IEEE PES TRANSFORMERS COMMITTEE

DIELECTRIC TEST SUBCOMMITTEE

The meeting was held at the Hyatt Regency, Vancouver, BC, Canada

Dielectric Tests Subcommittee		
Chair: Poorvi Patel	**Vice-Chair: Thang Hochanh**	**Secretary: Diego Robalino**
Room: Regency C/D	**Date:** Wednesday, March 13, 2024	**Time:** 11:00 am to 12:15 pm
Total DTSC Members: **154**	Members present at the meeting: **96**	Attendance according to sign in sheet: **196**
Guests present: **100**	Membership requested: **7**	Membership accepted: **6**
Members moved to Guest Status: **0**		

Chair's Remarks

The SC Secretary welcomed members and guests to the spring 2024 meeting in Vancouver, BC. In absence of SC Chair, SC Vice-Chair leads the session briefly introducing the agenda for today's meeting. Explanation about the roaster sheet provided to review e-mail address and provide any corrections to update the attendance list.

First, SC Secretary reviewed policies and procedures according to IEEE SA. Stated the need to identify potential essential patent claims. DTSC members and guests are reminded to inform SC Chair, SC Secretary or IEEE SA representative for our SC (Patrycja Jarosz, +19087268288, p.jarosz@ieee.org) of potential patent claims. Copyright policies, participation behavior, compliance with all applicable laws, including antitrust and competition laws.

It was requested to all attendees to approach the microphone for questions and comments during the meeting stating name and affiliation.

Future events:

2024 IEEE PES- T&D	May 6-9, Anaheim, CA
IEEE PES General Meeting	July 21-25, Seattle, WA
IEEE DEIS EIC 2024	June 2 – 6, Minneapolis, MN
IEEE PES Transformer Committee Meeting Fall 2024	**October 27-31, St Louis, MO**
IEEE PES Transformer Committee Meeting Spring 2025	March 23-27, Denver, CO

Next, SC Vice-Chair requested all TF and WG leaders to submit minutes on or before March 27th, 2024 including revised and updated attendance list. The information to be sent to SC Secretary via e-mail

(diego_robalino@ieee.org). The information must be consolidated and submitted to the Main Committee by April 15, 2024. Also, a reminder was made for any online meeting happening in-between the in-person meetings also should keep a recorded attendance and minutes.

- **ADCOM highlights**

Patrycja Jarosz - Standards Program Coordinator for the DTSC is looking after any questions related to PAR generation or extensions. Her contact information was provided for guests and members if questions arise.

Regarding WG and SC officer Training, it has become optional but highly recommended. IEEE SA's Antitrust, Competition, and Commercial Terms Policies remain mandatory. Standards Committee/Working Group Officers to complete within 90 days of appointment.

Training link: https://iln.ieee.org/Public/ContentDetails.aspx?id=AE404C2328DA4A39AAD7AB5117681F05

- **Optional** training that all current and future officers need to complete
- **Mandatory-** IEEE SA's Antitrust, Competition, and Commercial Terms Policies training shall be performed after appointment
    - Standards Committee/Working Group Officers within 90 days of appointment
    - Training is on demand
- **Recommend everyone to go through the training**

Regarding **'Memberplanet'** – No update and we continue manually recording attendance in our meetings.

The SC Vice-Chair indicated that all WG and TF leaders are requested to send the list of members or non-members to Patrycja to be updated in **MyProject**.

There is a new process for WGs to request an IEC standard using the IEC website and the link IEC Products & Services Portal (iec.ch) website.

- **Status of Active Standards**

Project	Title	Valid until	PAR Status
C57.127	Guide for the Detection of Acoustic Emissions from Partial Discharges	2028	WG Active (as stated during the meeting by Detlev Gross)
C57.160	Guide for the Elec. Measurement of PD in HV bushings and Instrument Transformers	2020	PAR 2023 Publishing process
C57.113	Recommended practice for PD Measurement Power	**2034**	**WG Inactive Published**
C57.98	Guide for Transformer Impulse Tests	2021	PAR 2024 extension granted (2 years)

C57.138	Recommended Practice for Routine Impulse Tests for Distribution Transformers	2026	PAR 2026
C57.161	Guide for DFR Measurements	2028	WG Inactive. TF Initiated
C57.168	Low-Frequency Test Guide	**2034**	**WG inactive.** **Published**
C57.12.200	Bushing Dielectric Frequency Response Guide (ENTITY WG)	2032	WG inactive

Next, NesCom/RevCom meeting dates and deadlines were reviewed.

Standard Board Meeting	**Submittal Deadlines**
19th – 20th of March 2024	09th of February 2024
06th May of 2024	**16th of April 2024**
05th of June 2024	

SC Secretary's Report

SC Secretary requested unanimous approval to record the meeting for the sole purpose of minutes reporting. None are against it, and the meeting is recorded (only voice no video).

- Total Attendees to DTSC F23 meeting: **220**
  - Total Members attended: **109** (out of 175)
- Requested Membership: **18**
  - Rejected Membership: **8**
  - Approved Membership: **10**

FIRST NAME	LAST NAME
Camilo	Casallas
Marco	Espindola
Miguel	Garcia
Fernando	Leal
Juliano	Montanha
Khan	Qasim
Rodrigo	Ronchi

Kushal	Singh
Matthew	Sze
Barrett	Wimberly

- Change Status Member to Guest due to no compliance with membership attendance requirements: **35**
    - Membership to DTSC was reviewed 2 out of 3 or 3 out of 5. The same applies to keep member status in the SC.
- **Total Members for Fall 2023 meeting: 154**

A list of members was presented to the audience to establish a quorum during this meeting. Looking at the list of members, we requested to stand up for headcount.

The headcount was completed with over **90** members attending the meeting. **Therefore, the quorum was achieved.** The final review will be carried out against roster signatures.

Secretary addressed a previous question from Sanjib Som requesting clarification on the SC membership. For clarity of the SC guests and members the link to the Technical Committee Policies and Procedures was provided:

https://grouper.ieee.org/groups/transformers/info/TC-PP-2-11-2019.pdf

4.3.1 Requirements for Voting Members

These requirements do not apply to ex-officio voting members.

A voting member of the Sponsor, or a Responsible Subcommittee is required to attend 3 of the last 5 meetings.

Requirements for attaining and continuing membership include the following:

a) Being a member in good standing of the IEEE Power & Energy Society (IEEE-PES) and IEEE Standards Association (IEEE-SA).
b) Contributing regularly as a member of a Responsible Subcommittee and Working Group(s) during a two-year period.
c) Being willing to devote time and effort to contribute to the advance of the art by:
    1. For Sponsor membership, regular attendance at Sponsor meetings and participation at the Subcommittee and Working Group level.
    2. For Responsible Subcommittee membership, regular attendance at Responsible Subcommittee meetings and participation at the Working Group level.
    3. Continued participation in Sponsor functions such as serving as an officer, liaison representative, Responsible Subcommittee member, or Working Group member.
    4. Membership in the IEEE Standards Association (IEEE-SA).
d) When a voting member is absent for more than two consecutive scheduled regular meetings and fails to participate by correspondence, the voting member may be removed from Sponsor or Responsible Subcommittee membership, subject to a review of the circumstances by the respective committee officers

- **Quorum, Approval of Minutes, and Agenda**

Once quorum was established, SC Vice-Chair requested a motion to approve the agenda:

- Motion by Sanjib Som, second Evgenii Ermakov
- No objection to the unanimous approval of the agenda hence approved.

Chairperson requested a motion to approve the Fall 2023 minutes from Kansas City meeting:

- Motion by Evgenii Ermakov, second David Wallace
- No objection to the unanimous approval of the agenda hence approved.

Attendance Summary

	By Roster
Total Attendees	196
Total # Of Members	154
Members Present	96
Quorum Present	**YES (62.3%)**

SC Discussions and Motion passed.

New Business: No New business discussed

Old Business: No old business

Taskforce and Working Group Reports

Reports are in the order presented during the meeting

TF Core Ground and Winding Insulation Resistance

Chair: Diego Robalino

Secretary: Aniruddha Narawane

Monday, March 11, 2024. Hyatt Regency, Vancouver, BC – Georgia A/B
(2) 11:00am – 12:15pm

Minutes prepared by Aniruddha Narawane, Secretary

- Meeting called to order by the chair at 11:00
- Patent claims and copyright shown – no issues or questions were raised.
- No Quorum
- Eduardo Tolcachir presented the data. A question was asked about the duration of test for the data presented.
- There were discussions around the data shared, significance of consistency in test voltage and connections. Chair explained the necessity of consistency in connection type during testing and test voltage with reference to data examples.
- A question was asked if there is value in doing both IR and PF test- at Factory.
- Various sections containing parameters impacting the Insulation resistance were formed and chair requested for volunteers to provide data with reference to the parameters and perform analysis on the data.
- Volunteers:
- Section I
    - Marcos Ferreira
    - Zach Weiss
- Section II
    - Mario Alonso
    - Zach Weiss
    - Jesse Duffy
- Section III
    - Ali Nadarien
- Section IV
    - Ajith Varghese
    - Sanjib Som
    - Fernando Miguel Leal Ramirez
    - Jean Carlos Hernandez

- Jesse Duffy

- Meeting was adjourned at 12.15.
- Roaster Attendance Record
  - Total Guests & Members attendence = 81
  - Total Members = 51
  - Total attending members = 19
  - Requested Membership = 10

Sr. No.	Last Name	First Name	Email	S22 - Denver	F22- Charlott
3	Aikons	Tom	tom-aikons@vantransformer.com		
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77	Leal	Fernando	ferleal@gmail.com		
113	Patel	Dipeshkumar	27dipesh@gmail.com		
137	Shaikh	Abdulmajid	ashaikh@deltastar.com		
150	Staley	Brad	brad.staley@leewardenergy.com		
168	Van Dreel	Cole	cvandreel@atclk.com		
175	Vyas	Pragnesh	pragnesh.vyas@sunbeltsolomon.com		

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TF Revision to Low Frequency Dielectric Tests

Vancouver, BC, Canada Meeting – March 12, 2024 1:45-3:30pm PDT

Chair: Ajith Varghese

Vice Chair: Markus Schiessl

Secretary: Jason Varnell

1. The meeting was called to order at 1:45 PM.

2. 97 individuals were in attendance. A quorum was achived with 33 of 48 total members present. 17 individuals requested membership; however, only 13 were given member status based on attendance and participation and will be added after the S24 meeting. 3 Members that were not present had missed 2 out of the last three meetings and will be moved to guest after the S24 meeting, which means there will be 58 members.
3. A motion was made by Steve Antosz (Stephen Antosz and Associates) and seconded by Fernando Leal (Prolec-GE) to approve the Spring 2024 meeting agenda. There were no objections to unanimous approval of the agenda. A motion was made by Kris Zibert (Allgeier, Martin and Associates) and seconded by Onome Avanoma (MJ Consulting) to approve the fall 2023 task force meeting minutes. There were no objections to unanimous approval of the fall 2023 task force meeting minutes.

4. PD in Bushings During Factory Testing

    a. The chair reviewed the history of the topic and the October 30, 2023 dielectric test sub-committee survey results. The survey returned with 82% approval rate. The survey results were as follows:

        i. Approved, No comments: 31

        ii. Approved with comments: 9

        iii. Disapproved: 7

        iv. Abstain: 2

    b. The chair provided a summary of each negative comment and opened the floor for discussion on each.

        i. Discussion on Note 1 of the surveyed text: There was discussion on the term “partial vacuum” since one Egon Kirchenmayer stated that his experience indicates that the bushings are “under pressure”. There was some disagreement in which term best describes the conditions and therefore it was suggested to modify the text using “and/or” conditions instead of only “or” conditions. A vote was taken with the modified text. There were 18 in favor for modify Note 1 with the “and/or” statement. There

were zero against and zero abstentions. The revised note will remain in the document.

ii. Discussion on Note 3 of the surveyed text: Negative survey comments wanted Note 3 to be deleted. Additionally, it was requested to clarify the term “parties”. It was agreed to replace the term “parties” with “manufacturer and purchaser.” There was a vote by task force members on whether or not to keep the revised note. 14 voted in favor of keeping the revised text, 0 voted in deleting the text and 4 abstained. The revised text will remain. Later, additional discussion came up regarding Note 3, in which it was observed that the note was actually normative since it gave requirements by using the term “shall”. The task force then voted 18 in favor of moving Note 3 out of the notes section and into the normative text of Subclause 10.8.5. There was 1 vote against and 0 abstention votes.

iii. Discussion on Note 4 of the surveyed text: One of the negative SC survey comments requested to delete the note since it was argued that the bubble formation is part of the physics of OIP bushings and is not design factor. Another person stated that not all OIP bushings have issues with bubble formation. There were 18 in favor for keeping Note 4. There was one for removing it and zero abstentions. The note will remain.

iv. Discussion on Note 5 of the surveyed text: One of the negative SC survey comments requested to delete the note since the field condition is not the same as the factory acceptance test condition. There were 21 in favor for keeping Note 5. There zero for removing it and zero abstentions. The note will remain.

v. Discussion on Note 6 and 7 of the surveyed text: It was stated that Note 7 should be deleted since it was referring to the temperature rise test and “other tests”; however, this note is only in the induced voltage test Subclause and therefore will have little meaning or usefulness. Additionally, it was noted that leaving bushings unsealed during factory acceptance testing is not a practice allowed by bushing suppliers, and the note also had some redundancy with note 6. There were 23 in favor for deleting Note 7 and keeping Note 6 as-is. There were zero for keeping Note 7 and deleting Note 6. There were zero abstentions. The Note 7 will be deleted and Note 6 will be retained.

vi. Dan Suer (Eaton Corporation) made a motion to take the revised text (copied below) to the dielectric tests subcommittee for a vote to later add it to C57.12.90. Detlev Gross (Power Diagnostix) seconded the motion. The motion passed with unamious approval.

If the partial discharge is measured during the Induced-voltage testing of the transformer and is suspected to be generated within an OIP (oil-impregnated-paper) bushing(s), it is permissible to “vent” the bushing(s) exhibiting partial discharge to the atmosphere using the bushing manufacturer’s instructions.

Unless agreed between manufacturer and purchaser, bushings shall not be vented proactively prior to dielectric testing. The Induced-voltage test shall be entirely repeated after venting the bushing and a note shall be added to the certified test report indicating bushing(s) were vented during the induced-voltage test.

Notes:

1) Partial discharge intended to be addressed by venting the bushing, is a low energy discharge arising from partial vacuum (pressure below atmosphere) created in the expansion chamber and/or gas bubbles generated during the Temperature Rise test and the cooling down afterwards. Partial vacuum is created in the expansion chamber due to absorption of nitrogen or air into oil, and gas bubbles are formed due to saturation of nitrogen or air. Partial discharges from these cases may be resolved by venting the bushing. If continuous gas bubble generation or elevated partial discharge remains after the venting, additional investigations are required.

2) If there are concerns of gas generation from the temperature rise test causing bushing failure during impulse or applied voltage test, an induced-voltage test can be performed before impulse testing for diagnostic purposes. A complete induced-voltage test shall be performed as the last dielectric test, as specified in subclause 10.1.5.1 for dielectric test sequence.

3) Not all OIP bushings exhibit these conditions, so bushing design can be a factor.

4) The same condition of gas bubble formation or partial vacuum may occur in service during normal operation of load and overload cycles.

5) Re-establishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer's instructions. The internal integrity of the bushing may be compromised by venting, by allowing in oxygen and moisture or by not reestablishing proper conditions.

5. Task Force on PD Testing of Class 1 Power Transformers – Don Ayers

    a. The Task Force did not meet in person during the week of the Spring 2024 IEEE Transformers Committee meeting.

    b. Don Ayers (Consultant) presented to the RLFT TF that the task force on PD testing of Class I Power Transformers agreed to a final draft for proposed changes to C57.12.00 and C57.12.90. Don Ayers made a motion to survey the proposed

changes to C57.12.00 and C57.12.90 for partial discharge testing of Class I power transformers to the RFLT and dielectric tests subcommittee. Detlev Gross (Power Diagnostix) seconded the motion. The motion passed with unamious approval. Text to be surveyed is in Appendix A.

6. Task Force on PD Testing and Limits for DTR, Wind and Solar transformers

    a. Due to a lack of time in the RLFT, this task force gave a brief update of the work performed by their task force. Minutes from task force meeting are in Appendix B. The chair discussed the objectives of the task force, which included:

        i. What is an accurate simulation and/or appropriate voltage level for transformers subjected to these applications which are built by distribution transformer manufacturers.

        ii. Review studies done by end users on voltage levels in alternative energy applications

        iii. Consult with Photo Voltaic and Wind inverter manufacturers on overvoltage recommendations.

        iv. Depending on what is determined to be the appropriate test voltage, should transformer component manufacturers design components to pass at these levels or should they be bypassed for testing? Bypassing components takes time in distribution transformer factories that are building hundreds of units a day.

        v. Is there a correlation to PD/Local Corona inherent in specific component use?

        vi. What is the method/Process for performing a PD test on a typical Distribution class transformer?

        vii. Consistency in test types - Design vs Other (user specified) test

    b. Several members of the attendance shared their opinion that the test should be a routine test for the Solar and Wind transformers, however it was shared by some manufacturers that this would have a considerable impact on the production cycle time, since the test would take a considerable amount of time.

    c. It was also mentioned that we need to equalize the methods and limits between the several standard applicable to this test, because as of right now, they are not aligned.

7. Old business

    a. The previous topic of contradictions within C57.12.90 and C57.12.00 related to the induced voltage test overvoltage factor was briefly discussed. The proprosed changes was displayed and briefly summarized by Jason Varnell (Doble

Engineering). Jason Varnell will send a survey to the RLFT TF for comments prior to the F24 RLFT TF meeting.

8. New business

    a. There was no new business.

9. The meeting was adjourned at 2:15 p.m. The next meeting will be in St. Louis, Missouri, USA at the Fall 2024 IEEE Transformers Committee Meeting.

Attendance Record

Role	First Name	Last Name	Company
Guest	Kayland	Adams	Prolec-GE Waukesha
Guest	Nabi	Almeida	Prolec-GE
Member	Stephen	Antosz	Stephen Antosz & Associates, Inc
Member	Elise	Arnold	SGB
Member	Javier	Arteaga	Hitachi Energy
Member	Onome	Avanoma	MJ Consulting
Member	Donald	Ayers	Ayers Transformer Consulting
Guest	Wallace	Binder	WBBinder Consultant
Member	Daniel	Blaydon	Baltimore Gas & Electric
Member	William	Boettger	Boettger Transformer Consulting LLC
Member	Alain	Bolliger	HV TECHNOLOGIES, Inc.
Member	Dominique	Bolliger	HV TECHNOLOGIES, Inc.
Guest	George	Bouty	Delta Star Inc.
Member	Jeffrey	Britton	Phenix Technologies, Inc.
Guest	Juan	Carrizales	Prolec GE
Guest	Eric	Davis	Consultant
Guest	Reto	Fausch	RF Solutions
Guest	Joseph	Foldi	Foldi & Associates, Inc.
Member	Raymond	Frazier	Ameren
Member	Rich	Frye	Eaton
Guest	Eduardo	Garcia Wild	Siemens Energy
Guest	Alexander	Gaun	Coil Innovation GMBH
Guest	Carlos	Gaytan	Prolec GE
Guest	Alireza	Gorzin	Black & Veatch
Member	Bill	Griesacker	Consultant
Member	Detlev	Gross	Power Diagnostix Consult GmbH
Guest	Peter	Heinzig	Weidmann Electrical Technology
Member	Sergio	Hernandez Cano	Hammond Power Solutions
Guest	Gary	Hoffman	Advanced Power Technologies

Member	Sramma	Hoffman	P&L
Member	Philip	Hopkinson	HVOLT Inc.
Guest	Chanmin	Jeong	HD Hyundai
Guest	Sheldon	Kennedy	Niagara Transformer
Member	Stacey	Kessler	ULTEIG ENGINEERS
Guest	Yeounsoo	Kim	MEPPI
Member	Egon	Kirchenmayer	Siemens Energy
Guest	Evan	Knapp	Eaton
Guest	Mathieu	Lachance	Omicron
Member	Mark	Lachman	Doble Engineering Co.
Guest	Andrew	Larison	Hitachi Energy
Member	Fernando	Leal	Prolec GE
Guest	Junho	Lee	HD Hyundai
Guest	Moonhee	Lee	Hammond Power Solutions
Guest	Samuel	Lewis	Hitachi Energy
Guest	Eric	Li	BC Hydro
Member	Gabriel	Mamede	Siemens Energy
Guest	Alberto	Martinez	WEG USA
Guest	James	McBride	JMX Services, Inc.
Member	Francis	Mills	Power Engineers
Member	Juliano	Montanha	Siemens Ltda
Member	Marta	Munoz	Hitachi Energy
Guest	Ali	Naderian	Metsco
Guest	Cuauhtemol	Ortiz	Power Transf
Guest	George	Partyka	PTI Transformers
Member	Monil	Patel	Pacific Gas & Electric Company
Member	Harry	Pepe	Phenix Technologies, Inc.
Member	Sylvain	Plante	Hydro-Quebec
Guest	Bertrand	Poulin	Hitachi ABB Power Grids
Guest	Ulf	Radbrandt	Hitachi ABB Power Grids
Guest	Juan	Reyes Perez	Hitachi Energy
Guest	Michael	Richardson	Ameren
Guest	Tim	Rocque	Prolec GE Waukesha
Member	Rodrigo	Ronchi	WEG-Voltran
Member	Hakan	Sahin	Virginia and Georgia Transformers
Member	Amitabh	Sarkar	Virginia Transformer Corp.
Guest	Gavret	Sarkinen	Exel Energy
Member	Daniel	Sauer	EATON Corporation
Vice-Chair	Markus	Schiessl	SGB
Member	Eric	Schleismann	Southern Company Services
Guest	Harmanseet	Selchon	PTI Transformers
Guest	Cihangir	Sen	Duke Energy

Guest	Aron	Sexton	Kinectrics
Member	AbdulMajid	Shaikh	Delta Star Inc.
Guest	Jaber	Shalabi	VanTran Industries, Inc.
Guest	Hemchandra	Shertukde	University of Hartford
Member	Christopher	Slattery	FirstEnergy Corp.
Member	Sanjib	Som	Pennsylvania Transformer
Member	Kyle	Stechschulte	American Electric Power
Guest	H. Allen	Steele	TVA
Guest	Andrew	Steineman	Delta Star Inc.
Member	Janusz	Szczechowski	Maschinenfabrik Reinhausen
Member	Matthew	Sze	OMICRON electronics Corp USA
Guest	Sachin	Tade	PTI Transformers
Guest	Jonathan	Tan	Northern Transformer
Guest	Andreas	Thiede	Highvolt Dresden
Member	Eduardo	Tolcachir	TTE S.A.
Chair	Ajith	Varghese	Prolec-GE Waukesha
Secretary	Jason	Varnell	Doble Engineering Co.
Member	Pragnesh	Vyas	Sunbelt-Solomon
Guest	John	Wagner	AEP
Guest	Mike	Waldrop	MLGW
Guest	David	Wallach	Duke Energy
Guest	Joshua	Watson	Nebraska Public Power District
Guest	Jeffrey	Wright	Duquesne Light Co.
Guest	Fei	Yang	Hitachi Energy
Member	Shibao	Zhang	PCORE Electric
Member	Kris	Zibert	Allgeier, Martin and Associates

Appendix A: TF Partial Discharge for Class I Transformers Survey Text

From C57.12.00

Table 3—Dielectric insulation levels for distribution and Class I power transformers, voltages in kV

Maximum system voltage (kV rms)	Nominal system voltage[c, d] (kV rms)	Applied- voltage test[f] (kV rms)			Induced-voltage test[b, f] (phase to ground) (kV rms)	Winding line-end BIL[c, f] (kV crest)			Neutral BIL[g, c, h] (kV crest)	
		Delta or fully insulated wye	Grounded wye	Impedance grounded wye or grounded wye with higher BIL		Minimum	Alternates		Grounded wye	Impedance grounded wye or grounded wye with higher BIL
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
Part A - Distribution transformers										
1.5	1.2[e]	10	-	10	1.4	**30**			30	30
3.5	2.5[e]	15	-	15	2.9	45			45	45
6.9	5[e]	19	-	19	5.8	**60**			60	60
11	8.7[e]	26	-	26	10	75			75	75
17	15	34	-	34	17	**95**	110		75	75
26	25	40	-	40	29	**125**	150		75	95
36	34.5	50	-	50	40	125	150	200	75	125
48	46	95	-	70	53	200	250		95	150
73	69	140	-	95	80	250	350		95	200
Part B - Class I power transformers without partial discharge testing										
1.5	1.2	10	10	10	1.4	**30**	45		45	45
3.5	2.5	15	15	15	2.9	**45**	**60**		60	60
6.9	5	19	19	19	5.8	**60**	75		75	75
11	8.7	26	26	26	10	75	**95**		95	95
17	15	34	26	34	17	**95**	**110**		95	110
26	25	50	26	40	29	**150**			95	125
36	34.5	70	26	50	40	**200**			95	150
48	46	95	34	70	53	200	250		110	200
73	69	140	34	95	80	250	350		110	250

Maximum system voltage (kV rms)	Nominal system voltage[c, d] (kV rms)	Applied- voltage test[f] (kV rms)			Induced- voltage test[i] (phase to ground) (kV rms)		Winding line-end BIL[c, f] (kV crest)		Neutral BIL[g, c, h] (kV crest)	
		Delta or fully insulated wye	Grounded wye	Impedance grounded wye or grounded wye with higher BIL	Enhanced 7200 cycles	One hour	Minimum	Alternate	Grounded wye	Impedance grounded wye or grounded wye with higher BIL
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 11	Col 12
Part C - Class I power transformers with partial discharge testing specifically requested by purchaser										
1.5	1.2	10	10	10	1.2	1.1	**30**	45	45	45
3.5	2.5	15	15	15	2.6	2.3	45	**60**	60	60
6.9	5	19	19	19	5.2	4.6	**60**	75	75	75
11	8.7	26	26	26	9	7.9	75	**95**	95	95
17	15	34	34	34	16	14	**95**	**110**	95	110
26	25	50	34	40	26	23	**150**		95	125
36	34.5	70	34	50	36	32	**200**		95	150
48	46	95	34	70	48	42	200	250	110	200
73	69	140	34	95	72	63	250	**350**	110	250

[a] For nominal system voltage greater than maximum system voltage, use the next higher voltage class for applied-voltage test levels.

[b] Induced-voltage tests shall be conducted at 2.0 × nominal system voltage for 7200 cycles.

[c] Bold typeface BILs are the most commonly used standard levels.

[d] Y-Y-connected transformers using a common solidly grounded neutral may use neutral BIL selected in accordance with the low-voltage winding rating.

[e] Single-phase distribution and power transformers and regulating transformers for voltage ratings between terminals of 8.7 kV and below are designed for both Y and Δ connection, and are insulated for the test voltages corresponding to the Y connection so that a single line of transformers serves for the Y and Δ applications. The test voltages for such transformers, when connected and operated, are therefore higher than needed for their voltage rating.

[f] For series windings in transformers, such as regulating transformers, the test values to ground shall be determined by the BIL of the series windings rather than by the rated voltage between terminals.

[g] Values listed as nominal system voltage in some cases (particularly voltages 34.5 kV and below) are applicable to other lesser voltages of approximately the same value. For example, 15 kV encompasses nominal system voltages of 14 440 V, 13 800 V, 13 200 V, 13 090 V, 12 600 V, 12 470 V, 12 000 V, and 11 950 V.

[h] Neutral BIL shall never exceed winding BIL.

[i] Induced voltage tests shall be conducted at 1.58 x nominal system voltage for one hour and 1.8 x nominal system voltage for enhanced 7200 cycle test.

From C57.12.90

10.7 Induced-voltage tests for distribution and Class I power transformers without partial discharge test

10.7.1 Test duration

The induced-voltage test shall be applied for 7200 cycles, or 60 s, whichever is shorter.

10.7.2 Test frequency

As an induced-voltage test applies greater than rated volts-per-turn to the transformer, the frequency of the impressed voltage shall be high enough to limit the flux density in the core to that permitted by 4.1.6.1 of IEEE Std C57.12.00-2021. The minimum test frequency to meet this condition is given in Equation (27).

$$\text{Minimum test frequency} = \frac{E_t}{1.1 \times E_r} \times \text{rated frequency} \quad (27)$$

where

E_t is the induced voltage across winding (V)
E_r is the rated voltage across winding (V)

10.7.3 Application of voltage

The voltage should be started at one quarter or less of full value and be brought up gradually to full value. After being held for the time specified in 10.7.1, it should be reduced gradually before the circuit is opened.

10.7.4 Grounding of windings

When a transformer has one end of the high-voltage winding grounded, the other windings should be grounded during the induced-voltage test. This ground on each winding may be made at a selected point of the winding itself or of the winding of a step-up transformer that is used to supply the voltage or that is connected for the purpose of furnishing the ground.

10.7.5 Need for additional induced tests

When the induced test on a winding results in a voltage between terminals of other windings in excess of the low-frequency test voltage specified in Table 3 or Table 4, as applicable, of IEEE Std C57.12.00-2021, the other winding may be sectionalized and grounded. Additional induced tests shall then be made to give the required test voltage between terminals of windings that were sectionalized.

10.7.6 Failure detection

Careful attention should be maintained for evidence of possible failure, such as an indication of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, a sudden increase in test circuit current, or an appreciable increase in partial discharge level. Any such indication should be carefully investigated by observation, by repeating the test, or by other tests to determine whether a failure has occurred.

10.7.7 Special induced voltage test for distribution and Class I power transformers with a wound core

This test to detect improper core grounding applies to distribution transformers and Class I power transformers, with a wound core, low–high winding construction, and having a high-voltage winding voltage of 25 kV (15 kV to ground) or greater. Note that this test is intended only for detection of inadequate core grounding issues and not for accessories like dead front bushings, tap-changers, current limiting fuses, or dual-voltage switches, which may have difficulty passing this test at 100 pC. The transformer may or may not contain such components. If the transformer fails the test with such components, the components may be removed or bypassed and the test re-run. The test shall be conducted on a transformer with functionally similar core grounding.

10.7.7.1 Minimum test duration and application of voltage

Partial discharge (PD) is to be measured as an apparent charge in picocoulombs (pC). One reading shall be made at the end of each interval. The minimum test durations and application of voltages are as follows:

a) Voltage shall be raised to 100% of rated volts for 30 s, and PD shall be measured and recorded.
b) Voltage shall be raised to 110% of rated volts for 30 s, and PD shall be measured and recorded.
c) Voltage shall be raised to 150% of rated volts for 60 s, and PD shall be measured and recorded.
d) Voltage shall be lowered to 140% of rated volts for 60 s, and PD shall be measured and recorded.
e) Voltage shall be lowered to 130% of rated volts for 60 s, and PD shall be measured and recorded.
f) Voltage shall be lowered to 120% of rated volts for 60 s, and PD shall be measured and recorded.
g) Voltage shall be lowered to 110% of rated volts for 10 min, and PD shall be measured and recorded.

10.7.7.2 Test frequency

The test frequency shall be in accordance with 10.7.2.

10.7.7.3 Grounding of windings

Windings shall be grounded in accordance with 10.7.4.

10.7.7.4 Failure detection

The test is considered passed if PD recorded in step g) of 10.7.7.1 does not exceed 100 pC. Judgment shall be used in test intervals such that momentary excursions beyond 100 pC may be acceptable; however, at the end of step g) of 10.7.7.1, PD shall not exceed 100 pC.

NOTE—Normally, transformers will pass the test if they are equipped with outside core grounds and with shielded and grounded inside outer core loops. In cases where pass–fail is marginal at the 110% voltage level, it is useful to continue reducing voltage until partial discharge is extinguished. Core gassing results in bubbles between core laminations that push liquid out and leave only gas that ionizes at much lower voltages than the insulating liquid. Hence, core gassing usually results in partial discharge extinction well below rated voltage. Most other components in the transformer behave more linearly and do not persist with partial discharge at or below rated voltage.

10.8 Induced-voltage tests for Class I power transformers with partial discharge test specifically requested by the purchaser

10.8.1 General

Each Class I power transformer shall receive an induced-voltage test with the required test levels induced in the high-voltage winding. The tap connections shall be chosen, when possible, so that test levels developed in the other windings during the one-hour test are x times their maximum operating voltages, as specified in Table 3, Part C of IEEE Std C57.12.00-2021, where x (also referred to as the "overvoltage factor" in the text that follows) is the ratio of the test voltage on the high-voltage winding to the maximum operating voltage.

For a transformer built with a single magnetic core holding all windings, all windings are excited at a unique induction level, often referred to as "volts-per-turn." During an induced-voltage test, with the transformer connected and excited as in service, all windings are excited at the same overvoltage factor, regardless of what

tap is selected. Each winding turn receives the same voltage. The tap connections shall be chosen, when possible, such that voltages developed across other windings meet or exceed the required overvoltage factor.

The situation is quite different when transformers are equipped with auxiliary devices with separate magnetic cores, such as preventive autotransformer (reactor), series (booster) transformer, or series regulator. Different magnetic cores can be excited at different levels during operation or testing. In certain tap positions, these auxiliary devices do not have their core excited at all and no voltage appears across their windings. For such cases, the selection of the tap-changer position shall be guided by the principles described below. One exception is when such auxiliary devices are not excited on a permanent basis but used only as transitional devices. If equalizing windings are used, the highest voltage impressed across the preventive autotransformer will occur in either the bridging or non-bridging positions. This is because the preventive autotransformer is energized in all tap positions (bridging and non-bridging).

NOTE 1—Equalizing windings are described in IEEE Std C57.131 and IEC 60214-1.

For transformers equipped with a series (booster) transformer, preventive autotransformer (reactor), or any other device, the selected tap position of the load tap-changer (LTC) shall be the one that produces the highest voltage across the windings of the series transformer, preventive autotransformer, and other auxiliary devices as applicable. There can be a conflict of choosing such a tap position when more than one such device is present. In such a case, the selected tap position of the LTC should be the best compromise so that all devices are tested with overvoltage. One common example is the case where a series transformer and preventive autotransformer are both present. In this case, the tap selected shall be the one that is closest to the position that produces the highest voltage across the windings of the series transformer and simultaneously excites the preventive autotransformer, which is typically a bridging position (not applicable when the preventive autotransformer is energized only during transition).

In order to test the series (booster) transformer, preventive autotransformer, and other devices, at the required minimum overvoltage factor, the voltage developed on the terminals of other windings may exceed the one-hour level mentioned in Table 3, Part C of IEEE Std C57.12.00-2021. In such cases, an alternative tap position may be selected by agreement between the manufacturer and the purchaser to avoid overstressing components such as bushings. Annex D shows examples that can serve as a guide to select the LTC tap position for transformers having series (booster) transformer and/or preventive autotransformers.

For certain types of devices such as series reactors used as current limiting devices, there is no voltage developed across their windings during the induced voltage test as these devices are only excited when current flows in their windings. There is no option available to apply any overvoltage for these devices during the induced test.

NOTE 2—The selection of the tap-changer position for induced test should be agreed upon between manufacturer and purchaser prior to design to avoid conflicts during final acceptance tests.

10.8.2 Test procedure

The voltage shall first be raised to the one-hour level and held for a minimum of 1 min or until a stable partial discharge level is obtained to verify that there are no partial discharge problems. The level of partial discharges shall be recorded just before raising the voltage to the enhancement level. The voltage shall then be raised to the enhancement level and held for 7200 cycles. The voltage shall then be reduced directly to the one-hour level and held for 1 h.

During this 1 h period, partial discharge measurements shall be made at 5 min intervals. Partial discharge acceptance criteria shall be based on each line terminal rated 34.5 kV and above. These measurements shall be made in accordance with 10.9.

The pressure inside the transformer tank during the induced test shall not be increased by artificial means for the purpose of reducing the PD level. The liquid level and pressure inside of the transformer tank and/or conservator tank shall be configured such that the oil head pressure during the induced test does not exceed the pressure under usual service conditions. Any exceptions that increase tank pressure by more than 3.5 kPa (0.5 psi) over normal operating pressure, such as the use of an elevated test facility conservator tank, requires customer approval prior to test. A note shall be added to the certified test report confirming this approval.

NOTE—Increasing the pressure for diagnostic purposes, such as to identify and possibly reduce suspected bubbles in the liquid, may be done as a remedial step to diagnose a source of high PD. To be considered valid, the test needs to be repeated with no added pressure as stated previously.

10.8.3 Connections

The transformer shall be excited exactly as it will be in service. The voltage may be induced from any winding or from special windings or taps provided for test purposes. Single-phase transformers shall be excited from single-phase sources. Three-phase transformers shall be excited from three-phase sources. The neutral terminals and other terminals that are normally grounded in service shall be solidly grounded. This will stress all of the insulation at the same per unit of overstress.

10.8.4 Frequency

The test frequency shall be increased, relative to operating frequency, as required to avoid core saturation. The requirements in 10.7.2 are also applicable in the case of this induced test.

10.8.5 Failure detection

Failure may be indicated by the presence of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, or a sudden increase in the test current. Any such indication shall be carefully investigated by observation, by repeating the test, and by other diagnostic tests to determine whether a failure has occurred. In terms of interpretation of partial discharge measurements, the results shall be considered acceptable and no further partial discharge tests required under the following conditions:

a) For transformers rated 34.5 kV and above the magnitude of the partial discharge level does not exceed 250 pC during the 1 h testperiod. For transformers rated below 34.5 kV, the magnitude of the partial discharge level shall be set by agreement between the purchaser and the manufacturer.

b) For transformers rated 34.5 kV and above the increase in partial discharge levels during the 1 h period does not exceed 50 pC. For transformers rated below 34.5 kV, the increase of the partial discharge level shall be set by agreement between the purchaser and the manufacturer.

c) The partial discharge levels during the 1 h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.

Judgment should be used on the 5 min readings so that momentary excursions of the partial discharge readings caused by cranes or other ambient sources are not recorded. Also, the test may be extended or repeated until acceptable results are obtained.

A failure to meet the partial discharge acceptance criterion shall not warrant immediate rejection, but it shall lead to consultation between purchaser and manufacturer about further investigations.

~~10.8~~10.9 Induced-voltage test for Class II power transformers

~~10.8.1~~10.9.1 General

Each Class II power transformer shall receive an induced-voltage test with the required test levels induced in the high-voltage winding. The tap connections shall be chosen, when possible, so that test levels developed in the other windings during the one-hour test are x times their maximum operating voltages, as specified in Table 4 of IEEE Std C57.12.00-2021, where x (also referred to as the "overvoltage factor" in the text that follows) is the ratio of the test voltage on the high-voltage winding to the maximum operating voltage.

For a transformer built with a single magnetic core holding all windings, all windings are excited at a unique induction level, often referred to as "volts-per-turn." During an induced-voltage test, with the transformer connected and excited as in service, all windings are excited at the same overvoltage factor, regardless of what tap is selected. Each winding turn receives the same voltage. The tap connections shall be chosen, when possible, such that voltages developed across other windings meet or exceed the required overvoltage factor.

The situation is quite different when transformers are equipped with auxiliary devices with separate magnetic cores, such as preventive autotransformer (reactor), series (booster) transformer, or series regulator. Different magnetic cores can be excited at different levels during operation or testing. In certain tap positions, these auxiliary devices do not have their core excited at all and no voltage appears across their windings. For such cases, the selection of the tap-changer position shall be guided by the principles described below. One exception is when such auxiliary devices are not excited on a permanent basis but used only as transitional devices. If equalizing windings are used, the highest voltage impressed across the preventive autotransformer will occur in either the bridging or non-bridging positions. This is because the preventive autotransformer is energized in all tap positions (bridging and non-bridging).

NOTE 1—Equalizing windings are described in IEEE Std C57.131 and IEC 60214-1.

For transformers equipped with a series (booster) transformer, preventive autotransformer (reactor), or any other device, the selected tap position of the load tap-changer (LTC) shall be the one that produces the highest voltage across the windings of the series transformer, preventive autotransformer, and other auxiliary devices as applicable. There can be a conflict of choosing such a tap position when more than one such device is present. In such a case, the selected tap position of the LTC should be the best compromise so that all devices are tested with overvoltage. One common example is the case where a series transformer and preventive autotransformer are both present. In this case, the tap selected shall be the one that is closest to the position that produces the highest voltage across the windings of the series transformer and simultaneously excites the preventive autotransformer, which is typically a bridging position (not applicable when the preventive autotransformer is energized only during transition).

In order to test the series (booster) transformer, preventive autotransformer, and other devices, at the required minimum overvoltage factor, the voltage developed on the terminals of other windings may exceed the one-hour level mentioned in Table 4 of IEEE Std C57.12.00-2021. In such cases, an alternative tap position may be selected by agreement between the manufacturer and the purchaser to avoid overstressing components such as bushings. Annex D shows examples that can serve as a guide to select the LTC tap position for transformers having series (booster) transformer and/or preventive autotransformers.

For certain types of devices such as series reactors used as current limiting devices, there is no voltage developed across their windings during the induced voltage test as these devices are only excited when current flows in their windings. There is no option available to apply any overvoltage for these devices during the induced test.

NOTE 2—The selection of the tap-changer position for induced test should be agreed upon between manufacturer and purchaser prior to design to avoid conflicts during final acceptance tests.

~~0.8.2~~10.9.2 Test procedure

The voltage shall first be raised to the one-hour level and held for a minimum of 1 min or until a stable partial discharge level is obtained to verify that there are no partial discharge problems. The level of partial discharges shall be recorded just before raising the voltage to the enhancement level. The voltage shall then be raised to the enhancement level and held for 7200 cycles. The voltage shall then be reduced directly to the one-hour level and held for 1 h.

During this 1 h period, partial discharge measurements shall be made at 5 min intervals. Partial discharge acceptance criteria shall be based on each line terminal rated 69 kV and above. These measurements shall be made in accordance with 10.9.

The pressure inside the transformer tank during the induced test shall not be increased by artificial means for the purpose of reducing the PD level. The liquid level and pressure inside of the transformer tank and/or conservator tank shall be configured such that the oil head pressure during the induced test does not exceed the pressure under usual service conditions. Any exceptions that increase tank pressure by more than
3.5 kPa (0.5 psi) over normal operating pressure, such as the use of an elevated test facility conservator
tank, requires customer approval prior to test. A note shall be added to the certified test report confirming this approval.

NOTE—Increasing the pressure for diagnostic purposes, such as to identify and possibly reduce suspected bubbles in the liquid, may be done as a remedial step to diagnose a source of high PD. To be considered valid, the test needs to be repeated

with no added pressure as stated previously.

~~10.8.3~~10.8.6 Connections

The transformer shall be excited exactly as it will be in service. The voltage may be induced from any winding or from special windings or taps provided for test purposes. Single-phase transformers shall be excited from single-phase sources. Three-phase transformers shall be excited from three-phase sources. The neutral terminals and other terminals that are normally grounded in service shall be solidly grounded. This will stress all of the insulation at the same per unit of overstress.

~~10.8.4~~10.8.7 Frequency

The test frequency shall be increased, relative to operating frequency, as required to avoid core saturation. The requirements in 10.7.2 are also applicable in the case of this induced test.

~~10.8.5~~10.8.8 Failure detection

Failure may be indicated by the presence of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, or a sudden increase in the test current. Any such indication shall be carefully investigated by observation, by repeating the test, and by other diagnostic tests to determine whether a failure has occurred. In terms of interpretation of partial discharge measurements, the results shall be considered acceptable and no further partial discharge tests required under the following conditions:

a) The magnitude of the partial discharge level does not exceed 250 pC during the 1 h test period.

b) The increase in partial discharge levels during the 1 h period does not exceed 50 pC.

c) The partial discharge levels during the 1 h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.

Judgment should be used on the 5 min readings so that momentary excursions of the partial discharge readings caused by cranes or other ambient sources are not recorded. Also, the test may be extended or repeated until acceptable results are obtained.

A failure to meet the partial discharge acceptance criterion shall not warrant immediate rejection, but it shall lead to consultation between purchaser and manufacturer about further investigations.

Appendix B: Task Force on Partial Discharge Testing in Distribution, Wind and Solar Transformers

Task Force on Partial Discharge Testing in Distribution, Wind and Solar Transformers - Vancouver - Spring 2024

This was the first meeting of the task force. We had **59** attendees and **25** indicated that they want to participate in the task force.

The meeting started at 9:30 on 3/11/2024. We had all attendants do a quick introduction and we started the discussion.

Andrew started giving a summary of the current standard requirements for PDs. Then dived into the details for C57.12.00, where it mentions the test is a design test. Moving onto C57.12.90, where it states that is acceptable to remove some components in case the test fails, and it's mentioned by the chair that this provision is not available in the other standards where PD is mentioned.

Then the details for Class II are discussed, where the limits are 250 pC. Then C57.159 is discussed the limit is 100 pC and refers to C57.12.01 (Dry-type Transformers), which requires ramping from to 180% then down to 130%.

A side-by-side comparison was then presented to the audience where it compares the different standards and their requirements.

The discussion then went into the components used in the transformers and their commonality in the Wind/Solar application and the fact that some of these components are known to generate PD/Corona which would impact the test results.

After sharing the information, the chair shared some intended goals for the TF and opened the discussion with the audience.

1. What is an accurate simulation and/or appropriate voltage level for transformers subjected to these applications which are built by distribution transformer manufacturers.
    1. Review studies done by end users on voltage levels in alternative energy applications
    2. Consult with Photo Voltaic and Wind inverter manufacturers on overvoltage recommendations.
2. Depending on what is determined to be the appropriate test voltage, should transformer component manufacturers design components to pass at these levels or should they be bypassed for testing? Bypassing components takes time in distribution transformer factories that are building hundreds of units a day.

3. Is there a correlation to PD/Local Corona inherent in specific component use?
4. What is the method/Process for performing a PD test on a typical Distribution class transformer?
5. Consistency in test types - Design vs Other (user specified) test.

Karl Jackob with Cargill shared his experience on DGA and how the PD affects this test. He asked if this was also a motivation for the TF. He mentions that FR3 has higher PD inception, and he is concerned about safety. He also asked whether the test being done simulates the application condition (inverter, etc).

Zach Weiss with WEG, he mentions that the 180% is too high for DT transformers and that historically, 130% should be more than enough for this type of transformer. He also mentions that it's very easy to reach 100 pC with only the active part, but when you add all the components in this type of transformer. There is correlation between PD and components. Their method of testing is by-passing the components. He also shared that from his experience the PD test is a protection for the mfg.

Harman Singh with PTI – He mentions that the initiative is a need for the industry and that for the users is very important to have clearly specified the requirements for the PD. He then mentions that looking at the important components of the test and that the survey proposed is a good start but that it will be difficult to find a solution for all the different applications. He encouraged everyone to move forward with this work.

Carlos Gaytan with PGE – He mentions that some customers require that more than one unit is tested and that doing the test together with induced test above 140% causes increase of time for testing in high production environments. He mentions about the different of the different requirements in the standards and shares details about a single phase transformer test where this test is done to validate the grounding of the core. He volunteers to participate in this TF to clarify all the test requirements.

Wolfgang Schmitt from Schneider Electric – He mentions that C57.12.90 already mentions some potential voltages from phase to ground and that he believes some manufacturers still do not understand what that means. So, he proposes that the first step is to really understand the results that come from the test and also that he believes that if the PD test was routine it would help in detecting Hydrogen generation in inverter transformers. He shared also that when speaking about the test level it's necessary to understand which are the voltage levels and mainly the voltage phase to ground. In his opinion, the phase-to-phase voltage is not the most critical for the PD detection. He mentions that from a user POV, if the PD test was not required by the customer at the time of purchase, and later is tested in the field it will have higher PD than the requirement does the unit fail?

Brian Sparling with Kinectrics – He requested clarification on the type of transformers and understood that all types of transformer are included. He mentions that from his experience,

having PD test should be mandatory for Solar type transformers because it would help to detect manufacturing defects.

Peter Heinzig with Weidmann - Recommended to have partial discharge test mandatory for all the transformers because this would allow to detect failures that damage the insulation and affect the transformer life. He also mentions about the ground and earthing practices and how the testing voltage should follow those requirements.

Paul Weyandt with Schneider Electric – He mentions that a lot of the components that are used do not have this type of test and the level of voltage that they can withstand and that this needs to be considered in the standard

Alexsander Levin with Weidmann – He asked for clarification if we are talking about the general distribution transformer versus the special application transformers (solar and wind) and the Chair mention that initially the idea was to compare the general DT with the other application. He mentions that the scope needs to be clearer where we want or not to change the standard DT transformer.

Volodymyr Pryichodko with ZTZ Services – asked if we are testing the transformer only during the FAT or also during the operation condition. He is asking if there is also the intention to monitor PD during operation.

After this, the meeting was adjourned with the feedback from the Chair that the information and the discussed topics would be shared with the main TF.

Name	Position	Email	Rooster Spring 202
Ajith Varghese	Guest	Ajith.Varghese@prolec.energy	n
Aleksandr Levin	Member	aleksandr.levin@weidmann-group.com	y
Andreas Thiede	Guest	a.thiede@highvolt.com	y
Andrew Larison	Chair	andrew.t.larison@hitachienergy.com	y
Aron Sexton	Guest	aron.sexton@kinectrics.com	y
Barroh Winberh	Guest	barroh.winberh@ge.com	y
Binzhan Chen	Guest	binzhan.chen@bchydro.com	y
Brad Greaves	Guest	brad.greaves@weidmann-group.com	y
Brian Sparling	Member	brian.sparling@kinectrics.com	y
Carlos Gaytan	Member	carlos.gaytan@prolec.energy	y
Chris Steineman	Guest	csteineman@hubbel.com	y
Christopher Slattery	Member	cslattery@firstenergycorp.com	n
Dan Sauer	Member	dmsauer@mtu.edu	n
Danitz Berler	Member	berlerdanitz@ztzservices.us	y
David Komm	Member	dkomm@hammondpowersolutions.com	y
Deniss Carr	Guest	deniss.carr@ge.com	y
Diego Robalino	Guest	diego.robalino@megger.com	y
Dominique Bolliger	Member	d.bolliger@hvtechnologies.com	y
Eloy Gasperin	Guest	mistras	y
Eric Davis	Guest	esctdavis@aol.com	y
Evan Knapp	Member	evanltknapp@gmail.com	y
Fernando Lagos	Guest	fernando.lagos@ge.com	y
Fernando Leal	Member	ferleal@gmail.com	y
Gabriel Delgado	Member	gdelgado@invenergy.com	y
Gary Hoffman	Guest	grhoffman@advpowertech.com	y
Grace Guang Yuan	Member	guang.yuan@hitachienergy.com	y
Harman Singh	Guest	hsekhonp@ptitransformers.com	y
Hemehandra Shertnkde	Member	shertnkde@hartford.edu	y
Igor Ziger	Guest	igor.ziger@toukar-mjt.hr	y
Janusz Szczechowski	Member	j.szczechowski@reinhousen.com	y
Jctlev Gross	Member	dwg@mailbox.com	y
Jose Gamboa	Member	joseg@h-j.com	y
Karl Jacob	Guest	karl_jakob@cargill.com	y
Liam Conway	Guest	liam.conway@ifdtech.com	y
Mak Lachman	Guest	mlachman@doble.com	y
Marilia Ribeiro	Guest	marilia.ribeiro@ge.com	y
Mario Alonso	Member	alonso.mario.ma@gmail.com	y
Mark Tostrud	Guest	mark.tostrud@gmail.com	y
Markus Soeller	Member	soeller@pdix.com	y
Mathew Sze	Guest	matthew.sze@omicronenergy.com	y
Mathieu Lachance	Guest	mathieu.lachance@omicronenergy.com	y
Matt Weisensee	Member	matthew.weisensee@pacificorp.com	n
Michael Gonzalez	Guest	michael.x.gonzales@scc.com	y
Nabi Almeida	Vice-Chair	nabi.almeida@prolec.energy	y
Nathan Jacob	Member	nathan.jacob@camlinenergy.com	y
Onome Avanoma	Member	o.avanoma@outlook.com	n
Patrick Foster	Guest	patrick.foster@fpl.com	y
Paul Weyandt	Member	paul.weyandt@se.com	y
Peter Heinzig	Guest	peter.heinzig@weidmann-group.com	y
Pedro Puente	Guest	pedro.puente@prolec.energy	y
Ronald Hernandez	Guest	rhernandez@doble.com	y
Sachin Tade	Guest	stade@ptitransformers.com	y
Sanjib Som	Member	ssom@patransformer.com	n
Saramma Hoffman	Member	shoffman@pplweb.com	n
Saurabh Ghosh	Member	sghrob@gmail.com	y
Sergio Hernandez Cano	Member	shernan@hammondpowersolutions.com	y
Shuzen Xu	Guest	shuzen.xu@fmglobal.com	y
Tom Melle	Member	t.melle@advtest.com	y
Troy Tanaka	Guest	ttanaka@burnsmco.com	y
Volodymyr Pryichodko	Member	vprykhodko@ztzservices.com	y
Waldemar Ziomel	Member	wziomel@ptitransformers.com	y
Wellian Boettger	Member	weboettger@aol.com	Y
Wolfgang Schmitt	Guest	wolfgang.schmitt@se.com	y
Yaw Nyanteh	Guest	yaw.nyanteh@hyosung.com	y
Zach Gagne	Guest	zach.gagne@ifdtech.com	y
Zach Weiss	Member	zweiss@weg.net	y

Task Force on Revision of Impulse Tests

Chair: Sylvain Plante

Vice Chair: Daniel Sauer

Vancouver, BC, Canada, Spring 2024

Unapproved meeting minutes

The TF met on March 12th, 2024, from 08:00 am to 09:15 am.

Twenty-seven (28) members and seventy-two (72) guests attended the meeting (see attached attendance list). Thirty-four (34) Guests were attending for the first time the Task Force. Twenty-two (22) guests requested membership but only Thirteen (13) are eligible to have attended at least 2 of the last 3 meetings. After this meeting, thirteen (13) members has been moved to guest list, not having attended 2 of the last 3 meetings. The meeting was chaired by Sylvain Plante, Chair of the TF. and Mr. Daniel Sauer was the vice-chair.

The meeting has been called to order by the Chair at 08:00 am.

Attendance has been recorded in the TF's attendance EXCEL spreadsheets and include in the annex.

IEEE Patents and Copyright slides were presented. There were no comments or requests regarding Patents and Copyrights.

Required quorum was met, presence of at least 27 members out of 53 members was required, we had 27 after third request of Quorum verification. The TF membership roster has been reviewed after last meeting and this one.

The meeting agenda has been approved unanimously. Motion has been made by Sanjib Som and was seconded by Onome Avanoma.

The F23 virtual meeting minutes have been approved unanimously. Motion has been made by John John and was seconded by David Wallach.

The first item of business was related to the results of a survey related to a proposal made by Ajith Varghese regarding the phase-to-phase switching impulse clause 10.2.4. This proposal is to add some text in the clause needed when the switching impulse is performed as an option and not mandatory. During last meeting in Kansas City, the TF has requested the Chair to make a proposal following the result of the survey.

After some discussion, the following text has been proposed to be added to clause 10.2.4.

"While selecting the tap connection complying to above requirements, the phase-to-phase voltage withstand capability of the transformer active part including LTC, bushings and all accessories shall be reviewed.

Testing on a non-compliant tap connection shall be discussed and agreed between manufacturer and purchaser."

It has been proposed by Ajith Varghese and seconded by Stephen Antosz to send the text to the Dielectric Test Sub Committee for vote. Motion has been unanimously approved.

A new business has been bring to the TF regarding the current sensitivity when for chopped wave.

A motion to create a TF to investigate the requirement for sensitivity of current measurement during chop wave compare with full wave lightning surge has been made by Jim McBride and second by Dan Sauer. Motion has been unanimously approved. Volunteer were Jim McBride, Stephen Antosz, Sylvain Plante and Dan Sauer. Dan will call the meeting.

Another new business has been brough by Jason Varnell regarding the need to compare only last lightning curve with the reduce. Detail information will be sent by E-mail for study during next meeting.

The meeting adjourned at 09:15 am on March 12th , 2024.

The next meeting is planned to be held in St-Louis, Missouri, October 27-31, 2024.

Minutes wrote by:

Sylvain Plante, Eng.

TF Chair

April 2nd , 2024

Attendance Record

Role	First Name	Last Name	Company
New Guest	Isaac	Abdalla	
Member	Kayland	Adams	GE Prolec
Member	Stephen	Antosz	Stephen Antosz & Associates, Inc
member	Javier	Artega	
Member	Onome	Avanoma	MJ Consulting
New Guest	sean	barker	
Member	William	Boettger	Boettger Transformer Consulting LLC
Member	Dominique	Bolliger, Ph.D.	HV TECHNOLOGIES, Inc.
Guest	Jeffrey	Britton	Phenix Technologies, Inc.

Guest	Juan Alfredo	Carrizales	Prolec GE
Member	camilo	casallas	
Guest	Vivian	Chan	Hitachi Energy
Guest	Eric	Davis	Consultant
Member	Gabriel	Delgado	Invenergy
Guest	Don	Dorris	Nashville Electric Service
New Guest	Jesse	Duffy	
Member	Janko	Dzodan	Koncar
New Guest	Eric	Elson	
New Guest	Miguel	Fernandez	
Member	Raymond	Frazier	Ameren
Member	Richard	Frye	EATON Corporation
New Guest	Dragana	Gasic	Koncar
Guest	Jeffrey	Gragert	Xcel Energy
Member	Peter	Heinzig	Weidmann Electrical Technology
New Guest	Kyle	Helden	
Member	Giovanni	Hernadez	
Member	Saramma	Hoffman	PPL
Member	saif	Hossain	Trench limited
New Guest	Chanman	Jeong	
Member	John	John	Virginia Transformer Corp.
New Guest	Jerzy	Kazmierzak	
New Guest	Stacey	Kessler	
New Guest	Yeounsoo	Kim	
Member	Evan	Knapp	Eaton corp
New Guest	Matija	Koprivnjak	Koncar dst
Member	Mark	Lachman	Doble Engineering Co.
Member	Fernando	Leal	Prolec GE
Member	Moonhee	Lee	Hammond Power Solutions
Member	Junho	Lee	Hyundai Electric
New Guest	Samuel	Lewis	
New Guest	Weijun	Li	
New Guest	Ricardo	Lopes Mamede	
New Guest	Alberto	Martinez	
Member	James	McBride	JMX Services, Inc.
New Guest	Gabriel	Menede	
Member	Francis	Mills	Power engineer
Member	Juliano	Montanha	Siemens Energy
New Guest	Rhea	Montpool	
Guest	Martha	Munoz	Hitachi Energy
Member	David	Murray	Tennessee Valley Authority

New Guest	Alireca	Nadenriar	
New Guest	anthony	Natalle	
New Guest	Kris	Neild	
New Guest		ortiz	
Guest	George	Partyka	PTI Transformers
New Guest	Monil	Patel	
Guest	Harry	Pepe	Phenix Technologies, Inc.
Chair	Sylvain	Plante	Hydro-Quebec
New Guest	Crhritoph	Ploetner	
Guest	Klaus	Pointner	Trench Austria GmbH
Member	Jarrod	Prince	ERMCO
New Guest	Juan	Reyes	Hitachi Energy
New Guest	Michael	Richardson	Ameren
New Guest	Time	Rocque	
New Guest	Matthew	S	
Member	Hakan	Sahin	Virginia/Georgia Transformer
Vice-Chair	Daniel	Sauer	EATON Corporation
Guest	Eric	Schleisman	Southern Company Services
Guest	Alfons	Schrammel	Siemens Energy
New Guest	Harmandret	Sekhon	
Member	Cihangir	Sen	Duke Energy
Member	Mike	Shannon	REA Magnet Wire
Guest	Michael	Sharp	Trench Limited
Guest	Hemchandra	Shertukde	University of Hartford
Member	Christopher	Slattery	FirstEnergy Corp.
Member	Sanjib	Som	Pennsylvania Transformer
Member	Kyle	Stechschulte	American Electric Power
Guest	Hampton	Steele	Tennessee Valley Authority
Guest	Andrew	Steineman	Delta Star Inc.
Guest	Shankar	Subramany	KEMA
New Guest	Sachin	Tade	
New Guest	Johnathan	Tan	
New Guest	Troy	Tanaka	
New Guest	Andrewa	Thiede	
Member	Scott	Thomas	Hitachi Energy
Member	Eduardo	Tolcachir	Tubos Trans Electric S.A.
Member	core	van dreel	american transmission
New Guest	John	Vandermaar	
Member	Ajith	Varghese	SPX Transformer Solutions, Inc.
Member	Jason	Varnell	Doble Engineering Co.
New Guest	Peagnesn	Vyas	

New Guest	John	Wagner	
Guest	Mike	Waldrop	
Member	David	Wallach	Duke Energy
New Guest	Alan	Washburn	
New Guest	soshua	Watson	
Guest	Matthew	Weisensee	PacifiCorp
Guest	Rene	Wind	Siemens Energy
New Guest	Terry	Wong	
Member	Kris	Zibert	Allgeier, Martin and Associates

Task Force on Guide for DFR Test (C57.161)

Chair: Evgenii Ermakov

Secretary: Diego Robalino

Vancouver, BC, Canada, Spring 2024

Unapproved meeting minutes

DFR TF summary 1:45 PM Regency E/F

Total attendees = 37

Attended members = 15 (no quorum)

Requested membership = 11

TF Chair informed this is the last meeting for this TF.

- Patent claim review
- Copyright policy review

A summary of the work done in the previous meetings was discussed.

TF Chair presented as agreed during the last virtual meeting, the new Title and Scope for the revision of the C57.161 guide.

The purpose of the guide was not modified.

Title

"IEEE Guide for Dielectric Frequency Response Test for liquid-immersed transformers and reactors."

Scope

This guide is applicable to Dielectric Frequency Response (DFR) measurement and analysis for liquid-immersed transformers and reactors. The guide includes recommendations for instrumentation, procedures for performing the tests, and techniques for analyzing the data. This guide can be used in both field and factory applications.

Purpose

The purpose of this guide is to provide the user with information that will assist in performing Dielectric Frequency Response measurements and interpreting the results from these measurements

With this information, the TF members voted affirmative during the virtual meeting carried out before the in-person meeting, to bring a motion to the DTSC to approve a new PAR to revise the C57.161 DFR guide.

Discussion of the TF guests and Members for the future revision (Upon PAR approval):

- TF Chair emphasized on:
  - The revision should cover potential gaps and improve some of the sections.
  - Add the link to IEEE Std C57.12.200™-2022 **Guide for the DFR Measurement of Bushings**
  - Provide more detailed description of moisture estimation algorithm
  - Further explanation to interpreting of GST measurements.
- Mario Locarno, mentioned that during the last meeting it was discussed the inclusion of alternative fluids. Literature review and data available.
- Ali Naderian commented – addressing GST measurements on distribution transformers with common neutral or grounded neutral.
- Charles Sweetzer – Other geometrical designs of core-coil assemblies to be considered.
- Open a discussion board for Comments – IEEE SA (ask Patrycja) – Suggested by M. Locarno

Meeting adjourned at 2:45 PM.

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Attendees to TF meeting

Role	First Name	Last Name	3/12/2024
Guest	Isaac	Abdalla	X
Guest	Dominique	Bolliger	X
Guest	Deniss	Carr	X
Guest	Vivian	Chan	X
Guest	Sami	Debass	X
Member	Gabriel	Delgado	X
Chair	Evgenii	Ermakov	X
Guest	Marco	Espindola	X

Guest	Marc	Foata	X
Guest	Lorne	Gara	X
Member	Rob	Ghosh	X
Member	Alireza	Gorzin	X
Member	Ismail	Guner	X
Member	Ronald	Hernandez	X
Guest	Giovanni	Hernandez	X
Guest	Egon	Kirchenmayer	X
Guest	Mark	Lachman	X
Guest	Fernando	Lagos	X
Member	Mario	Locarno	X
Guest	Kumar	Mani	X
Member	David	Murray	X
Member	Ali	Naderian	X
Guest	Mark	Newbill	X
Guest	David	Olan	X
Guest	Parminder	Panesar	X
Guest	Marilia	Ribeiro	X
Secretary	Diego	Robalino	X
Member	Rodrigo	Ronchi	X
Guest	Aron	Sexton	X
Guest	Markus	Soeller	X
Guest	Brad	Staley	X
Guest	Janusz	Szczechowski	X
Guest	Jonathan	Tan	X
Member	Eduardo	Tolcachir	X
Member	Drew	Welton	X
Member	Guang	Yuan	X
Member	Shibao	Zhang	X

TF C57.127- Revision of IEEE Guide for the Detection, Location and Interpretation of Sources of Acoustic Emissions from Electrical Discharges

Detlev Gross

Unapproved Meeting Minutes

Vancouver, March 12th, 2024, Room: Balmoral (3)

- **Meeting Attendance**

The working group met at 9:30 AM. 36 participants were in the room including 9 of the 20 members. Quorum was not met. Attendance list is shown at the end of the present minutes.

- **Discussions**

After the call for patent and showing the copyright policy, it was announced that after a few questions, the PAR was approved in February. Our work from now on will be conducted under an official working group. The schedule has been updated accordingly but the committee website is still pending an update.

Our intention to allow short presentations was validated with the subcommittee. They are beneficial to the entire group to establish a common ground on the technology as well as to introduce new methods. Such presentations can be scheduled within the working group with the following recommendations:

- Presentations must be sent in advance to the WG officers.
- Commercial references must be removed from the presentation.

Requests for presentation can be sent to officers (Detlev Gross, Jack Harley, David Larochelle).

It was mentioned that the document does not need major modifications and will surely be republished before the expiration of our PAR in 2028. The following remarks were made by group:

1. Add more details on what conditions usually trigger an acoustic measurement, for example PD levels, DGA, monitoring etc. (Markus Soeller)
2. Chapter 7.2 should provide more details on the injected signal properties. Is it possible to identify a procedure? (Markus Soeller)
3. Chapter 8.3 uses the term “calibrated” and should be reviewed (Markus Soeller)
4. Phase shift between electrical and acoustic PD could provide additional useful information. (Markus Soeller)
5. Acoustic cameras are used to detect if PD emitted from the surroundings and could be added to the section that introduces the parabolic acoustic sensors. (Detlev Gross)
6. Annex B on signal processing needs rework (Detlev Gross)
7. The section 9.1 refers to a severity threshold of 300 to 500 pC. Such range is dependent on the type of PD and its location. Should be reviews (Markus Soeller).
8. Table 1 could be updated with speed of sound in silicone and ester oil with references. (Mathieu Lachance)
9. Localization cases could be added to Annexe C. (Detlev Gross)

It was observed that a few individuals missed the meeting because of a schedule conflict with the Condition Assessment Guide working group (PC57.170). A schedule change will be requested.

- **Adjournment**

The meeting was adjourned at 10h30.

David Larochelle

- **Attendance List**

Last Name	First Name	Affiliation	Status
Barker	Sean	Hitachi Energy	G
Berler	Daniel	ZTZ Services	G
Bouty	Georges	Delta Star inc.	G
Chan	Vivian	Hitachi Energy	G
Chiang	Solomon	TGC	G
Gagné	Zach	IFD Technologies	G
Garcia	Eduardo	Siemens Energy	G
Gasperin	Eloy	Mistras	G
Grandbois	Luke	IFD Technologies	G
Gross	Detlev	Independent	C
Harley	John	FirstPower Group LLC	VC
Hollrah	Derek	Burns McDonnell	G
Juchem	Kevin	Hitachi Energy	G
Lachance	Mathieu	Omicron	G
Larochelle	David	NDB Technologies	S
Lewis	Samuel	Hitachi Energy	G
Lin	David	IFD Technologies	G
Lopez-Fernandez	Jose	Universidad de WGO	G
Mamede	Gabriel	Siemens Energy	G
Martinez	Alberto	WEG USA	G
Maryer	Robert	Siemens Energy	G
Mbouombouo	Mama	Hitachi Energy	G
Mendez	Omar	Prolec GE	G
Montanha	Juliano	Siemens Energy	G
Moreno	Andre	Siemens Energy	M
Newbill	Mark	Hitachi Energy	G
Ortiz	Cuauhtemol	Niagara Power	G
Reimer	Jonathan	Fortis BC	G
Rocque	Timothy	Prolec Energy	M
Shalkh	Abdulmajid	Delta Star inc.	M
Soeller	Markus	Power diagnostix Systems	M
Szczechowski	Janusz	Reinhausen	M
Sze	Matthew	Omicron	M
Tan	Jonathan	Northern Transformer	G
Todstrud	Mark	Dynamic Ratings	G

WG C57.138 - Recommended Practice for Routine Impulse Tests

Unapproved Meeting Minutes

Vancouver, BC, Canada, Spring 2024

Chair:	**Hakan Sahin**	**Vice-Chair**	**N/A**
Secretary	**David Wallace**	**Percent Complete**	**70%**

Current Draft Being Worked On: **Draft not started** **Dated:** **n/a**

PAR Expiration Date: **December 31, 2026**

Meeting Date: **12 March 2024** **Time:** **3:15pm**

Location: **Van Couver, BC, CA**

Attendance:	**Members**	**9**
	Guests	**23**
	Guests Requesting Membership	**4**
	Total*	**32**

*** Attendance list for this meeting is shown at end of meeting minutes**

Meeting Minutes / Significant Issues / Comments:

Meeting was called to order at 3:15pm, March 12, 2024.

1. Administrative
    a. IEEE Patent Policy and Call for Patents
        i. No comments from group.
    b. IEEE SA Copyright Policy
        i. No comments from group.

c. Review of agenda
    i. No comments from group.
d. Introductions of the attendees
    i. Attendance sheets were passed out.
e. Updated membership review and count for quorum
    i. 32 people were in attendance with 9 out of 15 members present. Quorum was **achieved.**
    ii. Fall_23 unapproved meeting minutes and Spring_24 agenda were approved with no objections from the members.
    iii. 4 attendees requested membership.

2. Old Business

WG continued to review the document from clause 6.2.3.5, where we had stopped at the end of Fall_23 meeting, thru clause 8.3.2, which is where we will continue from during the Fall_24 meeting. Proposed changes approved during the meeting. Below is the summary of the review comments.

6.2.3.5 – No change

6.2.3.6 – Update year of clause C57.12.90.

Move figure 19 so sentence with permissible are ahead of figure.

Figure 19 and 20 will be updated based on previous comments.

Clarify exciting current wording (excitation current)

6.3 – No change

7.0 - No change

7.1 – No change

7.2 – Typical value of capacitance should be increased to 10.0 µF from 2 µF. Votes were held with the members, no objections.

7.3 – No change.

7.3.1 – No change

7.3.2 – no change

8.0 – No change

8.1 – No change

8.2 – Instead of using specific clause number, list clause 10. Do not use the date in reference to the main clause. Remove the subclause numbers for the two test methods. No objections from the members on making the change.

8.3 – No change

8.3.1 – No change

8.3.2 – Remove “A digital system is changed by installing a new program.” Change to “A digital system can be adjusted by changing parameters in the software.” No objections from members.

Jim McBride and Dan Sauer to supply new waveform figures to replace figures 27 and 28.

Stopped review at Section 8.3.2

No objections to adjourning.

WG is well on track to complete the review, revise the document per all approved revisions by the par expiration date of 12/31/2026

3. Next meeting: FALL 2024 MEETING ST LOUIS, MISSOURI, USA OCTOBER 27 – 31, 2024

4. Close of meeting
    a. Meeting adjourned at 4:25pm

Submitted by: Hakan Sahin Date: 3/30/24

WG C57.138 Members and Guests list

Below membership as of Spring_24 meeting, which will be updated by the Fall-24 meeting

Last Name	First Name	Company	Status
Abdalla	Isaac	Hico America	Guest
Alonso	Mario	Georgia Transformers	Guest
Arnold	Elise	SGB	Guest
Avanoma	Onome	MJC	Guest
Beaudoin	Jason	Weidmann	Guest
Betancourt	Edwin	Siemens Energy	Guest
Binder	Wallace	Consultant	Guest
Bolliger	Alain	HV Technologies	Member
Bolliger	Dominiques	HV Technologies	Guest
Britton	Jeffery	Phenix Technology	Guest
Carr	Deniss	GE	Guest
Costa	Florian	Corimpex	Guest
CruzValdes	Juan Carlos	Prolec GE	Guest
Davis	Eric	Consultant	Guest
Derouen	Craig	ERMCO	Guest
Diaz	Cesar	Eaton	Guest
Dolloff	Paul	EKPC	Guest
Door	Jeffrey	H-J	Guest
Elliott	William	Prolec GE	Guest
Eshenroder	Jacob	Burns and McDonnell	Guest
Fausch	Reto	RF Solutions	Member
Fayad	Fadi	ASD	Guest
Flores	Hugo	Hitachi	Guest
Frye	Richard	Eaton	Member
Garcia	Eduardo	Siemens Energy	Guest
Gaytan	Carlos	Prolecge	Guest
Ghosh	Rob		Guest
Givaldo	Orlando	HJ Family	Guest
Hernandez	Giovannie	Virginia Transformers	Member
Himow	Monkin	Highvolt	Guest
Hochanh	Thang	PowerTech	Guest
Hopkinson	Phil	Hvolt	Member
Jarosz	Patrycja	IEEE SA	Guest
Jordan	Steve	TVA	Guest
Katz	Nathan	Pacificorp	Guest
Kennedy	Gael	GRKennedy&Associates LLC	Guest
King	Gary	Howard Industry	Guest
Knapp	Evan	Eaton	Guest
Lachman	Mark	Doble	Guest
Lambert	Jason	JST Power	Guest

Last Name	First Name	Company	Status
Leal	Fernando	Prolec GE	Guest
Lee	Moonhee	Hammond power solutions	Guest
Mani	Balakrishnan	ITEC	Guest
McBride	Jim	JMXHV	Member
Montanha	Juliano	Siemens Energy	Guest
Moreno	Andre	Siemens Energy	Guest
Morris	Tim	Walton EMC	Guest
Morrow	Gianetta	Crane Aerospace	Guest
Murray	David	TVA	Guest
Orozco	Polo	GE Grid Solutions	Guest
Owen	John	PowerTech Labs	Guest
Parrales	Herman	Prolec GE	Guest
Patel	Poorvi	EPRI	Member
Pepe	Harry	Phenix Technology	Guest
Plante	Sylvain	Hydro-Quebec	Guest
Plisic	Goran	Siemens Energy	Guest
Posadas	Daniel	CELECO	Guest
Pousset	Baptiste	Transformer Protection Co.	Guest
Prince	Jarrod	ERMCO	Guest
Rhett	Chrysler	ERMCO	Guest
Ronchi	Rodrigo	WEG	Guest
Sahin	Hakan	Virginia and Georgia	Member
Salinas	Fernando	Power Partners	Member
Sarkar	Amitabh	VA Transformer	Guest
Sauer	Dan	Eaton	Member
Schrammel	Alfons	Siemens Energy	Guest
seluargj	Pugual	VA Transformer	Guest
Sexton	Aron	Kinectrics	Guest
Shalabi	Jaber	Vantran	Guest
Sharp	Michael	Trench, LTD	Guest
Slattery	Chris	First Energy	Member
Snyder	Steve	Hitachi Energy	Guest
Som	Sanjib	PTI, LLC	Guest
Steele	Hampton	TVA	Guest
Stretch	Kerwin	Siemens Energy	Guest
Sze	Matthew	Omicron Energy	Guest
Thibolt	Mike	PG&E	Guest
Thomas	Scott	Hitachi Energy	Guest
Tillery	Tim	Howard Industry	Guest
Traut	Alan	Howard	Member
Verdell	Joshua	ERMCO	Guest
Waldrop	Mike	MLGW	Guest
Walker	David	MGM Transformers	Guest
Wallace	David	Mississippi State University	Member
Weisensee	Matt	Pacificorp	Guest
Wimbery	Barret	GE	Guest
Winter	Alexandar	Highvolt	Guest
Yun	Joshua	Virgina Transformer Corp	Member
Zanwan	Anand	Siemens Energy	Guest
Zhang	Shibao	PCORE	Guest
Ziger	Igor	Kovear	Guest

WG C57.160 PD in Bushings/PTs/CTs

Chair: Thang Hochanh
Vice Chair: Reto Fausch
Secretary: vacant

No meeting held in Vancouver. Document in publication process.

WG – Transformer Impulse Test Guide PC57.98

Unapproved Meeting Minutes

March 11, 2024 | 3:15pm – 4:30pm CST

Vancouver, BC Canada

Chair: Thang Hochanh
Vice Chair: Reto Fausch
Secretary: vacant

Meeting Attendance

The working group met at 3:15pm CST
There were 57 attendees 47 Guest
and 10 of 11 members present.
Quorum was achieved to conduct official business.

- The Minutes of Fall 2023 meeting in (Kansas City, MO, USA) had been approved as written.
  - Motion made by Waldemar Ziomek and second by Fernando Leal.
- approve the Agenda for this meeting
  - Motion made by Jeffrey Britton and second by Sylvain Plante .
- Call for patents
  - No claims
- No copyright violations noted.
- **Discussion of the Draft Document**
  - The following items were discussed the correction of Fig. 35 on Page 51 of the draft the labeling in the diagram of the test connection the – E/3 to – E/2, no comments and it was accepted as such
  - In comment to figure C1 we added a new phrase
    - Sudden drop of voltage results in insufficient electric stress across the gap at the time of chop

- In comment to figure C2 we added a new phrase
  - Changing the electronic trigger timing of the chopping gap may produce a chop. If this causes the chop time to be out of specification, it can be discussed between the customer and manufacturer.

    - Those changes were approved by the WG with no comments

- The final version of the complete draft was then presented to the WG and ask for submission of it to the SC for Ballotting.
  Motion made by Sylvain Plante and second by Sergio Hernandez

- WG ask for a 2 year extension of PAR to be submitted
  - Motion made by Waldemar Ziomek and second by Sylvain Plante

A CRG was formed with the following Volunteers

Waldemar Ziomek
Vivian Chan
Sergio Hernandez
James McBride

- Old business: None

  New business: None

  Adjournment: Motion made by Sergio Hernandez and second by Waldemar Ziomek

Thang Hochanh, Chair
Reto Fausch, Vice-Chair

Annex:

PC 57.98 - MEMBERS & Guests

MEETING - Fall 2023

Quorum

Total attendance: 57

Guests: 47

Members attending Spring 2023	
Oname	Avanoma
Dominique	Bolliger
Jeffrey	Britton
Reto	Fausch
Sergio	Hernandez Cano
Thang	Hochanh
Fernando	Leal
Gabriel	Mamede
Sylvain	Plante
Waldemar	Ziomek

Members	11
Memb. Present	10
Quorum	90.9%

Requested Membership	
James	McBride

Attendance Spring 2023	
Isaac	Abdalla
Mario	Alonso
Levant	Beser
Georges	Bouty
Deniss	Carr
Vivian	Chan
Jaroslaw	Chorzepa
Richard	Frye
Didier	Hamoir
Peter	Heinzig
Martin	Himow
Miljenko	Hrwac
Patrycja	Jarosz
Evan	Knapp
Fernando	Lagos
David	Larochelle
Samuel	Lewis
Eric	Li
David	Liu
Luc	Loisette
Ricardo	Lopez
Xose	Lopez-Fernandez
Alberto	Martinez
Mama	Mbouombouo
James	McBride
Julian	Montanho
Ismael	Naja
Mark	Newhill
Cauhtemoc	Ortiz
Joel	Pacas
Parminder	Panesar
Harry	Pepe
Goran	Plisic
Jonathan	Reimer
Aron	Sexton
AbdukMajid	Shaikh
Ho Allen	Steele
Sachin	Tade
Jonathan	Tan
Andreas	Thiede
Eduardo	Tolcachir
John	Vandermmaar
Mike	Waldrop
Joshua	Watson
Barret	Wimberly
Malia	Zaman
Gigi	Zhang

Liaison Report – HVTT

(J. Britton)

- **Standards Activity:**
- IEEE 1122 – IEEE Standard for Digital Recorders for Measurements in HV Impulse Tests
  - *Comment Resolution Completed (Jeff Britton)*
- IEEE 510 – IEEE Guide for Electrical Safety in High-Voltage Testing
  - *Draft Development Adding Clearances for Voltages 1kV-50kV (Jeff Hildreth)*
- IEEE P4.1 Implementation Guide for IEEE 4
  - *Draft Development – Uncertainty Estimation and K-Factor(Bill Larzelere)*
- IEEE P454 – Guide for the Detection, Measurement and Interpretation of Partial Discharges
  - *Draft Development (Glenn Behrmann)*
- IEEE P2426 – Guide for Field Measurement of Fast-Front and Very Fast-Front Overvoltages in Electric Power System
  - *Guide is Published (Shijun Xie)*
- IEEE 4 – Standard for High-Voltage Testing Techniques
  - *PAR for Revision Approved (Jeff Britton)*
- Meeting Activities:
  - All PSIM meetings are hybrid
  - JTCM – Annually (All PSIM Groups)
  - IEEE GM – Annually (Sensors and Electricity Metering)
- Upcoming Meetings:
  - IEEE P454 – March 25th, 2024 (Virtual)
  - HVTT Groups - Fall 2024, Atlanta GA (Hybrid)

WG to Investigate the Interaction between Substation Transients and Transformers in HV and EHV Applications and Revision of C57.142

Vancouver, BC Canada
Tuesday March 12th, 2024
11:00 AM – 12:15 PM PDT
Balmoral (Level 3)

Chairman – Jim McBride
Vice Chair – Xose Lopez-Fernandez
Secretary – Tom Melle

1) Welcome and Chair's Remarks

2) Circulation of Attendance Sheets

- Member count as indicated by signed attendance roster was 33 of 50 members; therefore, quorum was achieved. 60 Guests were present, 7 of which requested Membership. Total Attendance was 93. (Note: the room size was not sufficient for all Members and Guests)

3) IEEE Patent Policy Slides presented. There were no conflicts or patent claims.

4) Presentation and approval of meeting Agenda (motion by John John / second by Phil Hopkinson) and Minutes from Fall 2023 Meeting (motion by Amitabh Sarkar / seconded by Egon Kirchenmayer) – approved without opposition.

5) C57.142 Ballot and Comment Resolution – Jim McBride: The Chair presented a summary of the status of open comments before the ballot resolution group as follows:

Total Comments - 305
Comments Incorporated - 285
Remaining Comments to Address – 20
All Figures – Completed and Included thanks to Dr. Xose Lopez-Fernandez

The latest BRG document and link to the IEEE transactions paper (https://ieeexplore.ieee.org/document/9161400) are posted on WG website.

6) Update on Switchgear Liaison TF - No Task Force meeting held as the Document is in Ballot Resolution. Dave Caverly could not be present at this meeting.

7) Mitigation Methods Task Force Update – Jim McBride / Phil Hopkinson:

Chair requested the TF meet remotely as soon as next week. An invitation will be sent out in the coming days.

8) New Business

The chair discussed the submission of statements by Bertrand Poulin regarding transformer **protection by use of internal surge arrestors** in Section 7.5.

A motion was made by Bertrand Poulin / seconded by Phil Hopkinson to include the submitted paragraph in the Guide.

Discussion followed: Phil Hopkinson stated that series resonances are most damaging to the windings. Bertrand Poulin stated that "everything magnetically couples to everything" inside of a transformer. The WG by and large agreed with these points. Egon Kirchenmayer suggested deleting the phrase "*prevents the excitation of natural frequencies*", as this mitigation only dampens the voltage. Phil Hopkinson agreed this mitigation absorbs energy and provides damping; therefore, a motion was made by Jeffrey Britton / second by Ajith Varghese that the phrase "*reduces the amplitude of natural frequency oscillations*" be adapted. There was no opposition to the motion to include the amended statement and the motion carried without opposition.

The Chair presented prior comments from research by Jin Sim on STLI testing. Dharam Vir made a presentation and commented that in the past modeling was not possible, but modern software can model and predict stresses of a simulated STLI test. The content OF Dharam Vir's presentation will be included within the meeting slides and posted to the WG website.

Phil Hopkinson commented per (Loren Wagenaar) that for 765kV BIL steep-front / long tail should still be considered. Bertrand Poulin agreed with the conclusions of the presentation. Christopher Johnson commented that certainly different models could yield different results and each manufacturer must determine the need for STLI testing independently.

Open discussion of possible mitigation methods summary:

Chair suggested tutorial panel at upcoming TC meeting and a possible technical report or IEEE transactions paper.

Per the last meeting, the WG will move ahead with a group presentation for a future tutorial. Phil Hopkinson suggested eventually incorporating the potential technical report

into perhaps an annex of a future version of C57.142. Joe Watson suggested as we move forward we allow the Dielectric Subcommittee to decide if a new TF should be formed to pass on the WG recommendations to the appropriate standards groups.

9) Presentation by Phil Hopkinson – Switching Mitigation Concepts. Will be posted on the WG website

10) Next Meeting – Fall 2024 in St. Louis, MO

11) Motion to Adjourn at 12:17 PM CDT made by JC Hernandez / seconded by Jeffery Britton with no opposition.

Role	Last Name	First Name	Company
Chair	McBride	James	JMX High Voltage
Vice-Chair	Lopez-Fernandez	Xose	Universidade de Vigo
Secretary	Melle	Thomas	HIGHVOLT
Member	Betancourt	Enrique	Prolec GE
Member	Boettger	William	Boettger Transformer Consulting
Member	Britton	Jeffrey	Phenix Technologies, Inc.
Member	Caverly	David	Trench Limited
Member	Garcia Wild	Eduardo	Siemens Energy
Member	Hopkinson	Philip	HVOLT Inc.
Member	John	John	Virginia Transformer Corp.
Member	Kirchenmayer	Egon	Siemens Energy
Member	Lee	Moonhee	Hammond Power Solutions
Member	Li	Weijun	Braintree Electric Light Dept.
Member	Montanha	Juliano	Siemens Energy
Member	Pepe	Harry	Phenix Technologies, Inc.
Member	Pointner	Klaus	Trench Austria GmbH
Member	Poulin	Bertrand	Hitachi Energy
Member	Roussell	Marnie	Entergy
Member	Sarkar	Amitabh	Virginia Transformer Corp.
Member	Sen	Cihangir	Duke Energy
Member	Sharp	Michael	Trench Limited
Member	Spurlock	Mike	Spurlock Engineering Services
Member	Varghese	Ajith	SPX Transformer Solutions, Inc.
Member	Verdolin	Rogerio	Verdolin Solutions Inc.
Member	Vir	Dharam	Prolec-GE Waukesha

Member	Ziomek	Waldemar	PTI Transformers
Guest	Allison	Robert	Dominion Energy
Guest	Benach	Jeff	Megger
Guest	Bhatt	Vivek	Prolec-GE Waukesha
Guest	Bojan	Popovic	KPT
Guest	Bracum	Robert	KPT
Guest	Casallas	Camilo	Trench LTD
Guest	Digby	Scott	Duke Energy
Guest	Dolloff	Paul	EKPC
Guest	Dorpmanns	Luc	SMIT Transformatoren B.V.
Guest	Espindola	Marco	Hitachi Energy
Role	**Last Name**	**First Name**	**Company**
Guest	Fitzgerald	Sean	ComEd
Guest	Frazier	Raymond	Ameren
Guest	Gamboa	Jose	H-J Family of Companies
Guest	Gara	Lorne	Shermco
Guest	Garcia	Miguel	Hitachi Energy
Guest	Hakim	Shamaun	WEG Transformers USA Inc.
Guest	Hernandez	JC	Georgia Tech - NEETRAC
Guest	Hernandez	Giovanni	Virginia Transfomrer Corp.
Guest	Hoffman	Saramma	PPL Electric Utilities
Guest	Holifield	Thomas	Howard Industries
Guest	Hossain	Saif	Trench Limited
Guest	Howell	Logan	Hitachi Energy
Guest	Johnson	Christopher	Oncor
Guest	Katz	Nathan	Pacific Corp
Guest	Kennedy	Gael	GR Kennedy & Associates LLC
Guest	Kessler	Stacey	Ulteig Engineers
Guest	Khan	Qasim	Georgia Tech - NEETRAC
Guest	King	Gary	Howard Industries
Guest	Kiparizoski	Zan	Howard Industries
Guest	Leal	Fernando	Prolec GE
Guest	Lee	Junho	Hyundai Electric
Guest	Mani	Kumar	Duke Energy
Guest	Martinez	Alberto	WEG
Guest	McBride	Joseph	JMX High Voltage
Guest	Mikulecky	Filip	Siemens Energy
Guest	Munoz	Marta	Hitachi Energy
Guest	Naranjo	Volney	Megger
Guest	Natale	Anthony	HICO America
Guest	Nims	Joe	Allen & Hoshall, Inc.
Guest	Orr	Paul	NEMA
Guest	Pandza	Tihomir	Siemens Energy

Guest	Parkinson	Dwight	EATON Corporation
Guest	Partyka	George	PTI Transformers
Guest	Patel	Nitesh	Hyundai Power Transformers USA
Guest	Patel	Sanjay	SMIT Transformer Sales, Inc.
Guest	Pidcock	Jay	Ameren
Guest	Ploetner	Christoph	Siemens Energy
Guest	Prince	Jarrod	ERMCO
Guest	Radbrandt	Ulf	Hitachi Energy
Guest	Radu	Ion	Hitachi Energy
Guest	Raymond	Tim	EPRI
Guest	Reimer	Jonathan	Fortis BC
Role	**Last Name**	**First Name**	**Company**
Guest	Reyes Perez	Juan	Hitachi Energy
Guest	Richardson	Michael	Ameren
Guest	Rocque	Tim	Prolec GE Waukesha
Guest	Ronchi	Rodrigo	WEG-Voltran
Guest	Schleismann	Eric	Southern Company Services
Guest	Schrammel	Alfons	Siemens Energy
Guest	Sethi	Kabir	Hitachi Energy
Guest	Sharifi	Masoud	Siemens Gamesa Renewable
Guest	Sharpless	Samuel	Rimkus Consulting Group
Guest	Shertukde	Hemchandra	University of Hartford
Guest	Shull	Stephen	BBC Electrical Service, Inc.
Guest	Singh	Kushal	ComEd
Guest	Stacy	Fabian	Hitachi Energy
Guest	Steele	Hampton	Tennessee Valley Authority
Guest	Steineman	Andrew	Delta Star Inc.
Guest	Tabakovic	Dragan	Hubbell Power Systems
Guest	Tolcachir	Eduardo	TTE
Guest	Vermette	Yves	Electro Composites ULC
Guest	Vijayan	Krishnamurthy	PTI Transformers
Guest	Watson	Joe	JD Watson & Associates
Guest	Weatherbee	Eric	PCORE Electric
Guest	Weisensee	Matthew	PacifiCorp
Guest	Wong	Terry	Trench LTD
Guest	Yun	Joshua	Virginia Transformer Corp.
Guest	Zhang	Shibao	PCORE Electric

List of Attendees to the DTSC meeting of March 13, 2024

Role	First Name	Last Name	Company	3/13/2024
Guest	Isaac	Abdalla		X
Guest	Juan	Acosta	Ergon, Inc.	X
Guest	Mihir	Amin		X
Guest	Edmundo	Arevalo		X
Member	Javier	Arteaga	Hitachi Energy	X
Guest	Steven	Ashcraff		X
Member	Onome	Avanoma	MJ Consulting	X
Guest	Sean	Barker		X
Guest	Jason	Beaudoin		X
Guest	Jean-Noel	Berube	Rugged Monitoring Inc.	X
Guest	Edwin	Betancourt		X
Guest	Wallace	Binder	WBBinder Consultant	X
Member	Daniel	Blaydon	Baltimore Gas & Electric	X
Member	William	Boettger	Boettger Transformer Consulting LLC	X
Guest	Sanket	Bolar	Oncor Electric Delivery	X
Guest	George	Bonty		X
Guest	Jeremiah	Bradshaw	Bureau of Reclamation	X
Member	Jeffrey	Britton	Phenix Technologies, Inc.	X
Guest	Deniss	Carr		X
Member	Juan Alfredo	Carrizales	Prolec GE	X
Member	Juan	Castellanos	Prolec GE	X
Guest	Vivian	Chan		X
Guest	Eunyoung	Cho		X
Guest	Rhett	Chrysler	ERMCO	X
Guest	Lian	Conway		X
Member	Juan Carlos	Cruz Valdes	Prolec GE	X
Guest	Marcos	Czernorecki		X
Member	Eric	Davis	Burns & McDonnell	X
Guest	Pouneh	Davoudi	Delta Star Inc.	X
Member	Sami	Debass	Electric Power Research Institute (EPRI)	X
Guest	Gabriel	Delgado		X
Guest	Scott	Digby	Duke Energy	X
Guest	Nikolaus	Dillon	Dominion Energy	X
Member	Huan	Dinh	Hitachi Energy	X
Guest	Luc	Dorpmanns		X
Guest	Jesse	Duffy		X
Member	Samragni	Dutta Roy	Siemens Energy	X
Member	Evgenii	Ermakov	Hitachi Energy	X
Member	Marco	Espindola	Hitachi Energy	X

Member	Reto	Fausch	RF Solutions	X
Guest	Miguel	Fernandez		X
Guest	Marcos	Ferreira	Bonneville Power Adminitration	X
Member	Bruce	Forsyth	Bruce Forsyth and Associates PLLC	X
Member	Raymond	Frazier	Ameren	X
Guest	Rich	Frye	EATON Corporation	X
Guest	Jose	Gamboa	H-J Family of Companies	X
Member	Miguel	Garcia		X
Member	Rob	Ghosh	General Electric	X
Guest	Orlando	Giraldo	H-J Family of Companies	X
Guest	Alireza	Gorzin		X
Member	Bill	Griesacker	Duquesne Light Co.	X
Member	Detlev	Gross	Power Diagnostix Consult GmbH	X
Guest	Ravi	Gupta		X
Member	John	Harley	FirstPower Group LLC	X
Guest	Kyle	Heiden	EATON Corporation	X
Member	Ronald	Hernandez	Doble Engineering Co.	X
Member	Jean Carlos	Hernandez		X
Vice-Chair	Thang	Hochanh	Surplec Inc.	X
Member	Saramma	Hoffman	PPL Electric Utilities	X
Guest	Ryan	Hogg	Bureau of Reclamation	X
Guest	Derek	Hollrah	Burns & McDonnell	X
Guest	Traci	Hopkins		X
Member	Philip	Hopkinson	HVOLT Inc.	X
Guest	Miljenko	Hrkac		X
Guest	Patrycja	Jarosz		X
Guest	Marion	Jaroszelski		X
Guest	Chanmin	Jeong		X
Member	John	John	Virginia Transformer Corp.	X
Guest	Christopher	Johnson		X
Member	Kurt	Kaineder	Siemens Energy	X
Guest	Sergiur	Kapka		X
Member	Jerzy	Kazmierczak	Hitachi Energy	X
Member	Sheldon	Kennedy	Niagara Transformer	X
Member	Stacey	Kessler	TC Energy	X
Guest	Yeounsoo	Kim		X
Member	Egon	Kirchenmayer	Siemens Energy	X
Guest	Dmitriy	Klempner	Southern California Edison	X
Guest	Evan	Knapp	EATON Corporation	X
Guest	Anton	Koshel	Delta Star Inc.	X
Guest	Rafal	Kowalski		X
Guest	Fernando	Lagos		X
Guest	Andrew	Larison	Hitachi Energy	X

Member	David	Larochelle	NDB Technologies	X
Member	Fernando	Leal	Prolec GE	X
Member	Moonhee	Lee	Hammond Power Solutions	X
Guest	Junho	Lee		X
Guest	Angela	Leigl	EATON Corporation	X
Member	Aleksandr	Levin	Weidmann Electrical Technology	X
Guest	Samuel	Lewis		X
Member	Weijun	Li	Braintree Electric Light Dept.	X
Guest	Jinming	Li		X
Guest	Cesar	Lizcano		X
Guest	Ricardo	Lopez		X
Guest	Xose	Lopez-Fernandez	Universidade de Vigo	X
Guest	Tiffany	Lucas, P.E.	SPX Transformer Solutions, Inc.	X
Guest	Andrew	Lugge		X
Guest	Luis	Machain		X
Member	Tim-Felix	Mai	Siemens Energy	X
Guest	Jinesh	Malde		X
Guest	Alberto	Martinez		X
Guest	Robert	Mayer	Siemens Energy	X
Member	James	McBride	JMX Services, Inc.	X
Member	Thomas	Melle	HIGHVOLT	X
Guest	Omar	Mendez		X
Member	Francis	Mills		X
Member	Juliano	Montanha	Siemens Energy	X
Member	Emilio	Morales-Cruz	Qualitrol Company LLC	X
Guest	Gianetta	Morrow		X
Guest	Marta	Muñoz		X
Member	David	Murray	Tennessee Valley Authority	X
Member	Ali	Naderian	METSCO Energy Solutions Inc.	X
Guest	Ismael	Naja		X
Member	Aniruddha	Narawane	EATON Corporation	X
Guest	Kristopher	Neild	Megger	X
Guest	Mark	Newbill		X
Guest	Yaw	Nyanteh		X
Guest	Rudolf	Ogajanov	ABB Inc.	X
Guest	Cuauhtemoc	Ortiz		X
Member	Dwight	Parkinson	EATON Corporation	X
Guest	Pedro	Pedro		X
Member	Harry	Pepe	Phenix Technologies, Inc.	X
Member	Bertrand	Poulin	Hitachi Energy	X
Member	Thomas	Prevost	Weidmann Electrical Technology	X
Member	Jarrod	Prince	ERMCO	X
Member	Ulf	Radbrandt	Hitachi Energy	X

Guest	Farnoosh	Rahmatian		X
Member	Timothy	Raymond	Electric Power Research Institute (EPRI)	X
Member	Scott	Reed	MVA	X
Guest	Jonathan	Reimer	FortisBC	X
Guest	Juan	Reyes		X
Guest	Arash	Rezvan		X
Guest	Michael	Richardson		X
Secretary	Diego	Robalino	Megger	X
Guest	Tim	Rocque	SPX Transformer Solutions, Inc.	X
Member	Zoltan	Roman	GE Grid Solutions	X
Member	Rodrigo	Ronchi		X
Member	Mickel	Saad	Hitachi Energy	X
Member	Hakan	Sahin	Virginia/Georgia Transformer	X
Member	Amitabh	Sarkar	Virginia Transformer Corp.	X
Member	Daniel	Sauer	EATON Corporation	X
Member	Alan	Sbravati	Cargill, Inc.	X
Member	Markus	Schiessl	SGB	X
Guest	Eric	Schleismann	Southern Company Services	X
Member	Ewald	Schweiger	Siemens Energy	X
Member	Cihangir	Sen	Duke Energy	X
Member	Abdulmajid	Shaikh		X
Guest	Jin Woo	Shin		X
Guest	Stephen	Shull	BBC Electrical Services, Inc.	X
Member	Jonathan	Sinclair	PPL Electric Utilities	X
Member	Christopher	Slattery	FirstEnergy Corp.	X
Member	Steven	Snyder	Hitachi Energy	X
Member	Markus	Soeller	Power Diagnostix	X
Guest	Yong Tae	Sohn		X
Guest	Brian	Sparkins		X
Member	Fabian	Stacy	Hitachi Energy	X
Member	Brad	Staley	Salt River Project	X
Member	Kyle	Stechschulte	American Electric Power	X
Guest	Hampton	Steele	Tennessee Valley Authority	X
Member	Andrew	Steineman	Delta Star Inc.	X
Member	Charles	Sweetser	OMICRON electronics Corp USA	X
Member	Matthew	Sze	Omicron Electronics	X
Guest	Jonathan	Tan		X
Member	Troy	Tanaka	Burns & McDonnell	X
Member	Vijay	Tendulkar	Power Distribution, Inc. (PDI)	X
Guest	Marko	Teofanovic		X
Guest	Andreas	Thiede		X
Guest	Scott	Thomas	Hitachi	X
Guest	Mark	Tostrud	Dynamic Ratings, Inc.	X

Member	Alwyn	Van Der Walt	Electrical Consultants, Inc.	X
Guest	Cole	Van Dreel		X
Guest	John	Vandermar		X
Member	Ajith	Varghese	SPX Transformer Solutions, Inc.	X
Member	Jason	Varnell	Doble Engineering Co.	X
Member	Rogerio	Verdolin	Verdolin Solutions Inc.	X
Member	Dharam	Vir	SPX Transformer Solutions, Inc.	X
Guest	Richard	vonGemmingen	Dominion Energy	X
Member	Pragnesh	Vyas	Sunbelt-Solomon Solutions	X
Guest	John	Wagner		X
Member	Mike	Waldrop	Memphis Light, Gas & Water	X
Member	David	Wallace	Mississippi State University	X
Member	David	Wallach	Duke Energy	X
Guest	Alan	Washburn	Burns & McDonnell	X
Guest	Joshua	Watson		X
Member	Bruce	Webb	Knoxville Utilities Board	X
Member	Matthew	Weisensee	PacifiCorp	X
Member	Drew	Welton	Intellirent	X
Member	Daniel	Weyer	Nebraska Public Power District	X
Guest	Joe	White		X
Guest	Rene	Wind		X
Guest	Jeffrey	Wright	Duquesne Light Co.	X
Guest	Shuzhen	Xu		X
Guest	Fei	Yang		X
Guest	Guang	Yuan		X
Guest	Joshua	Yun	Virginia Transformer Corp.	X
Member	Kris	Zibert	Allgeier, Martin and Associates	X
Member	Waldemar	Ziomek	PTI Transformers	X

First Name	Last Name	Email	Company
Isaac	Abdulla	iabdulla@hicoamerica.com	
Kayland	Adams	kayland.adams@prolec.energy	SPX Transformer
Alex	Alahmed	alahmed.alex@gmail.com	Energy Wolf Cre
Daniel	Alelesnalmin	Daniel.alelesnalmin@hitachienergy.com	
Robert	Allison	robert.c.allison@dominionenergy.com	
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Elise	Arnold	elise.arnold@sgb-smit.group	SGB
Javier	Arteaga	javier.arteaga@ieee.org	Hitachi Energy
Onome	Avanoma	o.avanoma@outlook.com	MJ Consulting
Donald	Ayers	donald.ayers@ieee.org	Ayers Transform
Christopher	Baumgartner	chris.baumgartner@we-energies.com	We Energies

Jason	Beaudoin	jason.beaudoin@weidmann-group.com	Weidmann Elect
Enrique	Betancourt	ebetanco@ieee.org	Prolec GE
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Rahul	Bhardwaj	rbhardwaj@burnsmcd.com	
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Daniel	Blaydon	dblaydon@ieee.org	Baltimore Gas &
William	Boettger	weboettger@aol.com	Boettger Transfo
Sanket	Bolar	sanket.bolar@oncor.com	Megger
Michael	Botti	michael.botti@hyosung.com	Hyosung HICO
Jeffrey	Britton	jbritton@doble.com	Phenix Technolo
Wilerson	Calil	wilerson.calil@hitachienergy.com	
David	Calitz	david.calitz@siemens-energy.com	Siemens Energy
Deniss	Carr	deniss.carr@ge.com	GE Grid Solution
Juan Alfredo	Carrizales	juanalfredo.carrizales@prolec.energy	Prolec GE
Camilo	Casallas	camilo.casallas@trench-group.com	Trench Limited
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Eun	Cho	echo@hicoamerica.com	HICO America
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Craig	Colopy	craig.colopy@gmail.com	EATON Corporat
Daniel	Crochett	Dcrochett3@ameren.com	
Janet	Crockett	janet.crockett@faypwd.com	
Juan Carlos	Cruz Valdes	juancarlos.cruz@prolec.energy	Prolec GE
Marcos	Czernoucki	marcos.czernorucki@hitachienergy.com	
Roberto	Da Silva	roberto_ignacio@cargill.com	
Eric	Davis	esetdavis@aol.com	Burns & McDonn
Pouneh	Davoudi	pdavoudi@deltastar.com	Delta Star Inc.
Everton	De Oliveira	everton.oliveira@siemens-energy.com	Siemens Energy
Gabriel	Delgado	gdelgado@invenergy.com	
Scott	Dennis	scott.dennis@hitachienergy.com	Hitachi Energy
Scott	Digby	scott.digby@duke-energy.com	Duke Energy
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Meeting Adjourned at 12:15 PM.