# Annex G Insulating Fluids Subcommittee

**March 30, 2022**
**Denver Colorado - Hyatt Regency Room Centennial F-G**

**Chair: Scott Reed**
**Vice-Chair: Jerry Murphy (not present)**
**Secretary: Alan Sbravati**

## 1 Introductions, Roll Call of Members for Quorum, Meeting Agenda Approval, S21 Minutes Correction and Approval, and Chair's Comments

### 1.1 Chair's Opening Remarks:

a. Presentation of the Vice-Chair, Jerry Murphy, and the Secretary Alan Sbravati.

b. Reminded that the SC minutes are due May 13, 2022- WG and TF meeting minutes are due for submittal to the Insulating Fluids Subcommittee (IFSC) Secretary Alan Sbravati due within 15 days of their meetings (Apr 28th, 2022).

### 1.2 Roll Call of SC members: (Quorum requirement: 23 minimum)

a. 18 Members signed in, from a total of 44 members. Quorum was not achieved.

b. Total of 60 attendees. 26 Guests and 16 new attendees, and 14 requested membership, whose eligibility will be verified.

c. Registered Attendance:

| First Name | Last Name | Role |
|---|---|---|
| Juan | Acosta | Guest |
| Jennie | Aldenlid | Guest |
| Jared | Bates | Guest |
| Jean-Noel | Berube | Guest |
| Kevin | Biggie | Guest |
| William | Boettger | Member |
| Joshua | Bohrn | Guest |
| Jeremiah | Bradshaw | Guest |
| David | Calitz | Member |
| Juan Alfredo | Carrizales | Guest |
| Juan | Castellanos | Member |
| Stuart | Chambers | Member |
| Jonathan | Cheatham | Guest |
| Larry | Christodoulou | Member |
| Olivia | Cordova | Guest |
| Michael | Dahlke | Guest |
| Stephanie | Denzer | Member |
| Zachary | Draper | Guest |
| Florin | Faur | Guest |
| Sanford | Fong | Guest |
| Bruce | Forsyth | Guest |
| Rainer | Frotscher | Member |
| Alex | Gilliver | Guest |
| Orlando | Giraldo | Guest |
| Niklas | Gustafsson | Guest |
| Karl | Jakob | Guest |
| Kurt | Kaineder | Member |
| Zan | Kiparizoski | Member |
| John | Kotula | Guest |
| Angela | Leigl | Guest |
| Tiffany | Lucas, P.E. | Guest |
| Jinesh | Malde | Member |
| Brady | Nesvold | Guest |
| Ashmita | Niroula | Member |
| Jonas | Oliveira | Guest |
| Dwight | Parkinson | Member |
| Matt | Pinard | Guest |
| Daniel | Posadas | Guest |
| Thomas | Prevost | Member |
| John | Pruente | Guest |
| Scott | Reed | Chair |
| Sebastian | Rehkopf | Guest |
| Benjamin | Riggins | Guest |
| Diego | Robalino | Guest |
| Mickel | Saad | Member |
| William | Salmon | Guest |
| Alan | Sbravati | Secretary |
| Samuel | Sharpless | Guest |
| Jonathan | Sinclair | Guest |
| Brian | Sparling | Guest |
| Markus | Stanks | Guest |
| Gregory | Steeves | Member |
| Ryan | Thompson | Guest |

| | | | | | |
|---|---|---|---|---|---|
| Mark | Tostrud | Guest | Christopher | Whitten | Guest |
| Alwyn | Van Der Walt | Guest | Deanna | Woods | Member |
| Evanne | Wang | Guest | Malia | Zaman | Guest |
| William | Whitehead | Guest | | | |

**1.3 Agenda Approval:**

a. Since quorum was not achieved, it was not possible to have a motion for approval.

**1.4 Approval of minutes from the F21 meeting (virtual):**

a. Since quorum was not achieved, it was not possible to have a motion for approval.

