Annex J Performance Characteristics Subcommittee (PCS)

March 13th, 2024, Hyatt Regency, Vancouver, BC, CA

UNAPPROVED MINUTES

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

J.1 Introduction / Attendance

Quorum was achieved with 85 members present (75% in attendance). In addition, 110 guests were present at the meeting. The total attendance at the meeting was 195. 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 St. Louis, Missouri, October 27-31, 2024.

J.2 Chairman's Remarks

The Chair gave the Chairman's Remarks.

The Chair introduced himself, the Vice Chair and secretary and provided the below updates and comments.

The Chair discussed that the meeting would be recorded for minutes purposes and then deleted.

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

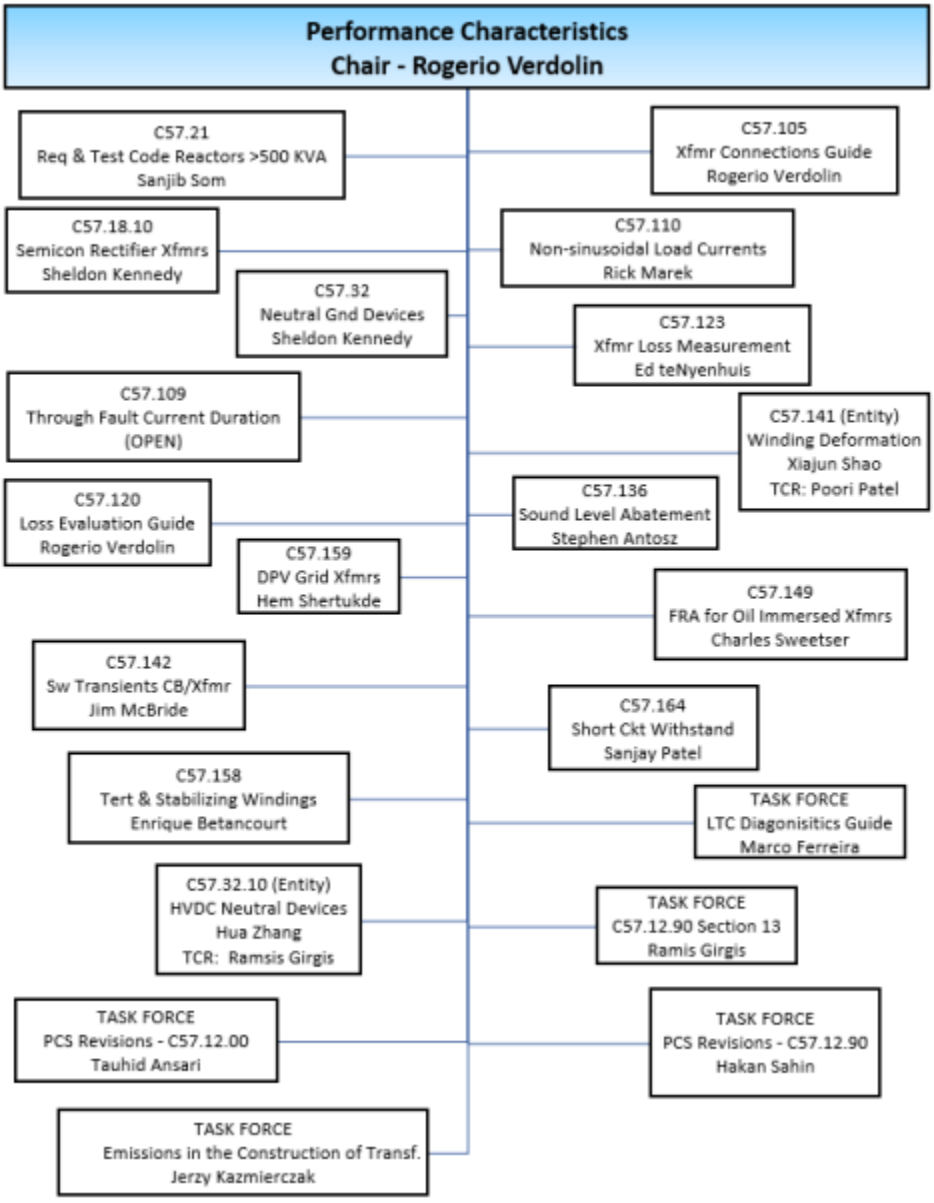
The Chair gave a reminder regarding affiliation data as a requirement and to continue updating attendance manually.

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 – 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
- C57.32.10 – Entity WG Neutral Grounding Reactors Guide for HVDC Converter Transformers – H. Zhang (TCR: R. Girgis)
- C57.105 – Transformer connections guide – R. Verdolin
- C57.109 – Through Fault Current Duration – OPEN
- 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
- C57.136 – Sound Abatement Guide – S. Antosz
- C57.141 - Entity - Winding Deformation – X. Shao (TCR: P. Patel)
- C57.142 – Switching Transients Circuit breaker/Transformer – J. McBride
- C57.149 – FRA for Oil Immersed Transformers – C. Sweetser
- C57.158 – Tertiary & Stabilizing Windings (2027) – E. Betancourt
- C57.159 – DPV Transformers (2026) – H. Shertukde
- C57.164 – Short Circuit Withstand – S. Patel
- TF for Insulating Fluid for Factory Testing – E. teNyenhuis
- TF for LTC Diagnostics Guide – M. Ferreira
- 60076-16 – Wind Turbine Generator Transformers – P. Hopkinson
- TF for Emissions in the Construction of Transformers – J. Kazmierczak

Status of Active PAR's:

- 2024 PAR's
  - C57.32.10 Entity WG Guide for the Selection of Neutral-Grounding Devices for HVDC Converter Transformers (Preballot)
  - C57.105-2019/Cor 1 (Submitted to RevCom)
  - C57.149 FRA Guide (Comment Resolution)
- 2025 PAR's
  - C57.136 Audible Sound Guide (Recirc Ballot Complete)
  - C57.142 Transient Guide (Comment Resolution)
  - C57.141 Entity WG Guide for Detection, Monitoring and Evaluation of Winding Deformation
- 2027 PAR's
  - C57.32 Neutral Grounding Devices (New WG)
  - C57.158 Application of Tertiary and Stabilizing Wdgs Guide (New WG)
- 2028 PAR's
  - C57.159 DPV Transformers Guide (New WG)

Status of Standards without active PARs

- C57.120-2017 – Loss Evaluation Guide (2027)
- 60076-16-2018 – Wind Turbine Generator Transformers (2028)
- C57.109-2018 – Through Fault Current Duration (2028)
- C57.110-2018 – Transf. Capability when Supplying Nonsinusoidal Loads (2028)
- C57.105-2019 – Transformer connections guide (2029)
- C57.123-2019 – Loss Measurement Guide (2029)
- C57.164-2021 – Short Circuit Withstand Guide (2031)
- C57.21-2021 – Shunt Reactors over 500kVA (2031)
- C57.18.10-2021 – Semiconductor Rectifier Transformers (2031)
- C57.105-2023 – Transf. Connections in Three-Phase Distribution Systems (2033)
- C57.136-2023 – Sound Level Abatement Guide (2033)

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 tc-webmaster@ieee.org.
- A patent and copyright call must occur at every WG/TF meeting
- Please send to Malia Zaman (m.zaman@ieee.org) your WG roster by March 28, 2024, including last name, first name, email address, and voting status.

Performance Characteristics Subcommittee Meeting Minutes

- Name of the group, time, date, and location of meeting
- Officers' names, meeting participants, member status, and affiliations
- 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 2 Members missed more than 2 consecutive meetings and have been moved to "Guest" status:

- Steve Schappell
- Dr Alexander Winter

Please contact Sanjib by sending him a message or see him after the meeting if you believe your membership status is not accurate and/or you would like to become a member.

Attendance / Membership – New Members

The following Guests requested membership at the Fall 2023 meeting and have attended 3 of the past 5 meetings:

- Kayland Adams
- Camilo Casallas
- Evgenii Ermakov
- Rob Ghosh
- Francis Mills
- Scott Thomas
- Alex Alahmed
- Nikolaus Dillon
- Marco Espindola
- Jerzy Kazmierczak
- Ewald Schweiger
- Drew Welton

Attendance / Membership – Quorum determination

- Current breakdown of the Subcommittee:
  - 113 Members
  - 57 are needed for a quorum
- Quorum was established with 85 members in attendance.

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 was made by H. Flores and seconded by A. Sarkar. The motion passed by unanimous consent.

J.4 Approval of Last Meeting Minutes

The Chair presented the minutes of meeting held in October 2023 and entertained a motion to approve. The minutes had been sent to the members by email several weeks prior to the meeting. The motion was made by H. Flores and seconded by A. Sarkar. 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).

- **TF CO2 Emissions in the Construction of Transformers** **J. Kazmierczak**
- **TF Audible Sound Rev to Test Code** **R. Girgis**
- **TF Continuous Revisions to C57.12.00** **T.Ansari**
- **WG Standard for DPVTs - C57.159** **H. Shertukde**
- **TF Continuous Revisions to Test Code C57.12.90** **H. Sahin**
- **WG Sw Transients Ind by Xfmr/Bkr Interaction PC57.142** **J. McBride**
- **WG C57.158 App. Guide for Tertiary and Stabilizing Windings** **E. Betancourt**
- **WG IEEE Neutral Grounding Devices PC57.32** **S. Kennedy**
- **WG PC57.32.10 Entity HVDC Neutral Grounding Device Guide** **Z. Hua**
- **WG PC57.141 Entity Winding Deformation Guide** **X. Shao**

Below are highlights that were discussed at the PCS meeting:

1) **TF CO2 Emissions in the Construction of Transformers** **J. Kazmierczak**
   - This was the second meeting of this TF.
   - A call to order was made at 11:00 AM PT.
   - The patent & copyright policy was reviewed.
   - Introduction of officers was made.
   - Introduction of attendees was made with a total of 70 attendees present.
   - Fifty-three attendees requested & were granted membership at the last meeting. Therefore, 27 needed to be in attendance to achieve quorum.
   - Initially a quorum was not achieved. However, shortly after the beginning of the meeting, another tally was taken.
   - Twenty-seven members were present. Quorum was achieved.

- Minutes of the last meeting were reviewed. John Sen, Duke Energy, made a motion to approve the minutes. Ed TeNyenhuis, Hitachi Energy, seconded.
- No objections. The minutes were unanimously approved.
- The agenda was reviewed. The agenda was also unanimously approved.
- After the Fall 2023 meeting in Kansas, there were approximately 5 online meetings with members held. During these meetings, we looked at what we currently have in relation to this topic in the industry, specifically what Cigre & IEC are currently doing. Many of these documents are still drafts. However, based on the reviews conducted we had a look again at the title of the proposed guide, and the group agreed that the title should be revised.
- A proposal for the revision of the title to: *IEEE guide for the environmental performance and life cycle assessment of Shunt Reactors, Distribution and Power Transformers*
- Additionally, a presentation of two slides prepared by Ghazi Kablouti, Hitachi Energy (not in attendance), was presented by the Chair detailing the established Life Cycle Analysis methodology and explaining the rationale of the suggested title amendment.
- An amended proposed scope was also presented.
- There was considerable discussion regarding the topic, including adding Evaluation to the title, the inclusion of instrument transformers, the difference between Environmental impact and carbon footprint, what the group should focus on in terms of scope (definition of inclusions/exclusions), the necessity to define the calculation method, if the topic needs to be from the manufacturer or end-user perspective and if the amended title covered these points in the proper manner.
- Luc Dorpmanns, SMIT, pointed out that ISO 14004 covers environmental impacts and that we may want to also look at this in further defining scope.
- Ultimately, it was agreed that the title needed to be amended.
- Curtis Frazier, Ameren, motioned to amend it to "**IEEE Guide for the Evaluation of the environmental impact & life cycle assessment of Transformers & Shunt Reactors**." Luiz Cheim, Hitachi, seconded the motion.
- A vote was taken on the amended title with 0 no's, 17 yes's, and 5 abstentions. The amended title was approved.
- Ed TeNyenhuis, Hitachi, made a motion to include the scope as is. John Sen, Duke Energy, seconded the motion.
- There was discussion on whether to replace "covers" with "includes", but ultimately it was decided to leave "covers" in the scope.
- Curtis Frazier, Ameren, moved to vote on the scope. John Sen, Duke Energy, seconded the motion.
- The scope: "**This guide covers the methodology of calculation and reporting of the environmental impact and carbon footprint of transformers and shunt reactors over their life cycle**" was unanimously approved.
- Ed TeNyenhuis, Hitachi, made a motion to adjourn. John Sen, Duke Energy, seconded.
- The meeting was adjourned at 12:15 PM PT.
- The next meeting will take place in St. Louis, Missouri, USA, during Fall IEEE Transformer Committee Meeting scheduled for October 27-31, 2024.

