudryk	Camlin Power
Guest	Anastasia	O'Malley	Consolidated Edison Co. of NY
Guest	Parminder	Panesar	Virginia Transformer Corp.
Guest	Vijay	Pargaonkar	Virginia Transformer Corp.
Guest	Nitesh	Patel	Hyundai Power Transformers USA
Guest	Homero	Portillo	Advanced Power Technologies

Guest	Oleg	Roizman	IntellPower Pty Ltd
Guest	Roderick	Sauls	Southern Company Services
Guest	Stefan	Schindler	Maschinenfabrik Reinhausen
Guest	Jacques	Vanier	Electro Composites (2008) ULC
Guest	Zachery	Weiss	WEG Transformers USA Inc.
Guest	Abderrahmane	Zouaghi	Hitachi ABB Power Grids

A PAR extension request had been discussed and approved during the working group meeting.
Mark Tostrud made a motion to request a PAR extension. The motion was seconded by Zan Kiparizoski. With no objections, the motion carried.

Mark Tostrud made a motion to make a scope change to the PAR to add a purpose statement as reviewed and approved by the working group. Zan Kiparizoski seconded the motion. The Chair requested whether there were any objections. There were no objections and the motion carried. The working group will amend the purpose statement and bring a revised version to the next meeting.

H.4.1.6 Working group on C57.169 Maximum Winding Temperature Rise in Liquid-Filled Transformers (PC57.169 replacing IEEE 1538) – Scott Digby

Unapproved Meeting Minutes
VIRTUAL MEETING | April 27th, 2021 | 12:55pm – 2:10pm Central Time

Chair: Scott Digby

Secretary: Cihangir John Sen

The Working Group for Determination of Maximum Winding Temperature Rise in Liquid-Immersed Transformers met for the fourth time on Tuesday, April 27, 2021 after the Fall 2020 meeting that was also held virtually.

This new standard will be replacing the existing Std. 1538 that will be expiring in 2021.

- The meeting started on time with the participation of 65 attendees according to the electronic polling system. The Chair requested a quorum check for the approval of the Agenda and the minutes of the last Fall 2020 meeting. According to the poll results 20 of the 47 members were present so the quorum was not established after the first attempt. The Chair decided to move on and try another poll later in the meeting (24 WG members needed to establish the quorum).
- The Chair presented the Patents and Copyrights policies. No essential patent claims or copyright violations were reported.
- It was noted that the PAR for this WG was approved in January 2019 and the expiration date is December 31, 2023.

The WG meeting continued with the Review of Activities Since Fall 2020 Meeting.

- First activity was to review the Section 4.1 of the document that provides details about direct temperature measurement with fiber optic probes. Several WG members commented that section being not clear about how to specify the number of probes and their recommended

locations in the windings. The Chair noted that this section of the document cited the CIGRE document.
Two volunteers (Jason Varnell and Gary Hoffmann) from our WG members have reviewed the originally cited CIGRE document (A2-307_2010) and found out that the section was also published in a CIGRE Technical Brochure (659-Transformer Thermal Modelling). The Chair confirmed that Copyright permission has already been granted by CIGRE for citation of the sections that are related with direct temperature measurement methods. Revisions have been received from the volunteers and incorporated in the Draft 4 of the document.

- Second group of volunteers (Gilles Bargone, Jean-Noel Berube, Hakim Dulac) reviewed the Annex-D section of the document for adding new content including the information on anchoring disc method. Updated content was finalized by these contributors and incorporated into the Draft D4 document.
- Draft #4 of the document was circulated within the members of the group between March 23rd and April 12th timeframe and several comments were received. Total of 41 comments were received from the volunteers and have been shared with the WG members in a spreadsheet one week before the meeting.
    - Thirty of those comments were editorial changes that are already incorporated into Draft D5 of the document.
    - Three of the comments were technical and were addressing the same item that was already discussed and agreed upon during the meeting.
    - Eight items in the General comments also needed further discussion within the group and all were closed with consensus.

