Annex G Insulating Fluids Subcommittee

October 30, 2024 – 3:00PM – 4:15PM
Hyatt Regency, St. Louis MO

Chair: Stephanie Mabrey
Vice-Chair: Jerry Murphy
Secretary: Mike Bonn

1. Call to Order 3:00PM
2. Stephanie Mabrey introduced herself as Chair, Jerry Murphy Vice-Chair, Mike Bonn Secretary
3. Presented IEEE Patent Policy, Copyright Policy and Code of Conduct
4. Opening Remarks
    i. Reminded that SC minutes are due to Stephanie Mabrey and Mike Bonn by November 15, 2024 and WG and TF minutes are due to Insulating Fluids Subcommittee (IFSC) Secretary Mike Bonn within 15 business days of their meetings and are to include attendance
    ii. Recommended new officers take SA training on website.
    iii. DGA Data to be submitted to c57data@ieee.org. A question was asked whether mineral oil data will also go to this address as it has been used for ester-filled transformers. It was confirmed that all users should email data to this address and put the WG number in the subject to differentiate.
    iv. Reminded of Membership requirements to attend 3 out of last 5 meetings and be a member in good standing of IEEE PES and IEEE SA.
5. Roll Call of SC Members – Quorum requirement -27
    i. 36 members signed in from of a total of 53 members achieving quorum
    ii. 89 attendees. 53 Guests. 17 requested memberships.
    iii. Both a QR code and paper attendance list were used to do roll call. 14 attendees used paper form only.

First Name	Last Name	Role	First Name	Last Name	Role
Adriana	Cisco-Sullberg	Guest	Luiz	Cheim	Member
Alfons	Schrammel	Guest	Luke	Wang	Guest-RM
Alireza	Gorzin	Guest - RM	Malia	Zaman	Guest
Alwyn	VanderWalt	Member	Marcos	Ferreira	Member
Anastasia	O'Malley	Guest	Mark	Tostrud	Member
Andreas	Kurz	Guest-RM	Michael	Bonn	Member
Anthony	Natale	Guest	Mick	Kasonga	Guest
Attila	Gyore	Member	Mickel	Saad	Member
Brian	Klaponski	Guest	Miguel	Garcia	Guest-RM
Chao	Li	Member	Naveen	Bhardwaj	Guest -RM
Chris	Franklin	Guest-RM	Nick	Perjanik	Guest-RM
Daniel	Obregón	Guest	Niklas	Gustavsson	Guest
David	Calitz	Member	Orlando	Giraldo	Member
David	Córdova	Guest	Paul	Boman	Member
Dean	Park	Guest	Pedro	Trujillo	Guest
Deanna	Woods	Member	Peter	Werelius	Guest
Didier	Hamoir	Guest	Rainer	Frotscher	Member
Diego	Robalino	Member	Rashid	Hussein	Guest

Donald	Lamontagne	Guest-RM	Robert	Mennonna	Guest
Dwight	Parkinson	Member	Roberto	Da Silva	Guest_RM
Ed	Casserly	Member	Roger	Hayes	Member
Fernando	Tirado	Guest	Ronald	Hernandez	Guest
Florin	Faur	Guest-RM	Rudolf	Ogajanov	Guest
Francis Felipe	Mantoan	Guest	Ryan	Thompson	Member
Gabriel	Delgado	Guest-RM	Samuel	Tekle	Guest
Gilles	Barthes	Guest	Scott	Reed	Member
Greg	Steeves	Member	Sean	Barker	Guest
Igor	Simonov	Guest-RM	Sebastien	Rehkopf	Guest
Ismael	Naja	Guest	Shivkumar	Morkhande	Guest
James	Gardner	Guest	Stephanie	Mabrey	Member
James	Beaudoin	Guest	Shuzen	Xu	Guest-RM
Jeremiah	Bradshaw	Member	Swapnil	Marathe	Guest-RM
Jerry	Murphy	Member	Thomas	Holifield	Guest
Jesse	Duffy	Guest	Thomas	Prevost	Member
Jim	Thompson	Guest-RM	Tiffany	Lucas	Member
Jinesh	Malde	Member	Tim	Dappen	Guest-RM
John	John	Member	Tim	Raymond	Member
John	Pruente	Member	Toni	Mellin	Member
Jonathan	Sinclair	Member	Traci	Hopkins	Member
Joshua	Garner	Guest	K	Viereck	Guest
Juan	Castellanos	Member	William	Boettger	Member
Katherine	Marulanda	Guest	William	Solano	Member
Kevin	Biggie	Member	William	Whitehead	Member
Leon	White	Guest	Yuri	Rossini	Guest-RM
Luc	Loiselle	Guest			

RM = Requested Membership

6. The posted agenda and minutes were amended to correct the year on the date from 2023 to 2024. A **Motion** was made by Diego Robalino and 2nd by Markos Ferreira to approve the changes. Motion unanimously approved.
7. A **Motion** to approve both the Spring 2024 Minutes and the Fall 2024 Agenda as amended was made by Jeremiah Bradshaw and 2nd by Traci Hopkins. Motion unanimously approved.
8. The list of open PARS was presented.
9. **WG & TF Reports Presented**
    i. **WG C57.155 – Guide for Interpretation of Gases Generated in Natural Ester and Synthetic Ester-Immersed Transformers** Chair: Alan Sbravati - Lance Lewand presented
        i. More than 100,000 records received and anonymized, however new data welcome
        ii. A preliminary review of the data was presented
        iii. New structure of annexes was presented
        iv. New case studies were requested

    See Appendix A for Minutes
10. **Study Group** to assess need for a Guide to Corrosive Sulfur – Lance Lewand
    i. Held 1st exploratory meeting to determine interest and there were over 80 attendees.
    ii. A presentation on corrosive sulfur was made, with discussion on possible sections to be included in the guide and discussion from the floor ensued.
    iii. There was unanimous agreement at meeting to proceed with a PAR Study Group

iv. A **Motion** was put forward to IFSC by Jinesh Malde and 2nd Michael Saad to Form a study group to do the work to submit a PAR for a Guide to Corrosive Sulfur – Motion unanimously approved.

See Appendix B for Minutes

11. **WGC57.130** – **Guide for the use of Dissolved Gas Analysis Applied to Factory Temperature Rise Tests for the Evaluation of Mineral Oil Filled Transformers and Reactors** Chair: Bruce Forsyth - Jinesh Malde presented
    i. Meeting took place on Oct 29th at 8:00AM
    ii. Quorum met with 20 of 26 members present
    iii. Agenda and minutes (F22-S24) were approved.
    iv. A new DGA form will be sent by Lance Lewand with the IEEE email address to share DGA results anonymously. The new form includes detailed instructions about what data to share and in what format.
    v. Data to be submitted by 1/31/25
    vi. Volunteers requested for a taskforce (TF) to start editorial work on the standard. TF meeting will be virtual.

