

Annex G Insulating Fluids Subcommittee

2025 March 26 – 3:00PM – 4:15PM

Hyatt Regency, Denver, CO

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 April 10 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. Please update website with minutes – tc-webmaster@ieee.org
 - iii. Reminded of Membership requirements to attend 3 out of last 5 meetings (there was confusion about this, but it was resolved prior to meeting) and be a member in good standing of IEEE PES and IEEE SA.
 - iv. IEEE Staff Contact – Patrycja Jarosz p.jarosz@ieee.org
5. Roll Call of SC Members – Quorum requirement -28
 - i. 38 members signed in from of a total of 55 members achieving quorum
 - ii. 88 attendees. 50 Guests. 14 requested memberships.
 - iii. QR Code was primary method for attendance – 2 people had problems and reported after.

Role	Last Name	First Name	Role	Last Name	First Name
Guest	Abdalla	Isaac	Guest	Kurz	Andreas
Guest	Balaji	Janakiraman	Guest	Kwan	Landen
Guest	Beaudoin	James	Guest	Labh	Ashwini
Guest	Bhardwaj	Naveen	Guest	Lewand	Lance
Member	Biggie	Kevin	Guest	Lizcano	Cesar
Member	Boettger	William	Guest	Loiselle	Luc
Member	Boman	Paul	Chair	Mabrey	Stephanie
Secretary	Bonn	Mike	Member	Malde	Jinesh
Guest	Bradshaw	Garrett	Guest	Mani	Balakrishnan
Member	Bradshaw	Jeremiah	Member	Mellin	Toni
Member	Calitz	David	Guest	Murillo	Hugo
Member	Casserly	Edward	Vice-Chair	Murphy	Jerry
Member	Castellanos	Juan	Member	Newbill	Mark
Guest	Cisco-Sullberg	Adriana	Guest	O'Malley	Anastasia
Member	da Silva	Roberto	Guest	Obregon	Daniel
Member	Dappen	Tim	Member	Parkinson	Dwight
Member	Delgado	Gabriel	Member	Perjanik	Nicholas

Guest	Espindola	Marco	Member	Pruente	John
Member	Faur	Florin	Guest	Puleo	Gerard
Guest	Felton	Todd	Guest	Ray	Sheila
Member	Ferreira	Marcos	Member	Raymond	Timothy
Member	Forsyth	Bruce	Member	Reed	Scott
Member	Garcia	Miguel	Guest	Rehkopf	Sebastian
Guest	Gardner	James	Guest	Rock	Patrick
Guest	Garner	Joshua	Member	Rossini	Yuri
Guest	Gaytan	Carlos	Guest	Rutledge	Christopher
Member	Giraldo	Orlando	Member	Saad	Mickel
Member	Gorzin	Alireza	Guest	Sanchez Roseiguez	Jesus
Guest	Greaves	Brad	Member	Sbravati	Alan
Guest	Greenhaw	Matthew	Guest	Schott	Cody
Guest	Gustafsson	Niklas	Guest	Shaikh	Salahuddin
Member	Gyore	Attila	Member	Sinclair	Jonathan
Guest	Hamoir	Didier	Guest	Solano	William
Member	Harper	Robert	Member	Steeves	Gregory
Member	Hayes	Roger	Guest	Tenyenhuis	Ed
Guest	Hernandez	Ronald	Member	Thompson	Ryan
Guest	Holifield	Thomas	Guest	Tillery	Timothy
Guest	Jarosz	Patrycja	Guest	Van Dreek	Cole
Member	John	John	Guest	Velasquez	Juan
Guest	Kaineder	Kurt	Guest	Werelius	Peter
Guest	Keels	Thomas	Guest	Whitten	Christopher
Guest	Khan	Qasim	Member	Woods	Deanna
Guest	Kim	Yeounsoo	Guest	Yeboah	Kwasi
Guest	Kiparizoski	Zan	Guest	Yuan	Guang

RM = Requested Membership

6. A **Motion** to approve both the Fall 2024 Minutes and the Spring 2025 Agenda as was made by Ed Casserly and 2nd by Mark Newbill. Motion unanimously approved.

7. The list of open PARS was presented.

8. 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 - presented

- i. Quorum achieved
- ii. TF1 – Statistical Analysis of Database – Lance Lewand Doble
- iii. State of analysis shown, proposed new limits for gases
- iv. 70,000 records from offline measurements / 35,000 records from online measurements
- v. Requested more data to c57data@ieee.org Subject: PC57.155 Revision
- vi. TF2 - Normalized Energy Index – Alan Sbravati Hitachi Energy
- vii. Equations of NEI and gas distributions for synthetic esters were presented
- viii. TF4 – Reviewing Annexes – Jinesh Malde Midel
- ix. Summary of Michel Duval presentation discussed

- x. New case studies needed on failed ester-filled transformers
- xi. 2 Year PAR extension approved
- xii. MOTION: Request PAR Extension by Alan Sbravati – Unanimously Approved.
- xiii. See Appendix A for Unapproved Minutes

9. Task Force on a Guide to Corrosive Sulfur – Lance Lewand

- i. 89 People in attendance
- ii. Met to determine Title, Scope and Purpose so a PAR could be registered.
- iii. Title: IEEE Guide to Evaluating Corrosive Sulfur Issues in Liquid-Filled Transformers and Reactors
- iv. Purpose: This guide assists in determining the presence of corrosive and potentially corrosive sulfur compounds in transformer and reactor insulating liquids and construction materials and also provides information to evaluate the risk of copper and silver sulfide formation with mitigation recommendations.
- v. Motion to accept Title, Purpose and Scope approved
- vi. Addressed possible task forces and got names of volunteers
- vii. MOTION: Proceed to PAR by Lance Lewand. Unanimously Approved.
- viii. See Appendix B for Unapproved Minutes

10. 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

- i. Met and had quorum
- ii. Struggle to get data for liquids other than mineral oil. See Appendix C for minutes
- iii. See Appendix C for Unapproved Minutes

11. WG/TF C57.146 Chair Paul Boman

- i. No meeting held
- ii. Draft guide on ballot, close date is April 12, 2025
- iii. 33% response rate. Will remind ballot pool via email
- iv. No Minutes

12. WG C57.139 - Guide for the Interpretation of Gases Generated in Liquid-Type Load Tap Changers (Expires 12/31/25) Chair: Rainer Frotscher

- i. Quorum not met
- ii. TF1 sufficient data for proposing gas/ratio limits on 10 LTC types from most sample data collected.
- iii. The TF leaders (4) update WG on proposed guide edits. Additional case studies for equipment with known faults.
- iv. First statistical evaluations done, ongoing work on Triangle use, etc.
- v. On-track for expected completion of draft guide before the PAR expiration date
- vi. See Appendix E for Unapproved Minutes

13. WG C57.166 – Guide for Acceptance and Maintenance of Insulating Liquids in Transformers and Related Equipment. Chair: Tom Prevost

- i. No Meeting
- ii. 350 Comments being reviewed. PAR extended. Resolution expected summer 2025.