The Chair went through the only comment that are technical in nature:

- This comment was about the Section 4.1.1 that provides some background information about the direct measurement. Below sentence in that section was defining the OD cooling as natural convection, which is an incorrect definition for the directed oil flow cooling method, so it was agreed to revise the sentence without the "natural convection" part.
    "…the load current is sinusoidal, and that the transformer has natural convection through cooling equipment and in windings (e.g., ON-, OF-, or *OD*)."
- The Chair presented the Draft 5 of the P57.169 and went through the four comments that were received during the circulation of Draft 4 and asked for the WG opinion:
    - First comment was suggesting adding "rating" at the end of maximum winding temperature. It was agreed not to add since it defines an absolute temperature.
    - One comment suggested to change the wording "perpendicular to the limb" as "perpendicular to yoke" since the limb is a circular structure and perpendicularity is not possible. It was agreed to change the definition as "perpendicular to core plane"
    - Another comment was about the frame MVA of the autotransformers. It was suggested to use "equivalent" in place of "frame". The Chair mentioned that the "equivalent MVA" is already described in the Annex-A of C57.12.00. It was agreed to use "equivalent MVA" instead of "frame MVA".
    - Last comment was about the paragraph under Section 4.1.3.1 that specifies Winding A as the inner winding and Winding B as the outer winding. The reviewer suggested to include additional wording that shows inner winding as "typically the LV winding" and outer winding as "typically the HV winding". That suggestion was agreed upon and will be implemented in the final revision.

- The Chair requested another poll for quorum check after the number of participants has reached to 85 but the quorum was not established after this second poll.
- The quorum was not established after the third attempt so the Agenda and the F2020 minutes were not approved.
- A motion to send the Draft D5 document to Ballot could not be entertained since the quorum was not achieved. According to the last (3rd) poll results: 23 members and 31 guests were present. 12 guests requested membership. 24 members were needed for the quorum.
- The Chair advised that he will seek approval of the Fall 2020 meeting minutes via letter ballot (email).
- The Chair also advised that he will seek approval via letter ballot (via email) from the WG to send the Draft D5 version of the document to ballot. If the required 2/3 majority is attained, the Chair will seek further guidance from the Insulating Fluids SC Chair on the next step towards obtaining SC approval to send the document for ballot.
- The Chair asked for volunteers to form a Ballot Resolution Group (BRG) before adjourning the meeting. Three of the WG members -also listed below- volunteered for the BRG t. Input from other WG participants will be sought throughout the process as the need arises.

First Name	Last Name	Company
Emilio	Morales-Cruz	Qualitrol Company LLC
Ryan	Musgrove	Oklahoma Gas & Electric
Jason	Varnell	Doble Engineering Co.

No new businesses were requested at the end of the meeting.

The need for a meeting time slot at the F21 Transformers Committee meetings will depend on the status of the potential balloting process.

The meeting was adjourned at 1:55pm Central.

Membership Requests: 13				New Members: 9		
1	Onome	Avanoma		**1**	Onome	Avanoma
2	Erich	Buchgeher		**2**	Erich	Buchgeher
3	Everton	De Oliveira		**3**	Everton	De Oliveira
4	Samragni	Dutta Roy		**3**	Samragni	Dutta Roy
5	Evgenii	Ermakov		**5**	Evgenii	Ermakov
6	Norman	Field		**6**	Norman	Field
7	Laszlo	Kadar		**7**	Laszlo	Kadar
8	Dmitriy	Klempner		**8**	Dmitriy	Klempner
9	Hugh	Waldrop		**9**	Hugh	Waldrop
10	Rashed	Minhaz				

11	Patrick	Picher				
12	Amitabh	Sarkar				
13	Drew	Welton				

Final Membership Status after the S2021 Meeting (36 Members):

First Name	Last Name	First Name	Last Name	First Name	Last Name
Onome	Avanoma	Gary	Hoffman	Cihangir	Sen
Gilles	Bargone	Laszlo	Kadar	Brad	Staley
Jean-Noel	Berube	Sheldon	Kennedy	Babanna	Suresh
Erich	Buchgeher	Egon	Kirchenmayer	Mark	Tostrud
Juan	Castellanos	Dmitriy	Klempner	Jason	Varnell
Eric	Davis	Darrell	Mangubat	Pragnesh	Vyas
Everton	De Oliveira	Emilio	Morales-Cruz	Hugh	Waldrop
Scott	Digby	Anatoliy	Mudryk	Sukhdev	Walia
Hakim	Dulac	Ryan	Musgrove	Matthew	Webb
Samragni	Dutta Roy	Afshin	Rezaei-Zare	Mana	Yazdani
Evgenii	Ermakov	Oleg	Roizman		
Norman	Field	Dinesh	Sankarakurup		
Bruce	Forsyth	Steven	Schappell		

