Annex J Performance Characteristics Subcommittee (PCS)

November 17th, 2021, In the Cloud

UNAPPROVED MINUTES

Chair: Rogerio Verdolin
Vice Chair: Sanjib Som
Secretary: Kris Zibert

J.1 Introduction / Attendance

There were 81 of the 114 PCS members in attendance so quorum was achieved (71% in attendance). In addition, 90 guests were present at the meeting. The total attendance at the meeting was 171. Guests should contact the Vice Chair to request membership. Their requests for membership and past attendance will be reviewed. If they meet the membership requirements, they will be granted membership before the next meeting in Denver, Colorado, March 27-31, 2022.

J.2 Chairman's Remarks

The Chair introduced himself, the vice–chair and secretary and provided the below updates and comments.

The Chair asked everyone to mute their microphones unless speaking and reminded everyone to identify themselves and their affiliation when speaking. The Chair discussed that the meeting would be recorded for minutes purposes and then deleted.

The Chair asked everyone to state any affiliation changes since last meeting in the chat window.

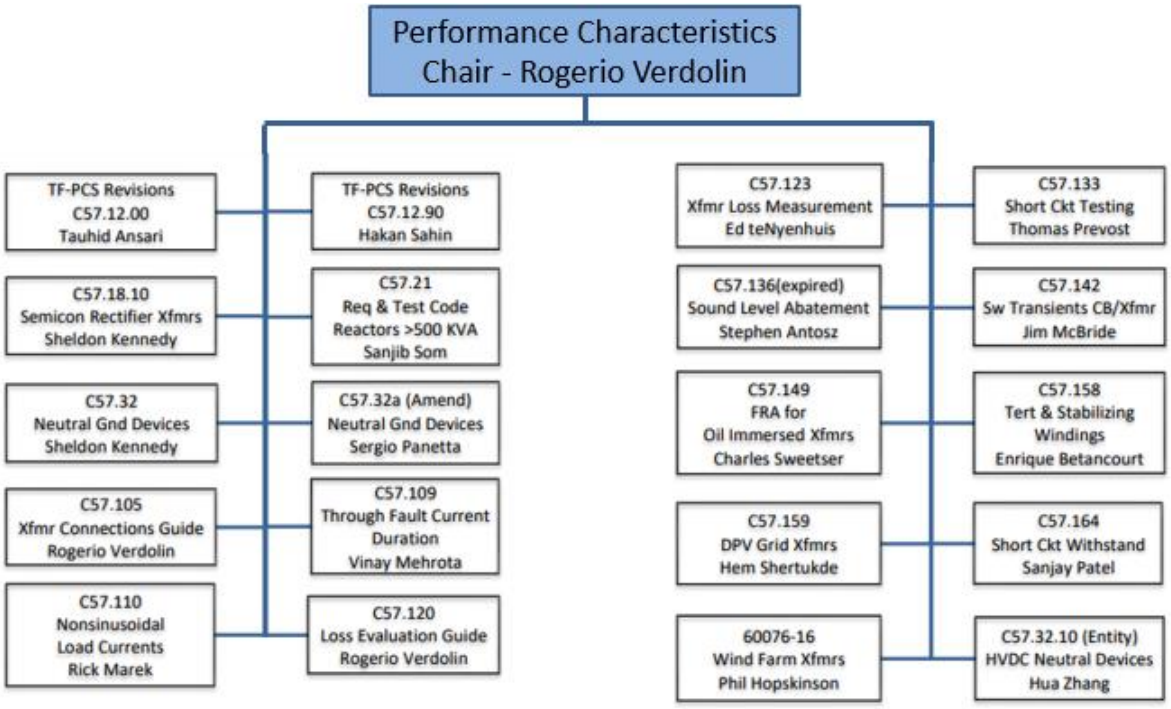
The Chair asked anyone with new business to submit in writing prior to the meeting.

PCS Responsibilities: Defined by the Transformers Committee Organization and Procedures Manual.

The Performance Characteristics Subcommittee shall be responsible for the following:

- Studying and reviewing the treatment of loss, impedance, exciting current, inrush current audible sound and vibration, and other performance characteristics and their methods of application, measurement, or test for liquid filled transformers and liquid filled and dry type reactors.
- Studying and reviewing the treatment of the performance characteristics of other special use transformers e.g. photovoltaic, wind, and rectifier transformers.
- Developing and maintaining related standards, recommended practices, and guides for such criteria
- Coordinating with other technical committees, groups, societies, and associations as required

Standards Supported by PCS:



- C57.12.00 – TF to provide PCS revisions – T. Ansari
- C57.12.90-2015 – TF to provide PCS revisions – H. Sahin (test code) & R. Girgis (audible sound)
- C57.18.10 – Semiconductor rectifier transformers – S. Kennedy
- C57.21 – Requirements & Test Code For Shunt Reactors >500kVA – S. Som
- C57.32-2015 – Neutral Grounding Devices (2025) – S. Kennedy
- C57.32a – Neutral grounding devices – S. Panetta
- C57.32.10 - new Entity PAR - WG Neutral Grounding Reactors Guide for HVDC Converter Transformers
- C57.105 – Transformer connections guide – R. Verdolin
- C57.109 – Through Fault Current Duration – V. Mehrotra
- C57.110 – Xfrmr Capability when Supplying Nonsinusoidal Load Currents – R. Marek
- C57.120 – Guide for loss evaluation – R. Verdolin
- C57.123 – Transformer Loss Measurement – E. teNyenhuis
- C57.133-exp – Guide for Short Circuit Testing (Expired – now covered by C57.12.90) – T. Prevost
- C57.136 – Sound Abatement Guide – S. Antosz
- C57.142 – Switching Transients Circuit breaker/Transformer – J. McBride
- C57.149 – New SFRA Guide (2022) – C. Sweetser
- C57.158 – Tertiary & Stabilizing Windings (2027) – E. Betancourt
- C57.159 – DPV Transformers (2026) – H. Shertukde
- C57.164-new – Short Circuit Withstand (in development) – S. Patel
- 60076-16 – Wind Turbine Generator Transformers – P. Hopkinson

Status of Active PAR's:

- **2021 PAR's**
  - **C57.142 Transient Guide (in Ballot Group Creation)**
  - **C57.164 Short Circuit Withstand Guide (at Rev Com)**
- **2022 PAR's**
  - **C57.32.10 Entity WG Guide for the Selection of Neutral-Grounding Devices for HVDC Converter Transformers (WG in draft development)**
  - **C57.149 SFRA Guide (WG in draft development)**
- **2024 PAR's**
  - **C57.105-2019/Cor 1 (New WG)**
- **2025 PAR's**
  - **C57.136 Audible Sound Guide (New WG)**

Status of Standards without active PARs

- C57.133 – Guide for Short Circuit Testing (Expired, now covered by C57.12.90)
- C57.136-2000 – Sound Abatement Guide (intentionally allowed to expire)
- C57.32-2015 – Neutral Grounding Devices (2025)
- C57.159-2016 – DPV Transformers (2026)
- C57.120-2017 – Loss Evaluation Guide (2027)
- C57.158-2017 – Application of Tertiary and Stabilizing Windings Guide (2027)
- 60076-16-2018 – Wind Turbine Generator Transformers (2028)
- C57.109-2018 – Through Fault Current Duration (2028)
- C57.110-2018 – Xfrmr Capability when Supplying Nonsinusoidal Loads (2028)
- C57.105-2019 – Transformer connections guide (2029)
- C57.123-2019 – Loss Measurement Guide (2029)

Performance Characteristics Subcommittee Membership Requirements

- Voting membership may be requested and granted after attending three of the last five meetings.
- If a voting member misses two consecutive meetings, his or her voting privileges may be revoked. Notification will be sent if voting privileges are revoked.
- Refer to TC P&P 4.3.1 for more information.

Performance Characteristics Subcommittee WG / TF Leaders

- Issue agenda at least 30 days ahead of time
- Minutes are due in 15 days, please get a rough draft of them to us today in MS Word (not PDF) format
- Please keep your webpages up to date – review regularly and send any content/files to Sue
- Must track attendance in AM System
- A patent and copyright call must occur at every WG/TF meeting

Performance Characteristics Subcommittee Meeting Minutes

- Name of the group, time, date, and location of meeting
- Officers names, meeting participants, and member status
- Chair's remarks and reminders of IEEE policies (Patent and Copyright)
- Approval of minutes of previous meeting and agenda

- Technical topics: Brief summary (discussions and conclusions, motions exactly as they are stated, including the names of mover and seconder, and the outcome of each motion)
- Action items, items reported out of executive session
- Recesses and time of final adjournment
- Next meeting—date, time, and location

WG / TF Balloting Reminder

- Working Groups must achieve a 2/3 majority to submit a document for Sponsor Ballot.
- The Subcommittee must achieve a simple majority to submit a document for Sponsor Ballot.

Attendance / Membership – moved to Guest status

The following 1 Member missed the past 2 meetings and have been moved to "Guest" status:

- Roger Fenton

Please contact Sanjib by sending him a message or see him after the meeting if you believe your membership status is not accurate.

Attendance / Membership – New Members

These 7 former Guests requested membership at the Fall 2019 meeting and have attended the past 2 of the last 3 meetings:

- Raj Ahuja
- Jose Gamboa
- Sergio Hernandez Cano
- Rashed Minhaz
- Afshin Rezaei-Zare
- Kyle Stechschulte

Welcome the New Members: We look forward to your contributions to the Subcommittee

Attendance / Membership – Quorum determination

- Current breakdown of the Subcommittee:
  - 114 Members
  - 58 are needed for a quorum
- Quorum was established.