- J. Kazmierczak made a motion to create a PAR with the following title and scope:
    - ***Title:*** *IEEE Guide for the Evaluation of the environmental impact & life cycle assessment of Transformers & Shunt Reactors*
    - ***The scope:*** *This guide covers the methodology of calculation and reporting of the environmental impact and carbon footprint of transformers and shunt reactors over their life cycle.*
- Motion passed by unanimous consent.

2) TF Audible Sound Code Revision **R. Girgis**

- The first item presented is data on impact of noise of Preventive Autotransformers (PAs) on sound level of the main transformer. The data demonstrated that noisy PAs increase sound level of the main transformer and can cause the transformer to exceed the guaranteed sound level.
- The Chairman then presented the following items:
    1. Methodology of determining the Sound pressure level of PAs in oil from sound level measurements of the main transformer at non-bridging and bridging tap positions.
    2. Data on 2 transformers that showed that the sound level of the PAs in oil was 4-6 dB lower than the sound level measured in air.
        - The discussion that followed showed that this difference appears to be dependent on the way the PA is installed in the main tank.
        - The Chairman requested attendees to submit data in this area to try to establish the value(s) at difference.
    3. Methodology of specifying the sound level of the PA in air such that the PA noise would have a minimal impact on the sound level of the main transformer at bridging tap positions.
    4. Information on measuring Sound level of PAs in air.
- The Chairman suggested that above information be added to the IEEE Noise Guide. Since the next revision of the Guide would be slated for several years yet, it was suggested to publish an IEEE paper that includes such information.

3) TF Continuous Revisions to C57.12.00 **T. Ansari**

- Meeting Date/Time: March 11, 2024, 3:15 PM
- Acting Chair: Enrique Betancourt (Prolec GE). Secretary: Mats Bernesjo (Hitachi Energy)
- After scope and purpose of the Group, the Chair presented IEEE Copyright and Patent statements, with no issues raised by Members present.
- 76 total attendees, consisting of 41 (out of 57) Members and 35 Guests, so a quorum was achieved; 9 Guests requested membership. Agenda and Minutes from previous meeting were unanimously approved.

- Highlights
  - Old Business
    1. WG Item 113, Measurement of Auxiliary Losses/Ajith Varghese (Prolec GE). To clarify what component's losses would be included as "control losses", to avoid different interpretation of "integral parts of the transformer", a new proposed text was presented to the Group and approved:
       - *For Class II transformers (see 5.10**), auxiliary cooling equipment** losses shall be measured and recorded. All stages of cooling, and all associated cooling control equipment shall be energized, **provided these components are integral parts of the transformer to meet guaranteed thermal performance**.*
         Note:
         *The auxiliary losses **do not include control cabinet components** including but are not limited to cabinet heaters, online DGA or ancillary devices such as dehydrate breathers, nitrogen cabinet heaters, etc.*
    2. WG Item 114, Modification of Sec 5.7.2/Steve Antosz (Prolec GE)
       - Proposal to add the phasor-group designation as required nomenclature for identifying the angular displacement between windings for three-phase power and distribution transformers. Std. C57.12.70 "Standard Terminal Markings and Connections" was recently revised and updated with that concept. As both standards are linked through mutual references, the proposal includes the phasor group designation be shown on the transformer's nameplate. The nomenclature is detailed in 12.70. This proposal also harmonized with IEC Stds.
       - Three motions passed:
         - Motion #1: Add the following sentence at the end of the second paragraph in Subclause 5.7.2: "The phasor group designation (vector group) shall be shown on the transformer's nameplate, near the phasor diagram."
         - Motion #2: Revise existing Figure 1 to describe the phasor group designation for the four example connections given, as: Dd0, Yd1, Yy0, Dy1
         - Motion #3: Revise Table 6, Row 11 for Nameplates A, B, and C. Change "Phasor Diagram" to "Phasor Diagram and Phasor Group Designation"
    3. WG Item 115, Adding Sec 4.1.10 on DC current injection limits as % of Rated current/Andrew Larison.
       - Andrew Larison could not attend the meeting to answer questions about his proposal. As the Group could not understand clearly the material presented as explanation for the request, a motion was made to survey the subject among the PCS to collect

feedback on its relevance and pertinence; the motion passed with 23 in favor, 1 against, 3 abstained. TF Chair will also ask DT SC Chair regarding his position to backup the request.

4. WG Item 116, Update of KVA levels in table 11/Ryan Hogg (Bureau of Reclamation).
    - Ryan gave the TF Group a presentation on how Table 11, defining kVA limits for single-phase and three-phase transformer, has remained consistent throughout the revisions of C57.12.00, 15-500 KVA category I. It was suspected that it could be a typo in this table, but it appears not to be.
    - By proposal from Dan Sauer, this matter was tabled for next TF meeting, expecting more supporting information from Ryan Hogg, as well as investigation of position of the DT Transformers SC.

- New Business
    1. Jason Varnell (Doble Engineering) proposed to add the duration of the heat-run test to the test report so gas generation rates could be estimated. After short discussion, he accepted to put together a proposal for the upcoming Fall meeting in St. Louis.
    2. With no further new business, the meeting was adjourned at 4:15 PM.

- E. Betancourt made a motion to forward the changes to Sec 5.7.2 to add the phasor group designation to nameplates to the C57.12.00 WG. It was seconded by H. Flores. There was an objection to unanimous consent of the motion. The motion passed by a show of hands.
- E. Betancourt made a motion to forward three changes to aux loss language to C57.12.00 WG. It was seconded by A. Varghese. The motion passed by unanimous consent.

4) WG Standard for DPV Transformers C57.159 H. Shertukde

- First Working Group meeting held on Monday, 4:45 PM in Regency C/D.
- 60 attendees.
- Presentation given by Phil Hopkinson discussing NEMA draft document 80042: Product Guide for Wye-Connected transformers for use with Inverters.
- Carlos Guitan summarized the significant contributions NEMA 80042.
- Standard document layout and section titles were presented.
- Volunteers were solicited to begin work on specific sections of the Standard.
- Working Group will meet in Fall 2024.

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

- 102 Total attendees
- 30/52 members were present—quorum was achieved
- Discussions continued on the Clause 5.1 – Determination of cold temperature, under Clause 5: Resistance measurements
- Group agreed (voted – passed) to hand this business over to TF Continuous Rev Clause 11 Temp Rise Tests C57.12.90, as the temperature recording of cold resistance for temperature rise test is very critical

- Group also agreed (voted – passed) to continue to review within our TF to possibly define type/class of transformers where the cold temperature determination can be adapted from the other TF when their work is completed, also define type/class where we can keep the current wording for
- Meeting adjourned on time

6) WG Switching Transients Ind by Xfmr/Bkr Interaction PC57.142 J. McBride

- Welcome and Chair's Remarks
- Circulation of Attendance Sheets (33 of 50 Members were present – quorum was achieved. 60 guests, Total 93 Attendees)
- IEEE Patent Policy Slides (no patent claims)
- Approval of Agenda and Minutes from Fall 2023 Meeting
- C57.142 Ballot status and Comment Resolution – Jim McBride
    - **Total Comments: 305** (Editorial Required – 107; Editorial Not Required – 109; Technical Required – 67; Technical Not Required – 22)
    - **Addressed Comments: 285; Need Resolution for Remaining Comments: 20**
    - Draft 12 has been completed and incorporates all the 284 addressed comments.
- CRG is reviewing all comments remaining. Plan is to meet the week of March 18, 2024, to review final comments. The group has members from both the Transformers and Switchgear Committees.
- A proposed change was presented to Section 7.5 of C57.142. This change was discussed and the change was introduced into Draft 12 for recirculation.
- Dharam Vir with GE Waukesha presented a summary of STLI Testing and Simulation Results with comparison to Standard LI Testing.
- Mitigation Methods Task Force Update – Those present agreed to proceed with the Transformers Committee panel session to present the summary of the full list of mitigation methods that has been compiled.
- Phil Hopkinson made presentation on shielding using series capacitance as mitigation method.
- Meeting adjourned at 12:17 PM

7) WG Guide for Application of Tertiary & Stabilizing Windings C57.158 E. Betancourt

- Meeting Date/Time: March 12, 2024; 4:45 PM
- Co-Chair: Xose M. Lopez-Fernandez (Universidad de Vigo), Secretary: Kayland Adams (Prolec GE)
- After scope and purpose of the Group, the Chair presented IEEE Copyright and Patent statements with no issues raised by Members present.
- With attendance of 23 out of 37 Members in the WG and 49 Guests, a quorum was established. Agenda and Minutes from previous meeting were accepted with no comments.
- Highlights
    1. The Chair explained that the base MS Word file for development of our Draft Document was already obtained from IEEE SA, with support of Malia Zaman.
    2. The Chair presented the Group SOW of 4 TF teams with following titles:
        - TF 1: General editorial overview

- TF 2: Recommendations for Y-connected transformers without a delta connected winding
- TF 3: Improvement and/or simplification of some concepts in the Guide
- TF 4: New recommendations for TW or SW

- The TF SOW and deliverables were accepted by the Group (Estimated 19 in favor and 2 Abstentions).
- Two WG Members readily volunteered as Leaders for TF 1 (Emilio Morales/Qualitrol) and TF2 (Dr. Xose Lopez-Fernandez/Universidad de Vigo).
- Recognizing that the subjects for TF 3 and TF 4 are more specialized, the WG Chair offered to produce a more detailed proposal to address WG Members before the next meeting
- TF groups will be formed with WG Members by invitation, and Guests were also offered the possibility to participate.

3. The Chair presented a preliminary timetable to identify correction or improvement opportunities to the existing document.
4. Suggestion was made to address IEEE and CIGRE for access to specific documents (IEEE articles, CIGRE GB, IEC) that will be explored next by the Chair.

- With no New Business, the meeting was adjourned at 5:30 PM.

8) WG IEEE Neutral Grounding Devices PC57.32 S. Kennedy

- Vice Chair: Tom Melle, Secretary: Ed teNyenhuis
- Met Tuesday, March 13 at 4:45 PM – 6:00 PM
- Achieved quorum
- Received reports from the 5 Task Forces
  - Clause 4 Grounding Reactors, Clause 5 Ground Fault Neutralizers, Clause 7 Neutral Grounding Resistors, and Clause 8 Combination Devices TF's have held meetings and plan to try to be complete by Fall
  - Clause 6 Grounding Transformers TF is complete
- Will begin to prepare document draft with TF inputs to review for Fall meeting

9) WG Entity HVDC Neutral Grounding Devices PC57.32.10 Z. Hua

- WG met in China and has held 5 working group meetings. The fifth working group meeting was held online on March 16, 2023. After the meeting, the working group made modifications to the content of the draft and formed the sixth version of the draft.
- In July 2023, internal email ballots were completed and the sixth draft was submitted to the TR PCS subcommittee. In October 2023, the working group sorted out your feedback on the opinions and suggestions of the committee members and provided a response. The draft content was also modified accordingly and the Draft 6.0-IEEE PC57.32.10-rev1025 version was formed.

- In November 2023, the working group initiated MEC and SA ballot invitation. By December 2023, the construction of the SA ballot pool was completed. So far, it has been over three months since the working group initiated the MEC review process. The working group is now waiting for the MEC review results in order to initiate the SA vote.
- MEC Review was sent back in December per Malia.

10) WG Entity Winding Deformation Guide PC57.141 X. Shao

- TCR: Poorvi Patel
- 6th WG meeting was held on January 8th and a follow up 7th WG meeting on March 7th.
- The document is almost complete – still a few comments from Pre-balloting to resolve.
- The document will then be sent in for editors' language revision/review
- After this the Document will be sent for approval to the Entity WG..
- Then it will be sent to SC in around 2-3 months for approval to send the document for balloting.

J.6 Unfinished (Old) Business

There was no unfinished business.

J.7 New Business

- J. Watson brought up for discussion a possible need to create a task force to determine if a WG should be formed to develop a document on transformer modeling data for use by system power flow models. J. Watson made a motion to create a task force to study this topic to determine what, if any, action should be taken by PCS. Seconded by M. Schiessl. Passed by show of hand.
- W. Ziomek presented on Renewable Energy Connected Transformers (RCTs).