**1.5 Chair's review of key IFSC Standards:**

a. The chair reviewed the status of each of the 10 guides under the Sub-Committee Insulating Fluids.

b. C57.166 PAR's expires in December 2022, and the first balloting is expected to happen in Feb/22. This will supersede C57.106, C57.111, C57.121, C57.147, so no activity is required at this point for these standards.

c. C57.155 will. C57.637, C57.130, C57.139 will expire in 2025.

d. C57.146 has a new chair, Paul Boman.

e. C57.130 has a new chair, Bruce Forsyth.

f. C57.104 did not meet this time.

g. C57.146, C57.155, C57.637 and C57.166 have active PAR's.

## 2 WG & TF Reports Presented at the SC Meeting

### 2.1.1 IEEE C57.166 Consolidation of Insulating Liquids Guides (PAR Expiration: Dec 2022)

2.1.1.1 WG Chair: Tom Prevost

**2.1.1.2 The report of the WG Meeting was presented at the IFSC meeting by the chair:**

a. The WG meeting had 24 of 41 members were present so a quorum was achieved.

b. Call for patents was presented without any claim.

c. Five Task Forces chairs each gave a status report of their respective sections.

d. TF1, with Jinesh Malde, already completed their draft and shared with TF6.

e. TF2 is with Scott Reed. Draft was shared with the group in Jan/22 and discussed during this meeting.

f. TF3 is with Alan Sbravati. Work is completed, and already shared with TF6.

g. TF5 is with Rainer Frotscher. The document is already completed and shared with TF6.

h. TF6 is with Toby Johnson, who is starting to edit the document.

i. The expectation is to have the guided balloted at the F22 meeting.

See ***Appendix I*** for the S22 Minutes (unapproved) of C57.166 WG Meeting as submitted.

### 2.1.2 IEEE C57.146 IEEE Guide for Interpretation of Gasses Generated in Silicone-Immersed Transformers (PAR Expiration extended to Dec 2024)

2.1.2.1 WG Chair: Paul Boman

a. Attendance total 34, members 9 out of 22, guest 22 and 4 requested membership. Quorum was not achieved.
b. No patent claim was presented.
c. Fall 2021 Working Group Minutes was not voted on because a quorum was not present. Planning to use an electronic ballot to approve all unapproved Meeting Minutes.
d. Chair gave timeline of Guide progress with the Guide expiration at the end of 2021, a PAR extension was given to 2024
e. Data review – 5 sources of data were provided along with the CIGRÉ data. The CIGRÉ data was limited to 25 transformers and was very different from the other 5 sources.
f. A request for sharing more case studies was presented by the chair, which must be also include a copyright release form.

**S**ee ***Appendix II*** for the S22 Minutes (unapproved) of C57.146 WG Meeting as submitted.

### 2.1.3 TF C57.104 IEEE Guide for the Interpretation of Gases Generated in Mineral Oil-Immersed Transformers

2.1.3.1 TF Chair: Claude Beauchemin

a. The working group did not meet.

**S**ee ***Appendix III*** has no minutes included.

### 2.1.4 C57.637 – Guide for the Reclamation of Mineral Insulating Oil and Criteria for Its Use

2.1.4.1 WG Chair: Stephanie Denzer

a. The Working Group (WG) has 54 members with 17 (32%) were present. Quorum not achieved.
b. Jon Karas has left IEEE and we have removed him from the membership list effective today. This would make the current membership number 53. We had 15 guests attend the meeting, and 10 have requested membership.
c. Call for patents was presented, without claims. Copyright slides were presented.
d. The four task forces presented the status of their work. A fifth task force will edit the final document.
e. The working group is requesting more volunteers for the task forces.