14. WG C57.637 – Guide for the Reclamation and Reconditioning of Insulating Liquids

Chair: Stephanie Mabrey

- i. Short meeting combined with C57.170
- ii. Quorum met
- iii. PAR Extension approved
- iv. Straw ballot resolution team to have document ready by fall 2025
- v. MOTION: 2 Year PAR Extension by Stephanie Mabrey. Unanimously Approved.
- vi. Scott Reed expressed concern that C57.637 cannot move forward without completion of C57.166
- vii. See Appendix G for Unapproved Minutes

**15. 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. Discussed data and collection templates
- ii. Monitoring templates discussed
- iii. Cleaning of monitoring data
- iv. Data interpretation
- v. See Appendix H for Minutes

16. Old Business – None

17. New Business-None

18. Next IFSC Meeting: 2025 October 19-23 Bonita Springs, FL

19. Adjournment at 4:11PM

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, March 24, 2025
09:30 – 10:45, Denver, CO, USA

Chairman: Alan Sbravati
Vice Chair: Lance Lewand
Secretary: Attila Gyore

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

There were 29 of 42 members present during the meeting. There were 54 guests, 19 membership requests, in sum 83 attendees.

The quorum was achieved.

1. Attendance list:

1	Kyungchan	An	Guest
2	Paul	Boman	Member
3	Mike	Bonn	Guest
4	Jeremiah	Bradshaw	Member
5	Griffin	Burk	Guest
6	Edward	Casserly	Member
7	Sudip	Chanda*	Guest
8	Luiz	Cheim	Member
9	Matt	Chu	Guest
10	Marcos	Czernorucki	Guest
11	Tim	Dappen	Guest
12	Roberto	Da Silva	Member
13	Zack	Draper	Member
14	Will	Elliott	Guest
15	Marco	Espindola*	Guest
16	Todd	Felton	Guest
17	Hugo	Flores	Guest
18	Bruce	Forsyth	Member
19	Jean-Philippe	Gagnon	Guest
20	James	Gardner*	Guest
21	Joshua	Garner*	Guest
22	Gilberto	Garza	Guest
23	Slaven	Goglia	Guest
24	Alireza	Gorzin	Member
25	Bill	Griesacker*	Guest
26	Attila	Gyore	Secretary
27	Robert	Harper	Member
28	Roger	Hayes*	Guest

29	Florian	Hermann*	Guest
30	Ronald	Hernandez	Guest
31	Traci	Hopkins	Member
32	Miljenko	Hrkac*	Guest
33	RYU	hyounggon	Guest
34	Balaji	Janakiraman	Guest
35	Braxton	Jones	Guest
36	Franjo	Kelemen	Guest
37	Egon	Kirchenmayer	Member
38	Rafal	Kowalski*	Guest
39	Arvind	Kumar*	Guest
40	Andreas	Kurz*	Guest
41	Sylvain	Lapointe	Guest
42	Lance	Lewand	Vice-Chair
43	Cesar	Lizcano	Member
44	Stephanie	Mabrey	Member
45	Jinesh	Malde	Member
46	Kumar	Mani*	Guest
47	Francis	Mantoan	Guest
48	Toni	Mellin	Member
49	Filip	Mikulecky	Guest
50	Justin	Minikel	Guest
51	Ali	Naderian*	Guest
52	Ashmita	Niroula*	Guest
53	Parminder	Panesar*	Guest
54	Pedro	Pedro*	Guest
55	Nick	Perjanik	Member
56	John	Pruente	Guest

57	Manuel	Quinones	Guest
58	Timothy	Raymond	Member
59	Scott	Reed	Member
60	Yuri	Rossini	Member
61	Chris	Rutledge*	Guest
62	Mickel	Saad	Member
63	Hakan	Sahin	Guest
64	Amitabh	Sarkar	Member
65	Alan	Sbravati	Chair
66	Alaor	Scardazzi	Guest
67	Marcus	Schaffer	Guest
68	Dario	Segovic	Guest
69	Jonathan	Sinclair	Member
70	Amitkumar	Singh	Guest

*membership requested

71	Markus	Soeller	Guest
72	Markus	Stank*	Guest
73	Greg	Steeves	Member
74	Leonard	Torchia	Guest
75	Valentina	Valori	Guest
76	Matthew	Webb	Guest
77	Zachery	Weiss	Member
78	Drew	Welton*	Guest
79	Christopher	Whitten	Guest
80	Deanna	Woods	Member
81	Jeffrey	Wright	Guest
82	Asam	Yu	Guest
83	Hongzhi	Zhang	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 Fall 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 → Updates on Normalized Energy Index
 4. Task Force 1 – Lance Lewand → Luiz Cheim, General Discussion
 - 5 . General discussion
 - H. Old Business / New Business
 - Request for PAR extension
 - I. Next Meeting
 - J. 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. Agenda for Spring 2025 was approved, motion: Jeremiah Bradshaw, second: Traci Hopkins
6. Fall 2024 Minutes was approved.
7. Discussions on Task Forces' work
 - a. TF1 Statistical Analysis of Database, TF Leader: Lance Lewand, Doble
Actual state of the data analysis and new proposed limits for gases were shown
About 70000 records from offline measurement and 35000 records were received from online measurement.
There is still opportunity to submit more dataset,
Please send them to c57data@ieee.org, subject: PC57.155 Revision
 - b. TF2 Normalized Energy Index, TF Leader: Alan Sbravati, Hitachi Energy
Equations of NEI and gas distributions for synthetic and natural esters were presented
 - c. TF3 Revision of the Document TF Leader: Stuart Chambers, EPRI International
There was no progress to report
 - d. TF4 Reviewing Annexes TF Leader: Jinesh Malde, MIDEL & MIVOLT Fluids
Summary on Michal Duval's presentation was discussed
New case studies are needed on failed ester filled transformers

The chair mentioned the plan of completing a first draft for a Straw Ballot by the F25 meeting.