J.8 Adjournment

- The meeting was adjourned at 4:28PM**.**

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

J.9.1 TF CO2 Emissions in the Construction of Transformers

Meeting Date/Time: Monday, March 11, 2024, 11:00 AM to 12:15 PM PT
Meeting Location: Vancouver, British Columbia, Canada
Chairman: J. Kazmierczak (Hitachi Energy)
Vice Chair: Ismail Guner (Hydro Quebec)
Secretary: Elise Arnold (SGB SMIT)

- This was the second meeting of this task force.
- A call to order was made at 11:00 AM PT.
- The patent & copyright policy was reviewed.
- Introduction of officers was made.
- Introduction of attendees was made, with a total seventy attendees present, plus three officers

- Fifty-three attendees requested & were granted membership at the last meeting. Therefore, twenty-seven needed to be in attendance achieve quorum.
- Initially a quorum was not achieved. However, shortly after the beginning of the meeting another tally was taken.
- Twenty-seven members were present. Quorum was achieved.
- The minutes of the last meeting were reviewed. John Sen, Duke Energy, made a motion to approve the minutes. Ed TeNyenhuis, Hitachi Energy, seconded.
- No objections. The minutes were unanimously approved.
- The agenda was reviewed. The agenda was also unanimously approved.
- After the fall 2023 meeting in Kansas there were approximately five online meetings with members held. During these meetings we looked at what we currently have in relation to this topic in the industry, specifically what Cigre & IEC are currently doing. Many of these documents are still drafts. However, based on the reviews conducted we had a look again at the title of the proposed guide and the group agreed that the title should be revised.
- A proposal for revision of title to: ***IEEE guide for the environmental performance and life cycle assessment of Shunt Reactors, Distribution and Power Transformers***
- Additionally, a presentation of two slides prepared by Ghazi Kablouti, Hitachi Energy (not in attendance) was presented by the chair detailing the established Life Cycle Analysis methodology and explaining the rationale of the suggested title amendment and.
- An amended proposed scope was also presented.
- There was considerable discussion regarding the topic, including adding Evaluation to the title, the inclusion of instrument transformers, the difference between Environmental impact and carbon footprint, what the group should focus on in terms of scope (definition of inclusions/exclusions), the necessity to define the calculation method, if the topic needs to be from the manufacturer or end-user perspective and if the amended title covered these points in the proper manner.
- Luc Dorpmans, SMIT pointed out that ISO 14004 covers environmental impacts and that we may want to also look at this in further defining scope.
- Ultimately, it was agreed that the title needed to be amended.
- Curtis Frazier, Ameren motioned to amend it to “IEEE Guide for the Evaluation of the environmental impact & life cycle assessment of Transformers & Shunt Reactors”. Luiz Cheim, Hitachi: seconded the motion.
- A vote was taken on the amended title with zero no’s, seventeen yes’s and five abstentions. The amended title was approved.
- Ed TeNyenhuis, Hitachi made a motion to include the scope as is. John Sen, Duke Energy seconded the motion.
- There was discussion on whether to replace “covers” with “includes”, but ultimately it was decided to leave “covers” in the scope.

- Curtis Frazier, Ameren moved to vote on the scope. John Sen, Duke Energy seconded the motion.
- The scope: “This guide covers the methodology of calculation and reporting of the environmental impact and carbon footprint of transformers and shunt reactors over their life cycle.” was unanimously approved.
- Ed TeNyenhuis, Hitachi made a motion to adjourn.
- John Sen, Duke: Seconded
- The meeting was adjourned at 12:15 PM Pacific Time Zone.
- The next meeting will take place in St. Louis MO, USA during IEEE Transformer Committee Meeting scheduled for October 27-31, 2024.

Title: *IEEE Guide for the Evaluation of the environmental impact & life cycle assessment of Transformers & Shunt Reactors*

The scope: *This guide covers the methodology of calculation and reporting of the environmental impact and carbon footprint of transformers and shunt reactors over their life cycle.*
List of Meeting Attendees from Spring 2024 meeting (including affiliation & member status).

Daniel	Aleksandrowicz	Hitachi Energy	Member
Elise	Arnold	SGB SMIT	Officer -Secretary
Levent	Baser	Hitachi Energy	Guest
Mats	Bernesjo	Hitachi Energy	Member
Piotr	Blaszczyk	Specialty Transformer Components	Guest
William	Boettger	Boettger Transformer Consulting LLC	Member
Juan	Castellanos	Prolec GE	Guest
Luiz	Cheim	Hitachi Energy	Member
Craig	Colopy	Retired from Eaton	Guest
Liam	Conwax	IDF Technologies	Guest
Wiliam	Coughlan	Metglas	Guest
Sami	Debass	EPRI	Guest
Nikolaus	Dillon	Dominion Energy	Member
Luc	Dorpmanns	Royal Smit Transformers	Member
Janko	Dzodan	Koncar	Guest
Ken	Fedor	SGB-SMIT Group	Guest
Raymond	Frazier	Ameren	Member
Jose	Gamboa	H-J Family of Comp	Guest
Miguel	Garcia	Hitachi Energy	Member
Dragana	Gasic	Koncar DRST	Guest
Alexander	Gaun	Coil Innovation	Member
Orlando	Giraldo	HJ Family of Companies	Member
Ramsis	Girgis	Hitachi Energy	Member
Eduardo	Gomez Henning	Siemens Energy	Guest
Ismail	Guner	Hydro Quebec	Officer - Vice Chair
Ryan	Hogg	Bureau of Reclamation	Guest
Saif	Hossain	Trench Ltd.	Member
Miljenko	Hrkac	Hitachi Energy	Guest
Segiursz	Kapka	Hitachi Energy	Guest
Jerzy	Kazmierczak	Hitachi Energy	Officer - Chair

Egon	Kirchenmayer	Siemens Energy	Member
Krzysztof	Klasek	Delta Star	Member
Evan	Knapp	Eton	Guest
Matjia	Koprivnjak	Koncar DRST	Guest
Antol	Koshel	Delta Star Inc	Guest
Luka	Kovacic	Koncar Instrument Transformer	Guest
Samuel	Lewis	Hitachi Energy	Guest
Jose Luis	Machain	Prolec GE	Guest
Gabriel	Mamede	Siemens Energy	Guest
Kumar	Mani	Duke Energy	Guest
Mama	Mbouombouo	Hitachi Energy	Guest
Omar	Mendez	Prolec GE	Guest
Francis	Mills	Power Engineers	Guest
Masta	Munoz	Hitachi Energy Spain	Member
Goran	Palisic	Siemens Energy	Guest
Dwight	Parkinson	Eaton	Guest
George	Partyka	PTI Transformers	Guest
Pedro	Pedro	Efacec	Guest
Pedro	Puente	Prolec GE	Guest
Kowalski	Rafal	Hitachi Energy	Member
Sebastian	Renkopf	Reinhausen Manufacturing	Guest
Michael	Richardson	Ameren	Member
Rodrigo	Ronchi	WEG Transformers	Member
Dinesh	Sankarakurup	Duke Energy	Member
Markus	Schiessl	SGB	Member
John	Sen	Duke Energy	Member
Michael	Sharp	Trench LTD.	Member
Andre	Simons	JFE Snoji Canda	Guest
Muhammad Abdullah	Sohail	Trench Limited	Guest
Michael	Swiatkowski	Hitachi Energy	Member
Jonathan	Tan	Northern Transformer	Guest
Marc	Taylor	JFE Snoji Canda	Guest
Ed	TeNyenhuis	Hitachi Energy	Member
Scott	Thomas	Hitachi Energy	Guest
Ryan	Thompson	Burns & McDonnell	Guest
Robert	Vary	Reinhausen Manufacturing	Guest
Rogerio	Verdolin	Verdolin Solution	Member
Richard	Von Gemmingen	Dominion Energy	Guest
Paul	Weyandt	Schneider Electric	Guest
Stefan	Wirth	Coil Innovation	Guest
Terry	Wong	Trench ltd.	Member
Igor	Ziger	Koncar Instrument Transformer	Guest
Waldemar	Ziomek	PTI	Guest

J.9.2 TF "Audible Sound Revision to Test Code"

Unapproved Minutes of Spring 2024 TF "Audible Sound Revision to Test Code" Meeting

The TF met at 1:45 PM, on Monday, March 11, 2024. Dr. Ramsis Girgis, Chairman of the TF, presided over
the meeting, with Mats Bernesjo being the Secretary.

The Chairman & Secretary welcomed the audience to this meeting and reviewed the proposed agenda. The agenda was unanimously approved as was the unapproved minutes of the Fall 2023 TF meeting in Kansas City (Sanjib Som 1st, Eduardo Garcia 2nd).

The TF meeting was attended by 39 out of 51 members and a total meeting attendance of 92. A quorum was established. 21 attendees requested membership at this meeting (listed below) **.

The Secretary introduced the topic of PA noise by playing a recording of the noise of a transformer with a noisy PA, provided by Scott Digby (Duke Energy). The recording demonstrated the higher sound level of the transformer when the Tap changer was moved from a non-Bridging to a Bridging tap position. This was followed by a presentation on impact of noise of the PA on sound level of the main transformer when on a bridging tap position, using 3 different cases: one with a low noise PA, one with a noisy PA, and one with a very noisy PA. The cases demonstrated that noisy PAs increase the sound level of the main transformer significantly. Following this presentation, Markus Schiessl of SGB presented measured sound levels of a large number of PAs measured in air. A few of these had high sound levels and needed to be replaced.

The chairman then presented the following:

1. Methodology of determining the Sound pressure level of the PA in oil from sound level measurements of the main transformer at non-bridging and bridging tap positions.

2. Data on 2 transformers where the sound level of the PA was measured in air and compared with the determined Sound Level of the PA in oil. These measurements showed that the sound level of the PA in these 2 cases was 4 – 6 dB lower in oil than the sound level measured in air. The Chairman requested attendees to submit data in this area to try to establish possible values of this difference. Based on the discussion that followed, this difference appears to be dependent on the way the PA is installed in the main tank. Following the meeting, representatives of a number of transformer manufacturers expressed willingness to provide such data. This will require transformer manufacturers to measure the sound level of the main transformer at both a bridging tap position and at a nonbridging tap position, as well as measuring sound level of the PA in air. Data received on this item will be presented in the fall meeting of this TF.

3. Methodology of specifying the sound level of the PA in air such that the PA noise would have a minimal impact on the sound level of the main transformer at bridging tap positions.

4. Information on measuring Sound level of PAs in air.

The Chairman suggested that the above information can be added to the IEEE Noise Guide C57.136 to provide guidance to the transformer industry on this subject. Since the next revision of the Guide would not be slated for a number of years yet, Steve Antosz suggested that, in the meantime, an IEEE paper that includes such information, could be published.

With no new additional business raised, the meeting was adjourned upon unanimous approval.

Respectfully submitted,

Mats Bernesjo, TF Secretary

Spring 2024 TF Meeting Attendance and Affiliation is as follows:

Kayland	Adams	Prolec GE Waukesha	Member
Thomas	Aikens	Delta Star	Guest
Daniel	Aleksanderowicz	Hitachi Energy	RM
Stephen	Antosz	Stephen Antosz & Associates, Inc	Member
Rezvan	Arash	Delta Star Inc.	Guest
Edmundo	Arevalo	BPA	RM
Elise	Arnold	SGB	Member
Javier	Arteaga	Hitachi Energy	RM
Onome	Avanoma	MJ Consulting	Member
Donald	Ayers	Ayers Transformer Consultants	Guest
Levent	Baser	Hitachi Energy	Guest
Paulo	Bautista	Enmax	Guest
Mats	Bernesjo	Hitachi Energy	Secretary
Enrique	Betancourt	Prolec GE	Member
William	Boettger	Boettger Transformer Consulting LLC	Member
Georges	Bouty	Delta Star Inc.	Guest
Darren	Brown	Howard Industries	Member
Alfredo	Carrizales	Prolec GE	Member
Camilo	Casallas	Trench ltd	Guest
Eunyoung	Cho	HICO America	Guest
William	Coughlan	Metglas	Guest
Juan Carlos	Cruz Valdes	Prolec GE	Member
Scott	Digby	Duke Energy	Member
Hugo	Flores	Hitachi Energy	Member
Joe	Foldi	F&A	Guest
Raymond	Frazier	Ameren	Guest
Richard	Frye	Eaton	Guest
Zach	Gagne	IFD Technologies	Guest
Eduardo	Garcia Wild	Siemens Energy	Member
Alexander	Gaun	Coil Innovation	Gust
Ramsis	Girgis	Hitachi Energy	Chair
Bill	Griesacker	W. Griesacker & Associates	Guest
Miljenko	Hrkac	Hitachi Energy	Guest
Nicholas	Jensen	Delta Star Inc.	Member
Chan Min	Jeong	HD Hyundai	RM
Jerzy	Kazmierczak	Hitachi Energy	Member
Sheldon	Kennedy	Sheldon P Kennedy Engineering PLLC	Guest
Dmitry	Klempner	Southern California Edison	Guest
Rafal	Kowalski	Hitachi Energy	Member
Mark	Lachman	Doble	Member
Junho	Lee	Hyundai Electric	Member
Samuel	Lewis	Hitachi Energy	Guest
Eric	Li	BC Hydro	Guest
Xose	Lopez-Fernandez	Universidade de Vigo	RM
Jose	Machain	Prolec GE	Member
Alberto	Martinez	WEG USA	RM
Mama	Mbouombouo	Hitachi Energy	RM
Brian	McCarrick	Virginia Transformer Corp.	RM
Francis	Mills	Power Engineers Inc	Guest