WG C57.169 – WG Participants List, Virtual, Spring 2021 Meeting				
	Role	**First Name**	**Last Name**	**Company**
1	Chair	Scott	Digby	Duke Energy
2	Secretary	Cihangir	Sen	Duke Energy
3	Member	Gilles	Bargone	FISO Technologies Inc.
4	Member	Jean-Noel	Berube	Rugged Monitoring Inc.
5	Member	Juan	Castellanos	Prolec GE
6	Member	Hakim	Dulac	Qualitrol Company LLC
7	Member	Sheldon	Kennedy	Niagara Transformer
8	Member	Egon	Kirchenmayer	Siemens Energy
9	Member	Darrell	Mangubat	Siemens Power Operations Inc.
10	Member	Emilio	Morales-Cruz	Qualitrol Company LLC
11	Member	Anatoliy	Mudryk	Camlin Power
12	Member	Ryan	Musgrove	Oklahoma Gas & Electric
13	Member	Afshin	Rezaei-Zare	York University
14	Member	Oleg	Roizman	IntellPower Pty Ltd

Annex H

15	Member	Dinesh	Sankarakurup	Duke Energy
16	Member	Steven	Schappell	SPX Transformer Solutions, Inc.
17	Member	Brad	Staley	Salt River Project
18	Member	Babanna	Suresh	Southwest Electric Co.
19	Member	Mark	Tostrud	Dynamic Ratings, Inc.
20	Member	Jason	Varnell	Doble Engineering Co.
21	Member	Sukhdev	Walia	New Energy Power Co.
22	Member	Matthew	Webb	SPX Transformer Solutions, Inc.
23	Member	Mana	Yazdani	Trench Limited
24	Guest	Kayland	Adams	SPX Transformer Solutions, Inc.
25	Guest	Nabi	Almeida	Prolec GE USA LLC
26	Guest	Edmundo	Arevalo	Bonneville Power Administration
27	Guest	Onome	Avanoma	MJ Consulting
28	Guest	Jared	Bates	Oncor Electric Delivery
29	Guest	Olle	Benzler	Megger
30	Guest	Mats	Bernesjo	Hitachi ABB Power Grids
31	Guest	William	Boettger	Boettger Transformer Consulting LLC
32	Guest	Erich	Buchgeher	Siemens Energy
33	Guest	Muhammad Ali Masood	Cheema	Northern Transformer
34	Guest	Jaroslaw	Chorzepa	ABB Inc.
35	Guest	Juan Carlos	Cruz Valdes	Prolec GE
36	Guest	Everton	De Oliveira	Siemens Ltda
37	Guest	Huan	Dinh	Hitachi ABB Power Grids
38	Guest	ANDY	DOWNEY	SPX TRANSFORMER SOLUTIONS
39	Guest	Samragni	Dutta Roy	Siemens Energy
40	Guest	Evgenii	Ermakov	Hitachi ABB Power Grids
41	Guest	Marco	Espindola	Hitachi ABB Power Grids
42	Guest	Norman	Field	Teshmont Consultants LP
43	Guest	Paul Gabriel	Florida	Howard Industries, Inc.
44	Guest	Raymond	Frazier	Ameren
45	Guest	Rob	Ghosh	GE
46	Guest	Tim	Gradnik	Elektroinsitut Milan Vidmar
47	Guest	Jeffrey	Gragert	Xcel Energy
48	Guest	Said	Hachichi	Hydro-Quebec
49	Guest	Thomas	Hartmann	Pepco Holdings Inc.
50	Guest	Saramma	Hoffman	PPL Electric Utilities
51	Guest	George	Jalhoum	PPl
52	Guest	Paul	Jarman	University of Manchester
53	Guest	Nicholas	Jensen	Delta Star Inc.
54	Guest	Laszlo	Kadar	Hatch
55	Guest	Gael	Kennedy	GR Kennedy & Associates LLC