8. New Business/Other Items for Discussion
 - a. A 2-year PAR extension request was approved
9. Next meeting at Fall 2025, Bonita Springs, Florida, USA
10. The meeting was adjourned at 10:44, on time

Attila Gyore, Secretary
Alan Sbravati, Chair

Appendix B

Task Force Corrosive Sulfur Issues in Transformers and Reactors

- This task force met on Tuesday, March 25th, 2025 at 11:00 AM at the Hyatt Regency in Denver, CO
- 90 people attended the meeting
- Roberto Da Silva of Reinhausen offered to be the secretary of this committee and his offer was accepted.
- Meeting minutes and agenda were not approved as there is not yet an active PAR
- Reviewed guidelines for IEEE SA Meetings
- Reviewed IEEE Codes of Ethics and Conduct
- Reviewed Copyright and Patent Policies and no essential patents were claimed
- Goal of the meeting was to come to agreement on a Title, Scope and Propose so that a PAR could be applied for, and secondarily to get a start on assignments of task forces in anticipation that a PAR would be approved.
- This document will be published as a Guide not a standard
- Several titles, scope and purpose were prepared in advanced for discussion at this meeting. A lively discussion took place among those attending in rewording and editing the three items. The term “liquid-filled” was used in the title as the preferred term.
- Based on conversations and debates held in the meeting, the following title, scope and purpose were prepared with the full participation of the audience and are stated as:

TITLE:

IEEE Guide to Evaluating Corrosive Sulfur Issues in Liquid-Filled Transformers and Reactors

SCOPE:

This guide applies to liquid-filled transformers and reactors and addresses:

1. *Introduction/Description of corrosive sulfur*
2. *Adverse effects from corrosive sulfur*
3. *Analytical tests*
4. *Evaluation and guidelines*
5. *Electrical tests*
6. *Risk Assessment and mitigation procedures*
7. *Case studies and examples*
8. *A bibliography of related literature*

The purpose had extensive discussion with about 10 to 15 different wording suggestions. It was finally resolved and stated as follows:

PURPOSE:

This guide assists in determining the presence of corrosive and potentially corrosive sulfur compounds in transformer and reactor insulating liquids and construction materials and also provides information to evaluate the risk of copper and silver sulfide formation with mitigation recommendations.

A motion was made to accept the Title, Scope and Purpose listed above by Ed Casserly, seconded by Griffin Burk. No nays were recorded and the motion passed unanimously.

Suggested Officers for the official working group once the PAR is approved:

Chair: Lance Lewand, Doble Engineering

Vice Chair: Stuart Chambers, EPRI International

Secretary: Roberto Da Silva, Reinhausen

The rest of meeting consisted of requesting volunteers to participate for the following task forces that may implemented once a PAR is approved.

The anticipated task forces were listed as follows:

Structure of the Task Forces and those that volunteered

1. Introduction - In-depth description what corrosive sulfur and the adverse effects in liquid-filled electrical equipment
 - Volunteers were Lance Lewand, Stuart Chambers, Ed Casserly, Roberto Da Silva, Vedantham Aparna, and Andreas Kurz
2. What compounds are known and descriptions
 - Volunteers were Lance Lewand, Stuart Chambers, and Ed Casserly
4. Effects on Metal Surfaces and Solid Insulating Materials
 - Volunteers were Lance Lewand, Stuart Chambers, Roberto Da Silva, and Jinesh Malde
5. Analytical Tests for Corrosive Sulfur
 - Volunteers were Lance Lewand, Stuart Chambers, Griffin Burk, Todd Felton, Joshua Garner, Attila Gyore, and Stephanie Mabrey
6. Electrical Tests
 - Volunteers were Poorvi Patel, Stephanie Mabrey, and someone from Doble Engineering
6. Flowchart on what actions to take
 - Volunteers were Lance Lewand, Stuart Chambers, and Attila Gyore

8. Prevention/Remediation/Mitigation

- Volunteers were Lance Lewand, Stuart Chambers, Roberto Da Silva, Jinesh Malde, and Griffin Burk

We received information from other people that they would like to be involved as well but did not indicate which tasks force.

The next steps are to bring this to Insulating Fluid subcommittee with a motion and then if approved file PAR

Meeting adjourned at 12:12 PM

Sincerely, Lance Lewand and Roberto Da Silva

List if attendees:

Last Name	First Name	Company Name
Viereck	Karsten	Reinhausen
Ansari	Tauhid	Hitachi Energy
Aparna	Vedantham	Virginia transformer corporation
Balakrishnan	Mani	Delta star field service
Boman	Paul	Hsbi&i
Bradshaw	Jeremiah	Bureau of Reclamation
Brekalo	Josipa	Koncar D&ST
Brzoznowski	Steven	BPA
Bule	John	DTE Energy
Burk	Griffin	Ergon
Casserly	Edward	Ergon
Castellanos	Juan	Prolec
Chanda	Sudip	Delta Star Inc
Cheim	Luiz	Hitachi
Cordova	Olivia	Bureau of Reclamation
Crockett	Janet	Fayetteville PWC
Da Silva	Roberto	Maschinenfabrik Reinhausen
Diaconu	Dumitru	Delta Star Inc
Dorpmanns	Luc	Royal SMIT Transformers
Draper	Zachary	Delta-X Research
Espitia	Egui	Reinhausen Manufacturing Inc
Farmer	James	Bureau of Reclamation
Felton	Todd	MVA Diagnostics, Inc.
Filip	Mikulecky	filip.mikulecky@siemens-energy.com
Foata	Marc	MR
Gardner	James	Prolec-GE Waukesha
Garner	Joshua	RESA Power
Geraldo	Magela junior	Siemens-energy

Goglia	Slaven	Koncar Power Transformers Ltd.
Greaves	Brad	Weidmann Electrical Technology, Inc
Gyore	Attila	MIDEL and MIVOLT Fluids Ltd
Hampton	Kevin	Siemens Energy
Harper	Robert	Soltex Inc.
Hayes	Roger	GE Vernova
Hershberger	Benjamin	Midwest Transformer
hyounggon	ryu	HD hyundai electric
Jeong	chanmin	HD Hyundai
Jones	Braxton	SD Myers
Kaineder	Kurt	Trench Austria
Kelemen	Franjo	Koncar Power Transformers Ltd.
Kelemen	Franjo	Koncar Power Transformers Ltd.
Kiparizoski	Zan	Howard Industries
Koprivnjak	Matija	Končar D&ST
Kurz	Andreas	Reinhausen Germany
Labh	Ashwini	Hitachi Energy
Labh	Ashwini	Hitachi Energy
Lewand	Lance	Doble Engineering Company
Lizcano	Cesar	Shell USA, Inc.
Loiselle	Luc	Tetra tech
Malde	Jinesh	MIDEL & MIVOLT Fluids Inc.
Mamede	Gabriel	Siemens Energy
Mantoan	Francis	Siemens Energy
Mabrey	Stephanie	AVO Diagnostic Services
Manzano	Moses	Hyosung HICO
Matt	Chu	Shihlin Electric
Mellin	Toni	Vaisala
Minikel	Justin	Eaton
OMalley	Anastasia	Consolidated Edison Co of NY
Ortiz	Cuauhtemoc	Niagara Power Transformer Corp
Palhatiya	Ajay	Virginia Transformer Corp
Pandya	Manan	Siemens Energy
Park	Jaeyong	LS Electric
Patel	Sanjay	Royal Smit Transformers
Perjanik	Nick	AVO Diagnostic Services
Portillo	Homer	Advanced Power Technologies
Pruente	John	APC Construction llc
Puleo	Gerard	Midel
Robles	Antonio	Bureau of Reclamation
Saad	Mickel	Hitachi Energy

Scardazzi	Alaor	Siemens Energy
Schrammel	Alfons	Siemens Energy
schweiger	ewald	siemens energy
Sebastian	Rehkopf	Reinhausen Germany
Shannon	Michael	Rea Magnet Wire
Singh	Amitkumar	Consolidated Edison Company of New York
Solano	William	Voltyx
Stank	Markus	MR
Stauffer	Jonathon	Bureau of Reclamation
Steeves	Greg	Baron USA, LLC
Thomas	Holifield	Howard Industries
Tillery	Timothy	Howard Industries
Tostrud	Mark	Dynamic Ratings
Van Dreel	Cole	American Transmission Co
Veeran	Kannan	Virginia/Georgia transformer
Villa	Hector	Ecuatran SA
Walters	Shelby	Howard Industries
Weisensee	Matt	PacifiCorp
White	Joe	POWER Engineers
Wright	Jeffrey	Duquesne Light
Yang	Fei	Hitachi Energy
Yong	Zhai	Sieyuan

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 24, 2025

8:00 – 9:15 am

Hyatt, Denver, CO, USA

Minutes of Working Group Meeting

Chair: Bruce Forsyth (BF)

Vice Chair/Secretary: Jinesh Malde (JM)

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 19 out of 37 members. There were 24 members in the meeting and quorum was met. The Chair showed the behavior expectations, IEEE 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. A motion was made to approve the agenda. With no objections, the agenda was approved. The Chair requested the members to approve the Fall 2024 meeting minutes. Jeremiah Bradshaw made a motion to approve the Minutes. With no objections, the meetings minutes were approved.

The Chair shared the timeline for the revision and mentioned that the working group was at least 1 year behind on the completion of the work and the PAR expires in Dec 2026 however the guide would become inactive in Dec 2025.

Jim Thompson who was past Chair of IEEE C57.130, explained the process used to come up with values listed in Table 2:

- Data on 386 transformers was collected from 4 data sets.
- Transformers ranged from 8.4 MVA to 700 MVA
- Volume of liquid ranged from 1300 gal to 34000 gal.
- All the data was collected and populated in an excel sheet. The values generated in Table 2 were discussed amongst members and guests and was compared to the IEC equivalent standards.

Lance Lewand updated the working group that the data survey on collecting data for mineral oil and ester filled transformers was sent out but only received 2 responses. Patrycja Jarosz from IEEE updated the group that the template prepared to collect the data was very complicated and IEEE was not capable of handling the information currently. A guest mentioned that Standard Association's inability to assist working groups is stalling the process of developing standards. Scott Reed mentioned that discussion on how to handle the situation with regards to storage, anonymization and use of data is ongoing.

The Chair mentioned that he is not in favor of a PAR extension because PAR extensions are generally requested when a working group is nearing the end of their work but need a little more time. Our working group has not even started work on analyzing data for non-mineral oil filled transformers because we have not received sufficient responses from our survey to create statistically reliable recommendations. He suggested that the working group consider focusing on completing the minor edits in the document and go to ballot without including updates for non-mineral oil liquids. The guide can be reopened for revision to add new information on alternative liquids after that. Jim Thompson made the motion to “Stop the review process on the guide due to lack of data on alternative liquids and to proceed with only minor revisions”. Ed Casserly seconded the motion. There were 13 yes and 8 no with no abstentions. The motion carried.

Call for volunteers was made. Zane Kiparizoski, Amitabh Sarkar, Jeremiah Bradshaw and Roberto Da Silva volunteered to help complete the minor revisions to the standard.

Meeting adjourned at 9:15 am.

Respectfully submitted,
Jinesh Malde, Secretary

Meeting Attendees

Last Name	First Name	Status
Forsyth	Bruce	Chair
Malde	Jinesh	Vice-Chair
Boettger	William	Member
Bradshaw	Jeremiah	Member
Castellanos	Juan	Member
Da Silva	Roberto	Member
Draper	Zachary	Member
Felton	Todd	Member
Hollrah	Derek	Member
Jensen	Nick	Member
Khan	Qasim	Member
Kiparizoski	Zan	Member
Kirchenmayer	Egon	Member
Lewand	Lance	Member
Mcbride	Brian	Member
Morales-Cruz	Emilio	Member
Perjanik	Nick	Member
Reed	Scott	Member
Sarkar	Amitabh	Member
Schweiger	Ewald	Member
Thompson	Ryan	Member
Thompson	Jim	Member
Vir	Dharam	Member
Yun	Joshua	Member
Arnold	Elise	Guest
Berube	Jean-Noel	Guest
Biggie	Kevin	Guest
Bonn	Mike	Guest
Botti	Michael	Guest
Bule	John	Guest
Burk	Griffin	Guest
Calil	Wilerson	
Casserly	Edward	Guest

Last Name	First Name	Status
Foata	Marc	Guest
Garcia	Eduardo	Guest
Garner	Joshua	Guest
Garza	Hector	Guest
Goglia	Slaven	Guest
Griesacker	Bill	Guest
Gyore	Attila	Guest
Harper	Robert	Guest
Hayes	Roger	Guest
Hermann	Florian	Guest
Jeong	Chanmin	Guest
Kadar	Laszlo	Guest
Kennedy	Sheldon	Guest
Kurz	Andreas	Guest
Lawless	Andrew	Guest
Lizcano	Cesar	Guest
Loiselle	Luc	Guest
Mabrey	Stephanie	Guest
Manuel	Quinones	Guest
Mellin	Toni	Guest
Mikulecky	Filip	Guest
Murcia	Fredy	Guest
Nims	Joe	Guest
Omar	Mendez Zamora	Guest
Ortiz	Juan	Guest
Patel	Sanjay	Guest
Patel	Monil	Guest
Pedro	Pedro	Guest
Raymond	Timothy	Guest
Robles	Antonio	Guest
Schiessl	Markus	Guest
Shertukde	Hemchandra	Guest
Sinclair	Jonathan	Guest

Last Name	First Name	Status
Singh	Amitkumar	Guest
Stauffer	Jonathon	Guest
Steeves	Greg	Guest
Tanaka	Troy	Guest
Tolcachir	Eduardo	Guest
Van Dreef	Cole	Guest
Viereck	Karsten	Guest
Weiss	Zachory	Guest
Welton	Drew	Guest
Weyandt	Paul	Guest
White	Joe	Guest
Wright	Jeffrey	Guest
Yeh	Stanley	Guest

Appendix D

C57.146 No Meeting Minutes

Appendix E

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

Spring 2025 Meeting Minutes
Unapproved

Chair Rainer Frotscher (not present)

Vice Chair John Prunte

Secretary Paul Boman

Meeting: Denver CO USA Tue March 25, 2025 3:15 – 4:30 PM

Attendance record: Total: 50, Members: 20, Guests: 30, with 7 requesting membership.
Quorum was not achieved.

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 F24
- Revision of C57.139 – Report of Task Forces TF1 - TF4
- Preparation of Final Document / Balloting
- New Business
- Closing Remarks / Adjourn Meeting

Minutes

1. The WG met Tue, March 25 2025, 3:15 pm. As the Chair was not present, the meeting was held by Vice Chair John Prunte.
2. Vice Chair showed membership list containing 42 members, with an initial count of 20 members attending
⇒ Quorum was not achieved.
3. Vice Chair asked for Essential Patent Claims ⇒ none stated.
4. Slides for Participant Behaviour and IEEE Copyright Policy were shown.
5. Spring 2025 Meeting Minutes were presented but could not be approved, as quorum was not met.
⇒ Approval postponed to F25 meeting.
6. Task Force Reports
 - 6.1. TF1 LTC Data Collection and Evaluation – Zachary Draper reports:
 - Zach Draper presented the current status of TF1 and gave detailed information on the multi-stage process the data underwent.
 - After anonymization and cleansing of data, 167,252 records were available for further evaluations.
 - Statistical calculations have been performed on absolute values, incremental changes between successive samples, rates of changes for individual gases, 3- and 5-gas ratios and other relevant ratios.
 - For the 5 most popular LTC classes (showing the highest number of samples), characteristic values of the statistical distribution of data (percentiles) have been provided for significant gases and gas ratios;

see 6.3.

Additionally, advice on DGA interpretation will be provided for 7 further significant LTC classes.

- To define the parameters which are the most useful to detect developing and imminent fault cases, several options were calculated, based on ROC (Receiver Operating Characteristic) analysis, which is a useful method for assessing the accuracy of model predictions. It has been found that the 90th, 95th and 99th percentiles are the most useful. They will be used for the Guide.
- Annex B will be updated accordingly to represent the new approach and discuss the relevance of the current statistical method (quartiles, U1, U2 limits).

6.2. TF2 Revision of General Section (Chapters 1-4) – Florin Faur reports:

- Draft 4 was distributed in Sep 2024 and discussed within TF2. New proposals from the TF were discussed and implemented.
- Definitions and Bibliography were updated.
- Chapter 4.4 “LTC faults” has to be aligned with Chapter 6.2. “Identification of LTC faults”

6.3. TF3 Revision of Basic Rules for LTC DGA interpretation (Chapter 5) – Deanna Woods reports:

- Draft 3 was distributed within TF3 Feb 2025. TF3 met 3 times and discussed the new Tables showing characteristic values (limit values) for popular and important LTC classes.
- Tables providing the 75th, 90th, 95th and 95th percentiles for LTC classes OAXCB, OAXDB, OAXSB/S, OARCB, OARDB, OVXCB/S, OVXDB, IARDB, IARSB, IVRDB, and IVRCB were set up. For IARDB, the huge spread of values renders the percentiles as ‘not useful’ to detect fault cases. A meaningful advice needs to be worked on.
- Meaningful gases and gas ratios were identified based on the ROC analysis: C2H2, CH4, C2H6, C2H4, CO, TDHG, TDHG/C2H2, C2H4/C2H2, C2H4/C2H6, C2H6/CH4 will be used in the Guide.

6.4. TF4 Revision of Chapter 6: Interpretation of LTC DGA Data – William Solano reports:

- Draft 2 was distributed within TF4 Mar 2025. TF4 held 1 meeting to discuss open topics.
- A revised Result Code Table was set up, which now shows 4 stages and concatenates the percentiles from the Tables in Chapter 5 with the stages:

Percentiles Range	Stage	Code	Description	Recommended Action
<90	1	Normal	No irregularity of gas pattern detected	Continue regular sampling
≥90 .. <95	2	Caution	Weak indication of a fault	Resample 3 months
≥95 .. <99	3	Alert	Strong indication of a fault	Resample 1 month, consider LTC lockout
≥99	4	Alarm	Imminent fault	Stop operation; investigate

- Toni Mellin (Vaisala) asked about specific LTC faults that lead to stage 3 and 4.
⇒ This will be included. TF4 is currently working on a description of LTC faults and which gases / gas patterns they produce (lead: Chris Whitten).
- How to use the Result Code Table will be supplemented by a flowchart, similar to C57.104 ⇒ to be set up.
- Question from audience: Will the guide present any recommendation about the initial years of operation of the tap-changer until the first DGA is taken? Paul Boman (HSB) answered that TF4 is currently working on the right words for such recommendations. For new equipment (and re-energized equipment after maintenance), baseline samples should be drawn and the trend monitored during the 1st year of operation.
- Case studies have been updated with investigations into assignment of typical LTC faults.
- A call was made to collect additional case studies.
- Applicability and use of Triangle #2 will be updated. For exceptional LTC types, there is current activity to replace the additional N zones by density plots with data from popular LTC classes where we have sufficient data.

7. Preparation of final Document / Ballot Process

The timeline of the WG activities which are necessary until the Ballot process can be started was presented. A first Draft of the revised Guide is planned to be sent out to the WG in July 2025 as Straw

Ballot, with feedback required. Patrycja Jarosz (IEEE) stated that a Straw Ballot is decided by the WG only. It is not required for submitting a Guide or Standard for a Ballot.

Comments on this Straw Ballot shall be resolved until the Fall 2025 WG Meeting, where a 2nd Draft will be presented. With this, the Ballot process is planned to be initiated.

8. New Business

8.1. Chris Whitten (Hitachi) requests a statement in the Guide about a combined fluid storage from different LTCs during a maintenance action, which will lead to cross-contamination that can disrupt DGA trending and diagnostic. ⇒ Task for Chris to write a proposal.

8.2. Toni Mellin (Vaisala) stated that CIGRÉ WG A2.69 is currently revising TB455 “Guide for Transformer Maintenance”, which includes some basic information on fluid diagnostic. The revised version is expected for 2025. Toni asks to study the Guide if it contains something relevant for C57.139.
⇒ Task for Toni to provide input.

9. Meeting was adjourned at 4:00 pm.

Attendees list:

First Name	Name	Affiliation	Status/ Membership Request
Anthony	Alexander	Hitachi Energy	Guest
Paul	Boman	The Hartford Steam Boiler	Secretary
John	Bule	DTE Energy	Guest
David	Burke	XCEL Energy	Guest
Edward	Casserly	Ergon	Member
Craig	Colopy	Retired from Eaton	Guest
Roberto	da Silva	MR	Guest ^{*)}
Dumitru	Diaconu	Delta Star Inn	Guest
Zachary	Draper	Delta-X Research	Member
Marco	Espindola	Hitachi Energy	Member
Florin	Faur	Prolec GE	Member
Kyle	Feaster	Xcel Energy	Guest
Todd	Felton	MVA Diagnostics	Member
Jean-Philippe	Gagnon	Qualitrol	Guest
Joshua	Garner	RESA Power	Guest
Niklas	Gustavsson	Hitachi Energy	Member
Attila	Gyore	MIDEL and MIVOLT Fluids Ltd	Member
Kevin	Hampton	Siemens Energy	Guest
Patrycja	Jarosz	IEEE SA	Guest
Chanmin	Jeong	HD Hyundai	Guest
Heonsu	Kim	LS Electric	Guest
Andreas	Kurz	MR	Guest ^{*)}
Ashwini	Labh	Hitachi Energy	Guest ^{*)}
Cesar	Lizcano	SHELL USA, Inc	Guest
Stephanie	Mabrey	AVO Diagnostics	Member
Francis	Mantoan	Siemens Energy	Guest

Tom	Matson	XCEL Energy	Guest ^{*)}
Lee	Matthews	Howard Ind.	Guest
Toni	Mellin	Vaisala	Member
Mark	Newbill	Hitachi Energy	Member
Anastasia	O'Malley	Consolidated Edison Co.	Guest
Verena	Pellon	FPL&NextEra	Guest ^{*)}
Nick	Perjanik	AVO Diagnostics	Member
John	Pruente	APC Construction llc	Vice Chair
Manuel	Quinones	GE Vernova	Guest
Sebastian	Rehkopf	MR	Member
Jonathan	Reimer	FortisBC	Guest
Chris	Rutledge	GE Vernova	Guest
Jesus	Sanchez Rodriguez	Vertiv	Guest ^{*)}
Alfons	Schrammel	Siemens Energy	Guest
Jonathan	Sinclair	Black and Veatch	Member
Jimmy	Smith	Howard Ind	Guest
William	Solano	Voltyx	Member
Cole	Van Dreel	ATC	Member
Kayla	Whitesel	DeltaX Research	Guest
Christopher	Whitten	Hitachi Energy	Member
Deanna	Woods	PTT	Member
Kwasi	Yeboah	GE Vernova	Guest ^{*)}
Samuel	Young	Hitachi Energy	Guest
Joshua	Yun	Virginia Transformer Corp.	Member

^{*)}: requesting membership

Appendix F

C57.166 No Minutes

Appendix G

Working Group for C57.637
Tuesday March 25, 2025
10:00 – 10:30 AM
Denver

The meeting was called to order at 10:06 am by Chair Stephanie Mabrey.

Attendees & Members:

The meeting was attended by 27 guests.

The Working Group (WG) has 30 members and 18 were present so quorum was reached.

1. Kevin Biggie
2. Jeremiah
Bradshaw
3. Paul Boman
4. Mike Bonn
5. Ed Casserly
6. Todd Felton
7. Marc Foata
8. Bob Harper
9. Andy Holden
10. Lance Lewand
11. Stephanie Mabrey
12. Jinesh Malde
13. Scott Reed
14. Mickel Saad
15. Alan Sbravati
16. Jonathan Sinclair
17. Greg Steeves
18. Deanna Woods

Chair's Remarks:

Chairwoman Mabrey (SM) made officer introductions. The Chair then slides containing the IEEE's copyright policy and a call for patents, of which no comments were made.

Quorum:

Quorum was confirmed by Secretary Andy Holden (AH). 18 members were present.

Approval of Minutes:

A motion to approve the Spring 2024 minutes by unanimous consent was made by Ed Casserly and it was seconded by Lance Lewand. The motion carried with no objections or abstentions.

Approval of Agenda:

A motion to approve the meeting agenda by unanimous consent was made by Ed Casserly and it was seconded by Lance Lewand. The motion carried with no objections or abstentions.

Agenda

- 1) Review Copywrite IEEE SA slides
- 2) Call for Patent-Related Information
- 3) Obtain Quorum
- 4) Ballot Resolution items
- 5) Present proposed next steps & timeline
- 6) Conclude

Proposed Next Steps & Timeline:

SM shared this timeline with the general working group.

- **Spring 2025**
 - Initial resolution Committee meeting
 - Par Extension
- **Fall 2025**
 - Present DRAFT document for ballot
 - Bring to subcommittee for ballot
 - MEC Review/Ballot group
- **Spring 2026**
 - Ballot Resolution / Recirculation

Approval of PAR Extension

A motion to extend the PAR by two years was approved by unanimous consent was made by Bob Harper and it was seconded by Mike Bonn. The motion carried with no objections or abstentions.

Ballot Resolution Committee (BRC)

The BRC will plan to meet virtually in April to resolve outstanding items. Additional meetings may be required before the Fall 2025 meeting to stay on timeline.

The BRC member include:

- 1) Stephanie Mabrey (President)
- 2) Scott Reed (Vice-Chair)
- 3) Andy Holden (Secretary)
- 4) Jeremiah Bradshaw (editor)
- 5) Mike Bonn
- 6) Ed Casserly
- 7) Stuart Chambers
- 8) Jinesh Malde
- 9) Jonathan Sinclair
- 10) Ed teNyenhuis
- 11) Deanna Woods
- 12) Gabriel Zamora

Conclusion:

The meeting was concluded at 10:20 am by SM.

Minutes of Meeting

C57.104 Guide for the Interpretation of Gases Generated in Mineral Oil- Immersed Transformers – Working Group

Denver CO – March 25, 2025 1.45pm – 3.00pm

- This was the second working group meeting 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.
- Attendance Rosters were circulated
- There were 234 in attendance (see list below) with 82 members and 152 guests.
- A patent call was made with no reply
- Quorum was achieved.
- Approval of Agenda – motion made by Deanna Woods and seconded by Lance Leward. Motion was approved.
- Approval of Minutes of Last Meeting – motion made by Marcos Espindola and seconded by Ed Casserly. Motion was approved.
- The Chair provided an explanation about DGA data anonymization for Laboratory DGA data and gas monitor DGA data. The DGA data is to be submitted to an IEEE account for anonymization. All attendees will have access to the data. The data will be retained after the completion of the guide revision. The data shall only be used for IEEE working group purposes.
- The Chair presented the DGA Data collection templates. The following comments / changes were requested by the working group:
 - Indication of failure or issue with each row of data either with pull down menu or comment
- The Chair presented the Gas Monitor template. The working group had the below comments / edits:
 - Some sensors will not provide data when below the minimum detection limit. Preferably the user sending the data can clean this, otherwise the Data Analysis Task Force will need to clean this.
 - If there is a failure, the timestamp should be noted in the comments
 - Make it clear that for gases not measured, the user should leave these columns blank
 - For file transfer, it may be required to have a data transfer site due to the potential large size of the files
- A Gas Monitor Conversion file is required for IEEE Staff to convert a gas monitor brand to gas monitor type and sensor type. The following persons volunteered to

prepare this conversion file: Toni Mellin, Zack Draper, Bill Whitehead, Lance Leward and Emilio Morales – Cruz.

- A Data Analysis Task Force will be formed to receive the data from IEEE, perform cleaning, do data analysis and present results to the working group. The following persons volunteered: Zach Draper, Tony Mellin, Luiz Cheim, Sami Debass, Adriana Cisco Sullberg, and Tim Raymond.
- It was requested the Chair send multiple e-mail reminders for the data collection.
- A presentation was made by Toni Mellin -
 - Mistakes in Duval triangle 4 & 5 & proposal to fix the mistakes
 - Proposal to update Duval triangle methods as per 2020 updates from Dr. Michel Duval
 - Corrections to Duval pentagons 1 & 2 and arcing sub-faults
 - Section 6.1 & 6.2 - What to do with online monitoring
 - CIGRE working group A2/D1.67 “Guideline for Online Dissolved Gas Analysis Monitoring” is in the process of starting data collection and data analysis for continuous online DGA monitoring data, this has been discussed to be done with IEEE collaboration
- A presentation was made by Zack Draper -
 - Suggestion to add a 4th status code. See “How to Improve IEEE C57.104-2019 DGA Fault Severity Interpretation” Draper, Dukarm, and Beauchemin. IEEE/PES T&D, 2022
 - Proposed a classification scheme for Oil Preservation types. O2 & N2 clearly affects the DGA statistics. But the association of O2 & N2 gas concentrations or ratios with the actual oil preservation type is somewhat weak (due to lack of data). See Draper & Dukarm, CIGRE Canada, 2024, no. 768, zhdraper@deltaresearch.com
- Lance Leward discussed the importance of translation regarding transformer fault. The word “Fault” is used incorrectly, and it is important that we need to be careful of that.
- There was insufficient time for the other 2 presentations prepared. These will be discussed in the next working group meeting
- There was no new business to discuss.
- A motion to adjourn the meeting was made by Lance Leward and seconded by Marco Espindola. The meeting was adjourned at 15.00.

=====

Attendance List

Last Name	First Name	Company Name	Member (Y)
Alonso	Mario	Georgia Transformer	Y
Aleksander	Owicz	Hitachi Energy	Guest
Attaullah	Ahmad G	Sabic	Guest
Balaji	Janakron	Virginia Transformers	Guest
Baser	Levent	Hitachi Energy	N
Biggie	Kevin	Weidmann Electrical Technolgy	Guest

Beck	Scott	Trantch	Guest
Betancourt	Edwin	Siemens Energy	Guest
Bradshaw	Jeremiah	Bureau of Reclamation	R
Brett	John	Delta-X Research	N
Boettger	William	Boettger Transformers Consulting LLC	Guest
Boman	Paul	HSB	Y
Bonn	Mike	SOLTEX	N
Brodeur	Samuel	Hitachi Energy	Guest
Burk	Griffin	Ergon	Guest
Casserly	Edward	Ergon	Y
Castellanos	Juan	Prolec GE	Y
Castello	Alonso	Kaedi Energy Solution	Guest
Chanda	Sudip	Delta Star Inc	Y
Chambers	Stuart	EPRI International	Y
Cheatham	Mark	GE	Y
Cheim	Luis	Hitachi Energy	Y
Chen	Kezmen	IFD Technologies	N
Chu	Matt	Shihlin Electric	Guest
S. Cisco sullberg	Adriana	Salt River Project	Guest
Colby	Caleb	Schneider Electric	Guest
Cordova	David	Maddox Industrial	Guest
Cordova	Olivia	Bureau of Reclamation	Guest
Cox	Randy	GE	Y
Crotty	John	Ameren	Guest
Cryer	Rich	DIGITALGRID, Inc	Guest
Dappen	Tim	Cargill	Guest
Debass	Sami	EPRI	Y
Delgado	Gabriel	Invenergy	Y
Dillon	Nikolaus	Dominion Energy	Guest
Doak	Eric	D4 Energy solutions	Guest
Doyle	Lee	Vaisala	Y
Draper	Zachary	Delta-X Research	Y
DA Silvia	Roberto	Maschinefabrik Reinhausen	Y
Duffy	Jesse	Nashville Electric Service	Y
Dukarm	James	Delta-X Research	Y
Dulac	Hakim	APT	Y
Edward	Tolcachir	TTR	Guest
Emilio	Morales - Cruz	Qualitrol	Y
Enmakov	Evgenii	Hitachi Energy	Guest
Elliott	Will	AEP SWECO	Y
Espindola	Marco	Hitachi Energy	Y
Fazlic	Zlatan	Camlin Energy	Y
Faur	Florin	Prolec GE WAUKESHA	Y
Felton	Todd	MVA Diagnostics	Y
Fernandez	Miguel	FEMK	Y
Ferreira	Marcos	Quanta Technology	Y
Finn	Mark	Hitachi Energy	Guest
Forsyth	Bruce	Cargill	Y
Florin	Hugo	ERMCO	R
Franklin	Chris	MG Power Associates	N
Frotscher	Rainer	Reinhausen Germany	N
Fujimori	Alen	Romagnole	Guest
Gagne	Zach	IFD Technologies	N
Gamer	Joshua	Independent Dielectrics	Guest

Gagnon	JeanPhilippe	Qualitrol	Guest
Gara	Lorne	Shermco	Guest
Garcia	Miguel	Hitachi Energy	Y
Gardner	James	Prolec-GE WAUKESHA	Y
Gasparini	Eloy	Mistras	Guest
Garner	Josh	Resa Power	Guest
Garza	Hector	Ovto De Mexico	N
Girgis	Ramsis	Hitachi Energy	Y
Goglia	Slaven	Konias Power Transformer	Guest
Gonzalez	Luis	Conduct Industries	Y
Gorzin	Alireza	Black and Veatch	Y
Gyore	Attila	Midel & Mivolt Fluids LTD	Guest
Guner	Ishmael	Hydro -Quebec	N
Hamoir	Didier	Transformer Protector Corp.	Guest
Hayes	Roger	GE Vernova	Guest
Hernandez	Giovanni	Virginia Transf. Corp	Y
Hernandez	Ronald	Doble Engineering	N
Hernandez-Mejia	Jean Carlos	Georgia Tech Neetrac	N
Herron	William	MR	N
Ho	Chanh Thang	BC Hydro	Guest
Holden	Andy	Ergon	Y
Hollrah	Dereck	Burns & McDonnel	N
Hopkins	Traci	H2Scan	Y
Hsiao	Yutso	Shihlin Electric	Guest
Foata	Marc	MR	Guest
Foata	Marc	MR	Guest
Jakob	Karl	Cargill	Guest
Jarosewski	Marion	Delta Star Inc	Guest
Jaros	Patrycja	IEEE SA	N/A
John	John	Virginia Transformer Corp.	Y
Jones	Braxton	SD Myers	Guest
Jonak	Ryan	PGE	Guest
Kadar	Laszlo	Laszlo & Associate	Guest
Kasonga	Mick	Oncor Elec	N
Kennedy	Sheldon	Sheldon P Kennedy Engineering	Guest
Keels	Thomas A.	KEelectric Engineering LLC	Guest
Khan	Qasim	NEETRAC- Georgia Tech	Guest
Kim	Yeounsoo	JST Power Equipment	Guest
Kim	Rebecca	CHERYONG ELECTRIC	Guest
Kirchenmayer	Egon	Siemens Energy	Y
Klempner	Dmitriy	SCE	Y
Komel	Lakhani	Siemens Energy	Guest
Kowacki	Rafal	Hitachi Energy	Guest
Kurz	Andreas	MR	N
Kwan	Lanen	US NRC	Guest
Larison	Andrew	Hitachi Energy	Guest
Labh	Sahwini	Hitachi Energy	Guest
Lamontagne	Donald	Arizona Public Service	Y
Lapointe	Sylvin	Rugged	Guest
Lee	KangJtn	Cheryong Electric	Guest
Lewand	Lance	Doble Engineering	Y
Li	Chao	Eaton	N
Li	Jinming	BC Hydro	Y
Li	Weijun	Braintree Electric Light Dept.	Y

Lin	David	IFD Technologies	N
Lizcano	Cesar	SHELL USA INC.	N
Loiselle	Luc	Tetra Tech	Y
Lopez	Richardo	EFACEC	Guest
Lucas	Tiffany	Prolec GE	N
Luke	Wang	BC Hydro	N
Mabrey	Stephanie	Weidmann	Y
Malde	Jinesh	MIDEL & MIVOLT Fluids Ltd	Guest
Mani	Kumar	Duke Energy	Y
Mani	Balakrshnan	Delta Star Inc	Guest
Mahajan	Kushal	Sungrow	Y
Mantoan	Francis	Siemens Energy	Guest
Mats	Bermejo	Hitachi Energy	Guest
Martinez	Alberto	WEG	Guest
Marulanda	Katherine	Magnetron S.A.S	Guest
Mbouombouo	Mama	Hitachi Energy	N
McLaughlin	Pat	PECO	Guest
Megdad	Mohammed	IPS	N
Mellin	Toni	VAISALA	Y
Mannannam	Robert	Maddox Industrial Transf.	N
Miller	Philip	MLGW	N
Moore	Curtis	DIGITALGRID, Inc	Guest
Morgan	Charles	Eversource Energy	Guest
Munoz	Martin	Orto	Y
Murkowski	Emma	Delta-X Research	Y
Murray	David	TVA	Y
Naja	Ismael	Eaton	Guest
Nambi	Shankar	Bechtel Energy	Guest
Newbill	Mark	Hitachi Energy	Y
Niroula	Ashmita	Ergon, Inc	Guest
Nims	Joe	Allen & Hoshall	N
Nolte	Mike	Kiewit	Guest
Obrepon	Daniel	TTE Transformers	Guest
O'Malley	Anastasia	Con Edison NY	N
Pacas	Joel	IFD Technologies	Guest
Panesar	Parminder	Virginia Transformer	Y
Palhatiya	Ajay	Virginia Transformer Inc	Guest
Patel	Poorvi	EPRI	Y
Patel	Vinay	Con Edison	Y
Patel	Rakesh	Hitachi Energy	Y
Pedro	Pedro	EFACEC-TRANSFORMERS	N
Perjanik	Nick	Avo Diagnostic Services	Y
Plisic	Goran	Siemens Energy KPT	N
Pruente	John	Prolec GE WAUKESHA	Y
Quinones	Manuel	GE vernova	Guest
Radu	Ion	Hitachi Energy	Y
Rapelly	Layman	GA Transformer	Guest
Ray	Sheila	US Nuclear Regulatory Commission	Guest
Raymond	Tim	Inductive Reasoning	Y
Reed	Scott	MVA	Y
Reeder	Perry	GE	N
Reimer	Jonathan	Fortis BC	Guest
Razvan	Arash	Delta Star Inc	Y
Rodriguez	Juan	Manetron	Guest

Robels	Antonio	Bureau of Reclaminion	Guest
Rossini	Yuri	Siemens Energy	Y
Rutledge	Chris	Gevernova	Guest
Saad	Mickel	Hitachi Energy	Y
Sanchez-Rodger	Jesus	Voltyx	Guest
Scaidazzi	Alaor	Siemens Energy	Guest
Shannon	Micheal	REA MAGNET WKS	Guest
Sarkar	Amitabh	Virginia Transformers	Y
Sbravti	Alen	Hitachienergy	Guest
Schott	Cody	The J-J Family of Camp	N
Schmitt	Wolfgang	Schneider Electric	Guest
Shaikh	Salahuddin	NGR	Guest
Shertukde	Emchrovdea	UHART	Guest
Singh	Amitkumar	ConEdision	Guest
Sinclair	John	Black and Veatch	Y
Simonov	Igor	Toronto Hydro	R
Smith	Jimmy	Howard Industries	Guest
Snyder	Jason	First Energy	Guest
Soeller	Markus	Power Diagnostix System	N
SOHN	Yong Tue	HYOSONG HICO	Y
Soto	Mauricio	Hitachi Energy	Y
Sparling	Brian	KINECTRICS	Y
Stauffer	Jonathan	BOR	Guest
Staley	Brad	Leeward Renewable Energy	Y
Steeves	Greg	Baron USA	Y
Sunny	Swarna	Virginia Transformer	Guest
Sweetser	Charles	Omicron	Guest
Witkowski	Michal	Hitachi Energy	Guest
Tanaka	Troy	Burns and McDonnell	Y
Thumpson	James	T&R Service	Guest
Teofanovic	Marko	Ontario Power Generation	Guest
Thierry	Juan Luis	Doble Engineering	Guest
Thomps	Jim	T&R Service Co.	R
Holifield	Thomas	Howard	Guest
Thomas	Prevost	Weidman	N
Thompson	Ryan	Burns and McDonnell	Y
Tillery	Tim	Howard Industries	Guest
Tostrud	Mark	Dynamic Ratings	Y
teNyenhuis	Ed	Hitachi Energy	Y
Trojrlo	Pedro	Hyundai	Guest
Van Drell	Cole	American Transmission Co	Y
Vanderwalt	Alwyn	ECI	Y
Verdolin	Rogerio	VERDOLIN Solutions	Y
Vir	Dharam	Prolec GE	Y
Volodymyr	Prykhodko	ZTZSETVECES	N
Vu	Nguyen	IFD Technologies	Guest
Wager	John	AEP	Guest
Washburn	Alan	Burns & McDonnell	Guest
Welton	Drew	Intellirent	Y
Watson	Joshua	NPPD	N
Weyer	Daniel	Monolith	Y
White	Elliot	SD Myers	N
Whitehead	Bill	H2Scan	Y
Whitesell	Kayla	Delta-X Research	Guest

Woods	Deanna	PTT LLC	Y
Wess	Zacan	Weg Trains	Guest
Wright	Jeffery	Duqlight	Guest
Xu	Shuzhen	FM Global	Y
Yeboah	Kwasi	GE Varnova	Guest
Yeh	Stanly	Shihlin Electric	Guest
Yuan	Grace Gung	Hitachi Energy	Guest
Yu	Zachary	Sieyuan Toshiba	Guest
Yu	Asam	Shihlin Electric	Guest
Zhn	zhinwring	Chint	Guest
Zhang	Hongzhi	Burns & McDonnell	Guest
Zuiderveen	Thomas	IFD Technologies	Guest
Stank	Markus	Reinhausen	Guest