Juliano	Montanha	Siemens Energy	Guest
Marta	Munoz	Hitachi Energy	RM
David	Murray	TVA	Guest
Joe	Nims	Allen & Hoshall	Member
Anastasia	O'Malley	ConEdison Co NY	Guest
Cuauhtemoc	Ortiz	Niagara Transformer	Guest
George	Partyka	PTI Transformers	Guest
Sylvain	Plante	Hydro-Quebec	Guest
Klaus	Pointner	Trench Austria GmbH	Member
Bertrand	Poulin	Hitachi Energy	Guest
Ulf	Radbrandt	Hitachi Energy	Member
Tim	Rocque	Prolec GE Waukesha	Member
Marnie	Rousell	Entergy	Member
Hakan	Sahin	Virginia/Georgia Transformer	RM
Dinesh	Sankarakurup	Duke Energy	Member
Amitabh	Sarkar	Virginia Transformer Corp.	RM
Daniel	Sauer	EATON Corporation	Member
Markus	Schiessl	SGB	Member
Cihangir	Sen	Duke Energy	Member
Abdulmajid	Shaikh	Delta Star	RM
Michael	Sharp	Trench Ltd Canada	Member
Andre	Simons	JFE Shoji	Member
Christopher	Slattery	FirstEnergy Corp.	Member
Jimmy	Smith	Howard Industries	Guest
Yong Tae	Sohn	Hyosung HICO	RM
Sanjib	Som	Pennsylvania Transformer	Member
Andy	Steineman	Delta Star Inc.	Member
Michal	Swiatkowski	Hitachi Energy	RM
Sachin	Tade	PTI Transformers	Guest
Troy	Tanaka	Burns & McDonnell	Member
Marc	Taylor	JFE Shoji Power Canada Inc.	Member
Ryan	Thompson	Burns & McDonnell	Member
Cole	Van Dreel	American Transmission Co	Guest
Alwyn	Vanderwalt	Electrical Consultant	RM
Ajith	Varghese	SPX Transformer Solutions, Inc.	Member
Jason	Varnell	Doble Engineering Co.	RM
Mike (Hugh)	Waldrop	MLG-W	Guest
David	Wallach	Duke Energy	Member
Stefan	Wirth	Coil Innovation	Guest
Jeffrey	Wright	Duquesne Light	Member
Fei	Yang	Hitachi Energy	Guest
Kim	Yeounsoo	MEPPI	Guest
Kris	Zibert	Allgeier Martin & Associates	Member

J.9.3 TF PCS Continuous Revisions to C57.12.00

PCS Task Force on General Requirements C57.12.00

Performance Characteristics Subcommittee
IEEE / PES Transformers Committee

March 11, 2024
Vancouver, BC (Canada)

UNAPPROVED MINUTES

The PCS Task Force on General Requirements for C57.12.00 met at 3:15 PM on Monday, March 11, 2024. Acting Chairman Enrique Betancourt presided over the meeting with Mats Bernesjo being the Acting Vice-chair / Formal secretary. The meeting was called to order and the Chairman reminded the group of the purpose and scope of this Task Force. The copyright and patent statements from IEEE were presented to the group; none of the members and guests present were aware of any issues related to this TF's activities.

The meeting was attended by **41** members (out of **57**), 35 guests, for a total meeting attendance of 76 people, including 9 requests for membership at this meeting. A quorum was established with 41 / 57 = 72 % attendance.

The agenda and the unapproved minutes from the previous meeting (Fall meeting, Kansas City, 2023) was unanimously approved (1st Hugo Flores, 2nd Eduardo Garcia Wild).

The following 9 guests requested membership:
Nick Jensen (Delta Star), Tom Melle (Highvolt), Eduardo Orozco (GE Grid Solutions), Subramany Shankar (KEMA), Rogerio Verdolin (Verdolin Solutions Inc), Alireza Gorzin (Black & Veatch), Arash Rezuan (Delta Star), Piotr Blaszcyk (STC), and Mohammad Abdullah Sohau (Trench Limited).

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

WG Item 113, Measurement of Auxiliary Loss

Submitted by Ajith Varghese:

"I see there is some disconnect between what different manufactures are doing for measuring control losses – based on how one interprets 'integral parts of transformers'".

"We can't have each component listed in IEEE, but I think there need to be some additional clarity needed. Some of the disconnects:

- Heaters
- When dual temp heaters, many are taking only one stage
- Heaters in Cubicles/bus duct (supplied with transformer) are not included
- Heaters in LTC cubicles
- Breathers

- Power for LTC Motor
- Power consumed by N2 generator
- Power consumed by Oil Filters.

Also – Need clarity of inrush/starting power needed for cooling fans, etc."

Present wording from C57.12.00 Sec 5.9.

For Class II transformers (see 5.10), control/auxiliary (cooling) losses shall be measured and recorded. All stages of cooling, pumps, heaters, and all associated control equipment shall be energized, provided these components are integral parts of the transformer.

A Taskforce meeting was held on Feb 20th, 2024, decided on following to replace the existing wording.

For Class II transformers (see 5.10), auxiliary cooling equipment losses shall be measured and recorded. All stages of cooling, and all associated cooling control equipment shall be energized, provided these components are integral parts of the transformer to meet guaranteed thermal performance.

Note:

The auxiliary losses do not include control cabinet components including but are not limited to cabinet heaters, online DGA or ancillary devices such as dehydrate breathers, nitrogen cabinet heaters etc.

The manufacturer to provide total power consumption of all devices on the control schematic drawing to evaluate the supply power requirements.

A short informative discussion was held on this topic with input from both Manufacturers, Utilities, and Consultants. A vote was held among the TF whether to approve the revised wording proposed (Ajith Varghese 1st, Dan Sauer 2nd). The majority of the members present voted in favor of approving the above wording, 1 vote opposed, 0 abstained. Hence, the motion to accept the changes to the writeup was approved.

WG Item 114, Modification of Sec 5.7.2

Steve Antosz proposed that we add a requirement that the phasor group designation (also known as: vector group or clock number notation) be the required IEEE nomenclature for identifying the angular displacement between windings for three-phase power and distribution transformers. The reason I am suggesting this is because C57.12.70 Standard Terminal Markings and Connections was revised and includes this slightly new requirement in Clause 7. See attached C57.12.70-2020 Clause 7 and Annex A. 12.00 already refers to 12.70 in subclauses 5.7.2 and 5.7.3; and most Product Standards refer to 12.70 also. So, I am proposing that we enhance 12.00 to highlight the requirement that the phasor group designation be shown on the transformer's nameplate. The nomenclature is detailed in 12.70. This proposal also harmonizes with IEC, for whatever that's worth.

Motion # 1:

Add the following sentence at the end of the second paragraph in Subclause 5.7.2:

"The phasor group designation (vector group) shall be shown on the transformer's nameplate, near the phasor diagram."

Motion # 2:

Revise existing Figure 1 to describe the phasor group designation for the four example connections given, as: Dd0, Yd1, Yy0, Dy1

Motion # 3:

Revise Table 6, Row 11 for Nameplates A, B, and C. Change; "Phasor Diagram" to "Phasor Diagram and Phasor Group Designation"

Vote on these motions was motioned by Steve Antosz (1st), Hugo Flores (2nd)

A good discussion across the TF members & guests was held on this topic until Dan Sauer called the question 2nd by Steve Snyder and to vote. A vote to end the discussion was held, none opposed, hence, calling the question was approved.

Vote on Motion 1: None opposed, none abstain, motion passed.

Vote on Motion 2 Hugo Flores 1st, Dan Sauer 2nd: None opposed, none abstain, motion passed.

Vote on Motion 3: Steve Snyder 1st, Hugo Flores 2nd). None opposed, none abstain, motion passed.

WG Item 115, Adding Sec 4.1.10 on DC current injection limits

Andrew Larison was unfortunately not able to attend. However, the WG item was presented to the TF and discussed. Dan Sauer (1st) and Jason Varnell (2nd) proposed to motion a survey to PCS with the content provided to get a broader consensus on the topic. There are lots of questions on this topic and its accuracy, and really needs to be reviewed. There appears not to be a theoretical basis for the 0.5 % limit.

A vote was held, 23 members voted to approve the motion to survey to PCS, 1 against, and 3 abstained. Motion to survey passed. Before setting the survey in motion, the TF Leaders intend to approach Distribution Transformers SC Leadership to understand their position about the proposal.

WG Item 116, Update of KVA levels in table 11

Ryan Hogg gave the TF an excellent presentation on this topic and how these levels (Table 11) have been consistent throughout the revisions, 15 – 500 KVA category I. It was suspected that it could be a typo in this table, but it appears not to be.

Dan Sauer 1st and Hugo Flores (2nd) proposed to table this matter. It was unanimously approved to discontinue the discussion, to be continued in future TF meetings.

New business

Ryan Hogg had new business items: adding zero sequence impedance to the nameplate and adding nameplate A, B, and C. He had prior to the meeting discussed with our Chair, Tauhid Ansari, deciding to withdraw the new business he proposed.

Other new Business

Jason Varnell, proposed to add the duration of the heat run test to the test report. He will put together a proposal for the Chairman and present at the upcoming Fall meeting in Saint Louis.

With a quiet floor, the Chairman asked for the meeting to be adjourned (1st Hugo Flores, 2nd by Dan Sauer)

Meeting was adjourned at 4:15 PM.

Respectfully submitted,

Enrique Betancourt	Mats Bernesjo
Vice-Chair	Secretary

Attendance Spring 2024 Meeting – PCS TF to Revision C57.12.00

Kayland	Adams	Prolec GE Waukesha	Member
Nabi	Almeida	Prolec GE	Guest
Stephen	Antosz	Stephen Antosz & Associates, Inc.	Member
Elise	Arnold	Starkstrom Geraetebau GMBH	Member
Stephen	Ashcraft	Hitachi Energy	Guest
Donald	Ayers	Ayers Transformer Consultants	Member
Mats	Bernesjo	Hitachi Energy	Member
Enrique	Betancourt	Prolec GE	Member
Piotr	Blaszcyk	STC	RM
William	Boettger	Boettger Transformer Consulting LLC	Member
Darren	Brown	Howard Industries	Member
Eunyoung	Cho	HICO-America	Guest
Michael	Craven	Qualus Power Services	Guest
Eric	Davis	Consultant	Guest
Nikolaus	Dillon	Dominion Energy	Member
Luc	Dorpmanns	Royal SMIT Transformers	Guest
Samragni	Dutta Roy	Siemens Energy	Member
Eric	Elson	SDGE	Guest
Hugo	Flores	Hitachi Energy	Member
Joe	Foldi	Foldi & Associates, LLC	Guest
Bruce	Forsyth	Bruce Forsyth and Associates LLC	Guest
Raymond	Frazier	Ameren	Member
Eduardo	Garcia Wild	Siemens Energy	Member
Dragana	Gasic	Koncar D&ST	Guest
Ramsis	Girgis	Hitachi Energy	Member
Alireza	Gorzin	Black & Veatch	RM
Bill	Griesacker	Duquesne Light	Member
Detlev	Gross	Power Diagnostic Consult	Guest
Shertukde	Hemchandra	University of Hartford	Member
Ryan	Hogg	USBR	Member
Philip	Hopkinson	HVOLT Inc	Member
Nick	Jensen	Delta Star Inc.	RM
Christopher	Johnson	Oncor	Member
Jerzy	Kazmierczak	Hitachi Energy	Member
Sheldon	Kennedy	Sheldon Kennedy Engineering, PLL	Member
Mark	Lachman	Doble	Member
Daniel	Martinez	JFE Shoji Power Canada	Guest
Tom	Melle	Highvolt	RM
Omar	Mendez	Prolec GE	Guest