    See Appendix C for minutes

12. **WG/TF C57.146** Chair Paul Boman
    i. 10 of 12 members were present with quorum met. 8 Guests.
    ii. PAR extension approved to December 2026.
    iii. Reviewed straw ballot comment resolutions. There was a comment to insert additional wording into PAR Purpose which did not receive a motion to proceed to vote.
    iv. Motion approved to request IFSC to move PC57.146 Draft 2 to a formal ballot.
    v. Motion approved to form a CRG Task Force with authority to resolve ballot comments.
    vi. A **Motion** was put forward to IFSC by Paul Boman 2nd Tom Prevost, to have PC157.146 draft 2 progress to ballot. Motion unanimously approved.

    See Appendix D for minutes

13. **WG C57.166 – Guide for Acceptance and Maintenance of Insulating Liquids in Transformers and Related Equipment.** Chair: Tom Prevost
    i. Did not meet as document is in comment resolution.
    ii. WG would like request a PAR extension. Tom Prevost moved to approve WG to submit request for PAR extension, 2nd Jinesh Malde. Motion unanimously approved.
    iii. Tom Prevost said the WG will resolve ballot comments and expects to have document our for recirculation prior to next meeting in Denver.

14. **WG C57.637** – **Guide for the Reclamation and Reconditioning of Insulating Liquids** Chair: Stephanie Mabrey
    i. Did not meet.
    ii. Ballot resolution group resolved comments.
    iii. Document is ready for ballot once C57.166 publishes
    iv. Goal at Spring 2025 meeting to request moving forward from Subcommittee to ballot.

15. **WG C57.139 - Guide for the Interpretation of Gases Generated in Liquid-Type Load Tap Changers (Expires 12/31/25)** Chair: Rainer Frotscher
    i. Data collection completed, data anonymized and cleaned. 130,000 samples ready for further processing.
    ii. First statistical evaluations done, ongoing work on Triangle use, etc.
    iii. All Task Forces active to improve the Guide in manifold ways.
    iv. Presentation by HE on gas emission from welded steel and insulating materials which could impede DGA of vacuum type LTCs.
    v. Rainer asked how to put presentation from the WG meeting on the IEEE website. Email presentation to tcwebmaster@ieee.org.

    See Appendix G for minutes

16. **WG C57.104 Guide for Interpretation of Gases Generated in Mineral Oil-Immersed (Expires 12/31/2029)** Chair: Ed teNyenhuis – Luis Cheim presented on behalf of Ed.
    i. Held guide chane presentations for including monitoring data, core overheating gassing, machine learning for monitoring and DGA flowchart change.
    ii. Approved TF to investigate monitoring section in Guide.
    iii. Approved to set up data collection via IEEE anonymization.
    iv. Agreed to hold virtual meeting to continue guide change presentations.

    See Appendix H for minutes

17. Old Business – None
18. New Business
    i. Presentation by Ethan Languri from Tennessee Tech University – Functionalized Nanodiamond Fluids for a Significant Improvement in Thermal Rating and Life of Transformers.
    ii. Ethan to send presentation to Scott Reed for posting to IEEE website
19. Next IFSC Meeting: 2025 March 23-27 – Denver Hyatt Regency
20. Adjournment at 4:13PM

Submitted by Mike Bonn, IFSC

Appendix A

Working Group for Guide for the Interpretation of Gases Generated in Natural and Synthetic Ester Liquid Type Transformers
C57.155
Monday, October 28, 2024
09:30 – 10:45, St Louis, MI, USA

Chairman: Alan Sbravati (absent)
Vice Chair: Lance Lewand, acting as chairman
Secretary: Attila Gyore

The meeting was called to order at 09:30 by the Chair.

There were 25 of 38 members present during the meeting. There were 56 guests, 19 membership requests, in sum 81 attendees.
The quorum was achieved.

1. Attendance list:

1	Daniel	Aleksandrowicz*	Guest
2	Robert	Allison	Guest
3	Sean	Barker	Guest
4	Barry	Beaster	Guest
5	**Paul**	**Boman**	Member
6	**Jeremiah**	**Bradshaw**	Member
7	**Edward**	**Casserly**	Member
8	**Stuart**	**Chambers**	Member
9	Vivian	Chan	Guest
10	**Luiz**	**Cheim**	Member
11	Bhaumik	Choksi	Guest
12	Caleb	Colby	Guest
13	David	Cordova	Guest
14	**Roberto**	**Da Silva**	Member
15	Eric	Doak*	Guest
16	Kenneth	Dugger	Guest
17	Will	Elliot	Guest
18	Quasi	Elnimri	Guest
19	Florin	Faur*	Guest
20	**Todd**	**Felton**	Member
21	Marcos	Ferreira*	Guest
22	Mark	Finn	Guest
23	Joseph	Foldi	Guest
24	Chris	Franklin	Guest
25	**Rainer**	**Frotscher**	Member
26	Peng	Fu	Guest
27	Joshua	Garner	Guest
28	**Alireza**	**Gorzin**	Member
29	Bill	Griesacker	Guest
30	Brad	Grooms*	Guest
31	**Attila**	**Gyore**	Secretary
32	Roger	Hayes*	Guest
33	**Traci**	**Hopkins**	Member
34	Zinan	Huang	Guest
35	Patrycja	Jarosz	IEEE Staff

36	Braxton	Jones	Guest
37	**Egon**	**Kirchenmayer**	Member
38	Seungmo	Kim	Guest
39	Rafal	Kowalski*	Guest
40	Andreas	Kurz	Guest
41	Ashwini	Labh	Guest
42	Don	Lamontage	Guest
43	**Lance**	**Lewand**	Vice-Chair
44	Mark	Lowther*	Guest
45	**Tiffany**	**Lucas**	Member
46	**Stephanie**	**Mabrey**	Member
47	**Jinesh**	**Malde**	Member
48	Francis	Mantoan	Guest
49	Swapnil	Marathe	Guest
50	Mama	Mbouombouo*	Guest
51	**Brian**	**McBride**	Member
52	**Toni**	**Mellin**	Member
53	Justin	Minikel	Guest
54	Shankar	Nambi	Guest
55	Dan	Nikelli	Guest
56	Parminder	Panesar*	Guest
57	Tihomir	Pandza	Guest
58	Pedro	Pedro	Guest
59	**Nick**	**Perjanik**	Member
60	Thien	Pham*	Guest
61	Goran	Plisic	Guest
62	John	Pruente	Guest
63	Gerard	Puleo	Guest
64	**Timothy**	**Raymond**	Member
65	**Scott**	**Reed**	Member
66	**Yuri**	**Rossini**	Member
67	**Mickel**	**Saad**	Member
68	**Amitabh**	**Sarkar**	Member
69	Jaber	Shalabi*	Guest
70	Jonathan	Sinclair*	Guest
71	Bradley	Staley*	Guest
72	Greg	Steeves*	Guest
73	Michael	Swiatkowski*	Guest
74	Matthew	Webb*	Guest
75	Drew	Welton	Guest
76	Peter	Werelius	Guest
77	Elliot	White	Guest
78	Bill	Whitehead*	Guest
79	**Deanna**	**Deanna**	Member
80	Fei	Yang*	Guest
81	Unknown	Unknown	Guest

2. Agenda for approval

A. Welcome & Introduction
B. Attendance and Establishment of Quorum
C. Call for Patent Disclosure
D. IEEE Copyright Policy
E. Approval of Spring 2024 Minutes
F. Working Group Activities
    1. Task Force 4: Task Force 4 – Jinesh Malde – Updates on the Annexes B to F
    2. Task Force 3 – Stu Chambers – Updates on the general document
    3. Task Force 2 – Alan Sbravati → No updates
    4. Task Force 1 – Lance Lewand → Luiz Cheim: 20 min, Toni Melin: 10 min
    5 . General discussion → 15 min

H. Old Business / New Business
I. Adjournment

3. Chair posted the Patent Claim. No claims were made.

4. Chair presented the copyright policy slides.

5. The agenda of the meeting was presented by the chair.

6. Agenda for Spring 2024 was approved, motion: Scott Reed, second: Timothy Raymond

7. Spring 2024 Minutes was approved, motion: Ed Casserly, second: Brian McBride Traci Hopkins

8. Discussions on Task Forces' work

    a. TF4 Reviewing Annexes TF Leader: Jinesh Malde, MIDEL & MIVOLT Fluids
    New structure of Annexes was presented
    Still new case studies are needed
    New Annex about retrofilling was introduced
    b. TF3 Revision of the Document TF Leader: Stuart Chambers, EPRI International
    Updates on the main text was carried out based on earlier received comments
    c. TF2 Normalized Energy Index, TF Leader: Alan Sbravati, Hitachi Energy
    There was no progress to report
    d. TF1 Statistical Analysis of Database, TF Leader: Lance Lewand, Doble
    Actual state of the data analysis was shown by the TF leader, Luiz Cheim and Toni Mellin
    More than 70000 records from offline measurement and more than 39000 records were received from online measurement.
    Results of analysis datasets from natural and synthetic ester filled transformers were presented.
    Different criteria and challenges during the data process were shown.
    A table about Provisional Comparison was presented which initiated discussion on the findings.
    There is still opportunity to submit more dataset, please reach out to Lance Lewand
    Toni Millen presented ester DGA monitor data

9. New Business/Other Items for Discussion: No new business.

10. Next meeting at Spring 2025, Denver, Colorado, USA

11. The meeting was adjourned at 10:45, on time, motion: Ed Casserly, second: Traci Hopkins

Attila Gyore, Secretary
Lance Lewand, Acting Chair

Appendix B

Meeting Minutes

Guide to Understanding Corrosive Sulfur Issues in Liquid-Filled Transformers, Reactors and Load Tap Changers

Ballroom F

Hyatt Regency – St, Louis, MO

October 29, 2024

No attendance required for Par Study Group

This was the first exploratory meeting of a task force to determine if there was enough interest to proceed with this project. There was a large attendance of at least 79 people that spilled out into the hallway. The proposed chair introduced the topic to the audience with a brief discussion of what corrosive sulfur is, what types of compounds are present that cause the issue, the role of oxygen and temperature in the process, how the reactions with the material inside the electrical equipment take place and the consequences of these reactions including copper or silver sulfide deposits on conductor and plating that occurs in the paper sometimes resulting in the failure of the apparatus.

The discussion then turned to the development of the guide itself and what sections to include In the guide. The following sections were proposed:

- In-depth discussion on what corrosive is and how it negatively impacts liquid-filled electrical equipment
- What corrosive sulfur compounds are known and descriptions
- The effects of corrosive sulfur compounds on metal surfaces and deposition in the paper
- Tests for corrosive sulfur
- Flowchart on what actions to take when corrosive sulfur is found
- Electrical tests to detect the presence of copper sulfide formation
- Corrosive sulfur formation from oil processing
- Remediation
- Bibliography

When the audience was queried, there was unanimous acceptance that the guide was of significant importance to the group and it should proceed.

Sincerely,

Lance Lewand, Doble Engineering

Appendix C

Working Group for IEEE C57.130: Guide for the Use of Dissolved Gas Analysis to Factory Temperature Rise Test for the Evaluation of Mineral Oil-Immersed Transformers and Reactors

Tuesday, March 29, 2024
8:00 – 9:15 am
Hyatt, Saint Louis, MO, USA
Minutes of Working Group Meeting

Chair: Bruce Forsyth (absent)
Vice Chair/Secretary: Jinesh Malde (JM)
Acting Secretary: Jason Beaudoin (JSB)

Membership list was updated prior to the meeting to ensure that members had either attended 2 consecutive meeting or 3 out of 5 meetings. Quorum requirement for the meeting was 14 out of 26 members. There were 17 members in the meeting and quorum was met.
The Vice Chair showed the behavior expectations, IEEEE patent and copyright policies, and asked the participants if there are any claims that should be reported regarding these policies. There were no claims brought up by attendees in the meeting.
The agenda was presented. Emilio Morales-Cruz made a motion to approve the agenda and Zan Kiparizoski seconded; with no objections, the agenda was approved. The Vice Chair requested the members to approve the Fall 2022, Spring 2023, Fall 2023 and Spring 2024 meeting minutes. Scott Reed made a motioned to approve the Minutes and Amitabh Sarkar seconded; with no objections, the meetings minutes were approved.
A PAR extension will need to be requested due to this WG being behind schedule. The Milestones will be updated prior to the next meeting.
The Vice Chair reminded the group that data is needed, and to use the template created by the working group that Lance Lewand (LL) showed in the meeting. The Vice Chair reminded all participants to share the data by 31 January 2025. Data should be sent to c57data@ieee.org and the subject line should state that it is for the IEEE C57.130 guide.
LL showed the template for data submission:

- LL showed the changes requested by IEEE to the template
- IEEE will clean up the data before sending information to WG in order to maintain anonymity. Data will be kept in IEEE database for future revision of the standard.
- Many of the data fields are drop-down lists: LL demonstrated some of the options available and explained that the drop-down options are to avoid confusion when entering data.
- To date there has only been 1 person who has responded with data.
- About 300 data points for each of the liquid types (Mineral, Natural Ester, Synthetic in order would be needed to perform statistical analyses.

- Jeremiah Bradshaw (JB), Bureau of Reclamation volunteered to provide data to the WG.

The Vice Chair showed a draft version of the Guide.

- It is not yet determined where the data (specifically esters) will be in the Guide; either in the main body or the Annex (if data will be submitted for ester liquids).
- If ester liquids will be added to the standard, the title, scope and purpose will have to be changed from "Mineral Oil" to "Liquid Immersed".
- Vice Chair requested volunteers for the revision. 4 people volunteered:
    - Ed Casserly
    - William Herron
    - Mama Mbouombouo
    - Juan Castellanos

Participants discussions:

- Jim Thompson mentioned that he has the anonymous data from the original study and can share.
- Juan Castellanos asked for clarification regarding the "insulation" option as it could be interpreted as paper and spacers, or only paper. LL said "paper only" and will clarify this in the spreadsheet.
- Fran Topol asked which Temperature Rise test is to be detailed before DGA is taken (ONAN, ONAF/etc).
    - LL explained that the details are in the spreadsheet.
- JB asked if all of the fields of information were not available, does the WG still want the data?
    - Yes.
- JB asked if manual testing values or online monitoring data is requested and whether this will be clarified in the template?
    - LL needs to add a field for this data as there will be multiple data points from the same unit.
- JSB asked if a value should be presented as a whole number, or if the data from the sampling company is shown as a "Less Than" value should the number be shared or not?
    - LL asked for only numbers. The template will have instruction on this.
- Joe Nims noted that in C57.12.00 meeting there was discussion to add details about the duration of the Heat Run and whether this standard would have guidelines on duration.
    - JM: this Guide doesn't detail how to perform the test, it only says to follow the test procedures in other Standards and compare the results from the test to the limits in the guide.
- JB asked if the WG was looking for defects found during FAT? Specifically, how to note if the unit failed during the Heat Run.

    - LL mentioned that there is a field to state whether the unit failed FAT.
- Nick Jensen asked if they should detail after which portion of heat run tests the samples were taken from.
    - LL said “final DGA” only.

There was no other old or new business to discuss.

Meeting adjourned at 8:43 am.
Respectfully submitted,
Jason Beaudoin, Acting Secretary
Date of Submission: Nov 4th, 2024

Meeting Attendees

Last Name	First Name	Status
Malde	Jinesh	Vice-Chair
Boettger	William	Member
Castellanos	Juan	Member
Debass	Samson	Member
Felton	Todd	Member
Kiparizoski	Zan	Member
Kirchenmayer	Egon	Member
Lewand	Lance	Member
Li	Chao	Member
Morales-Cruz	Emilio	Member
Perjanik	Nick	Member
Reed	Scott	Member
Sarkar	Amitabh	Member
Staley	Brad	Member
Thompson	Ryan	Member
Vir	Dharam	Member
Yun	Joshua	Member
Beaudoin	Jason	Guest
Blaydon	Daniel	Guest
Bonn	Mike	Guest
Botti	Michael	Guest
Bradshaw	Jeremiah	Guest
Casserly	Edward	Guest
chanda	sudip	Guest
Cuauhtemoc	Ortiz	Guest
Da Silva	Roberto	Guest
Digby	Scott	Guest

Last Name	First Name	Status
Ferreira	Marcos	Guest
Foldi	Joseph	Guest
Frotscher	Rainer	Guest
Garcia	Eduardo	Guest
Garcia-Paredes	David	Guest
Garner	Joshua	Guest
Gorzin	Ali	Guest
Griesacker	Bill	Guest
Hernandez	Ronald	Guest
Hollrah	Derek	Guest
Jensen	Nick	Guest
John	John	Guest
Jones	Braxton	Guest
Juchem	Kevin	Guest
Kennedy	Sheldon	Guest
Kurz	Andreas	Guest
Lamontagne	Donald	Guest
Lamontagne	Donald	Guest
Loiselle	Luc	Guest
Mabrey	Stephanie	Guest
Mbouombouo	Mama	Guest
Mcbride	Brian	Guest
Mellin	Toni	Guest
Mendez	Omar	Guest
Natale	Anthony	Guest
Nims	Joe	Guest
Panesar	Parminder	Guest

Last Name	First Name	Status
Park	Dean	Guest
Patel	Sanjay	Guest
Pedro	Pedro	Guest
Saad	Mickel	Guest
Sanchez rodriguez	Jesus	Guest
schweiger	ewald	Guest
Shaikh	Abdul Majid	Guest
Simon	Preston	Guest
Sinclair	Jonathan	Guest
Som	Sanjib	Guest
Thompson	Jim	Guest
Tolcachir	Eduardo	Guest
Topol	Fran	Guest
Vanderwalt	Alwin	Guest
von Gemmingen	Richard	Guest
Watson	Joshua	Guest
Weiss	Zachory	Guest
Weyandt	Paul	Guest
Weyer	Daniel	Guest
White	Joe	Guest
White	Elliot	Guest
Whitehead	Bill	Guest
Wright	Jeffrey	Guest
YU	ZHENQUAN	Guest
do Prado	Gustavo	Guest
Hernandez Decanini	Giovanni	Guest

Appendix D

PC 47.146 – Guide for Interpretation for Gasses Generate in Silicone Immersed Transformers

Unapproved

Monday, October 28, 2024, St. Louis, MO

Chair: Paul Boman

Vice Chair: Lance Lewand

Secretary: Tiffany Lucas

The meeting was called to order by chairman at 11am CST. Twelve of 12 members were present, quorum was achieved.

Scott	Reed	Member	MVA
Eunyoung	Cho	Guest	Hico America
Peter	Werelius	Guest	Megger sweden
Paul	Boman	Member	Hsb
Traci	Hopkins	Member	H2scan
Lance	Lewand	Member	Doble Engineering
Caleb	Colby	Member	Schneider Electric
Rainer	Frotscher	Guest	Maschinenfabrik Reinhausen GmbH
Mickr	Saad	Guest	Hitachi Energy
Florin	Faur	Member	Prolec-GE Waukesha
Todd	Felton	Member	MVA Diagnostics
Nick	Perjanik	Member	AVO Diagnostic Services
Stephanie	Mabrey	Member	Avo Diagnostics
Tiffany	Lucas	Member	Prolec-GE Waukesha
Joshua	Garner	Guest	Independent Dielectrics
John	Pruente	Member	APC Construction
Cuauhtemoc	Ortiz	Guest	Niagara Power
Roberto	Da Silva	Guest	MR Reinhausen
Andreas		Guest	Maschinenfabrik Reinhausen

Bill	Whitehead	Member	H2scan

The agenda was presented:

Agenda

- Welcome
- Approval of Agenda
- Membership / Quorum
- Call for Patent Claims / IEEE SA Copyright Policy
- Approval of Meeting Minutes S24
- Straw Ballot comments
- New Business
    - Ballot
    - Ballot Resolution Committee
- Adjourn Meeting

Tracy Hopkins made a motion to accept the agenda, Stephanie Mabrey – 2nd to

approve Agenda Vote: 11 to approve, 0 opposed, 0 abstain

Chairman reviewed the venue safety information and IEEE patent and copyright slides.

There were no patent statements made by attendees.

Review of 2024 Vancouver meeting minutes by WG.

Lance Lewand motion to approve after no corrections to meeting minutes

Scott Reed 2nd the motion to approve the meeting minutes

In absence of objection, meeting minutes were approved by unanimous consent.

Straw ballot resolution committee comments reviewed by Working Group.

Chairman reviewed the straw ballot comments that were used specifically as provided, there were 18 comments that were modified in some way.

- Working group reviewed the suggestions of the modified purpose from the straw ballot. Changes made by Lance and Toni to proposed Guide Purpose Statement. No motion was made to change to the proposed purpose. Some felt that the original purpose was preferred and more concise.

Surveillance samples and periodic samples were noted in the straw ballot comments (line 9 in the spreadsheet), specific to the incremental magnitude statement. Incremental magnitudes are similar to the rate of change, adding that language would be repetitive. Incremental is a step change, vs a ratio per Florin Fauer.

- we want the incremental change, not the rate of change - Don
- Lance Lewand, maybe instead of saying "incremental" or "rate", we just say "increasing gassing" or "change in gassing".
- The magnitude of change and the rate of change are the important things to monitor. – Toni
- Lance Lewand – "degree of deterioration from increasing gas concentrations".
- Don, Toni, Traci, Lance, John, many head nods in the group. Paul (chair)said based on head nods we will accept the modification to the straw ballot comment.

John Pruente – makes a motion to accept the modification to the proposed change "degree of deterioration from increasing gas concentrations"

Lance Lewand – 2nd the motion

No further discussion, 11 approved, 0 opposed, 0 abstain

The Duval Triangle had an incorrect boundary point. Lance Lewand will provide appropriate boundary point to chairman Boman.

Last WG meeting Stephanie Mabrey brought up a change in the chart in Figure 2, the committee provided a resolution and it was accepted by the WG.

Industry recommended sampling suggestions was questioned in the straw ballot – NFPA 70B, C57.104 give annual sampling recommendations. The WG, with nods, felt that the sampling criteria should be left in the guide.

Andy Keels – insurance company may dictate the sampling requirements.

Upon completion of straw ballot comment review, chairman proposed moving the document to ballot in Standards Committee Meeting.

Scott Reed made a motion to move the document to ballot. Lance Lewand 2nd the motion. Discussion – none. Unanimous approval to move the document to ballot via WG vote. 0 opposed, 0 abstain

Lance Lewand made a motion to form a ballot resolution committee.

Scott Reed made a motion to amend Lance's motion to form a ballot resolution committee with the empowerment to make changes to the document based on the decisions of the committee.

Lance Lewand rescinded his previous motion in agreement with Scott's proposal for empowerment of the committee.

Scott's motion with the empowerment of the committee to rectify ballot comments was 2nd by John Pruente. There was no discussion. Unanimous approval by WG members, 0 opposed, 0 abstain.

A ballot resolution group was formed and will include: Lance Lewand

Todd Felton Nick Perjanik

Stephanie Mabrey Paul Boman

Tiffany Lucas

Approval of the Balloting group – 11 approve, 0 opposed, 0 abstain

The adjournment of the meeting was on the agenda and the WG agreed to adjourn at approximately 12:05pm CST.

Appendix E

Working Group for Acceptance and Maintenance of Insulting Liquids PC57.166

No meeting minutes.

Appendix F

Working Group for Acceptance and Maintenance of Insulting Liquids PC57.637

No meeting minutes.

Appendix G

WG C57.139 Guide for the Interpretation of Gases generated in Liquid-Type Load Tap Changers

Fall 2024 Meeting Minutes
Unapproved

Chair	Rainer Frotscher
Vice Chair	John Pruente
Secretary	Paul Boman
Meeting:	St. Louis MO USA Tue October 29, 2024 3:15 – 4:30 PM
Attendance record:	Total: 55, Members: 24, Guests: 31, with 14 requesting membership. Attendees list: see end of these Minutes.

Agenda

- Welcome
- Membership / Quorum
- Approval of Agenda
- Call for Patent Claims / IEEE SA Copyright Policy
- Approval of Meeting Minutes S24
- 5-letter Classification
- Revision of C57.139 – Report of Task Forces TF1 - TF4
- Presentation by Niklas Gustavsson (HE) on “Gas generation in vacuum on-load tap-changers”
- New Business
- Closing Remarks / Adjourn Meeting

Minutes

1. The WG met Tue, Oct 29, 3:15 pm. Chair asked for approval of the agenda; motion by Mark Newbill, 2nd by Ed Casserly => agenda was unanimously approved.
2. Chair showed membership list containing 39 members, with an initial count of 24 members attending => Quorum was achieved.
3. Chair asked for Essential Patent Claims => none stated.
4. Slides for Participant Behaviour and IEEE Copyright Policy were shown.
5. Spring 2024 Meeting Minutes: motion to approve by Marcos Ferreira, 2nd by Deanna Woods.
6. Chair then explained the 5-letter classification, as agreed in the previous meeting. All attendees should get familiar with this classification, as this is now, after the anonymization of data, the only descriptor to identify an LTC design.

I	In-tank (LTC mounted inside transformer tank)	
O	On-tank (LTC mounted at the side wall of the transformer)	
	A	Arcing (arcing contacts with switching arcs occurring in oil)
	V	Vacuum (arcing contacts with switching arcs occurring in vacuum interrupters)

		R	Resistor type (transition through resistors)		
		X	Reactor type (bridging through a reactance)		
			S	Selector compartment only	
			C	Combined compartment (selector and diverter in same compartment)	
			D	Diverter compartment only	
				S	Sealed tank (with or without pressure relief device)
				B	Non-sealed (breathing)

Craig Colopy mentioned that, in LTC Standard C57.131, on-tank type LTCs are named "compartment types". Chair answered that this definition is confusing and therefore will be re-defined. In C57.139, the word "compartment" describes the different oil compartments from which DGA samples are analyzed.

Craig further recommends using "OLTC" instead of "LTC", to comply with C57.131.
Chair will check if "OLTC" is going to be defined as alternative to "LTC" in future editions of C57.12.80 (Terminology Standard).

Jesus Sanchez…? asked how DGAs from selector tanks which communicate with the transformer main tank shall be handled. Chair said that they fall under transformer DGA.

7. Task Force Reports

7.1. TF1 LTC Data Collection and Evaluation
- TF leader Zach Draper was not present, so results were presented by Chair.
- Data collection has been completed, data were anonymized and cleaned, so ~130'000 samples are ready for further processing.
- Basic Statistics and Calculation of Ratios were performed on important LTC classes (OAX*B, OAR*B, OVX**, IAR*B, IVR**; with "*" = wildcard for existing variants to be compared).
- Box Plots showing the data distribution of single gases and ratios of some of these LTC classes were presented. They clearly show if it is possible to derive limit or 90/95% values for the respective class – or not. The evaluation is ongoing.
- ROC curves could help to identify meaningful gases which allow a failure detection. Examples were shown for increments and rates of the OAXCB class.

7.2. TF2 Revision of General Section (Chapters 1-4) – Florin Faur reports:
- Edits on Scope, Purpose, Normative References and Definitions (chapters 1-3) are completed.
- Draft 4 was distributed Sep 2024 and discussed within TF2.
- Chapter 4 (Nature, purpose and basis for LTC DGA) needs further revision, e.g. on LTC faults; edits will be done by John Pruente.

7.3. TF3 Revision of Basic Rules for LTC DGA interpretation (Chapter 5) – presented by Deanna Woods:
- Chapter 5 contains the 5-letter classification.
- The classification is supplemented by Annex A, which is a list with elementary LTC model names and their classification.
- Text and graphics were added to explain the most meaningful gases/ratios, and how to identify a worsening condition.
- The value of additional data (old data, frequency of operation, …) are explained.
- Chapter 5 will hold the Tables with limit values and 90/95% values, based on the data analysis from TF1.
  They are meant to give initial orientation, when no individual statistics of a specific LTC population exists.
- Discussion about meaningful ratios. Ratios in the current version of the Guide were revised.
- Bill Whitehead stated that hydrogen is unfavorable in ratios as well as in absolute values, as it is so volatile. It is not helpful to be used in laboratory DGA but gives good information in online DGA diagnostics.

7.4. TF4 Revision of Chapter 6: Interpretation of LTC DGA Data – William Solano reports:
- The existing Result Code was supplemented by a 4th stage "Alarm" – to specify imminent faults. Recommendations for actions should be added.

- Further revisions in Chapter 6 and Annexes C (Case Studies) and D (use of Duval Triangle) to be done.
- Luis Cheim stated that Duval Triangle #2 must be used with caution, as different LTC classes may show their normal gassing outside of the standard “N” zone.
- Toni Mellin presented an example of contour plots, showing the density distribution of data in the Duval Triangle. This could be used to identify the “Normal” area for LTC classes which do not match with the standard “N” zone of Triangle 2. Further work on this is to be done.

8. Presentation by Niklas Gustavsson (Hitachi Energy) on “Gas generation in vacuum on-load tap-changers”
   - Questions from customers asking about low levels of hydrogen or acetylene in vacuum tap-changers with very few operations led to investigations to understand the origin of these gases.
   - For normal (fault-free) LTC operation, three gas sources were identified:
     a) Generation of low amounts of sparking or arcing gases, caused by internal by-pass or change-over selector contacts.
     b) Retrofit installations where residual, gas-contaminated oil from the traditional arcing-in-oil diverter remains in the tap-changer compartment, pipes and conservator.
     c) Materials used in OLTCs may release or generate gases.
   - Laboratory investigations were performed which revealed that polyester laminates, SMC materials and varnishes can emit significant amounts of hydrogen and methane, with values going beyond 100ppm. Additionally, welded steel structures can emit acetylene, resulting from the welding process (~40ppm).
   - Brian Sparling added that galvanized steel surfaces may lead to catalytical reactions in combination with dissolved water, producing hydrogen.
   - There was a common understanding of the WG to address these gas sources in the Guide.
   - Paul Boman stated that, similar to C57.104, a baseline sample prior to energizing the equipment would help to identify such sources. Additional DGA samples during the first year of operation will give additional information.
9. Chairman will retire Nov 30, 2024, but stays under contract with MR until July 2026. Currently examining legal requirements under which sponsoring by MR is possible to continue work in IEEE. From now on, email address rainer.f@ieee.org should be used.
10. Meeting was adjourned at 4:30 pm.

Attendees list:

First Name	Name	Affiliation	Status/ Membership Request
Anthony	Alexander	Hitachi Energy	Guest*)
Robert	Allison	Dominian Energy	Guest
Piotr	Blaszezyk	STC	Guest*)
Paul	Boman	The Hartford Steam Boiler	Secretary
Jones	Braxton	SD Myers	Guest
Edward	Casserly	Ergon	Member
Marcelo	Catugas	Neil Service Inc.	Member
Luiz	Cheim	Hitachi Energy	Member
Craig	Colopy	Retired from Eaton	Guest
Roberto	da Silva	MR	Guest*)
Sami	Debass	EPRI	Member
Marco	Espindola	Hitachi Energy	Member
Egui	Espitia	Reinhausen Mfg.	Guest
Florin	Faur	Prolec SPX Waukesha	Member
Zlatan	Fazlic	Camlin Energy	Member
Todd	Felton	MVA Diagnostics	Member
Marcos	Ferreira	Quanta Technology	Member
Marc	Foata	MR	Guest*)
Rainer	Frotscher	MR	Chair
Joshua	Garner	Independant Dielectrics	Guest
Alireza	Gorzin	Black and Veatech	Guest*)
Niklas	Gustavsson	Hitachi Energy	Member
Attila	Gyore	MIDEL	Member
Thang	Hochanh	BC Hydro	Guest*)
Traci	Hopkins	H2Scan	Member
Patrycja	Jarosz	IEEE SA	Guest
Kurt	Kaineder	Trench Austria	Guest
Andreas	Kurz	MR	Guest
Ashwini	Labh	Hitachi Energy	Guest*)
Stefan	Lembacher	Siemens Energy	Guest
Tiffany	Lucas	Prolec SPX Waukesha	Member
Stephanie	Mabrey	AVO Diagnostics	Member
Francis	Mantoan	Siemens Energy	Guest
Lee	Matthews	Howard Ind.	Guest
Mama	Mbouombono	Hitachi Energy	Guest*)
Toni	Mellin	Vaisala	Member
Mark	Newbill	Hitachi Energy	Member
Nick	Perjanik	AVO Diagnostics	Member
John	Pruente	Prolec SPX Waukesha	Vice Chair

Sebastian	Rehkopf	MR	Member
Mickel	Saad	Hitachi Energy	Member
Jesus	Sanchez …?	Voltyx	Guest
Alfons	Schrammel	Siemens Energy	Guest
Jonathan	Sinclair	Black and Veatech	Member
William	Solano	Voltyx	Member
Brian	Sparling	Kinetrics	Guest*)
Daniel	Weyer	Monolith	Member
Leon	White	Hedrich	Guest
Bill	Whitehead	H2Scan	Member
Kayla	Whitesel	DeltaX Research	Guest*)
Christopher	Whitten	Hitachi Energy	Member
Deanna	Woods	Prolec GE Waukesha	Member
Shuzhen	Xu	FM Global	Guest
Joshua	Yun	Virginia Transformer Corp.	Member
Peter	Zhao	Hydro One	Guest

*): requesting membership

Appendix H

Minutes of Meeting
C57.104 Guide for the Interpretation of Gases Generated in Mineral Oil-Immersed Transformers – Working Group
St Louis MO – Oct 29, 2024

- This was the first working group for the revision of C57.104
- The Chair, Ed teNyenhuis, led the meeting. The Chair introduced the Vice-Chair, Luiz Cheim, and the Secretary, Sami Debass who recorded the attendance and meeting minutes.
- There were 134 persons in attendance (see list below). There were 8 persons requesting membership and 37 guests. Since this was the first meeting, quorum was reached.
- The Meeting Agenda was reviewed. A motion to approve the agenda was made by Mickel Saad and seconded by Marko Teofanovic. The agenda was unanimously approved.
- The TF Spring 2024 Meeting Minutes were reviewed. Toni Mellin moved to approve the agenda, which was seconded by Mario Alonso. The minutes were unanimously approved.
- A call for patents was made with no response.
- The Chair earlier invited members to present suggested changes to the guide using a presentation template. The working group had 4 presentations discussed below.
- Presentation # 1 – Luiz Cheim - Section 6.1 & 6.2 - What to do with online monitoring data versus laboratory data.
    - There are differences in results between different monitoring technologies and the lab technology
    - A motion was made by Emilio Morales-Cruz and seconded by Matt Chu to create a task force to investigate this matter to potentially include in this guide, create a new guide, or publish a white paper. The motion was approved.
- Presentation # 2 – Ramsis Girgis - Create a new section in the guide about 6-8:1 H2 to CH4 ratio generation caused by moderate overheating of thin oil film between laminations of core
    - Based on publications by Ramsis Girgis and Ed teNyenhuis in 2009 (already cited in the guide)
    - It may be included in the Annex E Case Studies Section
    - Ramsis Girgis made a motion (seconded by Evgenii Ermakov) to write and submit text to the WG for inclusion in the guide. The motion was approved.
- Presentation # 3 - Don LaMontagne - Discussion on Section A.3 Future Work
    - It was proposed to use Artificial Neural Networks in the guide as a new clause (for online and offline DGA)
    - Don LaMontagne suggested creating an online repository of a failure database with pre-failure DGA and RCA results that can be used to train future classification algos
    - Lance Leward made a motion (seconded by Stuart Chambers) that this should be rolled into the earlier approved TF about online monitoring. This motion was approved.
- Presentation # 4 - Rainer Frotscher- Flowchart in 6.1.1: should be AND instead OR in the second decision diamond

- This would significantly reduce the number of transformers that end up as Status 3, moving those other results to Status 2.
- The data set that was used in Annex A was “destroyed” so we cannot run the change in the flow chart algorithm to perform any statistics.
- Sami Debass requested that we create an anonymous data repository.
- IEEE is doing this for esters to collect and anonymize the data and pass it to the transformer committee.
- Patrycja Jarosz from IEEE SA gave information about how the existing esters database works if we wanted to go forward with a similar process for the creation of an IEEE database.
- Tim Raymond made a motion (Adrina S Cisco seconded) for the WG chair to begin a discussion with IEEE for the creation of an anonymized DGA mineral oil database. This motion was approved.

- There was insufficient time for the other 2 presentations prepared but these will be discussed in a virtual working group meeting in Jan / Feb 2025.
- There was no new business to discuss.
- The meeting was adjourned at 15.00.

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Attendance List

NO.	Last Name	First Name	Company Name	Members Attending (Y/N) & Guests
1.	Alonso	Mario	Georgia Transformer	Y
2.	Aleksander	Owicz	Hitachi Energy	G
3.	Attaullah	Ahmad G	Sabic	Guest
4.	Baser	Levent	Hitachi Energy	N
5.	Betancourt	Edwin	Siemens Energy	Guest
6.	Bradshaw	Garrett	Howard Industries	
7.	Brett	John	Delta-X Research	N
8.	Boettiger	William	Boettiger Transformers Consulting LLC	Guest
9.	Boman	Paul	HSB	Y
10.	Bonn	Mike	SOLTEX	N
11.	Brodeur	Samuel	Hitachi Energy	Guest
12.	Burk	Griffin	Ergon	Guest
13.	Casserly	Edward	Ergon	Y
14.	Castellanos	Juan	Prolec GE	Y
15.	Castello	Alonso	Kaedi Energy Solution	Guest
16.	Chanda	Sudip	Delta Star Inc	Y
17.	Chambers	Stuart	EPRI International	Y
18.	Cheatham	Mark	GE	Y
19.	Cheim	Luis	Hitachi Energy	Y
20.	Chen	Kezmen	IFD Technologies	N
21.	Chu	Matt	Shihlin Electric	Guest
22.	S. Cisco sullberg	Adriana	Salt River Project	Guest
23.	Colby	Caleb	Schneider Electric	Guest
24.	Cordova	David	Maddox Industrial	Guest
25.	Cox	Randy	GE	Y
26.	Debass	Sami	EPRI	Y
27.	Delgado	Gabriel	Invenergy	Y
28.	Dillon	Nikolaus	Dominion Energy	Guest
29.	Doak	Eric	D4 Energy solutions	Guest
30.	Doyle	Lee	Vaisala	Y

31.	Draper	Zachary	Delta-X Research	Y
32.	DA Siliva	Roberto	Maschinefabrik Reinhausen	Y
33.	Duffy	Jesse	Nashville Electric Service	Y
34.	Dukarm	James	Delta-X Research	Y
35.	Dulac	Hakim	APT	
36.	Edward	Tolcakir	TTR	Guest
37.	Emilio	Morales - Cruz	Qualitrol	Y
38.	Ellitt	Will	AEP SWEPCO	Y
39.	Espindola	Marco	Hitachi Energy	Y
40.	Fazlic	Zlatan	Camlin Energy	Y
41.	Faur	Florin	Prolec GE WAUKESHA	Y
42.	Felton	Todd	MVA Diagnostics	Y
43.	Fernandez	Miguel	Braintree Electric Light Dept.	Y
44.	Ferreira	Marcos	Quanta Technology	Y
45.	Finn	Mark	Hitachi Energy	Guest
46.	Forsyth	Bruce	Cargill	Y
47.	Franklin	Chris	MG Power Associates	N
48.	Frotscher	Rainer	Reinhausen Germany	Y
49.	Gagne	Zach	IFD Technologies	N
50.	Gamer	Joshua	Independent Dielectrics	Guest
51.	Gara	Lorne	Shermco	Guest
52.	Garcia	Miguel	Hitachi Energy	Y
53.	Gardner	James	Prolec-GE WAUKESHA	Y
54.	Gasparini	Eloy	Mistras	Guest
55.	Garza	Hector	Ovto De Mexico	N
56.	Girgis	Ramsis	Hitachi Energy	Y
57.	Gonzalez	Luis	Conduct Industries	Y
58.	Gorzin	Alireza	Black and Veatch	Y
59.	Gyore	Attila	Midel & Mivolt Fluids LTD	Guest
60.	Guner	Ishmael	Hydro -Quebec	N
61.	Hamoir	Didier	Transformer Protector Corp.	Guest
62.	Hernandez	Giovanni	Virginia Transf. Corp	Y
63.	Hernandez	Ronald	Doble Engineering	N
64.	Hernandez-Mejia	Jean Carlos	Georgia Tech Neetrac	N
65.	Herron	William	MR	N
66.	Holden	Andy	Ergon	Y
67.	Hollrah	Dereck	Burns & McDonnel	N
68.	Hopkins	Traci	H2Scan	Y
69.	Foata	Marc	MR	Guest
70.	Jakob	Karl	Cargill	Guest
71.	Jarosewski	Marion	Delta Star Inc	Guest
72.	Jarosz	Patrycja	IEEE SA	N/A
73.	John	John	Virginia Transformer Corp.	Y
74.	Jones	Braxton	SD Myers	Guest
75.	Jonak	Ryan	PGE	Guest
76.	Kasonga	Mick	Oncor Elec	N
77.	Khan	Qasim	NEETRAC- Georgia Tech	Guest
78.	Kirchenmayer	Egon	Siemens Energy	Y
79.	Klempner	Dmitriy	SCE	Y
80.	Kowackl	Rafal	Hitachi Energy	Guest
81.	Kurz	Adreas	MR	N
82.	Lamontagne	Donald	Arizona Public Service	Y
83.	Lewand	Lance	Doble Engineering	Y
84.	Li	Chao	Eaton	N
85.	LI	Jinming	BC Hydro	Y
86.	Li	Weijun	Braintree Electric Light Dept.	Y
87.	Lin	David	IFD Technologies	N
88.	Lizcand	Cesar	SHELL USA INC.	N

89.	Loiselle	Luc	Tetra Tech	Y
90.	Lucas	Tiffany	Prolec GE	N
91.	Luke	Wang	BC Hydro	N
92.	Mabrey	Stephanie	Weidmann	Y
93.	Malde	Jinesh	MIDEL & MIVOLT Fluids Ltd	Guest
94.	Mani	Kumar	Duke Energy	Y
95.	Mani	Balakrshnan	Delta Star Inc	Guest
96.	Mahajan	Kushal	Sungrow	Y
97.	Mantoan	Francis	Siemens Energy	Guest
98.	Mbouombouo	Mama	Hitachi Energy	N
99.	Megdad	Mohammed	IPS	N
100.	Mellin	Toni	VAISALA	Y
101.	Mannannam	Robert	Maddox Industrial Transf.	N
102.	Miller	Philip	MLGW	N
103.	Morgan	Charles	Eversource Energy	Guest
104.	Munnoz	Molina	Orto	Guest
105.	Murkowski	Emma	Delta-X Research	Y
106.	Murray	David	TVA	Y
107.	Naja	Ismael	Eaton	Guess
108.	Nambi	Shankar	Bechtel Energy	Guest
109.	Newbill	Mark	Hitachi Energy	Y
110.	Nims	Joe	Allen & Hoshall	N
111.	Nolte	Mike	kiewit	Guest
112.	O'Malley	Anastasia	Con Edison NY	N
113.	Pacas	Joel	IFD Technologies	Guest
114.	Panesar	Parminder	Virginia Transformer	Y
115.	Patel	Vinay	Con Edison	Y
116.	Patel	Rakesh	Hitachi Energy	Y
117.	Pedro	Pedro	EFACEC-TRANSFORMERS	N
118.	Perjanik	Nick	Avo Diagnostic Services	Guest
119.	Plisic	Goran	Siemens Energy KPT	N
120.	Pruente	John	APC Construction	Y
121.	Radu	Ion	Hitachi Energy	Y
122.	Raymond	Tim	Inductive Reasoning	Y
123.	Reed	Scott	MVA	Y
124.	Reeder	Perry	GE	N
125.	Reimer	Jonathan	Fortis BC	Guest
126.	Razvan	Arash	Delta Star Inc	Y
127.	Rossini	Yuri	Siemens Energy	Y
128.	Saad	Mickel	Hitachi Energy	Y
129.	Schott	Cody	The J-J Family of Camp	N
130.	Schmitt	Wolfang	Schneider Electric	Guest
131.	Sinclair	John	Black and Veatch	Y
132.	Smith	Jimmy	Howard Industries	Guest
133.	Soeller	Markus	Power Diagnostix System	N
134.	SOHN	Yong Tue	HYOSONG HICO	Y
135.	Soto	Mauricio	Hitachi Energy	Y
136.	Sparling	Brian	KINECTRICS	Y
137.	Staley	Brad	Leeward Renewable Energy	Y
138.	Steeves	Greg	Baron USA	Y
139.	Sweetser	Charles	Omicron	Guest
140.	Witkowski	Michal	Hitachi Energy	Guest
141.	Tanaka	Troy	Burns and McDonnell	Y
142.	teNyenhuis	Ed	Hitachi Energy	Y
143.	Teofanovic	Marko	Ontario Power Generation	Guest
144.	Thierry	Juan Luis	Doble Engineering	Guest
145.	Thomas	Prevost	Weidman	N
146.	Thompson	Ryan	Burns and McDonnell	Y

147.	Tillery	Tim	Howard Industries	Guest
148.	Tostrud	Mark	Dynamic Ratings	Y
149.	teNyenhuis	Ed	Hitachi Energy	Y
150.	Van Drell	Cole	American Transmission Co	Y
151.	Vanderwalt	Alwyn	ECI	Y
152.	Verdolin	Rogerio	VERDOLIN Solutions	Y
153.	Vir	Dharam	Prolec GE	Y
154.	Volodymyr	Prykhodko	ZTZSETVECES	N
155.	Vu	Nguyen	IFD Technologies	Guest
156.	Wager	John	AEP	Guest
157.	Washburn	Alan	Burns & McDonnell	Guest
158.	Welton	Drew	Intellirent	Y
159.	Watson	Joshua	NPPD	N
160.	Weyer	Daniel	Monolith	Y
161.	White	Elliot	SD Myers	N
162.	Whitehead	Bill	H2Scan	Y
163.	Whitesell	Kayla	Delta-X Research	Guest
164.	Woods	Deanna	ATC	Y
165.	Wess	Zacan	Weg Trains	Guest
166.	Xu	Shuzhen	FM Global	Y
167.	Zhn	zhinwring	Chint	Guest
168.	Zuiderveen	Thomas	IFD Technologies	Guest