J.3 Approval of Agenda

The Chair presented the agenda and entertained a motion to approve. The agenda had been sent to the members by email several weeks prior to the meeting. The motion passed by unanimous consent.

J.4 Approval of Last Meeting Minutes

The Chair presented the minutes of meeting held in the Spring 2021 – April 28th, 2021 and entertained a motion to approve. The minutes had been sent to the members by email several weeks prior to the meeting. The motion passed by unanimous consent.

J.5 Minutes from Working Groups and Task Force

The following WG and Task Force reports were received (the reports are appended later).

- **WG Guide for FRA for Liquid Filled Transformers C57.149** **C. Sweetser**
- **TF PCS Audible Sound Revision to Test Code** **R. Girgis**
- **TF PCS Continuous Revisions to C57.12.00** **T. Ansari**
- **TF PCS Continuous Revisions to Test Code C57.12.90** **H. Sahin**
- **WG HV & EHV Breaker & Transformer Sw. Transients C57.142** **J. McBride**

Below are highlights that were discussed at the PCS meeting:

1) WG Guide for FRA for Liquid Filled Transformers C57.149 **C. Sweetser**

Meeting Date/Time: November 15, 2021 10:25 AM
Vice-Chair: Poorvi Patel (EPRI)
Secretary: James Cross (Kinectrics)
80 total attendees, consisting of 17 members and 63 guests. The WG achieved a quorum. 17/32
Highlights:

- Consolidated failure mode considerations
- New Analysis Section for Radial Deformation
- Included 2 - Radial Deformation Cases
- Discussed frequency range identification
- Presented newly reformatted connection tables:

Table 1—Two winding transformers – 15 tests

Test type	Test #	3ϕ	1ϕ
HV Open Circuit (OC) All Other Terminals Floating	1	Phase A	Phase A
	2	Phase B	
	3	Phase C	
LV Open Circuit (OC) All Other Terminals Floating	4	Phase A	Phase A
	5	Phase B	
	6	Phase C	
Short Circuit (SC) Short [X1-X2-X3][a]	7	Phase A	Phase A Short [X1-X2][a]
	8	Phase B	
	9	Phase C	
Capacitive Inter-Winding All Other Terminals Floating	10	Phase A	H1-X1
	11	Phase B	
	12	Phase C	
Inductive Inter-Winding High (H) to Low (L) Ground (H- and X-)[b]	13	Phase A	Phase A Ground [H2, X2]
	14	Phase B	
	15	Phase C	

Table 1— SFRA test connection for even phase deviation between windings

Transformer vector Diagram	Phase	HV winding	Phase group/LV winding connection					
			0	2	4	6	8	10
1ph	A	H1-H2	X1-X2	n/a	n/a	n/a	n/a	n/a
	B	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	C	n/a	n/a	n/a	n/a	n/a	n/a	n/a
YNyn	A	H1-H0	X1-X0	X0-X2	X3-X0	X0-X1	X2-X0	X0-X3
	B	H2-H0	X2-X0	X0-X3	X1-X0	X0-X2	X3-X0	X0-X1
	C	H3-H0	X3-X0	X0-X1	X2-X0	X0-X3	X1-X0	X0-X2
Dd	A	H1-H3	X1-X3	X1-X2	X3-X2	X3-X1	X2-X1	X2-X3
	B	H2-H1	X2-X1	X2-X3	X1-X3	X1-X2	X3-X2	X3-X1
	C	H3-H2	X3-X2	X3-X1	X2-X1	X2-X3	X1-X3	X1-X2

Table 2— SFRA test connections for odd phase deviation between windings

Transformer Vector Diagram	Phase	HV winding	Phase group/LV winding connection					
			1	3	5	7	9	11
YNd	A	H1-H0	X1-X2	X3-X2	X3-X1	X2-X1	X2-X3	X1-X3
	B	H2-H0	X2-X3	X1-X3	X1-X2	X3-X2	X3-X1	X2-X1
	C	H3-H0	X3-X1	X2-X1	X2-X3	X1-X3	X1-X2	X3-X2
Dyn	A	H1-H3	X1-X0	X0-X2	X3-X0	X0-X1	X2-X0	X0-X3
	B	H2-H1	X2-X0	X0-X3	X1-X0	X0-X2	X3-X0	X0-X1
	C	H3-H2	X3-X0	X0-X1	X2-X0	X0-X3	X1-X0	X0-X2

- Connection tables are completed
- Test order lists will be added for 2W, 3W, and Auto

2) TF on Audible Sound Revision to Test Code/C57.136 Guide for Audible Sound **R. Girgis/S. Antosz**

- The TF met on Monday.
  - 25 members attended, out of a total of 61 total attendance.
  - The TF has 44 members now.
- First technical item on the Agenda :
  - Overview of the items discussed in detail at previous TF meetings with the resolution to address them in more detail in the new Noise Guide PC57.136
    - Impact of temperature on core noise

        - Impact of temperature on load noise
        - Impact of tap position on core noise
        - Impact of tap position on load noise
- Second technical item on the Agenda:
    - Overview of resolutions of comments received on ballots of the C57.12.00 and C57.12.90
        - Table C.1 of Annex C on No Load Sound levels was expanded to include sound levels of both Power & Distribution transformers
        - Add text in the Noise Guide explaining the relative levels of no load and load noise.
        - Requesting No-Load sound level measurements to be required to be made (and guaranteed) at the highest sound producing tap position combinations
            - This will require a change in C57.12.00 and therefore is planned to be discussed in a future TF meeting.
        - Requesting whether to add ambient sound pressure measurements arithmetically or logarithmically, to determine the average level.
            - Difference is <1 dB. Plan to be discussed and decided upon in a future TF meeting.
        - Requesting measuring load noise after the Heat-Run test
            - Already discussed in detail, impact is small, and is being discussed in Noise Guide.

3) WG on Noise Guide C57.136 S. Antosz

- WG held first meeting
- Chair presented background and status of the guide and an overview of the content of the guide.
- A solicitation of those in attendance was initiated to request membership. A total of 22 requests were received.
- Input to specific parts of the Guide was requested.
- The plan is to include these into the next draft of the Guide and send it back to the WG for comments and additional input.
- The updated draft of the Guide will be posted on the committee website in the C57.136 section under Performance Characteristics Subcommittee.

4) TF on PCS Continuous Revisions to C57.12.00 T. Ansari

- TF group met Nov 15, 14:20 hr with 40 out of 79 Members present.
- The Chair presented Copyright and Patents Disclosure documents from IEEE.
- Minutes from Spring 2021 Meeting were approved.
- Agenda Item discussed: Addition of transformer core information on Type C Nameplate.
    - Accepted to indicate Type of Core: “Shell” or “Core”.
    - Discussion not finished to define Specific type of construction: “D or Conventional”, for Shell type transformers, number of columns and how many of those wound, for “Core” type transformers.
- Meeting adjourned at 15:35 hr.

5) TF on PCS Continuous Revisions to Test Code C57.12.90 H. Sahin

- Meeting started at 9:25 am CST. Quorum was not achieved during the first poll. Meeting continued to share the information
- 30 minutes into the meeting, a second poll was conducted, and quorum was achieved with 37/69 members’ presence out of 79 total attendees
- Agenda and previous meeting minutes were officially approved

- Updated the TF that the revision to the "Ratio Test Methods" under section 7.3 was passed on to the PCS
- TF second revision survey results and comments for proposed changes to the "Ratio tests voltage and frequency" section 7.1.2 was reviewed. Members voted to pass the new version of the section to the PCS
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- Agenda and previous meeting minutes were officially approved
- Updated the TF that the revision to the "Ratio Test Methods" under section 7.3 was passed on to the PCS
- TF second revision survey results and comments for proposed changes to the "Ratio tests voltage and frequency" section 7.1.2 was reviewed. Members voted to pass the new version of the section to the PCS
- Discussion took place regarding surveying the recommendations of this TF to the PCS SC for approval.

6) **WG on HV & EHV Breaker & Transformer Sw. Transients C57.142 J. McBride**
   - 58 total attendees, consisting of 25 members and 33 guests. The WG did not achieve a quorum. 25 / 56
   - Agenda and Minutes were Approved via e-mail.
   - IEEE Transactions Paper developed by those in the C57.142 WG has been published and is now available at https://ieeexplore.ieee.org/document/9161400.
   - Transformers WG and Switchgear Committee Task Force have unanimously approved Draft 9B which has now been submitted to MEC for review.
   - The ballot group formation has been initiated and those who wish to join the ballot group should join before December 10th, 2021.
   - We have received a PAR extension to complete the balloting process. PAR now expires on December 31st, 2023.
   - Switchgear Committee has requested that we help to provide dielectric transient withstand information on transformers and reactors. There was some discussion on this topic and a small TF was formed to help draft a response. Any response will be reviewed and approved prior to sending.
   - We reviewed the Mitigation Methods which have been presented and discussed in our WG meetings. There was an open discussion to organization of these items for presentation to the Dielectric Tests subcommittee. Several participants offered to assist in future virtual meeting to help draft a completed response to Dielectric Test Subcommittee task.
   - New Business – Deepak Kumaria - Requested inclusion of instrument transformers in our mitigation studies. This topic was postponed due to lack of time remaining in today's meeting.
   - Next Meeting: Spring 2022 – Denver, CO on March 29th, 2022.
   - The meeting was Adjourned at 3:40pm Central Time.