**S**ee ***Appendix IV*** for the S22 Minutes (unapproved) of C57.637 WG Meeting as submitted.

### 2.1.5 C57.155 – Guide for Interpretation of Gases Generated in Natural and Synthetic Ester Liquid Type Transformers

2.1.5.1 WG Chair: Alan Sbravati

a. There were 12 of 24 members present during the meeting. Quorum was not achieved when verified during the meeting.
b. No patent claims were presented. Copyright slides were presented.
c. Main discussion for this meeting was the progress of TF1, on collecting the DGA data.
d. Two presentations were made, by Zach Draper and Lance Lewand
e. Meeting was adjourned.

**S**ee ***Appendix V*** for the S22 Minutes (unapproved) of C57.155 WG Meeting as submitted.

### 2.1.6 Task Force C57.139 – Guide for the Interpretation of Gases generated in Liquid Type Load Tap Changers

2.1.6.1 TF Chair: Rainer Frotscher

a. Th Total attendance record: 33, members: 7, Guests: 26, with 11 attendees requesting membership.
b. Established Quorum, 7 members were present out of 13 members in total
c. Call for essential patent Claims: Ed teNyenhuis stated there was one LOA from 2013 by Reinhausen Germany.
d. Copyright Policy was discussed.
e. Introduction of WG Officers
f. PAR was reviewed, as approved by NesCom, with expiration in December 2026. All work incl. Ballot should be done by end of 2025.
g. The chair presented his vision for the guide, bringing the statistical analysis and the section on Duval triangles to the normative portion, adding sections around the limitations and validation of the DGA's, and topical format as much as possible aligned with C57.104.

See ***Appendix VI*** for the S22 Minutes (unapproved) of C57.139 TF Meeting as submitted.

### 2.1.7 Working Group C57.130 – Guide for the Use of Dissolved Gas Analysis Applied to Factory Temperature Rise Tests for the Evaluation of Mineral Oil-Immersed Transformers and Reactors

2.1.7.1 WG Chair: Bruce Forsyth

a. There were 72 participants present and 50 participants requested voting membership. Since this was the first meeting of the Working Group, voting membership was automatically granted to those who checked the Membership Request box in the attendance roster
b. Call for essential patent Claims: no claims presented.
c. Copyright Policy was presented / no comments.
d. Review of the agenda
e. PAR was reviewed, as approved by NesCom.
f. The group decided in favor of modifying the approved PAR for including ester liquids in the scope of this standard. A Task Force led by Lance Lewand will work on this topic.
g. Another discussion was raised around the inclusion of limits of gas generation during overload tests and other dielectric tests.

See ***Appendix VII*** for the S22 Minutes (unapproved) of C57.130 WG Meeting as submitted.

## 3 Old Business

a. Migration of TF2 previously associated with WG C57.154 from ILSC to IFSC
As the working group activities are closed, for the standard is already completing the balloting process, and the task force did not reach a conclusion, the group requested keeping the activities.
It was agreed during this meeting that the current chair of the task force will consult with the members for stablishing a new Task Force under the IFSC. This groups will focus on preparing a positioning paper for the testing procedure and continuous operating temperature of ester liquids in transformer

## 4 New Business

a. No new business.

## 5 Next IFSC Meeting:

October 19th, 2022 – Charlotte, NC

## 6 Adjournment

A motion for the meeting to be adjourned was presented by Claude Beauchemin and seconded by Ed Casserly.

The subcommittee adjourned at 3:32 p.m.

Respectively Submitted, Alan Sbravati, Secretary IFSC

*Unapproved Minutes from the F21 IFSC WG and TF meetings*

# *Appendix I*

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

**Tuesday, March 29, 2022**
**1:45 – 3:00 PM**
**Hyatt Regency Denver – Room Centennial F**

Chairman Tom Prevost
Vice Chair Scott Reed
Secretary Alan Sbravati

The meeting was called to order at 1:49 pm by the Chair.

There were 24 of 41 members present. Total of 53 attendees, including 29 guests. A membership quorum was achieved.