Francis J	Mills	Power Engineers	Member
Marta	Munoz	Hitachi Energy	Guest
David	Murray	TVA	Member
Kristopher	Neild	Megger	Member
Joe	Nims	Allen & Hoshall	Member
Edward	Orozco	GE Grid Solutions	RM
George	Partyka	PTI Transformers	Guest
Monil	Patel	PG&E	Guest
Bertrand	Poulin	Hitachi Energy	Member
Jarrod	Prince	ERMCO	Member
Ulf	Radbrandt	Hitachi Energy	Guest
Juan	Reyes Perez	Hitachi Energy	Guest
Arash	Rezuan	Delta Star Inc.	RM
Marnie	Roussell	Entergy	Member
Hakan	Sahin	Virginia / Georgia Transformers	Member
Sherif	Salem	Eversource Energy	Guest
Fernando	Salinas	Power Partners / ERMCO	Guest
Farwaha	Sanjeev	Snohomish county PUD	Guest
Dinesh	Sankarakurup	Duke Energy	Guest
Amitabh	Sarkar	Virginia Transformers	Member
Daniel	Sauer	Eaton Corporation	Member
Markus	Schiessl	SGB	Member
Harmanpreet	Sekhon	PTI Transformers	Guest
Cihangir	Sen	Duke Energy	Member
Subramany	Shankar	KEMA	RM
Christopher	Slattery	FirstEnergy Corp.	Member
Steven	Snyder	Hitachi Energy	Member
Mohammad Abdullah		Sohau	Trench Limited RM
Yong Tae	Sohn	Hyosung HICO	Member
Kyle	Stachshulte	AEP	Guest
Ajith	Varghese	Prolec GE	Member
Jason	Varnell	Doble Engineering	Member
Rogerio	Verdolin	Verdolin Solutions Inc	RM
Dharam	Vir	Prolec GE Waukesha	Member
David	Wallach	Duke Energy	Member
Rene	Wind	Siemens Energy	Guest
Faye	Yang	Hitachi Energy	Guest

J.9.4 WG Standard for DPVTs C57.159

Working Group C57.159: Standard for Distributed Photo-Voltaic Transformers (DPVTs)
Unapproved Meeting Minutes
Spring 2024 Meeting
Vancouver, BC, Canada
4:45-6:00 PM, March 11, 2024

The Working Group met at the Hyatt Hotel – Regency C/D Conference Room. The meeting was called to order at 4:45 PM by Chair, Dr. Hemchandra Shertukde.

Chair made opening comments.

60 attendees. This is the first meeting of the Working Group.

Chair presented Working Group Policies stating all attendees at first meeting today requesting membership are granted membership.

Introductions -

Call For Patents: The Chair presented the information on Patent Disclosures and asked the group to report any relevant patent issues – None were communicated.

Copyright Notice: The Chair presented the IEEE_SA Copyright Policy. No discussion.

Approval of Agenda: The Spring 2024 agenda was approved unanimously without discussion.
Motion: Steve Oaks
Second: Kumar Mani

Old Business
Chair reviewed PAR Status - Approved
Chair reviewed Approved Scope and Purpose – No discussion.

New Business
Review NEMA document 80042, Product Guide for Wye-Connected transformers for use with Inverters – Phil Hopkinson

Carlos Guitan– presented significant contributions of NEMA 80042.

- A significant number of transformer failures have occurred due to the interaction between the inverter output with high harmonic content, and the transformer primary winding.
- This situation is not specific to the transformer or inverter manufacturers.
- High frequency harmonics, up to the 200th order, have been measured.
- Harmonics are not an issue as long as the input windings are not grounded.
- NEMA 80042 describes mitigation measures such as:
    - Suitable core grounding practices, based on the core construction (wound/stacked)
    - Alternatives for the use of a core ground shield, and how it would be required or not, depending on such core construction.
    - Harmonics are not an issue as long as the input windings are not grounded.
    - Importance of impedance requirements between multiple LV windings, for transformers connected to multiple inverters.

Standard document layout and section titles were reviewed. Standard IEEE-TC template to develop the standard for C.57.159 presented.

Proposed chapter titles were presented.
Discussion regarding chapter contents and Scope
Items such as Power Quality, Safety, and Relaying we discussed and were deemed beyond the scope of this Standard.

Volunteers were solicited to begin working specific sections.

Chapter 1
Introduction DPV Transformers - Joe Watson
Chapter 2
Voltage Flicker and Variation – Hemchandra Shertukde
Chapter 3
Harmonics and Waveform Distortion – Gaytan Carlos
Chapter 4
Frequency Variation - Gaytan Carlos
Chapter 5
Power Factor Variation – Hemchandra Shertukde
Chapter 6
Safety and Protection Related to Public - Paul Weyandt & Wolfgang Schmidt
Chapter 7
Islanding – Paul Weyandt & Wolfgang Schmidt
Chapter 8
Removed - Relay Protection ; Steve Shull
Chapter 9
DC Bias
Chapter 10
Thermo Cycling (Loading)
Chapter 11
Neutral Grounding – Phil Hopkinson
Chapter 12
Low Voltage Fault Ride-Through David Walker
Chapter 13
Power Storage – David Walker
Chapter 14
Voltage Transients and Insulation Coordination – Hemchandra Shertukde
Chapter 15
Magnetic Inrush Current – Hemchandra Shertukde
Chapter 16
Eddy Current and Stray Losses – Hemchandra Shertukde
Chapter 17
Design Considerations: Inside/Outside Windings -David Walker; Zak Weiss
Chapter 18
Special Tests Considerations – A Naderian; Hemchandra Shertukde : Class I or Class II
Chapter 19
Special Design Consideration - NEMA guidelines – Phil Hopkinson
Chapter 20
Battery Storage – David Walker

Many more members were requested to be contributors, who will send us their emails and interests when ready to do so.

Further Discussion:

Some inverter manufacturers require the neutral of the transformer to be grounded.

The inverter OR the transformer can be grounded, but not both.

Battery energy storage needs to be considered in this standard.

Testing should be considered (Class 1 or Class 2)

Adjourned at 6:05

The Working Group will meet again at the Fall 2024 meeting,

Chair: Dr. Hemchandra Shertukde
Vice Chair: Phil Hopkinson
Secretary: Rhea Montpool

Meeting Attendance:

Mihir	Amin	Eaton	Member
Stephen	Ashcraft	Hitachi Energy	Member
Donald	Ayers	Ayers Transform Consulting	Member
Jason	Beaudoin	Weidmann Electrical Tech	Member
Kevin	Biggie	Weidmann Electrical Tech	Guest
Gabriel	Delgado Zamora	Invenergy	Member
Huan	Dinh	Hitachi Energy	Member
Jeff	Door	The H-J Family of Companies	Member
Marco	Espindola	Hitachi Energy	Guest
Jose	Gamboa	H-J Familiy of Companies	Member
Miguel	Garcia	Hitachi Energy	Member
Carlos	Gaytan	Prolec GE	Member
Rafael	Grajeda	Eaton	Member
Bill	Griesacker	W. Griesacker & Assoc	Member
Phil	Hopkinson	Hvolt	Member
Sheldon	Kennedy	Sheldon P Kenndy Engineering	Member
Dave	Komm	HPS	Member
Andrew	Larison	Hitachi Energy	Member
Moonhee	Lee	HPS	Member
Angela	Leigl	Eaton	Member
Aleksandr	Levin	Weidmann Electrical Tech	Member
Ricardo	Lopes	Efacec Transformers	Guest
Xose	Lopez-Fernandez	Universidade De Vigo	Member
Kumar	Mani	Duke Energy	Member
Daniel	Martinez	JFE	Guest
Toni	Mellin	Vaisala	Guest
Rhea	Montpool	Schneider Electric	Member
Tyler	Morgan	Duke Energy	Member
Ali	Naderian	BBA	Member
Aniruddha	Narawane	Eaton	Member
Mark	Newbill	Hitachi Energy	Member
Stephen	Oakes	WEG	Member
Paul	Orr	NEMA	Guest
Dwight	Parkinson	Eaton	Member
George	Partyka	PTI Transformers	Member
Dipesh	Patel	Eaton	Member
Harry	Pepe	Phenix Technologies	Guest

Miguel	Plascencia	PGE	Guest
Jarrod	Prince	Ermco	Guest
Pedro	Pueute	Prolec GE	Guest
Alberto	Sandoval	Eaton	Member
Manish	Saraf	HPS	Member
Wolfgang	Schmitt	Schneider Electric	Member
Russ	Sewel	Quality Switch	Guest
Steven	Shull	BBC Electrical Services In	Member
Steven	Snyder	Hitachi Energy	Guest
Brad	Staley	Leeward Renewable Energy	Member
David	Stockton	Stockton Business Consulting	Member
Janosz	Szczechowski	MR GmbH	Member
Vijay	Tendulkar	Eaton	Member
Ed	teNyenhuis	Hitachi Energy	Member
Fernando	Tirado	Prolec GE	Guest
Retinaldo	Valentin	Duke Energy	Member
Rogerio	Verdolin	Verdolin Solutions	Member
David	Walker	MGM Transformer Co	Guest
Joe	Watson	JD Watson & Assoc	Member
Zachery	Weiss	WEG	Member
Paul	Weyandt	Schneider Electric	Member
Joe	White	Power Engineers	Member
Guang	Yuan	Hitachi Energy	Member

J.9.5 PCS Task Force Continuous Revision to Test Code C57.12.90

Vancouver, BC, Canada
March 12, 2024
9:30 AM – 10:45 AM
Chair – Hakan Sahin
Vice Chair – Pugal Selvaraj
Secretary – Adam Sewell

Meeting Minutes / Significant Issues / Comments:

Meeting was called to order at 9:30am, March 12, 2024, at Hyatt Regency Vancouver; Vancouver, British Columbia, Canada.

1. Administrative
    a. IEEE Patent Policy and Call for Patents and IEEE SA Copyright Policy
        i. No comments from group
    b. Review of Spring 2024 agenda
        i. No comments from group
    c. Introductions of the attendees
        i. Attendance sheets were passed out. Due to time constraints, chair did not have each attendee announce their name/affiliation. Name/affiliation was announced as attendees spoke during the meeting.
        ii. Secretary asked all who wanted on email distribution for the C57.12.90 PCS Task Force to send him an email at: adamsewell@ieee.org

d. Updated membership review and count for quorum
    i. 52 members were listed and 27 were counted as present by hand count. Based on the hand count, the chair announced there was QUORUM for this meeting.
    ii. *Attendance sheets after meeting completed showing 31 members attended.*
    iii. **Members are expected to attend and stay in the meeting so business can be conducted.**
    iv. **Member requests should be sent to secretary – adamsewell@ieee.org**
e. Approval of Fall 2023 unapproved minutes
    i. Chair asked if there was any opposition to unanimous approval of the minutes
        1. No opposition to unanimous approval – minutes approved
f. Approval of Spring 2024 agenda
    i. Chair asked if there was any opposition to unanimous approval of the agenda
        1. No opposition to unanimous approval – agenda approved

2. Old Business
    a. Chair reviewed a proposed revision to Clause 5.1: Determination of cold temperature, under Clause 5: Resistance measurements and had discussions among the task force members.
        i. MOTION made by D.Sauer, 2nd by S.Antosz – Leave Clause 5.1 as is and send topic to Insulation Life Subcommittee TF Continuous Rev Clause 11 Temp Rise Tests C57.12.90.
            1. During discussions, it was brought up that the temperature recording of cold resistance for temperature rise test is very critical
            2. No objections to unanimous approval – APPROVED
    b. MOTION made by R.Frazier, 2nd by J. Varnell - Continue to review within our TF to possibly define type/class of transformers where the cold temperature determination can be adapted from the other TF when their work is completed, also define type/class where we can keep the current wording for.
        i. Vote: 15 APPROVE, 8 REJECT, 5 ABSTAIN - APPROVED
3. New Business
    a. J.Varnell proposed suggested wording for the TF discussion on the winding resistance:
        i. The cold temperature of the windings for class II transformers shall be determined by a thermocouple or suitable thermometer immersed directly immersed in oil.
4. Membership changes
    a. Officers will look at attendance and change TF membership status before next meeting.
5. Next meeting: October 29, 2024 at Fall 2024 Transformer Committee Meeting scheduled for October 27-31, 2024, St. Louis, Missouri, USA.
6. Close of meeting
    a. Meeting adjourned at 10:45am – Motion-D.Sauer, 2nd-J.John
        i. No opposition to unanimous approval – MOTION APPROVED