J.6 Unfinished (Old) Business

- **There was no old busines.**

J.7 New Business

- **There was no new business.**

J.8 Adjournment

- **The meeting adjourned at 3:21PM.**

J.9 Minutes of Meetings of Working Group (WG) and Task Force (TF) Reports (all unapproved)

J.9.1 WG Guide for FRA for Liquid Filled Transformers C57.149

Working Group "Guide for FRA for Liquid-Filled Transformers" C57.149
(Performance Characteristics Sub-Committee)

Meeting Date/Time: November 15, 2021 1010 H
Meeting Location: Virtual – On-Line
Chairman: Charles Sweetser [CS] (Omicron)
Vice-Chair: Poorvi Patel (EPRI)
Secretary: James Cross (Kinectrics)

Meeting was convened at 1010 H by Chairman Charles Sweetser with 70 total attendees, consisting of 18 members and 52 guests. A quorum was achieved.
AGENDA

1. Introduction and Member confirmation / Attendance poll
2. Meeting Guidelines and Patent information.
3. Review Agenda
4. Approval of Minutes from October 19, 2020 and April 26, 2021 Meetings (Virtual) Discussions
    a. Update/Presentation – Analysis and Interpretation (New Radial Format)
        i. Peter Werelius (Megger) - Lead
    b. Connection Table Discussion – Presentation of new tables
        i. Diego Robalino (Megger)
5. Old Business
6. New Business
7. Adjourn

CS reviewed the IEEE Working Group meeting guidelines and the standard patent disclosure info. (No response from attendees to request for patent info.)
CS showed a slide showing the WG membership in preparation for the electronic polling of attendance. Attendees of the virtual meeting were instructed to confirm whether or not their name was on the membership roster.
CS waited 5 minutes before triggering the attendance poll to allow people to sign into the meeting.
The membership list shows 32 WG members.
18 members were present at this meeting, so quorum was achieved.
The agendas and minutes were approved, both Fall 2020 and Spring 2021.
CS noted that there is a 1 year left on the PAR and so we need to get the draft prepared this year for balloting.
Discussions:
Revision tasks are wrapping up with the main focus on consolidated failure modes, connection tables, and analysis.
Latest work included:

1. Consolidated failure mode considerations

The consolidation is as follows:

- Radial "Hoop Buckling" Deformation of Winding

    - Axial Winding Elongation “Telescoping”
    - Overall- Bulk & Localized Movement
    - Core Defects
    - Winding Turn-to-Turn Short Circuit
    - Winding Looseness due to Transportation
    - Residual Magnetization
2. New Analysis Section for Radial Deformation
    - Introduced newly formatted Radial Winding deformation section. Several new edits were discussed. Two new figures added along with two new case studies.
    - Discussions focused around identifying frequency ranges associated with Radial Winding deformation. The WG will keep the original ranges.
3. Presented newly reformatted connection tables:
    - Connection tables are completed and presented by Diego Robalino
    - Test order lists will be added for 2W, 3W, and Auto

- Section leadership assignments for final wrap-up
    - Grounding – Wes Schrom
    - Connection – Diego Robalino
    - Analysis – Mario Locarno

List of meeting participants with membership status at the end of the meeting:

Ali Naderian	
Jonathan Reimer	
Rogerio Verdolin	Member
Amitabh Sarkar	
Taylor Gray	
Sergio Hernandez Cano	
Sudip Chanda	
Fernando Leal	Member
Jeremiah Bradshaw	
Mark Perkins	
Drew Welton	
Suresh Babanna	
Eduardo Garcia	
Eric Davis	
Stacey Kessler	
Luiz Cheim	Member
Sanket Bolar	
Philip Miller	
George Frimpong	
Diego Robalino	Member
Alwyn VanderWalt	
vinay mehrotra	
Jeff Ray JLR Consulting	
Loren Wagenaar	
Rodrigo Ocon	
Jason Varnell	Member
Emilio Morales-Cruz	
Charles Sweetser	Member
Jonathan Sinclair	Member
Waldemar Ziomek	
Shibao Zhang	Member
Pranav Ketharam Pattabi	

Leopoldo Rodriguez	
Mario Locarno	Member
Rob Ghosh	
Zack Draper	
James Gardner	
James Cross	Member
Wes Schrom	Member
Dwight Parkinson	
Daniel Weyer	Member
Paul Boman	
Hakan Sahin	
arturo nunez	
Donnie Rackley	
Kenn Skinger	
David Murray	
Jim McBride	Member
Roger Hayes	
Rakesh Patel	Member
Balakrishnan Mani	
Marco Espindola	
Wayne Ellis	
Scott Reed	Member
Bill Whitehead	
Shawn Gossett	
Patrick Picher	Member
Arup Chakraborty	
Matthew Mcfadden	
Larry Christodoulou	
Gael R Kennedy	
Brady Nesvold	
Bertrand Poulin	
Ed teNyenhuis	
Chris Slattery	
Mickel Saad	Member
K.Vijayan	
Steve Jordan	
Peter Werelius	Member
Evgenii Ermakov	Member
Alexander Kraetge	
Paul Jarman	
Jos Veens	
Matthew Pinard	
Lorne Gara	

Respectfully submitted,

James Cross
Secretary
C57.149 WG

J.9.2 TF PCS Continuous Revisions to Test Code C57.12.90

Meeting was called to order at 9:25 AM CST, November 16, 2021.

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. Introduction of the new officers
        i. Chair: Hakan Sahin
        ii. Vice-Chair: -
        iii. Secretary: Pugal. Selvaraj
    d. Update on membership and Quorum
        i. First poll conducted at 9:30AM did not achieve quorum, second poll conducted at 11 AM, achieved quorum with 37/69 members' presence
    e. Approval of Agenda
        i. No opposition to unanimous approval. APPROVED
    f. Approval of minutes from Fall 2020 and Sprint 2021 TF Meeting
        i. Minutes of both Fall 2020 meeting and Spring 2021 meetings were approved.

2. **Old Business – "Ratio Test Methods" clause 7.3**

    a. Chair provided update on the status of changes to "Ratio Test Methods" under section 7.3. This revision was already approved by poll during the Spring-21 meeting. However, Chair needed to confirm the poll submitters' member status. Chair shared with the group that he had confirmed the poll member count, and the revision was passed on to PCS for survey. Revision as below:

7.3 Ratio test method

7.3.1 Electronic ratio and phase measurement meters

An electronic meter that determines the transformer turns ratio, polarity and phase angle may be used for the measurement of these parameters

7.3.2 Voltmeter method (This is currently 7.3.1)

(Clause number changes and descriptions stay the same**)**

7.3.3 Comparison method (This is currently 7.3.2)

(Clause number changes and descriptions stay the same**)**

Current 7.3.3 Ratio meter clause (R/R1) to be removed

3. **Old Business - "Ratio tests voltage and frequency" under section 7.1.2**

Chair shared the proposed changes with the group, which was surveyed within the TF. The proposed revision was:

Ratio test Voltage and Frequency

CURRENT:

7.1.2 Voltage and frequency

- The ratio test shall be made at rated or lower voltage and rated ~~or higher~~ frequency.

NEW PROPOSAL:

7.1.2 Voltage and frequency

- The ratio test shall be made at rated or lower voltage and be such that the ratio of test voltage to test frequency is less than or equal to the ratio of rated voltage to rated frequency.

Survey results within the Task Force was:

Approved:	**22**
Disapproved:	**6**
Abstain:	**2**
Total Response:	**30**

Chair commented to pass the revision to PCS to be surveyed since it has passed with majority approvals. However, Bruce Forsyth corrected the Chair that since the total responses were less than the half of the total members, it would not count as "pass" within the TF, hence recommended to survey during the meeting since we had the quorum. Peter Klaine made motion to accept the proposed revisions to the ratio voltages and test frequency under section 7.1,2 and pass on the survey results to PCS. Steve Antoz seconded the motion. Daniel Blaydon made objection for unanimous approval and the motion was set on floor for voting. Motion was accepted with 29 members for, 3 against and 3 abstain.

4. Old Business – "Number of short circuit tests" under section 12.3.4

Chair presented the proposed changes to the "Number of short circuit tests" under section 12.3.4 along with the survey results which was done within the Task Force. The proposed revision and the survery results are as follows:

Current Version:

12.3.4 Number of tests

Each phase of the transformer shall be subjected to a total of six tests satisfying the symmetrical current requirement specified in 12.3.1 or 12.3.2, as applicable. Two of these tests on each phase shall also satisfy the asymmetrical current requirements specified in 12.3.3.

Proposed Version

12.3.4 Number of tests

- When a three-phase transformer is tested in a three-phase test circuit or in a single-phase test circuit as given in Annex C, each phase of the transformer shall be subjected to three tests satisfying the asymmetrical current requirements specified in 12.3.3. The tests shall be performed on one of the outer phases with the tap-changer in the maximum position, on the other outer phase with the tap-changer in the minimum position and on the middle phase with the tap-changer in the principal position
- When a single-phase transformer is tested in a single-phase test circuit the transformer shall be subjected to three tests satisfying the asymmetrical current requirements specified in 12.3.3. The three tests shall be performed one each, with the tap-changer in the maximum, minimum and principal position.

Approved:	**20**
Disapproved:	**3**
Abstain:	**8**
Total Response:	**31**

Since we had the quorum, Chair asked if anyone had any objections to passing the presented revision. John John made motion to accept the proposed revisions to the number of short circuits under section 12.3.4 and forward survey results to PCS. Peter Klaine seconded the motion. Chair opened the floor for discussions comments and objections. Motion passed.

5. Old Business - N*ew* proposed test sections 8.7 & 9.6 for OLTC tests

Chair Presented the new proposed test sections for OLTC tests under section 8.7 and 9.6, along with the Task Force survey results, which are as follows:

8.7 On Load Tap Changer Voltage Test

8.7.1 General

In order to verify the performance of a transformer that has an on load tap changer (OLTC), the OLTC shall be operated through one end-to-end-to-end sequence (from one tap extreme to the other tap extreme and back again) with the transformer energized at rated voltage.