Attendance list:

| | | | |
|---|---|---|---|
| Juan Acosta | Guest | Dominic Pollaro | Guest |
| Elise Arnold | Guest | Thomas Prevost | Chair |
| Jeff Benach | Guest | John Pruente | Guest |
| Dominique Bolliger, Ph.D. | Member | Scott Reed | Vice-Chair |
| Paul Boman | Member | Rerry Reeder | Guest |
| Mike Bonn | Member | Sebastian Rehkopf | Guest |
| Jeremiah Bradshaw | Member | Diego Robalino | Member |
| Stuart Chambers | Member | Zoltan Roman | Guest |
| Larry Christodoulou | Guest | Mickel Saad | Member |
| Olivia Cordova | Guest | Alan Sbravati | Secretary |
| Stephanie Denzer | Member | Pugal Selvaraj | Member |
| Zachary Draper | Guest | Jonathan Sinclair | Member |
| Rainer Frotscher | Member | Brian Sparling | Guest |
| Lorne Gara | Guest | Thomas Spitzer | Guest |
| Robert Harper | Member | Gregory Steeves | Member |
| Andrew Holden | Member | Dean Summer | Guest |
| Miller Kent | Guest | Phil Swan | Guest |
| Zan Kiparizoski | Member | Troy Tanaka | Guest |
| Michelle Kutzleb | Guest | Risto Trifunoski | Guest |
| Aleksandr Levin | Guest | Alwyn Van Der Walt | Member |
| Lance Lewand | Guest | Evanne Wang | Member |
| Tiffany Lucas, P.E. | Guest | Leon White | Guest |
| Jinesh Malde | Member | William Whitehead | Guest |
| Kumar Mani | Member | Christopher Whitten | Guest |
| Brian McBride | Member | Roger Wicks | Guest |
| Ashmita Niroula | Guest | Malia Zaman | Guest |
| Parminder Panesar | Member | | |

Introductions
Approval of Agenda

- Motion for approving agenda presented by Diego Robalino and second by Kumar Mani

Approval of Fall 2021 Minutes

F21 minutes approval

- Motion for approving the minutes presented by Stephanie Denzer and second Jeremiah Bradshaw

The chair presented the slides on the Call for Patents and no claims of essential patents was presented.

The chair presented the slides on Copyright Policy, also informing the participants the overall IEEE procedures for the meeting.

Chair presented scope and purpose of the standard for a refreshing

- The group identified the need of removing the references to reclaim and reconditioning from the scope
- PAR needs to be updated accordingly

Chair presented the current version of the standard.
Presentations of the task force activities

TF 1 – Jinesh Malde

- The draft was completed and shared with Toby Johnson. No pending topics.

TF 2 – Scott Reed

- Draft of the session was shared with the group in January. Received comments will be discussed during this meeting.

TF 3 – Alan Sbravati

- The draft was completed and shared with Toby Johnson. No pending topics.

TF 5 – Rainer Frotscher

- The draft was completed and shared with Toby Johnson. No pending topics.

TF 6 – Toby Johnson

- No status was presented.

Next topic was the comments presented by Rainer Frotscher.

In the draft sent in Jan, the tables listing limits for the fluids' properties were separated according to the liquid type. Rainer did a proposal merging all liquids in a single table.

He also proposed to change the term used for the classification of the fluids from "class I, II and II" to "state I, II, III". During the discussions additional suggestions were presented, such as "status" and "condition"

After the discussions, Jinesh Malde presented a motion for using the term "condition". He was seconded by Michael Saad.

Several attendees supported the use of that terminology.

On top of that Rainer also proposed adding the words "Good", "Fair" and "Poor" for conditions 1, 2 and 3. This was discussed and not supported by the group. Several attendees were against this suggestion. Since it was not part of the presented motion, it was dismissed.

Regarding the presented motion, 21 members voting for approval and there was one abstention.

Motion cares. Instead of Class the new term is Condition.

Next Rainer presented his version of the table, combining the fluids in a single table.