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

March 12, 2024, Meeting Attendance:
(RM3=Requested Membership 3 times, RM2=Requested Membership 2 times, RM1=Requested Membership 1st time)

Kayland	Adams	Prolec GE Waukesha	Member
Alex	Alahmed	Evergy	Guest-RM1
Tauhid	Ansari	Hitachi Energy	Guest-RM1

Stephen	Antosz	Stephen Antosz & Associates, Inc.	Member
Elise	Arnold	SGB	Member
Hugo	Avila	Hitachi Energy	Guest-RM1
Donald	Ayers	Ayers Transformer Consulting	Member
Gilles	Bargone	FISO Technologies Inc.	Guest-RM3
Chris	Baumgartner	We Energies	Member
Duvier	Beoya	Hitachi Energy	Member
Mats	Bernesjo	Hitachi Energy	Member
Daniel	Blaydon	Baltimore Gas & Electric	Member
William	Boettger	Boettger Transformer Consulting LLC	Member
Sanket	Bolar	Oncor	Guest
Dominique	Bolliger	HV Technologies, Inc.	Guest-RM1
Elizabeth	Bray	Southern Company Services	Guest
Jeffrey	Britton	Phenix Technologies, Inc.	Member
Darren	Brown	Howard Industries	Guest
Juan Alfredo	Carrizales	Prolec GE	Guest
Thomas	Dauzat	AEP-SWEPCO	Guest-RM3
Everton	De Oliveira	Siemens Energy	Member
Scott	Dennis	Hitachi Energy	Member
Nikolaus	Dillon	Dominion Energy	Guest
Luc	Dorpmanns	SGB SMIT	Guest
Samragni	Dutta Roy	Siemens Energy	Member
Evgenii	Ermakov	Hitachi Energy	Guest
Florin	Faur	Prolec GE Waukesha	Guest
Sean	Fitzgerald	ComEd	Guest
Raymond	Frazier	Ameren	Member
Richard	Frye	EATON Corporation	Guest
Renjie	Fu	ERMCO	Guest
Ramsis	Girgis	Hitachi Energy	Member
Alireza	Gorzin	Black & Veatch	Guest-RM1
Shawn	Gossett	Ameren	Guest-RM2
Ravi	Gupta	Megger	Guest-RM2
Shamaun	Hakim	WEG Transformers USA Inc.	Guest
Giovanni	Hernandez	Virginia Transformer Corp.	Guest-RM1
Sergio	Hernandez Cano	Hammond Power Solutions	Guest
John	Herron	Raytech USA	Member
Martin	Himow	HIGHVOLT	Guest-RM1
Thomas	Holifield	Howard Industries	Guest
Mohammad	Iman	MGM Transformer Company	Guest
Nathan	Jacob	Camlin Energy	Guest-RM1
John	John	Virginia Transformer Corp.	Member
Jerzy	Kazmierczak	Hitachi Energy	Guest-RM1
Sheldon	Kennedy	Sheldon P. Kennedy Engineering, LLC	Guest
Stacey	Kessler	Ulteig Engineers	Guest-RM2
Gary	King	Howard Industries	Member
Evan	Knapp	Eaton	Guest
Mark	Lachman	Doble Engineering Co.	Member
Fernando	Leal	Prolec GE	Member
Moonhee	Lee	Hammond Power Solutions	Guest
Swapnil	Marathe	Megger	Guest
Tim	Menter	Lincoln Electric System	Guest
Francis	Mills	Power Engineers	Guest
Juliano	Montanha	Siemens Energy	Guest
Marta	Munoz	Hitachi Energy	Guest
David	Murray	TVA	Member
Ali	Naderian	METSCO Energy Solutions Inc.	Guest-RM1

Ismael	Naja	Eaton	Guest-RM2
Shankar	Nambi	Bechtel Energy	Guest
Kristopher	Neild	Megger	Member
Joe	Nims	Allen & Hoshall	Guest
George	Partyka	PTI Transformers	Guest
Sanjay	Patel	Smit Transformers	Member
Harry	Pepe	Phenix Technologies, Inc.	Member
Miguel	Plascencia	PG&E	Guest
Bertrand	Poulin	Hitachi Energy	Guest
Jarrod	Prince	ERMCO	Guest
Sebastian	Rehkopf	Maschinenfabrik Reinhausen	Guest
Juan	Reyes Perez	Hitachi Energy	Guest
Michael	Richardson	Ameren	Guest
Marnie	Roussell	Entergy	Guest
Hakan	Sahin	Virginia/Georgia Transfomer	Member-Chair
Dinesh	Sankarakurup	Duke Energy	Guest
Daniel	Sauer	EATON Corporation	Member
Markus	Schiessl	SGB	Member
Pugal	Selvaraj	Virginia Transformer Corp.	Member-Vice Chair
Kabir	Sethi	Hitachi Energy	Guest-RM1
Adam	Sewell	Quality Switch, Inc.	Member-Secretary
Hemchandra	Shertukde	University of Hartford	Member
Kushal	Singh	ComEd	Guest
Christopher	Slattery	FirstEnergy Corp.	Guest-RM3
Jason	Snyder	FirstEnergy Corp.	Guest
Sanjib	Som	Pennsylvania Transformer	Member
Mike	Spurlock	Spurlock Engineering Svcs	Member
Andrew	Steineman	Delta Star Inc.	Guest
Michael	Swiatkowski	Hitachi Energy	Guest-RM1
Ed	teNyenhuis	Hitachi Energy	Member
Andreas	Thiede	HIGHVOLT	Guest
Scott	Thomas	Hitachi Energy	Guest
Cole	Van Dreel	American Transmission Company	Guest-RM3
Ajith	Varghese	Prolec GE Waukesha	Member
Jason	Varnell	Doble Engineering Co.	Member
Rogerio	Verdolin	Verdolin Solutions Inc.	Guest-RM1
Krishnamurthy	Vijayan	PTI Transformers	Member
Pragnesh	Vyas	Sunbelt Solomon	Guest-RM3
David	Wallach	Duke Energy	Guest
Shelby	Walters	Howard Industries	Guest
Guang	Yuan	Hitachi Energy	Gust
Malia	Zaman	IEEE SA	Guest
Kris	Zibert	Allgeier, Martin & Associates	Guest
Waldemar	Ziomek	PTI Transformers	Guest-RM3

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

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

Vancouver, BC, Canada
Tuesday, March 12, 2024
11:00 AM – 12:15 PM PT
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
   - **Discussion of transformer protection**:
     i. The chair discussed the submission of statements by Bertrand Poulin regarding transformer **protection by use of internal surge arrestors** in Section 7.5.
     ii. A motion was made by Bertrand Poulin / seconded by Phil Hopkinson to include the submitted paragraph in the Guide.
     iii. 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.

iv. 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.

v. 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:**
  i. Chair suggested tutorial panel at upcoming TC meeting and a possible technical report or IEEE transactions paper.
  ii. 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 PT made by JC Hernandez / seconded by Jeffery Britton with no opposition.

Spring 2024 WG Meeting Attendance and Affiliation (pending):

Robert	Allison	Dominion Energy	Guest
Jeff	Benach	Megger	Guest
Enrique	Betancourt	Prolec GE	Member
Vivek	Bhatt	Prolec-GE Waukesha	Guest
William	Boettger	Boettger Transformer Consulting	Member
Popovic	Bojan	KPT	Guest
Robert	Bracum	KPT	Guest
Jeffrey	Britton	Phenix Technologies, Inc.	Member
Camilo	Casallas	Trench LTD	Guest
David	Caverly	Trench Limited	Member
Scott	Digby	Duke Energy	Guest
Paul	Dolloff	EKPC	Guest
Luc	Dorpmanns	SMIT Transformatoren B.V.	Guest
Marco	Espindola	Hitachi Energy	Guest
Sean	Fitzgerald	ComEd	Guest
Raymond	Frazier	Ameren	Guest
Jose	Gamboa	H-J Family of Companies	Guest
Lorne	Gara	Shermco	Guest

Miguel	Garcia	Hitachi Energy	Guest
Eduardo	Garcia Wild	Siemens Energy	Member
Shamaun	Hakim	WEG Transformers USA Inc.	Guest
JC	Hernandez	Georgia Tech - NEETRAC	Guest
Giovanni	Hernandez	Virginia Transfomrer Corp.	Guest
Saramma	Hoffman	PPL Electric Utilities	Guest
Thomas	Holifield	Howard Industries	Guest
Philip	Hopkinson	HVOLT Inc.	Member
Saif	Hossain	Trench Limited	Guest
Logan	Howell	Hitachi Energy	Guest
John	John	Virginia Transformer Corp.	Member
Christopher	Johnson	Oncor	Guest
Nathan	Katz	Pacific Corp	Guest
Gael	Kennedy	GR Kennedy & Associates LLC	Guest
Stacey	Kessler	Ulteig Engineers	Guest
Qasim	Khan	Georgia Tech - NEETRAC	Guest
Gary	King	Howard Industries	Guest
Zan	Kiparizoski	Howard Industries	Guest
Egon	Kirchenmayer	Siemens Energy	Member
First Name	Last Name	Company	Role
First Name	Last Name	Company	Role
Fernando	Leal	Prolec GE	Guest
Moonhee	Lee	Hammond Power Solutions	Member
Junho	Lee	Hyundai Electric	Guest
Weijun	Li	Braintree Electric Light Dept.	Member
Xose	Lopez-Fernandez	Universidade de Vigo	Vice-Chair
Kumar	Mani	Duke Energy	Guest
Alberto	Martinez	WEG	Guest
James	McBride	JMX High Voltage	Chair
Joseph	McBride	JMX High Voltage	Guest
Thomas	Melle	HIGHVOLT	Secretary
Filip	Mikulecky	Siemens Energy	Guest
Juliano	Montanha	Siemens Energy	Member
Marta	Munoz	Hitachi Energy	Guest
Volney	Naranjo	Megger	Guest
Anthony	Natale	HICO America	Guest
Joe	Nims	Allen & Hoshall, Inc.	Guest
Paul	Orr	NEMA	Guest
Tihomir	Pandza	Siemens Energy	Guest
Dwight	Parkinson	EATON Corporation	Guest
George	Partyka	PTI Transformers	Guest
Nitesh	Patel	Hyundai Power Transformers USA	Guest
Sanjay	Patel	SMIT Transformer Sales, Inc.	Guest
Harry	Pepe	Phenix Technologies, Inc.	Member
Jay	Pidcock	Ameren	Guest
Christoph	Ploetner	Siemens Energy	Guest
Klaus	Pointner	Trench Austria GmbH	Member
Bertrand	Poulin	Hitachi Energy	Member
Jarrod	Prince	ERMCO	Guest
Ulf	Radbrandt	Hitachi Energy	Guest
Ion	Radu	Hitachi Energy	Guest

Tim	Raymond	EPRI	Guest
Jonathan	Reimer	Fortis BC	Guest
Juan	Reyes Perez	Hitachi Energy	Guest
Michael	Richardson	Ameren	Guest
Tim	Rocque	Prolec GE Waukesha	Guest
Rodrigo	Ronchi	WEG-Voltran	Guest
Marnie	Roussell	Entergy	Member
Amitabh	Sarkar	Virginia Transformer Corp.	Member
Eric	Schleismann	Southern Company Services	Guest
Alfons	Schrammel	Siemens Energy	Guest
Cihangir	Sen	Duke Energy	Member
Kabir	Sethi	Hitachi Energy	Guest
Masoud	Sharifi	Siemens Gamesa Renewable	Guest
Michael	Sharp	Trench Limited	Member
Samuel	Sharpless	Rimkus Consulting Group	Guest
Hemchandra	Shertukde	University of Hartford	Guest
Stephen	Shull	BBC Electrical Service, Inc.	Guest
Kushal	Singh	ComEd	Guest
Mike	Spurlock	Spurlock Engineering Services	Member
Fabian	Stacy	Hitachi Energy	Guest
Hampton	Steele	Tennessee Valley Authority	Guest
Andrew	Steineman	Delta Star Inc.	Guest
Dragan	Tabakovic	Hubbell Power Systems	Guest
Eduardo	Tolcachir	TTE	Guest
Ajith	Varghese	SPX Transformer Solutions, Inc.	Member
Rogerio	Verdolin	Verdolin Solutions Inc.	Member
Yves	Vermette	Electro Composites ULC	Guest
Krishnamurthy	Vijayan	PTI Transformers	Guest
Dharam	Vir	Prolec-GE Waukesha	Member
Joe	Watson	JD Watson & Associates	Guest
Eric	Weatherbee	PCORE Electric	Guest
Matthew	Weisensee	PacifiCorp	Guest
Terry	Wong	Trench LTD	Guest
Joshua	Yun	Virginia Transformer Corp.	Guest
Shibao	Zhang	PCORE Electric	Guest
Waldemar	Ziomek	PTI Transformers	Member

J.9.7 WG C57.158 Application Guide for Tertiary and Stabilizing Windings

PCS Working Group Revision of Application Guide for Tertiary and Stabilizing Windings C57.158

Performance Characteristics Subcommittee
IEEE / PES Transformers Committee

March 12, 2024
Vancouver, BC (Canada)

UNAPPROVED MINUTES

This group met for the second time Tuesday March 12, 2024 at 4:45 PM in Vancouver BC Canada. The attendance record showed **73** people attended the meeting with **23** out of the **37** Members present; a quorum to conduct business was established.

Following **15** Guests requested Membership (to be awarded after consecutive attendance to two WG meetings):
Yao Fu (BC Hydro), Orlando Giraldo (The HJ Family of Companies), Alireza Gorzin (Black & Veatch), Chanmin Jeong (HD Hyundai), Jerzy Kazmierzak (Hitachi Energy), Junho Lee (HD Hyundai), Kumar Mani (Duke Energy), Mama Mbouombouo (Hitachi Energy), Eduardo Orozco (GE Grid Solutions), Miguel Plascencia (PG&E), Bertrand Poulin (Hitachi Energy), Vyas Pragnesh (Sunbelt Solomon), Marnie Rousel (Entergy), Jonathan Tan (Northern Transformer), Joshua Watson (Nebraska Public Power District).

The officers were introduced as Enrique Betancourt Chair, Xose Lope-Fernandez Vice Chair, and Kayland Adams Secretary.

IEEE Patent slides were covered, no issues were brought up.
IEEE Copyright Policy slides were discussed, no issues were brought up.

Attendance was conducted and quorum was achieved.

Agenda was presented. Motion unanimously passed to approve agenda (Amitabh Sakar, Eduardo Garcia). The Minutes from the last meeting were also unanimously approved (Eduardo Garcia, Hemchandra Shertukde).

OLD BUSINESS
Four task forces were proposed by the chair.

Task Force 1: General editorial overview
SOW

- Review of current version of C57.158 for any visible editorial improvements.
- Confirm harmonization with recent changes in C57.12.00, C57.12.90, C57.12.10, C57.105 and C57.163, Others.
- Review CIGRE's Transformers' Green Book for concurrent references to TW or SW application.

DELIVERABLES

- List of possible editorial (or technical) improvements and suggested new text.
- List of (extracted) paragraphs from reviewed documents, that refer to TW or SWs, and possible suggested action for revised C57.158 (delete, change, or add segments).

Emilio Morales-Cruz (Qualitrol) volunteered to lead Task Force 1.

Task Force 2: Recommendations for Y-connected transformers without a delta connected winding.
SOW

- Expand section about Y-connected transformers without a TW or SW.

DELIVERABLES

- Paragraph(s) with recommendations to mitigate operation issues related to zero-sequence flux effects in three-phase transformers. (References for protection schemes?).
- General reference about when a delta-connected winding could be spared (possible extension to what is already stated in the Guide].
- Definition of Z0 for a three-phase, three-legged core transformer.

Dr. Xose Lope-Fernandez volunteered to lead Task Force 2.

Task Force 3: Improvement and, or simplification of some concepts in the Guide
SOW

- Describe more concisely the application of multi-winding transformers with different power factor loads.
- Expand discussion on transferred voltages to half-floating stabilizing windings (one corner grounded), and those with current limiting reactors (review also Annex D of IEC 60071-2018).
- Short-circuit requirements considering all windings connected to voltage sources.
- Recommendations for bushings layout of large TW, if heat run test required. Comments regarding heat-run request for a SW.

DELIVERABLES

- Suggested paragraphs to simplify, or to improve existing material in the Guide, with references for a deeper understanding, if necessary.

With no volunteer to lead Task Force 3, the Chair offered to appoint a leader at later date. [After the meeting, Krzysztof Kulasek (Delta Star) volunteered to lead this TF3].

Task Force 4: New recommendations for TW or SW Applications.

SOW

- Some experiences with collector transformers in Renewables Plants.
- Tertiaries for axial-split, Y-connected LVs.
- Section of grounding of neutrals in Y-connected transformers.

- Caution for application of outer-most Tertiaries: electrostatic voltage pick-up.
- Effects from Reverse Power Flow.
- Circulating currents in delta of single-phase banks.

DELIVERABLES

- Proposed new paragraph(s) on (possible) recommendations to evaluate or control above-described phenomena, with references to further understanding of the subject (if applicable).

No volunteer for Task Force 4. Chair will appoint leader at later date.

Motion passed with 19 Members in favor to approve the creation of the above task forces. Raymond Frazier made the motion, Eduardo Garcia seconded.

Next Steps were discussed:

New MS-Word version of standard has already been provided by IEEE SA (support from Malia Zaman). The Chair will distribute a PDF workfile for the Group´s reference.

Invitation remains open for WG Members to sign up to participate in the approved Task Forces. [At the end of the meeting, some participants already approach TF Leaders to sign up].

Task Forces to develop material for WG review.

Working group to meet and discuss TF findings over the next two committee meetings.

Assemble and organize new draft document.

NEW BUSINESS
No new business was brought up.

ADJOURNMENT
Motion passed to adjourn the meeting by 5:25 PM (Hemchandra Shertukde, Raymond Frazier).

Respectfully submitted,

Enrique Betancourt	Dr. Xose Lopez-Fernandez	Kayland Adams
Chairman	Co-Chair	Secretary

Attendance Spring 2024 Meeting
RM=Request Membership

Onome	Avanoma	MJ Consulting	Member
Sean	Barker	Hitachi Energy	Guest
Levent	Baser	Hitachi Energy	Guest
William	Boettger	Boettger Transformer Consulting	Member
Vivian	Chan	Hitachi Energy	Guest
Marcos	Czernorucki	Hitachi Energy	Guest
Pouneh	Davoudi	Delta Star	Member
Gabriel	Delgado Zamora	Invenergy	Guest
Nikolaus	Dillon	Dominion Energy	Guest
Jesse	Duffy	Nashville Electric Service	Guest
Janko	Dzodan	Koncar D&ST	Guest
Eric	Elson	SDGE	Guest
Raymond	Frazier	Ameren	Member
Yao	Fu	BC Hydro	RM
Eduardo	Garcia	Siemens Energy	Member
Dragana	Gasic	Koncar D&ST	Guest
Orlando	Giraldo	The H.J Family of Companies	RM
Alireza	Gorzin	Black & Veatch	RM
Bill	Griesacker	W.Griesaker & Assoc	Guest
Derek	Hollrah	Burns & McDonnell	Guest
Nick	Jensen	Delta Star	Guest
Chanmin	Jeong	HD Hyundai	RM
John	John	Virginia Transformer	Member
Ryan	Jonak	PG&E	Guest
Kevin	Juchem	Hitachi Energy Germany AG	Guest
Jerzy	Kazmierczak	Hitachi Energy	RM
Egon	Kirchenmayer	Siemens-Energy	Member
Matija	Koprivnjak	Koncar D&ST	Guest
Anton	Koshel	Delta Star	Guest
Krzysztof	Kulasek	Delta Star	Member
Fernando	Leal	Prolec GE	Guest
Junho	Lee	HD Hyundai	RM
Xose	Lope-Fernandez	Universidade De Vigo	Member
Ricardo	Lopes	EFACEC Transformers	Guest
Gabriel	Mamede	Siemens-Energy	Guest
Kumar	Mani	Duke Energy	RM
Daniel	Martinez	JFE Canada	Member
Alberto	Martinez	WEG USA	Guest
Mama	Mbouombouo	Hitachi Energy	RM
Juliano	Montanha	Siemens-Energy	Guest
Marta	Munoz	Hitachi Energy	Member
Joe	Nims	Allen & Hoshall	Guest
Eduardo	Orozco	GE Grid Solutions	RM
Monil	Patel	PG&E	Guest
Miguel	Plascencia	PG&E	RM
Bertrand	Poulin	Hitachi Energy	RM
Vyas	Pragnesh	Sunbelt Soloman	RM
Pedro	Puente	Prolec GE	Guest

Michael	Richardson	Ameren	Member
Tim	Rocque	Prolec GE Waukesha	Member
Rodrigo	Ronchi	WEG	Member
Marnie	Roussell	Entergy	RM
Dinesh	Sankarakurup	Duke Energy	Member
Amitabh	Sarkar	Virginia Transformer	Member
Markus	Schiessl	SGB	Member
Harmanpreet	Sekhon	PTI Transformers	Guest
Hemchandra	Shertukde	UHART	Member
Christopher	Slattery	First Energy	Guest
Sanjib	Som	Pennsylvania Transformers	Member
Andrew	Steineman	Delta Star	Guest
Sachin	Tade	PTI Transformers	Guest
Jonathan	Tan	Northern Transformer	RM
Marc	Taylor	JFE Canada	Guest
Ajith	Varghese	Prolec GE	Member
Jason	Varnell	Doble	Member
Hugh	Waldrop	MLGW	Guest
Joe	Watson	JD Watson & Assoc	Guest
Joshua	Watson	Nebraska Public Power District	RM
Bruce	Webb	K.U.B	Guest
Matt	Weisensee	PacifiCorp	Guest
Joe	White	Power Engineers	Member
Fei	Yang	Hitachi Energy	Guest
Kris	Zibert	Allgeier Martin	Guest

J.9.8 WG PC57.32 Neutral Grounding Devices

IEEE Neutral Grounding Devices Working Group Meeting
Hyatt Regency Hotel
Vancouver, BC, Canada

Tuesday, March 12, 2024
4:45 PM – 6:00 PM

Chair – Sheldon P. Kennedy
Vice-Chair – Thomas Melle
Secretary – Ed teNyenhuis

1. Welcome and Chair's Remarks

2. Circulation of attendance sheets. (Quorum achieved – 14 of 24 Members; 15 Guests present). There were 2 guests requesting membership. Since they have attended the last 2 meetings they will be granted membership. This includes Scott Thomas and Terry Wong.

3. Approval of Agenda (Motion to approve by Don Ayers, Second by Klaus Pointner – motion passed without objection)

4. Patent Call

5. Copyright and IEEE Ethics Policies
6. Approval of Minutes from previous Meeting.
    - (No objection to unanimous approval.)

7. Reports from TF Leader Assignments
    - **Clause 4 – Neutral Grounding Reactors** – Camilo Casallas
        i. There has been 1 virtual TF meeting. The proposed changes were reviewed in the WG. These sections will be finalized by the Fall meeting.
    - **Clause 5 – Neutral Ground Gault Neutralizers** – Klaus Pointner
        i. There has been 1 virtual TF meeting. It is planned to make this section consistent with IEC 60076-6 which is presently is not published yet. The WG will later need permission from IEC. The TF will put the changes into the document. The TF also requested to do a technical presentation at the Fall meeting if time allowed.
    - **Clause 6 – Neutral Grounding Transformers** – Don Ayers
        i. The TF is complete and has a document with the proposed changes.
        ii. There was discussion on the Table 21 BIL values in relation to C57.12.00 Table 4 Column 13 where the max BIL is 350kV. Tom Melle will prepare text to explain this apparent inconsistency.
    - **Clause 7 – Neutral Grounding Resistors** – Ryan Hogg, Sergio Panetta
        i. The TF has held 13 meetings so far and has processed 85% of the comments. It is planned to be completed by the Fall meeting.
    - **Clause 8 – Combinational Devices** – Sergio Panetta
        i. The TF is working through suggested changes.

8. Old Business
    - None

9. New Business
    - None

10. Next in-person meeting – Fall 2024 (IEEE TC October 27-31, 2024, in St. Louis, Missouri, USA)

11. Adjournment at 5:31 PM PT (motion by Don Ayers; Second by Ryan Hogg)

List of Meeting Attendees from Fall 2023 meeting (including affiliation & member status).