8.7.2 Control voltage

Control voltage for the OLTC motor during the test shall be as near to rated voltage as possible, with a minimum of 85%.

8.7.3 Preparation for the test

The OLTC shall be fitted with all included equipment. It shall be connected as it will be in service, including protective devices.

8.7.4 Procedure

Either the high or low voltage winding of the transformer under test shall be energized at rated voltage and frequency, unless otherwise specified. The OLTC shall be operated using the motor drive but not manual rotation. The OLTC shall be operated through all tap positions twice, starting at one tap extreme and progressing to the other tap extreme, and then return back again to the original tap position.

The test may be performed at intervals, if necessary, such as to adjust the test circuit for the applied voltage to be adjusted to the rated voltage of the tap position, but it is a requirement that the transformer be energized at no less than rated voltage corresponding to each tap to be changed.

8.7.5 Observations and Analysis

8.7.5.1 Audible Sound

The transformer shall be observed during this test and the operator shall identify that the sound during the tap changing operations was either normal or abnormal. With some types of tap changers, there will be abnormally loud sounds if components are not assembled properly. Note that during operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

8.7.5.2 Supply Test Circuit

The test control system shall be monitored for any trip of the test circuit that automatically stops the circuit from keeping the transformer energized.

8.7.5.3 Dissolved Gas-in-Oil Analysis

Oil samples shall be taken from the LTC compartment of vacuum type tap-changers before and after the test and analyzed for dissolved gasses. Results of the analysis may show some increase of dissolved gases due to current commutation, resistor heating and / or stray-gassing of the oil.

8.7.6 Failure Detection and Acceptance Criteria

The transformer will have passed this OLTC Voltage test if:

- The tap changer operates normally with no abnormal sound
- The transformer stays energized without a trip in the supply test circuit
- For mineral oil filled vacuum OLTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type OLTCs and 6 ppm for compartment type LTCs.
- For non-vacuum type OLTCs, or OLTCs filled with a liquid other than mineral oil, the determination of acceptance criteria is through sound only and there is not a limit for increase in gases.

9.6 On Load Tap Changer Current Test

9.6.1 General

In order to verify the performance of a transformer that has an on load tap changer (OLTC), the OLTC shall be operated through one end-to-end-to-end sequence (from one tap extreme to the other tap extreme and back again) with the transformer current flowing through the windings, corresponding to the top nameplate MVA rating.

9.6.2 Control voltage

Control voltage for the OLTC motor during the test shall be as near to rated voltage as possible, with a minimum of 85%.

9.6.3 Preparation for the test

The OLTC shall be fitted with all included equipment. It shall be connected as it will be in service, including protective devices.

9.6.4 Procedure

The test shall be performed by applying a short circuit either the high-voltage winding or the low-voltage winding and applying sufficient voltage across the other winding to cause a specific current to flow in the windings. The OLTC shall be operated using the motor drive but not manual rotation. The OLTC shall be operated through all tap positions twice, starting at one tap extreme and progressing to the other tap extreme, and then return back again to the original tap position.

The test may be performed at intervals, if necessary, such as to adjust the test circuit for the applied voltage to be adjusted to the required current of the tap position, but it is a requirement that the transformer be energized at no less than 80% of the top MVA nameplate current value for each tap change.

9.6.5 Observations and Analysis

9.6.5.1 Audible Sound

The transformer shall be observed during this test and the operator shall identify that the sound during the tap changing operations was either normal or abnormal. With some types of tap changers, there will be abnormally loud sounds if components are not assembled properly. Note that during operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

9.6.5.2 Supply Test Circuit

The test control system shall be monitored for any trip of the test circuit that automatically stops the circuit from keeping the transformer energized.

9.6.5.3 Dissolved Gas-in-Oil Analysis

Oil samples shall be taken from the LTC compartment of vacuum type tap-changers before and after the test and analyzed for dissolved gasses. Results of the analysis may show some increase of dissolved gases due to current commutation, resistor heating and / or stray-gassing of the oil.

9.6.6 Failure Detection and Acceptance Criteria

The transformer will have passed this OLTC Current test if:

- The tap changer operates normally with no abnormal sound
- The transformer stays energized without a trip in the supply test circuit
- For mineral oil filled vacuum OLTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type OLTCs and 6 ppm for compartment type LTCs.
- For non-vacuum type OLTCs, or OLTCs filled with a liquid other than mineral oil, the determination of acceptance criteria is through sound only and there is not a limit for increase in gases.

Approved:	**25**
Disapproved:	**3**
Abstain:	**4**
Total Response:	**32**

Chair asked the group if anyone had any objections to approving to pass the new section to PCS for survey. Steve Antoz made motion to accept the proposed revisions to the LTC tests under section 8.7 and 9.6 as presented and forward the survey results to PCS. Hugo Flores seconded the motion. However, there was an objection to the approval, as:

Dr Alexander commented that some factories may not have needed power source to conduct the test per proposed revisions and sought permission to make a presentation on the impact of the changes. Due to lack of time, and the long history of the work performed on these new clauses, which was presented, Chair declined the request of Dr. Alexander for making presentation. Rainer Frotscher commented that the discussions regarding power source requirements were discussed in the past meetings and clarified. Dr. Alexander made objection for unanimous approval. The Motion was sent for poll voting. Motion passed with 34 approval, 2 opposed and 5 abstain. The group approved the new sections to be sent to PCS for survey.

Chair commented that since there is no definitive conclusion to either using "LTC" or "OLTC", he will change the acronym to the most commonly known "LTC" and send the new clauses to PCS to be surveyed.

6. **New Business - Request by Jason Varnell to revise the subclauses 9.3.a and 9.3.b, "Tests for measuring load losses and impedance voltage" to bring better clarity, and Chair's proposal for this revision**

   Chair presented the new business requested by Jason Vernal's to revise the subclauses 9.3.a and 9.3.b for better clarity. Chair presented the question and his answers to each, as follows:

Q: Does the requirement for no more than a 5°C temperature difference stated in 9.3.a.1 apply for both of the measurements taken immediately before and after the load loss test as stated in 9.3.a.2 or is just applicable to the before test measurement?

A: 9.3.a.1 is for before. However, we will discuss 9.3.a.3 refers to in the next slide

9.3 Tests for measuring load losses and impedance voltage

Regardless of the test method selected, the following preparatory requirements shall be satisfied for accurate test results:

a) To determine the temperature of the windings with sufficient accuracy, the following conditions shall be met, except as stated in the NOTE in 3). ~~2).~~

   1) The temperature of the insulating liquid has stabilized, and the difference between top and bottom liquid temperatures does not exceed 5 °C.

   2) The temperature of the windings shall be taken immediately before and after the load losses and impedance voltage test in a manner similar to that described in 5.1. The average shall be taken as the true temperature.

   3) The difference in winding temperature before and after the test shall not exceed 5 °C.

Q: I've observed that some interpret 9.3.a.1 as a prerequisite to start the test but that subclause 9.3.a.3 is the criteria for the after test measurement and that the 5ºC temperature difference between the top and bottom liquid does not apply to the after test measurement.

A: 9.3.a.3 interpretation is such that, the top and bottom oil temperatures difference after completion of the Load Loss test to before temp difference shall not exceed 5ºC difference. The purpose is to perform the load loss tests in timely manner not to heat the windings up more than they would. We also need to pay attention to "9.3.a.2", as in sequence and look at section 5.1

5.1 Determination of cold temperature

The cold temperature of the winding shall be determined as accurately as possible when measuring the cold resistance. The precautions in 5.1.1, 5.1.2, and 5.1.3 shall be observed.

5.1.1 General

Cold-resistance measurements shall be made on a transformer only when the liquid or winding temperature is stable. The temperature is considered stable if the top liquid temperature does not vary more than 2 °C in a 1-h period.

5.1.2 Transformer windings immersed in insulating liquid

The temperature of the windings shall be assumed to be the same as the average temperature of the insulating liquid, provided:

a) The windings have been under insulating liquid with no excitation and with no current in the windings for a minimum of 3 h for a transformer without pumps and for 1 h for transformer with pumps running before the cold resistance is measured.

b) The temperature of the insulating liquid has stabilized, and the difference between top and bottom temperature does not exceed 5 °C.

Q: Why is subclause 5.1 referenced in subclause 9.3.a.2 and which specific sub-section of 5.1?
A: Answered in the previous slide

I assume the reference is to subclause 5.1.2 but 5.1.2.e (it should be noted that this subclause is incorrectly labeled as "e" instead of "a" Corrected in the new revision) states that the transformer should have no excitation for 3 hours prior to the measurement. Is that the intent of referencing to subclause 5.1? I don't think so. It should be noted that if the reference was for subclause 5.1.1 then that directly contradicts the criteria given in 9.3.a.1. Discussed in the previous slide

In subclause 9.3.a, there is a reference to a "NOTE in 2)" but there is only a note after "3)". Corrected in the new revision

Q: Which "leads" from subclause 9.3.b are to be considered? Is it the lead cables/bus that are internally connected to the bushings or the winding lead exits? Internal bushing line leads In my opinion it is unclear. I assume that it refers to the cross-sectional area of the conductors connected internally to the bushing. Some have interpreted it as the external bushing spades. I have observed that the "leads" design information is not frequently given to the test department and it is difficult to obtain the design values unless there was a design review or request to engineering.

b) The conductors used to short-circuit the low-voltage high-current winding of a transformer shall have a cross-sectional area equal to or greater than the corresponding transformer leads.

Raja Ahuja commented that the clarification is sufficient, and revision is not necessary. Steve Antoz recommended to Jason to make a proposal of the revision for review and Jason Vernal agreed to provide the proposed changes to Chair.

Final Remark by the Chair:

I will send all these revisions and new clauses to PCS and work closely with PCS Chair Rogerio and help during the PCS survey of these clauses. We will target to get these done in January 2022.

7. Next meeting: TBD at Spring 2022 Transformer Committee Meeting scheduled for March 27-31, 2022 in Denver, Colorado, USA

8. Close of meeting
    a. Meeting adjourned at 10:40 AM CST
9. Attendee's list is provided in Annexure - A

Submitted by: Hakan Sahin Date: 12/27/21

Annexure – A Meeting Attendance:

Aaron Meyers	EATON Corporation
Ajith Varghese	SPX Transformer Solutions, Inc.
Alain Bolliger	HV TECHNOLOGIES, Inc.
Alexander Kraetge	OMICRON electronics Deutschland GmbH
Amitabh Sarkar	Virginia Transformer Corp.
Andy Steineman	Delta Star Inc.
Anthony Franchitti	PECO Energy Company
Antonio Ceballos	Georgia Transformer
Arup Chakraborty	Delta Star Inc.
Axel Kraemer	Maschinenfabrik Reinhausen
Barry Beaster	The H-J Family of Companies
Bertrand Poulin	Hitachi ABB Power Grids
Bill Griesacker	Boettger Transformer Consulting LLC
Brady Nesvold	Xcel Energy
Brandon Dent	Memphis Light, Gas & Water
Bruce Forsyth	Bruce Forsyth and Associates LLC
Charles Sweetser	OMICRON electronics Corp USA
Chris Baumgartner	We Energies
Chris Powell	Intermountain Electronics
Chris Slattery	FirstEnergy Corp.
Craig Colopy	EATON Corporation
Curtiss Frazier	Ameren
Daniel Blaydon	Baltimore Gas & Electric
Daniel Weyer	Nebraska Public Power District
DANIELA EMBER BACIU	Hydro-Quebec IREQ
Darren Brown	Howard Industries
David Murray	Tennessee Valley Authority
David Walker	MGM Transformer Company
Digby Scott H	Duke Energy
Don Dorris	Nashville Electric Service
Donald Ayers	Ayers Transformer Consulting
Alexander Winter	HIGHVOLT Pruftechnik Dresden
Duvier Bedoya	Hitachi ABB Power Grids
Dwight Parkinson	EATON Corporation

Eduardo Garcia	Siemens AG
Elise Arnold	SGB
enrique betancourt	Prolec GE
Eric Schleismann	Southern Company Services
Eric Weatherbee	PCORE Electric
Evgenii Ermakov	Hitachi Energy
Feras Fattal	Manitoba Hydro
Fernando Leal	Prolec GE
Gael Kennady	GR Kennedy & Associates LLC
Gary King	Howard Industries
Hakan Sahin	Virginia and Georgia Transformers
Harry Pepe	Phenix Technologies, Inc.
Hemchandra Shertukde	University of Hartford
Hugo Flores	Hitachi ABB Power Grids
J.Dennis Marlow	DenMar TDS Transformers
Jarrod Prince	ERMCO
Jason Varnell	Doble Engineering Co.
Javier Arteaga	Hitachi Energy
Jeff Britton	Phenix Technologies, Inc.
Jeff Door	H-J Family of Companies
Jeff Gragert	JLR Consulting, Inc.
Jeffrey Wright	Duquesne Light Co.
Joe Watson	JD Watson and Associates Inc.
John Crouse	Roswell Alliance
John Herron	Raytech USA
John K John	Virginia Transformer Corp.
John Lackey	PowerNex Associates Inc.
Jorge Cruz	PTI Transformers
Juan Carlos Cruz Valdes	Prolec GE
Krishnamurthy Vijayan	PTI Transformers
Kannan Veeran	Georgia Transformer
Kerwin Stretch	Siemens Energy
Kris Neild	Megger
Kris Zibert	Allgeier, Martin and Associates
KUSHAL SINGH	ComEd
Mahesh Sampat	EMS Consulting Inc.
Marc Taylor	Taylor
Markus Schiessl	SGB
Mats Bernesjo	Hitachi Energy
Mike Iman	MGM Transformer Company
Mike Warntjes	American Transmission Co.

Marnie Roussel	Entergy
Muhammad Ali	Northern Transformer
Nicholas Jensen	Delta Star Inc.
Norman Field	Stantec
Peter Kleine	US Army Corps of Engineers
Phil Hopkinson	HVOLT Inc.
Polo Rodríguez	
Pugal Selvaraj	Virginia Transformer Corp.
Rainer Frotscher	Maschinenfabrik Reinhausen
Raj Ahuja	Raj Ahuja Consulting
Ramsis Girgis	Hitachi Energy
Reto Fausch	RF Solutions
Reza Torabi	SMIT Transformatoren B.V.
Rhea Montpool	Schneider Electric
Rhett Chrysler	ERMCO
Rod Sauls	Southern Company Services
Rogerio Verdolin	Verdolin Solutions Inc.
Samragni Dutta Roy	Siemens Energy
Sanjay Y. Patel	Smit Transformer
Sanjib Som	Pennsylvania Transformer
Sankarakurup, Dinesh	Duke Energy
Saramma Hoffman	PPL Electric Utilities
Sen, Cihangir John	Duke Energy
Shankar Subramany	KEMA Labs
Shawn Gossett	Ameren
Sheldon Kennedy	Niagara Transformer
Steve Antosz	Stephen Antosz & Associates, Inc
Steve Brzoznowski	Bonneville Power Administration
Sukhdev Walia	New Energy Power Co.
Suresh Babanna	SPX Transformer Solutions, Inc.
Susan McNelly	Xcel Energy
Terence J. Martin	Cleveland
Tiffany Lucas	SPX Transformer Solutions, Inc.
Toby Johnson	Hunt Electric
Troy Tanaka	Burns & McDonnell
Ulf Radbrandt	Hitachi ABB Power Grids
vinay mehrotra	SPX Transformer Solutions, Inc.
Wallace Binder	WBBinder Consultant
Weijun Li	Braintree Electric Light Dept.
William Boettger	Boettger Transformer Consulting LLC

Quorum Confirmation by the second poll:

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1.What is your status for this meeting?
        A.Member          36/117 ( 31%)
        B.Non Member      44/117 ( 38%)
        C.I don't know     2/117 (  2%)
No Answer    35/117 ( 30%)
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36 + from K.Vijayan to everyone: Krishnamurthy Vijayan- I voted first

time but could not vote the 2nd time. I am member and so include me for attendance

Total 37 members were present

J.9.3 TF PCS Audible Sound Revision to Clause 13 of C57.12.90

Unapproved Minutes of Fall 2021 TF PCS Audible Sound Revision to Clause 13 of C57.12.90
The task force met at 12:55 PM, on Monday, November 15, 2021. Chairman, Dr. Ramsis Girgis, presided over the technical part of the meeting and Secretary, Barry Beaster, handled the administrative duties of the meeting.
After the Spring 2021 meeting, the membership was adjusted to 44 members. There was 25 of 44 members with a total of 61 persons in attendance. A quorum was established with 56.8 % of the membership. A call was made for any objections for a unanimous approval of the Spring 2021 TF minutes; no objections were raised so minutes are approved as written. A revised agenda was presented without objections for approval. Two requests for membership have been reviewed.
The first technical agenda item was a summary of items previously considered for inclusion in Clause 13 of C57.12.90. The following bullets describe these four subjects with the previously agreed upon action by the TF.

- Impact of temperature on Core Noise
- Impact of temperature on Load Noise
- Impact of Tap position on core noise
- Impact of Tap position on load noise

Previous decision: These items are to be addressed in more detail in the noise guide rather than in the C57.12.90 Standard. This is already addressed in Clauses 3.2.1.6, 3.2.2.6, 3.2.1.4, and 3.2.2.5 of the present draft of the new noise guide, C57.136.
The next agenda item was a review of resolutions previously agreed upon at earlier TF meetings on comments received from balloting of C57.12.00 and C57.12.90. These are:

1. Comment: Table C1 in C57.12.00 starts at 700 kVA and refers to “Power Transformers”, Table C2 refers to “Distribution Transformers”, covers up to 3 MVA, and C57.12.36 for distribution substation transformers has a scope of up to 10 MVA.

Resolution (already incorporated in the new revision of C57.12.00):

- No Load Sound levels for ratings below 700 kVA were added to Table C1.
- Original Tables C1 and C2 have been replaced by a revised Table C1.
- “Distribution transformers” were added to title of Annex C. The title now reads: “Audible sound pressure levels for No-Load and Load noise of liquid immersed power and distribution transformers”. Title of Table C1 was supposed to include Distribution transformers but it was missed. The chairman of C57.12.00 will try to correct this before publication but if not, then through a Corrigenda.

2. Comment: Table C.3 in C57.12.00 specifies audible sound levels of load noise without the consideration of BIL, and these levels are much lower than the no-load levels specified in Table C.1.

Resolution: Add such an explanation into the Noise Guide with a few clarifying sentences. It is being planned.

3. Comment: No-Load sound level measurements should be required to be made (and guaranteed) at the highest sound producing tap position combinations and not on the rated tap position.

Related text present in Clause 13.3.3.1 of C57.12.00 : Core noise is to be measured at rated tap position and only upon request by customer that the transformer is tested at highest noise producing tap position.
Issue: This will require changes in C57.12.00 and C57.12.90. The TF needs to decide whether the existing text is, or is not, sufficient.
Resolution: This is planned to be discussed in a future meeting of the TF. Also, the impact of Tap Position on Core noise is discussed in the noise guide

4. Comment: Related to whether to add ambient sound pressure measurements arithmetically, or logarithmically, to determine the average level

Issue: The difference is typically a fraction of 1 dB. Also, this will require changes in C57.12.90
Resolution: This is planned to be discussed in a future meeting of the TF

5. Comment: Related to whether to measure load noise after the Heat-Run test

Resolution: This item was discussed in great detail at previous TF meetings. Also, impact of temperature on Load noise is small and Text on this impact has already been incorporated in the Noise Guide (C57.136).
The next agenda item dealt with the new "*Guide for Audible Sound of Liquid-Immersed Power Transformers",* IEEE PC57.136. The officers for this Guide WG are Stephen Antosz as Chair, Ramsis Girgis as Vice-Chair, and Mats Bernesjo as Secretary. Separate minutes of the WG meeting will be submitted to the PCS separately.
A discussion was raised about the continuous operation conditions of certain transformers operating in a step-up condition, e.g. GSUs, where the core flux density is typically higher than the rated flux density which, in turn, causes the core noise level to be higher than at rated. A request was made to review if factory testing might be able to address this condition. Joe Foldi asked how to incorporate in-service modes of operation to factory testing. Should the worst case tap position be used? The Chairman responded that the core flux density, under such loading conditions, can be calculated and the transformer can be tested for core noise in the factory at that flux density. Also, Joe requested that some text be added in the Guide about whether the guaranteed sound level should be based on the worst case tap position. Presently C57.12.90 has the guarantee based on the nominal tap position, unless otherwise specified by the User. The Chairman responded that text on this subject will be added to the Guide as part of "Impact of Load and Power Factor on Core noise". However, requiring core noise to be tested at the worst case tap position will need to be discussed at another Audible Sound TF meeting.
A solicitation of those in attendance was initiated to request membership in the Noise Guide. A total of twenty-two requests were received. Names and affiliations of these new WG members are included in the minutes of the Guide WG meeting.
With no new business raised, the meeting was adjourned.
Respectfully submitted,
Barry Beaster, TF Secretary

Spring 2021 Task Force Meeting Attendance and Affiliation is as follows:

First Name	Last Name	Company
Kayland	Adams	SPX Transformer Solutions, Inc.
Raj	Ahuja	Raj Ahuja Consulting
Stephen	Antosz	Stephen Antosz & Associates, Inc
Edmundo	Arevalo	Bonneville Power Administration

Elise	Arnold	SGB
Donald	Ayers	Ayers Transformer Consulting
Suresh	Babanna	SPX Transformer Solutions, Inc.
Barry	Beaster	H-J Family of Companies
Mats	Bernesjo	Hitachi Energy
Enrique	Betancourt	Prolec GE
Thomas	Blackburn	Gene Blackburn Engineering
William	Boettger	Boettger Transformer Consulting LLC
Darren	Brown	Howard Industries
Steven	Brzoznowski	Bonneville Power Administration
Arup	Chakraborty	Delta Star Inc.
John	Crouse	Roswell Alliance
Everton	De Oliveira	Siemens Energy
Scott	Digby	Duke Energy
Thomas	Eagle	SPX Transformer Solutions, Inc.
Thomas	Falkenburger	Coil Innovation USA, Inc.
Hugo	Flores	Hitachi Energy
Joseph	Foldi	Foldi & Associates, Inc.
Eduardo	Garcia Wild	Siemens Energy
Mohammad	Gholami	Trench Limited
Ramsis	Girgis	Hitachi Energy
Ismail	Guner	Hydro-Quebec
Thomas	Hartmann	Pepco Holdings Inc.
Nicholas	Jensen	Delta Star Inc.
John	John	Virginia Transformer Corp.
Stephen	Jordan	Tennessee Valley Authority
Kurt	Kaineder	Siemens Energy
Xose	Lopez-Fernandez	Universidade de Vigo
Vinay	Mehrotra	SPX Transformer Solutions, Inc.
Aaron	Meyers	EATON Corporation
Rashed	Minhaz	Transformer Consulting Services Inc.
Paul	Morakinyo	PSEG
Joe	Nims	Allen & Hoshall, Inc.
Sanjay	Patel	Smit Transformer
Sylvain	Plante	Hydro-Quebec
Klaus	Pointner	Trench Austria GmbH
Pierre	Riffon	Pierre Riffon Consultant Inc.
Tim	Rocque	SPX Transformer Solutions, Inc.
Dinesh	Sankarakurup	Duke Energy
Amitabh	Sarkar	Virginia Transformer Corp.
Daniel	Sauer	EATON Corporation

Markus	Schiessl	SGB
Cihangir	Sen	Duke Energy
Michael	Sharp	Trench Limited
Christopher	Slattery	FirstEnergy Corp.
Sanjib	Som	Pennsylvania Transformer
Marc	Taylor	JFE Shoji Power Canada Inc.
Ryan	Thompson	Burns & McDonnell
Reza	Torabi Goodarzi	SMIT Transformatoren B.V.
Ajith	Varghese	SPX Transformer Solutions, Inc.
Jason	Varnell	Doble Engineering Co.
Kiran	Vedante	Ritz Instrument Transformers
Jos	Veens	SMIT Transformatoren B.V.
David	Wallach	Duke Energy
Terry	Wong	Trench Limited
Jeffrey	Wright	Duquesne Light Co.

J.9.4 WG PC57.136 Noise Guide

Unapproved Minutes of Fall 2021 TF PCS IEEE PC57.136, "Guide for Audible Sound of Liquid-Immersed Power Transformers"

The task force met at 12:55 PM, on Monday, November 15, 2021 as part of the TF PCS Audible Sound Revision to Clause 13 of C57.12.90 meeting. Chairman Steve Antosz presided over the meeting with Ramsis Girgis being the Vice-Chair, and Mats Bernesjo as Secretary.

The total membership of the WG is 47, including 22 requested membership at this meeting. The total attendance was 51.

First, the Chairman gave the following background for the new Guide:

- C57.136 was the "Sound Abatement Guide" and the document expired several years ago
- 2019/2020 was decided to resurrect/update it
- The PAR was approved in early 2021
- An early draft was circulated to TF participants in April 2021
- Some feedback was received and incorporated
- The draft was updated Summer/Fall 2021

The new guide has made significant progress and noise experts are asked to review the latest draft and provide more material where needed. The following list of technical chapters and sections of the Guide are summarized below:

Chapter 3 Basics and Standards of Transformer Noise

3.2 Sources and characteristics of transformer noise

3.2.1 Core noise

3.2.1.1 Impact of Core design & material

3.2.1.2 Frequency spectrum

3.2.1.3 Impact of Core and Tank resonances

3.2.1.4 Impact of Tap Changer position

3.2.1.5 Impact of load and load power factor

3.2.1.6 Impact of core temperature

3.2.2 Load noise

7.2 Determination of appropriate noise level of a transformer on site

It was reported that input into Clauses 6.1 and 6.2 was solicited from Sanjay Patel and is expected to be received in the next week or two. Also, material of Clause 7.2 was requested from Chris Howell of Burns & McDonnel and was recently received. These will be added in the next draft of the Guide.

In relation to clause 7.2 regarding methods of determination of appropriate noise level of a transformer on site, one manufacturer noted that some specifications from the north-east region of the country specify the same low total noise level for transformers of a wide range of MVA ratings. This represents added expense to the customer to try to achieve such low noise levels for larger transformers. Several utility representatives commented on how they determine sound requirements for their transformer Specifications. The Vice Chair commented that he previously gave a presentation at a tutorial (Fall 2020 meeting) specifically on issues with some sound requirements in Specification. He promised to add this presentation to the website of the IEEE Standards.

A solicitation of those in attendance was initiated to request membership in the Noise Guide. A total of twenty-two requests were received. The following names are included in this following table.

Scott Digby	Hugo Flores	Ajith Varghese	Vinay Mehrotra	David Wallach
Chris Slattery	Klaus Pointer	Marc Taylor	Sanjib Som	William Boettger
John K. John	Eduardo Garcia	Enrique Betancourt	Elise Arnold	Markus Schiessl
Steve Brzoznowski	Kurt Kaineder	Everton De Oliveira	K. Vijayan	Thomas Hartmann
Kiran Vendante	Kayland Adams			

Finally, a request was made to members of the newly formed Guide WG to review the next draft of the Noise Guide and provide feedback, add text, as well as add their experience to Chapter 6 on methods on noise mitigation on site. The current Draft will be posted on the committee website in the C57.136 section under Performance Characteristics Sub Committee and it will be posted again after updates are made.

With no new business raised, the meeting was adjourned.

Respectfully submitted,

Mats Bernesjo, WG Secretary

J.9.5 TF PCS Continuous Revisions to C57.12.00

PCS Task Force on General Requirements C57.12.00

Performance Characteristics Subcommittee
IEEE / PES Transformers Committee

November 15, 2021 2:20 PM
On-Line Meeting; Virtual, CT Time Zone USA

UNAPPROVED MINUTES

The PCS Task Force on General Requirements for C57.12.00 met on Monday, November 15, 2021. The Chair Tauhid Ansari called the Group to order at 2:20 PM and reminded purpose and scope of the TF. The copyright statement from IEEE was presented to the Group, as well as the essential patents claim; none of the members and guests present was aware of issues related to this TF's activities. There were **46** Members and **66** Guests present. The quorum to conduct regular business was achieved, as **77** members are registered in the Task Force.

The following **8** guests requested membership:

Alexander Kraetge	OMICRON
Dan Sauer	Eaton
Deepak Kumaria	Applied Materials
Mats Bernesjo	Hitachi Energy
Ryan Hogg	Bureau of Reclamation
Samragni Dutta Roy	Siemens Energy
Suresh Babanna	SPX Transformer Solutions
Vinay Mehrotra	SPX Transformer Solutions

The Agenda proposed by the TF Chair was unanimously approved by the Group (Motion Raj Ahuja, Second Phil Hopkinson), and also were approved the minutes from the Spring 2021 meeting, with none opposed (Motion Sylvain Plante, Second Eduardo Garcia).

Next, the Chair briefly provided background and relevance of each item brought for Group's discussion in the agenda. The Chair started Group's regular business.

1. OLD BUSINESS
   - **A. Inclusion of Core information on Nameplate**

     This request had originally been brought up by Bipin Patel, expecting to simplify GIC evaluation of power transformers (type C Nameplate). In course of discussion with subject matter experts, it turned out that much more information would be required for a proper evaluation. However, a second group of participants saw value on having core type information on nameplate and the topic came back within Group's business agenda.
     With support of a TF of WG Members, the Chair developed new proposed text to include on Table 6 of C5.12.00 standard. WG Member Ramsis Girgis provided detailed description of core type options currently applied in industry. The Chair opened the floor for discussion.

     Group's general opinion was in favor of including either "Shell" or "Core" on "Core Design" (new, line 25) of Table 6, but there was lengthy discussion as for "Core Type" options. Main arguments brought up by meeting participants follow:

     - There are different types of Shell design cores which designations should be stated as possible inputs for Table 6. Option to include sketches as part C57.105 was mentioned but was not considered within TF's scope.
     - Recommendation was given to let manufacturers freely state "core type", according to own definitions.
     - Recommendation was given to address at least 80% of industry application, leaving special cases to manufacturer's own definitions.

The Chair tried to lead the Group to agree on a new version of proposed Line 26 to Table 6, showing different options, but it was not possible to reach a consensus within the time of the meeting. The subject will remain within TF's agenda.

Meeting was adjourned at 15:35 hr. (Motion Phil Hopkinson, Second Eduardo García).

Respectfully submitted,

Tauhid Ansari
WG Chair

Enrique Betancourt
Co-Chair and Acting Secretary

Name of attendees

Joe Foldi	Donald Ayers	Jim Graham
Ajith Varghese	Dr. Alexander Winter	John Crouse
Alexander Kraetge	Duvier Bedoya	John Herron
Ali Naderian	Ed teNyenhuis	John K John
Allan Bartek P.E.	Eduardo Garcia	John Lackey
Amitabh Sarkar	Elise Arnold	K.Vijayan
Anderson, Greg	Encore 12	Kenneth Skinger
Andrew Larison	enrique betancourt	Kevin Biggie
Anthony Franchitti	Eric Schleismann	Kris Neild
Arup Chakraborty	Evan H.B. Knapp-Eaton	Kris Zibert
Bertrand Poulin	Everton De Oliveira	Larry Dix
Bruce Forsyth	Feras Fattal	Leopoldo Rodriguez
Bruce Webb KUB	Gary King	Marc Taylor
Chris Baumgartner	hachichi said	Mark Perkins
Chris Slattery FirstEnergy	Hakan Sahin	Markus Schiessl
Craig Colopy	Harry Pepe	Marnie Roussell
Dan Sauer - Eaton	HUAN DINH	Mats Bernesjo
Daniel Blaydon	J.Dennis Marlow	Michael Botti
DANIELA EMBER BACIU	Jarrod Prince - ERMCO	Michael Zarnowski - Carte
Darren Brown	Jason Varnell	Muhammad Ali Masood Cheema
deepak	Javier Arteaga	Nicholas Jensen - Delta Star
Don Dorris	Jeff Schneider	Olle Benzler

pedro	Shawn Gossett	Zachery Weiss
Philip Hopkinson	Sheldon Kennedy	Zan Kiparizoski
Polo Rodríguez	Stephen Oakes	
Raj Ahuja	Steve Antosz	
Ramsis Girgis	Steve Brzoznowski	
Reza Torabi	Steve Jordan	
Richard von Gemmingen	Steve Schroeder	
Rod Sauls	Steve Snyder	
Rodrigo Ocon	Sukhdev Walia	
Rogerio Verdolin	Suresh Babanna	

Ronnie Minhaz (Rashid)	Sylvain Plante Hydro-Quebec
Ross McTaggart	Tauhid Ansari
Rudolf Ogajanov	Terence J. Martin
Ryan Hogg	Thomas Tom Dauzat
Ryan Musgrove - OG&E	Tiffany Lucas - Prolec GE - Waukesha
Samragni Dutta Roy	Toby Johnson
Sanjay Patel	Tommy Eagle
Sankarakurup, Dinesh	Kent Miller
Sanket Bolar	vinay mehrotra
Saramma Hoffman	Waldemar Ziomek
Sen, Cihangir John	Will Elliott - Prolec-GE
Sergio Hernandez Cano	William Boettger

J.9.6 WG HV & EHV Breaker & Transformer Sw. Transients C57.142

MEETING NOTES
IEEE / PES Transformers Committee
Performance Characteristics Subcommittee
WG to Investigate the Interaction between Substation Transients
And Transformers in HV and EHV Applications and Revision of C57.142
Virtual Meeting
Tuesday, April 27, 2021
2:30 PM – 3:35 PM Central Time Zone - USA
Chairman – Jim McBride
Vice Chair – Xose Lopez-Fernandez
Secretary – Tom Melle

1) Meeting called to order at 2:20 PM Central Time.
Welcome and Chair's Remarks
2) Two Attendance Poll were taken.
First at 2:25 PM 52Attendees were present (31 Guests) 21 of 56 Members present
Second 3:00 PM 58 Attendees were present (33 Guests) 25 of 56 Members present
Quorum was not achieve. Therefore, the Spring Minutes will be sent by e-mail for approving.
3) IEEE Patent Policy Slides and Copyrights slides (NO essential patent claims or copyright issues)
4) Approval of Agenda and Minutes from Last Meeting.
Quorum was not achieve. Therefore, the Spring Minutes will be sent by e-mail for approving.
5) Switchgear Liason Task Force Update – Dave Caverly
The Switchgear Task Force met on OCTOBER 21, 2021, but there is nothing new this time.
6) Status of Current Draft 9B and Comments – Jim McBride
Some editorial changes made to Draft 9B before submitting to MEC which corrected errors in the TOC and references. The document from the Transformers website highlights in blue all changes to the C57.142-2010 Guide. And the focus now will be on Mitigation Methods for the upcoming meeting.
7) Request to Proceed to Ballot with Draft 9B – Jim McBride
The Formation of Ballot Group has been initiate and the invitation to join the ballot group for C57.142 logging into the myProject, Close Date is December 10, 2021. The track changes version of Draft 9B can download from the Transformers Committee Website.
8) Mitigation Methods

Jim made a summary about the mitigation methods discussed in previous meetings.

Switchgear Committee has requested that we help to provide dielectric transient withstand information on transformers and reactors. A short discussion was stablished among Phil Hopkinson, Pierre Riffon, Egon Kirchenmayer and Jim about switching reignitions and prestrikes due to circuit breakers operation with reactors and sometimes with transformers, which not always are covered by standard factory acceptance tests. Pierre Riffon quoted C57.21 IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA, which stablishes limits of chopping waves in percent. A group was formed by Pierre Riffon, Bertrand Poulin and Jim McBride to work on a response to Switchgear Committee which may include references to Clause B.6 of Std C57.21

Mitigation methods discussion was open to brainstorming additional options. Discussion on use of of internal arresters was stablished as a mitigation method, which not always is well accepted by the users. A presentation will be expected to made on it in next meetings. Finally, discussion was focused to additional factory tests. In this respect volunteers were request to work on a recommendation of voltages classes and dielectric tests requirements. Initially offered Phil Hopkinson, K. Vjayan, Amitbh Sakar, Deepak kumaria. And all interest to join this group could email to Jim McBride.

9) New Business – Deepak Kumaria asked about possibly including the study of transients on instrument transformers in our WG. Due to the lack of remaining time for today's meeting, this topic was postpone until our next meeting.
10) Next Meeting (Spring 2022 – Denver (Hyatt Regency, Conv. Center), Colorado USA, March 27 – 31, 2022)
11) Motion to Adjournment made by Phil Hopkinson / 2nd by Mike Spurlock
Meeting was adjourned at 3:38 PM without objection.

J.10 Adjournment

The Chair entertained a motion to adjourn. D. Sauer made the motion, seconded by A. Joshi. The meeting was adjourned at 3:37PM

J.11 Performance Characteristics Subcommittee Attendance List

Role	First Name	Last Name	Company
Guest	Nabi	Almeida	Prolec GE
Member	Tauhid Haque	Ansari	Hitachi Energy
Member	Stephen	Antosz	Stephen Antosz & Associates, Inc
Guest	Edmundo	Arevalo	Bonneville Power Administration
Member	Javier	Arteaga	Hitachi Energy
Member	Donald	Ayers	Ayers Transformer Consulting
Guest	Suresh	Babanna	SPX Transformer Solutions, Inc.
Member	Robert	Ballard	DuPont
Member	Gilles	Bargone	FISO Technologies Inc.
Member	Christopher	Baumgartner	We Energies
Member	Barry	Beaster	H-J Family of Companies
Guest	Mats	Bernesjo	Hitachi Energy

Member	Enrique	Betancourt	Prolec GE
Member	Wallace	Binder	WBBinder Consultant
Member	Wallace	Binder	WBBinder Consultant
Guest	Thomas	Blackburn	Gene Blackburn Engineering
Member	Daniel	Blaydon	Baltimore Gas & Electric
Member	William	Boettger	Boettger Transformer Consulting LLC
Guest	Elizabeth	Bray	Southern Company Services
Member	Jeffrey	Britton	Phenix Technologies, Inc.
Guest	Darren	Brown	Howard Industries
Guest	Steven	Brzoznowski	Bonneville Power Administration
Guest	Jagdish	Burde	Virginia Transformer Corp
Guest	Juan Alfredo	Carrizales	Prolec GE
Guest	David	Caverly	Trench Limited
Guest	Rhett	Chrysler	ERMCO
Member	Craig	Colopy	EATON Corporation
Guest	Jorge	Cruz	PTI Transformers
Guest	Juan Carlos	Cruz Valdes	Prolec GE
Guest	Juan Carlos	Cruz Valdes	Prolec GE
Member	J. Arturo	Del Rio	Siemens Energy
Guest	Brandon	Dent	Memphis Light, Gas & Water
Guest	Huan	Dinh	Hitachi Energy
Guest	Samragni	Dutta Roy	Siemens Energy
Guest	Thomas	Eagle	SPX Transformer Solutions, Inc.
Guest	William	Elliott	Prolec GE
Guest	Daniela	Ember Baciu	Hydro-Quebec IREQ
Guest	Evgenii	Ermakov	Hitachi Energy
Guest	Marco	Espindola	Hitachi Energy
Guest	Feras	Fattal	Manitoba Hydro
Member	Reto	Fausch	RF Solutions
Member	Hugo	Flores	Hitachi Energy
Member	Joseph	Foldi	Foldi & Associates, Inc.
Member	Bruce	Forsyth	Bruce Forsyth and Associates PLLC
Guest	Anthony	Franchitti	PECO Energy Company
Guest	Raymond	Frazier	Ameren
Member	Jose	Gamboa	H-J Family of Companies
Member	Eduardo	Garcia Wild	Siemens Energy
Guest	Rob	Ghosh	General Electric
Member	Ramsis	Girgis	Hitachi Energy
Member	Shawn	Gossett	Ameren
Member	Bill	Griesacker	Duquesne Light Co.
Guest	Ismail	Guner	Hydro-Quebec

Member	Said	Hachichi	Hydro-Quebec
Member	Thomas	Hartmann	Pepco Holdings Inc.
Guest	Giovanni	Hernandez	Virginia Transformer Corp.
Member	Sergio	Hernandez Cano	Hammond Power Solutions
Member	John	Herron	Raytech USA
Guest	Saramma	Hoffman	PPL Electric Utilities
Guest	Ryan	Hogg	Bureau of Reclamation
Member	Philip	Hopkinson	HVOLT Inc.
Guest	Ramadan	Issack	American Electric Power
Guest	Nicholas	Jensen	Delta Star Inc.
Member	John	John	Virginia Transformer Corp.
Member	Stephen	Jordan	Tennessee Valley Authority
Guest	Laszlo	Kadar	Hatch
Member	Sheldon	Kennedy	Niagara Transformer
Guest	Gael	Kennedy	GR Kennedy & Associates LLC
Member	Stacey	Kessler	TC Energy
Guest	Gary	King	Howard Industries
Guest	Dmitriy	Klempner	Southern California Edison
Guest	Alexander	Kraetge	OMICRON electronics Deutschland GmbH
Guest	Krzysztof	Kulasek	Hitachi Energy
Member	Deepak	Kumaria	Applied Materials
Guest	Moonhee	Lee	Hammond Power Solutions
Member	Aleksandr	Levin	Weidmann Electrical Technology
Member	Weijun	Li	Braintree Electric Light Dept.
Guest	Mario	Locarno	Doble Engineering Co.
Member	Xose	Lopez-Fernandez	Universidade de Vigo
Guest	Colby	Lovins	Federal Pacific
Member	Tim-Felix	Mai	Siemens Energy
Member	Richard	Marek	Retired
Corresponding Member	Dennis	Marlow	DenMar TDS Transformers
Guest	Lee	Matthews	Howard Industries
Member	James	McBride	JMX Services, Inc.
Member	James	McBride	JMX Services, Inc.
Guest	Matthew	McFadden	Oncor Electric Delivery
Guest	Susan	McNelly	Xcel Energy
Member	Vinay	Mehrotra	SPX Transformer Solutions, Inc.
Member	Rashed	Minhaz	Transformer Consulting Services Inc.
Guest	Manoj Kumar	Mishra	ASAsoft (Canada) Inc

Member	Rhea	Montpool	Schneider Electric
Member	Emilio	Morales-Cruz	Qualitrol Company LLC
Member	David	Murray	Tennessee Valley Authority
Member	Ryan	Musgrove	Oklahoma Gas & Electric
Guest	Ali	Naderian	METSCO Energy Solutions Inc.
Member	Kristopher	Neild	Megger
Guest	Rodrigo	Ocon	Industrias IEM
Guest	Rudolf	Ogajanov	ABB Inc.
Member	Sanjay	Patel	Smit Transformer
Member	Sanjay	Patel	Smit Transformer
Corresponding Member	Paulette	Payne-Powell	Retired
Guest	Harry	Pepe	Phenix Technologies, Inc.
Guest	Caroline	Peterson	Xcel Energy
Guest	Matthew	Pinard	Weidmann Electrical Technology
Member	Sylvain	Plante	Hydro-Quebec
Guest	Cornelius	Plath	OMICRON Energy Solutions GmbH
Member	Klaus	Pointner	Trench Austria GmbH
Guest	Chris	Powell	Intermountain Electronics
Member	Jarrod	Prince	ERMCO
Member	Ulf	Radbrandt	Hitachi Energy
Member	Ion	Radu	Hitachi Energy
Member	Afshin	Rezaei-Zare	York University
Member	Pierre	Riffon	Pierre Riffon Consultant Inc.
Guest	Diego	Robalino	Megger
Member	Tim	Rocque	SPX Transformer Solutions, Inc.
Member	Marnie	Roussell	Entergy
Guest	Hakan	Sahin	Virginia/Georgia Transformer
Guest	Albert	Sanchez	Knoxville Utilities Board
Guest	Dinesh	Sankarakurup	Duke Energy
Guest	Amitabh	Sarkar	Virginia Transformer Corp.
Member	Daniel	Sauer	EATON Corporation
Guest	Roderick	Sauls	Southern Company Services
Member	Steven	Schappell	SPX Transformer Solutions, Inc.
Guest	Markus	Schiessl	SGB
Guest	Stephen	Schroeder	Hitachi Energy
Guest	Dan	Schwartz	Quality Switch, Inc.
Guest	Ewald	Schweiger	Siemens Energy
Guest	Pugal	Selvaraj	Virginia Transformer Corp.
Guest	Cihangir	Sen	Duke Energy
Guest	Devki	Sharma	Entergy
Guest	Michael	Sharp	Trench Limited

Member	Samuel	Sharpless	Rimkus Consulting Group
Member	Hemchandra	Shertukde	University of Hartford
Guest	Thomas	Sizemore	ABB Inc.
Member	Kenneth	Skinger	Scituate Consulting, Inc.
Member	Christopher	Slattery	FirstEnergy Corp.
Vice-Chair	Sanjib	Som	Pennsylvania Transformer
Member	Mike	Spurlock	Spurlock Engineering Services, LLC
Guest	Brad	Staley	Salt River Project
Member	Kyle	Stechschulte	American Electric Power
Guest	Andrew	Steineman	Delta Star Inc.
Guest	Neil	Strongosky	Memphis Light, Gas & Water
Member	Charles	Sweetser	OMICRON electronics Corp USA
Guest	Janusz	Szczechowski	Maschinenfabrik Reinhausen
Guest	Marc	Taylor	JFE Shoji Power Canada Inc.
Guest	Dervis	Tekin	Meramec Instrument Transformer Co.
Member	Ed	teNyenhuis	Hitachi Energy
Guest	Alan	Traut	Howard Industries
Member	Ajith	Varghese	SPX Transformer Solutions, Inc.
Guest	Joshua	Verdell	ERMCO
Chair	Rogerio	Verdolin	Verdolin Solutions Inc.
Member	Krishnamurthy	Vijayan	PTI Transformers
Guest	Pragnesh	Vyas	Sunbelt-Solomon Solutions
Corresponding Member	Loren	Wagenaar	WagenTrans Consulting
Guest	Hugh	Waldrop	Memphis Light, Gas & Water
Member	Sukhdev	Walia	New Energy Power Co.
Guest	David	Wallach	Duke Energy
Member	Joe	Watson	JD Watson and Associates Inc.
Member	Bruce	Webb	Knoxville Utilities Board
Guest	Drew	Welton	Intellirent
Corresponding Member	Peter	Werelius	Megger
Guest	Daniel	Weyer	Nebraska Public Power District
Guest	William	Whitehead	H2scan Corporation
Guest	Helena	Wilhelm	Vegoor Tecnologia Aplicada
Member	Dr. Alexander	Winter	HIGHVOLT Pruftechnik Dresden
Member	Jeffrey	Wright	Duquesne Light Co.
Guest	Joshua	Yun	Virginia Transformer Corp.
Guest	Malia	Zaman	IEEE
Member	Peter	Zhao	Hydro One
Secretary	Kris	Zibert	Allgeier, Martin and Associates
Role	First Name	Last Name	Company

Guest	Nabi	Almeida	Prolec GE
Member	Tauhid Haque	Ansari	Hitachi Energy
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