Group highlighted there was some missing values, marked with question marks. There were several discussions around the inclusion of values of IFT for ester fluids, the limits of DDF at 25°C and 100°C, and more, which were considered followed by the task force chair. Scott Reed will work on the draft and share a new version.

Tom Prevost informed the attendees that the drafts will be posted drafts in the WG website, under the task forces.

No new business.

Meeting adjourned at 2:46pm

Alan Sbravati, Secretary
Scott Reed, Vice Chair

# *Appendix II*

# Working Group C57.146 IEEE Guide for DGA in Silicone

**Monday, March 28th, 2022**
**11:00 AM to 12:00 PM (MDT)**
**Hyatt Regency Denver Colorado**
**Minutes of Working Group Meeting**

Chair Paul Boman / Vice Chair Lance Lewand
Secretary vacant

Attendance total 34, members 9, guest 22 and 4 requested membership but need to attend in the Fall 2022. The WG has 22 Members, so a WG quorum was not present, so no business was conducted. At the Fall 2022 meeting, 14-members will be removed for non-participation.

S22 Meeting Attendance at end of meeting

| Role | First Name | Last Name |
|---|---|---|
| Chair | Paul | Boman |
| Committee Member | Eric | Davis |
| Committee Member | Stephanie | Denzer |
| Interested Individual | Zachary | Draper |
| Active Participant | Florin | Faur |
| Active Participant | John | Pruente |
| Committee Member | Scott | Reed |
| Guest | Jeff | Benach |
| Guest | Juan | Castellanos |
| Interested Individual | Larry | Christodoulou |
| Guest | George | Frimpong |
| Guest | Rainer | Frotscher |
| Guest | Axel | Kraemer |
| Interested Individual | Michelle | Kutzleb |
| Guest | Hali | Moleski |
| Guest | Arturo | Nunez |
| Guest | Mauricio | Soto |
| Guest | Bill | Whitehead |
| Vice-Chair | Lance | Leward |
| Interested Individual | Phil | Hopkinson |
| Guest | Chao | Li |
| Guest | Jebashan | Rehhopl |
| Guest | Andy | Downey |
| Guest | Tiffany | Lucons |
| Guest | Arwyn | Vanderwalt |
| Guest | Lorne | Gara |
| Guest | Jonathan | Sinclair |
| Guest | Sanford | Fong |
| Guest | Mickel | Saad |

| | | |
|---|---|---|
| Guest | Wes | Schrom |
| Guest | Evanne | Wang |
| Guest | Stephanie | Denzer |
| Member | John | Pruente |
| Guest | Christopher | Whitten |

*Requested Membership

Call for essential patents – none at this time
Copyright usage was discussed during the meeting
Agenda – no additions were made to the agenda. Motion made Zach Draper to accept the Agenda and seconded by John Pruente

Fall 2021 Working Group Minutes was not voted on because a quorum was not present. Planning to use an electronic ballot to approve all unapproved Meeting Minutes.

Copyright discussed – no copyright releases were discussed for the citation papers in the document

Data review – 5 sources of data were provided along with the CIGRÉ data. The CIGRÉ data was limited to 25 transformers and was very different from the other 5 sources. The type of transformers (traction, power, distribution, etc.) involved in the original data collection was unknown. Planning to use an electronic ballot to select an appropriate data set for threshold values. Phil Hopkinson stated that true distribution transformers have a sealed preservation system with dry air while power transformers will have a dry nitrogen gas blanket.

There was some discussion at what temperature the gases are formed in silicone and also related to the oxygen concentrations. Phil Hopkinson discussed core lamination issues which would influence the production of gases in all liquid filled transformers.

Case Studies – There was a request from Paul Boman that more case studies were needed for the document. If case studies are submitted, they need to be on company letterhead and provide a copyright release. The form for the copyright release can be found on the Transformer committee's website.

Paul Boman will issue electronic vote on data sets in regard to how to use the data. Paul will discuss with Claude to get information on the different data sources. There was also some discussion on data statistics but on a very cursory level. There was a comment that IEEE no longer has access to the individual data from source 5. Discussion of the data as whether or not the original data contained information on manufactures, geographical locations of transformer installations and other items that might help to qualify the data. It was explained that the names of manufacturers could not be used as per IEEE regulations and there was no way to know where the geographic locations were.

There was additional discussion on harmonizing sections in this guide in relation to C57.104 that can be harmonized. Lance Lewand suggested not to use the rate calculations from C57.104 because it is so complex and the amount of data available may not be able to provide those calculations anyway. Paul would like to see information on actions to take after threshold values have been reached such as confirmation and surveillance samples.

Adjourned Meeting

# *Appendix III*

## TF Next Revision to C57.104: Guide for Interpretation of Gases Generated in Mineral Oil-Immersed

**No meeting minutes**

# *Appendix IV*

# Working Group C57.637 Guide for the Reclamation of Mineral Insulating Oil and Criteria for Its Use

**Tuesday, March 29, 2022**
**9:30 AM – 10:45 AM (mountain time)**
**Hyatt Regency Denver Colorado**

**Minutes of Working Group Meeting**

The meeting was called to order at 9:30 am by Chair Stephanie Denzer. Scott Reed (Vice-Chair) and Andy Holden (Secretary) were also present.

Attendees:

The Working Group (WG) has 54 members with 17 (32%) were present.

Present

1. Alan Sbravati
2. Andy Holden
3. Ashmita Niroula
4. Christopher Whitten
5. Ed teNyenhuis
6. Greg Steeves
7. Jeremiah Bradshaw
8. Jinesh Malde
9. John Pruente
10. Jonathan Sinclair
11. Kevin Biggie
12. Larry Christodoulou
13. Mickel Saad
14. Paul Boman
15. Robert Harper
16. Scott Reed
17. Stephanie Denzer

Jon Karas has left IEEE and we have removed him from the membership list effective today. This would make the current membership number 53.

We had 15 guests attend the meeting, and 10 have requested membership.

Due to the time constraints, attendees did not introduce themselves.

Agenda

1) Introduction
2) Review Copyright Notification
3) Review Call for Patents
4) Review Membership
5) Introduction of Task Force leaders and updates

Chair's Remarks:

Chairwoman Denzer (SD) requested a call for patents and no claims were made. Lance Lewand (guest) did ask for clarification about the patent policy, and it was provided by Tom Prevost (guest), Ed teNyenhuis (member), and Stephanie Denzer (chair).

Next, the Chair reviewed with the Task Force (TF) the IEEE's copyright policy, of which no comments were made.

The Chair commented that first meeting (Spring 2021) was focused on clarifying the purpose and scope of the WG. The second meeting (Fall 2021) was focused on sectionalizing the document and enlisting Task Force leaders for each section. All attendees of the Fall meeting automatically gained WG membership.

The Chair then asked each Task Force leader to introduce themselves and share a brief update of any progress made to date. The following Task Forces leaders presented.

- Task Force 1 – Overview, Normative References, & Definitions
  - Jeremiah Bradshaw
- Task Force 2 – Classification of Service Aged Oils (Liquids) & Criteria for Reuse
  - Jinesh Malde & Ismail Guner (absent)
- Task Force 3 – Types of Reconditioning & Reclamation Processes
  - Ed teNyenhuis & Dave Sundin (absent)
- Task Force 4 – Oil (liquid) Tests & Their Significance
  - Andy Holden & Ismail Guner (absent)
- Task Force 5 -- Editor at Large
  - Jinesh Malde & Ed teNyenhuis

Task Force 1 Update

- Plan is to add the topic of PCBs and other fluids to the existing section
- There are currently 3 additional volunteers, and any additional volunteers should email the TF leader at jeremiah.l.bradshaw@ieee.org

Task Force 2 Update

- Work will begin on this section after the Spring 2022 meetings
- The TF leader asked to receive the current C57.637 document and that will be provided by the Secretary
- There are currently no volunteers for this group outside of the two TF leaders so anyone who wants to contribute should email the TF leader at jineshmalde@mimaterials.com

Task Force 3 Update

- Work has begun and is projected to be 90% complete at this time
- There was no request for volunteers
- The TF leader reviewed the current edits with the attendees. Most of these were adding clarification text to the existing document.
- A wider review including others may determine that some sections are no longer valid to the industry.
- Several topics and questions were raised including:
  - Lance Lewand (LL) asked if the document is required to use SI units as is the practice with ASTM
  - Scott Reed (SR) suggested that the group consider removing those sections no longer technologically relevant
    - LL suggested that references to the blotter Press be removed

- Jinesh Malde (JM) reminded the group that the word “oil” should be replaced with liquids in a similar was as done in C57.166
- Mike Bonn (MB) offered that a clear definition of rerefined and reclaimed oil would be useful for the reader
  - Note made by TF1
  - LL offered that ASTM addresses rerefined and IEEE addresses reclaimed
  - JM offered that C57.166 has sections dedicated to the definitions of liquids
  - SD suggested that a reference to C57.166 be included inside C57.637
- Stuart Chambers (SC) asked a clarifying question about the size of units (distribution vs. power) being referenced
- LL inquired about how ester manufacturers are measuring the concentration of inhibitor and proprietary additives after filter with Fuller’s Earth
- Alan Sbravati (AS) shared that he and JM are working on a new method at ASTM and that esters do not see as large a loss in additives compared to mineral oil after clay treatment
- LL suggested that the word “moisture” be replaced with water to improve accuracy of the document
- Deanna Woods (DW) shared that her company, Alliant Energy, has an extensive library of data about DGA on ester filled transformers and would be willing to contribute that if it brings value

Task Force 4 Update

- Work will begin on this section after the Spring 2022 meetings
- There is currently one volunteer for this group outside of the two TF leaders so anyone who wants to contribute should email the TF leader at andy.holden@ergon.com

Task Force 5 Update

- Both TF leaders were present, but no update was provided
- The Chair reminded all TF leaders to use the IEEE template provided to them and not deviate from that format

Task Force actions planned before the Fall 2022 (Charlotte) meeting:

- Each TF will begin their efforts and report back with an update
- Any questions, comments, concerns, or needs should be brought to the attention of the Chair and Secretary in the interim

With no other business to address the meeting was adjourned by the Chair at 10:02am.

# *Appendix V*

# Working Group C57.155 – Guide for Interpretation of Gases Generated in Natural Ester and Synthetic Ester-Immersed Transformers

**Tuesday, March 29, 2021**
**3:15 PM – 4:30 PM (Mountain time)**
**Virtual Meeting**

**Minutes of Working Group Meeting**

Chairman: Alan Sbravati
Vice Chair: Lance Lewand
Secretary: Interim secretary Jinesh Malde

The meeting was called to order at 3:15 pm by the Chair.

Attendance roster was circulated. There were 55 participants in the meeting, 12 out of 24 members were present as per sign in attendance sheet however when roll call was done only 10 members were present. Quorum was not met during roll call. Table below shows the participants in the meeting.
Attendance list:

| | Last Name | First Name | Role |
|---|---|---|---|
| 1. | Almeida | Nabi | Guest |
| 2. | Arnold | Elise | Member |
| 3. | Arteaga | Javier | Guest |
| 4. | Biggie | Kevin | Guest |
| 5. | Boman | Paul | Member |
| 6. | Bonn | Mike | Guest |
| 7. | Bradshaw | Jeremiah | Member |
| 8. | Calitz | David | Guest |
| 9. | Castellanos | Juan | Guest |
| 10. | Chambers | Stuart | