

## **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  
Chair: 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, Samraghi 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 Szweczyk 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.

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

**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.
Samraghi	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

Jarrold	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