56	Guest	Stacey	Kessler	Basin Electric Power Cooperative
57	Guest	Dmitriy	Klempner	Southern California Edison
58	Guest	John	Lackey	PowerNex Associates Inc.
59	Guest	Xose	Lopez-Fernandez	Universidade de Vigo
60	Guest	Rogelio	Martinez	Georgia Transformer
61	Guest	Robert	Mayer	Siemens Energy
62	Guest	Rashed	Minhaz	Transformer Consulting Services Inc.
63	Guest	Shankar	Nambi	Bechtel
64	Guest	Kristopher	Neild	Megger
65	Guest	Nitesh	Patel	Hyundai Power Transformers USA
66	Guest	Vinay	Patel	Consolidated Edison Co. of NY
67	Guest	Patrick	Picher	Hydro-Quebec IREQ
68	Guest	Alvaro	Portillo	Ing. Alvaro Portillo
69	Guest	Tejasvi	Prakash	Schweitzer Engineering Labs
70	Guest	Jarrod	Prince	ERMCO
71	Guest	Jeffrey	Ray	JLR Consulting, Inc.
72	Guest	John	Reagan	Oncor Electric Delivery
73	Guest	Larry	Rebman	EMLS, Inc.
74	Guest	Samuel	Reed	EATON Corporation
75	Guest	Perry	Reeder	SPX Transformer Solutions, Inc.
76	Guest	Tim	Rocque	SPX Transformer Solutions, Inc.
77	Guest	Amitabh	Sarkar	Virginia Transformer Corp.
78	Guest	Samuel	Sharpless	Rimkus Consulting Group
79	Guest	Muhammad	Sohail	Trench Limited
80	Guest	Arthur	Speegle	Entergy Services, Inc.
81	Guest	Christopher	Steineman	Delta Star Inc.
82	Guest	Jos	Veens	SMIT Transformatoren B.V.
83	Guest	Kannan	Veeran	Georgia Transformer
84	Guest	Richard	vonGemmingen	Dominion Energy
85	Guest	Hugh	Waldrop	Memphis Light, Gas & Water
86	Guest	Alan	Washburn	Burns & McDonnell
87	Guest	Bruce	Webb	Knoxville Utilities Board
88	Guest	Drew	Welton	Intellirent

Respectfully submitted,

Scott Digby – **Chair**

Cihangir John Sen – **Secretary**

H.4.1.7 Task Force C57.12.90 Clause 11, Temperature Rise Tests – Dinesh Sankarakurup

Virtual Meeting - April 27, 2021 at 5:10 PM

Chair: Dinesh Sankarkurup – Duke Energy
Vice Chair: TBD
Secretary: John Reagan – Oncor

Attendance

There were 38 attendees. Since this was the first meeting, all present were considered members for this meeting.

Discussions

1. Since this was the first meeting, it was determined no need for Agenda Approval. Bruce Forsyth confirmed.
2. No essential patent claims or copyright violations were noted.
3. Scope was reviewed. No comments from attendees.
4. Jason Varnell's initial comments for Clause 11 were displayed and reviewed for attendees.
    a. Jason had observed few manufacturers who had taken an average over the last 4 hours of the heat run to get the "Ultimate Temperature".
5. Ajith asked if scope of TF was limited to TF Scope or if the TF would be updating other discrepancies in Clause 11.
    a. The group concluded the TF would prioritize Clause 11.3.2 then move on to sub clauses as needed.
6. Jason brings up that his initial proposal was to add wording at the end of the paragraph for clarity.
    a. Dinesh reminds that Correction factors need to be applied to measured value
        i. Juan Castellanos (Prolec GE) asks if it is the practice for manufacturer to show the measured value, correction factor, and final corrected value on test reports.
            1. Not standardized within industry how they are presented
7. Jason states his initial intent was to tie C57.12.90 to C57.12.00 test reporting TOR. Without statement nothing to tie it back to TOR. He wants to ensure there is no grey area.
8. Tim Raymond Motions to add sentence add end of paragraph
    a. Proposed Text: *The final liquid temperature rise, shall be taken, at the end of the total loss run, and shall not be averaged over time.*
    b. Jason seconds if we add "The" at the beginning of sentence.
    c. Dennis Marlow asks for clarification of where the sentence will be added.
    d. Dinesh Confirmed it would be at end of first paragraph of 11.3.2.
    e. Dennis Marlow asks to strike the word "final" from the proposed text. Concerns over consistency with other standards and how the word "final" could be interpreted.
    f. After some discussion a second motion to edit the proposed first motion text was made.
9. Bruce Forsyth adds motion: Strike "taken" and replace with "the final temperature rise measured"
    a. Bruce – Calls for motion and wants to get second

b. Sheldon Kennedy – Seconds motion
c. John K John - suggests below
d. Motion 1
    i. Slight modification to Tim's initial proposed statement
    ii. "The final liquid temperature rise shall be ~~taken~~ the ~~final~~ liquid temperature measured at the end of the total loss run and shall not be averaged over time"
    iii. This will be added to end of first paragraph of 11.3.2
    iv. Juan Castellanos suggested it should say "liquid temperature Rise".
    10.
a. Motion 2: (to propose word changes in Motion 1)
    i. Bruce - Add "Rise" after temperature, per Juan's suggestion
    ii. "The final liquid temperature rise shall be ~~taken~~ the ~~final~~ liquid temperature Rise measured at the end of the total loss run and shall not be averaged over time"
    iii. Sheldon agrees with above

11. Motion 2 Vote
    a. Results
        i. For = 25
        ii. Against = 1
        iii. Abstain = 2
        iv. No Answer = 10
12. Motion 1 Vote
    a. Results
        i. For = 24
        ii. Against = 1
        iii. Abstain = 4
        iv. No Answer = 9
13. Dinesh calls for new Business
    a. Bertrand Poulin
        i. C57.12.119-2018 guide for overload tests
        ii. Shows typical profile, with differences in top oil temperature for OFAF and OFWF compared to ONAN and ONAF
        iii. Later in document shows calculations for difference, but in 12.90 there is not mention of the differences
        iv. Propose to ensure 12.90 makes this reference to difference between OFAF and others.
14. Motion to Adjourn
    a. John K. John
    b. Sam Sharpless seconds
15. Meeting concluded at 6:29 pm

Based on the Task Force's discussions, Dinesh Sankarakurup made a motion to consider amending clause:

11.3.2 Liquid Temperature Rise Determination

Liquid temperature rise is the difference between the liquid temperature and ambient temperature. The ultimate liquid temperature rise above ambient shall be considered to be reached when the top liquid temperature rise does not vary more than 2.5% or 1°C, whichever is greater during a consecutive 3-h period. The final liquid temperature rise shall be the liquid temperature rise measured at the end of the total loss run and shall not be averaged over time.

David Wallach seconded the motion. After further discussion of the proposed wording, the motion was withdrawn to be further worked on by the Task Force.

H.4.1.8 Task Force C57.12.00 Clause 5.11.1.4, Rises of Metallic Parts Other than Windings – Toby Johnson

Task Force discussions recommend adding text to clarify Clause 5.11.1.4 as:

5.11.1.4 Rises of Metallic Parts Other than Windings

Metallic parts in contact with current-carrying conductor insulation shall not attain a temperature rise in excess of the winding hottest-spot temperature rise.

The core hot spot temperature shall be limited to 130°C for the condition of highest core over-excitation, rated load, and the maximum average daily ambient temperature for transformers filled with mineral oil. For example, if the average daily temperature is 30°C, the core hot spot temperature rise shall be limited to 100°C for the condition of highest core excitation. This is to avoid the problem of gas generation in the core caused by thermal breakdown of the thin film between the core laminations. Under the same operating conditions, the core surface temperatures shall be limited by the temperature capability of the insulation materials in contact with the core surfaces.

Metallic parts other than those previously described shall not attain excessive temperature rises at maximum rated load. Excessive temperature rise shall be interpreted to mean a temperature rise that results in an operating temperature that would exceed the temperature limits of the insulation material that is in contact with the metallic part.

Toby Johnson made a motion to amend clause 5.11.1.4 as stated above. Jeff Ray seconded the motion. With no objections, the motion carried.

H.4.1.9 Liaison Report

Liaison report for Volts/Hz Task Force presented by Jeff Ray.

The Volts/Hz Task Force met on April 27th. They agreed on wording to be sent to C57.116 Working Group for discussion of volts/hz effects on transformers on generator trip and coast down. The current wording needs to be expanded. Dr. Ramsis Girgis made a presentation focusing on the volts/hz capability during the first two minutes of coast down. Further work is needed to develop a methodology and parameters to develop such a curve for transformers. The Volts/Hz Task Force will continue to work on this effort reporting to the Power Transformer Subcommittee.