Robert	Allison	Dominion Energy	Guest
Robert	Arritt	EPRI	Member
Donald	Ayers	Ayers Consulting	Member
Jason	Beaudain	Wiedmann	Guest
Rahul	Bharduoaj	Burns & McDonnell	Guest
Vivek	Bhatt	Prolec GE	Guest
Sankey	Bolar	ONCOR	Member
Susan	Bonfiglio	WAPA	Member

Camilo	Casallas	Trench Ltd.	Member
David	Caverly	Trench	Guest
Arup	Chakraborty	Delta Star	Member
Juan Carlos	Cruz Valdes	Prolec GE	Member
Huan	Dinh	Hitachi Energy	Member
teNyenhuis	Ed	Hitachi Energy	Secretary
Will	Elliott	AEP/SWEPCO	Guest
Jeff	Grager	Xcel Energy	Guest
Ravi	Gupta	Megger	Guest
Roger	Hayes	GE	Guest
Ryan	Hogg	Bureau of Reclamation	Member
Darren	Hoppins	SensorLink	Guest
Saif	Hossain	Trench Ltd.	Member
Kevin	Juchem		Guest
Kurt	Kaineba	Trench Austria	Guest
Sheldon	Kennedy	Sheldon P. Kennedy Engineering PLLC	Chair
Klaus	Koeck	Trench Austria	Guest
Jusuf	Krvavac	Sargent & Lundy	Member
Mark	Lowthor	Kruger	Guest
Jim	McBride	JMX High Voltage	Member
Thomas	Melle	HIGHVOLT	Vice-Chair
Sergio	Panetta	I-Gard Corp.	Member
Klaus	Pointner	Trench Austria	Member
Daniel	Posadas	Prolec GE	Guest
Ulf	Radbrandt	Hitachi Energy	Member
Pugal	Selvaraj		Guest
Mike	Sharp	Trench Ltd.	Member
Kyle	Stechschulte	AEP	Member
Troy	Tanaka	Burns & McDonnell	Guest
Scott	Thomas	Hitachi Energy	Guest
Cody	Vanwyck	Commonwealth Associates	Member
Alan	Washburn	Burns & McDonnell	Member
Trenton	Williams	Advanced Power Technologies	Member
Terry	Wong	Trench	Guest
Maria	Zaman	IEEE	Guest
Kris	Zibert	Allgeier, Martin & Assoc.	Member

J.10 Performance Characteristics Subcommittee Attendance List

First Name	Last Name	Affiliation	Status
Kayland	Adams	Prolec-GE	Member
Mihir	Amin	EATON	Guest
Stephen	Ashcraft		Member
Onome	Avanoma	MJ Consulting	Guest
Alex	Ayala	Power Partners	Member
Donald	Ayers	Ayers Transformer Consulting	Guest
Robert	Ballard	DuPont	Member
Gilles	Bargone	FISO Technologies Inc.	Guest
Jason	Beaudoin	Weidmann	Guest

Enrique	Betancourt	Prolec GE	Guest
Wallace	Binder	WBBinder Consultant	Guest
Zack	Blackwell	TCI	Member
Piotr	Blaszczyk		Member
Daniel	Blaydon	Baltimore Gas & Electric	Guest
William	Boettger	Boettger Transformer Consulting LLC	Guest
Sanket	Bolar	Oncor Electric Delivery	Guest
Georges	Bouty		Guest
Jeffrey	Britton	Phenix Technologies, Inc./Doble Eng.	Guest
Juan Alfredo	Carrizales	Prolec GE	Guest
Camilo	Casallas	TRENCH	Guest
Ricardo	Castro Lopes	Efacec Transformers	Guest
Binzhan	Chen		Guest
Eunyoung	Cho	HICO-America	Member
Rhett	Chrysler	ERMCO	Guest
Craig	Colopy	Retired - EATON Corporation	Guest
Michael	Craven	Qualus Power Services	Guest
Janet	Crockett	Fayetteville PWC	Guest
Juan Carlos	Cruz Valdes	Prolec GE	Guest
Pouneh	Davoudi	Delta Star Inc.	Guest
Samson	Debass	EPRI	Member
J. Arturo	Del Rio	Siemens Energy	Guest
Scott	Digby	Duke Energy	Guest
Nikolaus	Dillon	Dominion Energy	Guest
Luc	Dorpmanns	Royal Smit Transformers	Member
Samragni	Dutta Roy	Siemens Energy	Member
Janko	Dzodan	Koncar D&ST	Member
Eric	Elson	SDGE	Guest
Evgenii	Ermakov	Hitachi Energy	Member
Marco	Espindola	Hitachi Energy	Member
Reto	Fausch	RF Solutions	Guest
Miguel	Fernandez	Braintree Electric Light Dept.	Member
Hugo	Flores	Hitachi Energy	Guest
Raymond	Frazier	Ameren	Member
Rich	Frye	EATON Corporation	Guest
Yao	Fu		Guest
Jose	Gamboa	H-J Family of Companies	Guest
Miguel	Garcia	Hitachi Energy	Guest
Eduardo	Garcia Wild	Siemens Energy	Member
Dragana	Gasic	Koncar D&ST	Member
Rob	Ghosh	General Electric	Guest

Eduardo	Gomez Hennig	Siemens Energy	Guest
Brad	Greaves	Weidmann	Guest
Bill	Griesacker	Duquesne Light Co.	Member
Ismail	Guner	Hydro-Quebec	Member
Ravi	Gupta	Megger	Guest
Kevin	Hampton	Siemens Energy	Guest
Peter	Heinzig	Weidmann Electrical Technology	Member
Sergio	Hernandez Cano	Hammond Power Solutions	Member
Jean	Hernandez-Myia	Georgia Tech	Guest
Miljenko	Hikac		Guest
Saramma	Hoffman	PPL Electric Utilities	Member
Ryan	Hogg	Bureau of Reclamation	Guest
Derek	Hollrah	Burns & McDonnell	Guest
Philip	Hopkinson	HVOLT Inc.	Guest
Saif	Hossain	Trench Limited	Member
Ramadan	Issack	American Electric Power	Guest
Marion	Jaroszewski		Member
Nicholas	Jensen	Delta Star Inc.	Guest
Chanmin	Jeong		Member
John	John	Virginia Transformer Corp.	Guest
Christopher	Johnson	Oncor Electric Delivery	Guest
Kurt	Kaineder		Guest
Jerzy	Kazmierczak	Hitachi Energy	Guest
Sheldon	Kennedy	Sheldon P. Kennedy Engineering, PLLC	Guest
Stacey	Kessler	Ulteig Engineers	Guest
Yeounsoo	Kim		Corresponding Member
Egon	Kirchenmayer	Siemens Energy	Guest
Dmitriy	Klempner	Southern California Edison	Member
Dave	Komm		Guest
Matija	Koprivnjak	Koncar D&ST	Guest
Anton	Koshel	Delta Star Inc.	Guest
Krzysztof	Kulasek	Delta Star Inc.	Guest
Andrew	Larison	Hitachi Energy	Guest
Fernando	Leal		Member
Junho	Lee	Hyundai Electric	Guest
Moonhee	Lee	Hammond Power Solutions	Guest
Angela	Leigl	EATON Corporation	Member
Aleksandr	Levin	Weidmann Electrical Technology	Guest
Eric	Li	BC Hydro	Guest
Weijun	Li	Braintree Electric Light Dept.	Guest

Xose	Lopez-Fernandez	Universidade de Vigo	Guest
Jose Luis	Machain	Prolec GE-Waukesha	Guest
Tim-Felix	Mai	Siemens Energy	Member
Alberto	Martinez	WEG Transformers USA Inc.	Member
James	McBride	JMX Services, Inc.	Guest
Thomas	Melle	HIGHVOLT	Guest
Omar	Mendez	Prolec-GE	Guest
Francis	Mills	Power Engineers	Guest
Juliano	Montanha	Siemens Energy	Member
Rhea	Montpool	Schneider Electric	Guest
Emilio	Morales-Cruz	Qualitrol Company LLC	Guest
Marta	Munoz	Hitachi Energy	Guest
David	Murray	Tennessee Valley Authority	Guest
Ryan	Musgrove	Oklahoma Gas & Electric	Member
Ali	Naderian	METSCO Energy Solutions Inc.	Guest
Aniruddha	Narawane	EATON Corporation	Guest
Kristopher	Neild	Megger	Guest
Yaw	Nyanteh	Hyosung Hico	Member
Rudolf	Ogajanov	Hitachi Energy	Guest
Anastasia	O'Malley	Con Edison, NY	Guest
Dipesh	Patel		Member
Monil	Patel	Pacific Gas & Electric	Member
Harry	Pepe	Phenix Technologies, Inc.	Guest
Sylvain	Plante	Hydro-Quebec	Guest
Christoph	Ploetner	Siemens Energy	Member
Klaus	Pointner	Trench Austria GmbH	Guest
Daniel	Posadas	Prolec-Celeco	Guest
Bertrand	Poulin	Hitachi Energy	Guest
Jarrod	Prince	ERMCO	Member
Ulf	Radbrandt	Hitachi Energy	Member
Ion	Radu	Hitachi Energy	Guest
Farnoosh	Rahmatian	NuGrid Power	Guest
Jonathan	Reimer	FortisBC	Guest
Juan	Reyes	Hitachi Energy	Guest
Arash	Rezvan		Member
Michael	Richardson	Ameren	Guest
Tim	Rocque	Prolec GE Waukesha	Guest
David	Rohrer	First Energy	Guest
Rodrigo	Ronchi	WEG-Voltran	Member
Marnie	Roussell	Entergy	Member
Hakan	Sahin	Virginia/Georgia Transformer	Guest

Sherif	Salem	Eversource Energy	Guest
Fernando	Salinas		Guest
Dinesh	Sankarakurup	Duke Energy	Guest
Amitabh	Sarkar	Virginia Transformer Corp.	Guest
Daniel	Sauer	EATON Corporation	Guest
Markus	Schiessl	SGB	Member
Eric	Schleismann	Southern Company	Guest
Alfons	Schrammel	Siemens Energy	Member
Ewald	Schweiger	Siemens Energy	Guest
Cihangir	Sen	Duke Energy	Guest
Adam	Sewell	Quality Switch, Inc.	Member
Abdul Majid	Shaikh	Delta Star, Inc.	Guest
Michael	Sharp	Trench Limited	Guest
Harmanpuet	Singh Sekhon		Guest
Christopher	Slattery	FirstEnergy Corp.	Guest
Jimmy	Smith	Howard Industries	Guest
Steven	Snyder	Hitachi Energy	Guest
Yong Tae	Sohn	Hyosung Hico	Guest
Sanjib	Som	Pennsylvania Transformer	Guest
Mauricio	Soto	Hitachi Energy	Guest
Brad	Staley		Member
Kyle	Stechschulte	American Electric Power	Member
Andrew	Steineman	Delta Star Inc.	Guest
Charles	Sweetser	OMICRON electronics Corp USA	Member
Sachin	Tade		Member
Jonathan	Tan	Northern Transformer	Guest
Troy	Tanaka	Burns & McDonnell	Guest
Valeriu	Tatu	Powersmiths	Guest
Marc	Taylor	JFE Shoji Power Canada Inc.	Member
Vijay	Tendulkar	EATON Corporation	Guest
Andreas	Thiede	Highvolt Dresden	Guest
Scott	Thomas	Hitachi Energy	Guest
Tim	Tillery	Howard Industries	Guest
Fernando	Tirado	Prolec Energy	Guest
Mark	Tostrud	Dynamic Ratings	Guest
Bjorn	Vaagensmith	Idaho National Laboratory	Guest
Cole	Van Dreel	ATC	Guest
Jeramy	Van Horn	IFD Technologies	Guest
Ajith	Varghese	Prolec GE-Waukesha	Member
Jason	Varnell	Doble Engineering Co.	Guest
Joshua	Verdell	ERMCO	Guest
Rogerio	Verdolin	Verdolin Solutions Inc.	Chair
Dharam	Vir	Prolec-GE	Member

Richard	vonGemmingen	Dominion Energy	Member
Pragnesh	Vyas	Sunbelt-Solomon	Member
John	Wagner		Guest
David	Wallach	Duke Energy	Member
Alan	Washburn	Burns & McDonnell	Guest
Joe	Watson	JD Watson and Associates Inc.	Member
Joshua	Watson	Nebraska Public Power District	Guest
Bruce	Webb	Knoxville Utilities Board	Member
Matthew	Weisensee	PacifiCorp	Guest
Joe	White	Power Engineers	Guest
Chris	Whitten		Guest
Terry	Wong	Trench Limited	Guest
Jeffrey	Wright	Duquesne Light Co.	Guest
Shuzhen	Xu		Guest
Fei	Yang	Hitachi Energy	Guest
Guang	Yuan	Hitachi Energy	Guest
Joshua	Yun	Virginia Transformer Corp.	Member
Malia	Zaman	IEEE	Guest
Peter	Zhao	Hydro One	Member
Kris	Zibert	Allgeier, Martin and Associates	Secretary
Waldemar	Ziomek	PTI Transformers	Member