H.5 Old Business

The Chair reported to the subcommittee that he was unable to execute a motion passed at the last committee meeting, "To approve the establish a taskforce under IEEE 1276 WG to investigate the addition of new material to an existing Annex in 1276 and to develop a PAR for the amendment", because there was no active IEEE 1276 working group. The chair asked for a valid replacement motion and some alternatives were discussed. Ultimately, Alan Sbravati made the following motion "To form a Task Force to consider amendment of IEEE 1276 annex B and develop a corresponding PAR, if merited." The motion was seconded by Marcos Ferreira. With no objections, the motion was approved. After the meeting, the Chair appointed Kevin Biggie to lead this Task Force.

H.6 New Business

There was no new business items discussed.

H.7 Adjournment

Toby Johnson made a motion to adjourn the meeting. The motion was seconded by Marcos Ferreira. There were no objections to adjournment. The meeting was adjourned at 9:20AM.

Attendance Roster

Last Name	First Name	Role	Company
Adams	Kayland	Guest	
Arnold	Elise	Guest	SGB-SMIT Group
Arteaga	Javier	Member	ABB Enterprise Software Inc
Avanoma	Onome	Member	Transformer Consulting Services Inc.
Ayers	Donald	Member	Ayers Transformer Consulting
Ballard	Robert	Member	DuPont
Bargone	Gilles	Member	FISO Technologies Inc.
Barrientos	Israel	Guest	Prolec GE
Baumgartner	Christopher	Guest	We Energies
Beaster	Barry	Member	H-J Enterprises, Inc.
Beauchemin	Claude	Member	TJH2b Analytical Services
Benzler	Olle	Guest	
Biggie	Kevin	Member	Weidmann Electrical Technology
Bishop	Ryan	Guest	Minnesota Power
Blackburn	Thomas	Guest	Gene Blackburn Engineering
Blaydon	Daniel	Guest	
Boettger	William	Member	Boettger Transformer Consulting LLC
Bolliger	Alain Dominique	Guest	
Bonn	Mike	Guest	Soltex Inc.

Bradshaw	Jeremiah	Guest	
Brown	Darren	Guest	Howard Industries
Calitz	David	Guest	Siemens Energy
Carrizales Baaldua	Juan Alfredo	Guest	
Casserly	Edward	Member	Ergon, Inc.
Castellanos	Juan	Member	Prolec GE
Chambers	Stuart	Member	Powertech Labs Inc.
Cheim	Luiz	Member	Hitachi ABB Power Grids
Chiang	Solomon	Member	The Gund Company
Chrysler	Rhett	Guest	ERMCO
Crouse	John	Guest	Roswell Alliance
Davis	Eric	Guest	Burns & McDonnell
De Oliveira	Everton	Member	
Denzer	Stephanie	Guest	Alliant Energy
Dillon	Nik	Guest	
Digby	Scott	Member	Duke Energy
Dix	Larry	Guest	Quality Switch, Inc.
Doak	Eric	Guest	D4EnergySolutions LLC
Dorris	Don	Guest	Nashville Electric Service
Downey	Andy	Guest	
Dulac	Hakim	Guest	Qualitrol Company LLC
Eagle	Tommy	Guest	
Espindola	Marco	Guest	ABB Enterprise Software Inc.
Fenton	Roger	Guest	
Ferreira	Marcos	Member	Advisian-Worley Parsons
Florida	Paul	Guest	
Forsyth	Bruce	Member	Bruce Forsyth and Associates LLC
Foschia	John	Guest	
Franchek	Michael	Guest	Retired
Franchitti	Anthony	Guest	PECO Energy Company
Frazier	Curtiss	Guest	
Frimpong	George	Member	Hitachi ABB Power Grids
Frotscher	Rainer	Guest	Maschinenfabrik Reinhausen
Garcia	Eduardo	Member	
Gardner	James	Guest	SPX Transformer Solutions, Inc.
Gaytan	Carlos	Guest	Prolec GE
Giraldo	Orlando	Guest	
Gossett	Shawn	Guest	

Gragert	Jeff	Guest	
Graham	James	Member	Weidmann Electrical Technology
Gray	Taylor	Guest	
Griesacker	Bill	Member	Duquesne Light Co.
Guner	Ismail	Guest	Hydro-Quebec
Gyore	Attila	Member	M&I Materials Ltd
Hampton	Kenneth	Guest	Baltimore Gas & Electric
Hanson	David	Guest	TJH2b Analytical Services
Hartmann	Thomas	Member	
Hayes	Roger	Member	General Electric
Heiden	Kyle	Guest	EATON Corporation
Hernandez Cano	Sergio	Guest	Hammond Power Solutions
Hoffman	Gary	Member	Advanced Power Technologies
Hoffman	Saramma	Member	PPL Electric Utilities
Holden	Andrew	Guest	Ergon, Inc.
Hollrah	Derek	Guest	Burns & McDonnell
Hopkinson	Phillip	Guest	
Jalhoum	George	Guest	PPL Electric Utilities
Jarman	Paul	Guest	University of Manchester
Jensen	Nicholas	Guest	
John	John	Member	Virginia Transformer Corp.
Johnson	Toby	Guest	
Jordan	Stephen	Member	Tennessee Valley Authority
Joshi	Akash	Member	Black & Veatch
Kadar	Laszlo	Guest	Hatch
Kaineder	Kurt	Member	Siemens Energy
Kell	Megan	Guest	
Kennedy	Sheldon	Member	Niagara Transformer
Kennedy	Gael	Member	GR Kennedy & Associates LLC
Kessler	Stacey	Member	Basin Electric Power Cooperative
King	Gary	Guest	Howard Industries
Kinner	Robert	Guest	FirstPower Group LLC
Kiparizoski	Zan	Member	Howard Industries
Kirchenmayer	Egon	Member	Siemens-Energy
Klein	Ken	Guest	
Kleine	Peter	Guest	US Army Corps of Engineers
Klempner	Dmitriy	Guest	
Kutzleb	Michelle	Guest	

Lamontagne	Donald	Guest	Arizona Public Service Co.
Larison	Andrew	Guest	Hitachi ABB Power Grids
Lee	Moonhee	Member	Hammond Power Solutions
Levin	Aleksandr	Member	Weidmann Electrical Technology
Li	Yaquan (Bill)	Guest	BC Hydro
Li	Weijun	Member	Braintree Electric Light Dept.
Locarno	Mario	Member	Doble Engineering Co.
Lucas	Tiffany	Guest	SPX Transformer
Macias	Alejandro	Guest	
Malde	Jinesh	Vice Chair	M&I Materials Inc.
Mani	Balakrishnan	Guest	Virginia Transformer Corp.
Mani	Kumar	Member	Duke Energy
Marek	Richard	Member	Retired
Marlow	Dennis	Guest	DenMar TDS Transformers
McNelly	Susan	Member	Xcel Energy
Mehrotra	Vinay	Member	SPX Transformer Solutions, Inc.
Millard	Zach	Guest	
Minhaz	Ronnie	Guest	
Montpool	Rhea	Guest	Schneider Electric
Morakinyo	Paul	Guest	PSE&G
Murray	David	Member	Tennessee Valley Authority
Musgrove	Ryan	Guest	Oklahoma Gas & Electric
Nambi	Shankar	Member	Bechtel
Natale	Anthony	Guest	HICO America
Neild	Kristopher	Guest	Megger
Nunes	Jayme	Guest	
O'Malley	Anastasia	Secretary	Consolidated Edison Co. of NY
Panesar	Parminder	Guest	Virginia Transformer Corp.
Parkinson	Dwight	Member	
Patel	Nitesh	Guest	Hyundai Power Transformers USA
Patel	Rakesh	Guest	
Patel	Moni	Guest	
Patel	Poorvi	Member	Electric Power Research Institute (EPRI)
Penny	Brian	Guest	American Transmission Co.
Ploetner	Christoph	Guest	Hitachi ABB Power Grids
Pointner	Klaus	Member	Trench Austria GmbH
Powell	Chris	Guest	Intermountain Electronics
Prevost	Thomas	Member	Weidmann Electrical Technology

Prince	Jarrod	Guest	ERMCO
Quispe Cuadrado	Lesther Alex	Guest	EATON Corporation
Rapp	Kevin	Member	Cargill, Inc.
Rasco	Jimmy	Member	
Ray	Jeffrey	Member	JLR Consulting, Inc.
Raymond	Timothy	Guest	Electric Power Research Institute (EPRI)
Reagan	John	Guest	Oncor Electric Delivery
Rebman	Larry	Guest	
Reed	Scott	Guest	MVA
Reeder	Perry	Guest	
Reiss IV	Clemens	Guest	Custom Materials, Inc.
Rocque	Tim	Guest	SPX Transformer Solutions, Inc.
Roy	Samragni Dutta	Guest	
Polo	Rodriguez	Guest	
Roizman	Oleg	Guest	IntellPower Pty Ltd
Saad	Mickel	Member	Hitachi ABB Power Grids
Sanchez	Albert	Guest	Knoxville Utilities Board
Sankarakurup	Dinesh	Guest	Duke Energy
Sarkar	Amitabh	Member	
Sauls	Roderick	Guest	Southern Company Services
Sawant	Anil	Guest	
Sbravati	Alan	Member	Cargill, Inc.
Schappell	Steve	Guest	
Schiessl	Markus	Guest	SGB
Schindler	Stefan	Guest	
Schleismann	Eric	Guest	Southern Company Services
Schneider	Jeffrey	Guest	EATON Corporation
Schwartz	Dan	Guest	Quality Switch, Inc.
Schweiger	Ewald	Member	Siemens Energy
Sen	Cihangir	Guest	Duke Energy
Shalabi	Jaber	Guest	
Sharma	Devki	Guest	Entergy
Sharpless	Samuel	Chair	Rimkus Consulting Group
Shertukde	Hemchandra	Member	University of Hartford
Shingari	Avijit	Guest	
Siebert-Timmer	Audrey	Guest	IFD Corp
Sinclair	Jonathan	Guest	PPL Electric Utilities
Skinger	Kenneth	Guest	Scituate Consulting, Inc.

Slattery	Christopher	Guest	FirstEnergy Corp.
Sparling	Brian	Guest	
Staley	Brad	Member	
Stankes	David	Guest	3M
Stechschulte	Kyle	Guest	American Electric Power
Steel	Hampton	Guest	
Steineman	Chris	Guest	
Suresh	Babanna	Member	Southwest Electric Co.
Sweetser	Charles	Guest	
Szczechowski	Janusz	Member	Maschinenfabrik Reinhausen
Tanaka	Troy	Member	Burns & McDonnell
Taylor	Marc	Guest	Cogent Power Inc.
Thompson	Jim	Guest	
Tostrud	Mark	Member	Dynamic Ratings, Inc.
Traut	Alan	Member	
Varghese	Ajith	Member	SPX Transformer Solutions, Inc.
Varnell	Jason	Member	Doble Engineering Co.
Verdell	Joshua	Guest	ERMCO
Verdolin	Rogerio	Member	Verdolin Solutions Inc.
Vijayan	Krishnamurthy	Guest	PTI Transformers
Vir	Dharam	Member	SPX Transformer Solutions, Inc.
Vo	Duy	Guest	Central Maine Power (AVANGRID)
Vyas	Pragnesh	Guest	Sunbelt-Solomon Solutions
Wagenaar	Loren	Guest	WagenTrans Consulting
Waldrop	Mike	Guest	
Walia	Sukhdev	Member	New Energy Power Co.
Wallach	David	Member	Duke Energy
Walters	Shelby	Guest	Howard Industries
Wang	Evanne	Guest	DuPont
Warntjes	Michael	Guest	American Transmission Co.
Washburn	Alan	Guest	Burns & McDonnell
Webb	Bruce	Guest	Knoxville Utilities Board
Welton	Drew	Guest	Intellirent
Werelius	Peter	Guest	
Whitehead	William	Member	
Wicks	Roger	Member	DuPont
Williams	Trenton	Guest	Advanced Power Technologies
Yang	Baitun	Member	

Zanwar	Anand	Guest	
Zhao	Peter	Member	Hydro One
Zibert	Kris	Guest	Allgeier, Martin and Associates
Ziomek	Waldemar	Guest	PTI Transformers

Respectfully submitted,

Anastasia O'Malley
Secretary, Insulation Life Subcommittee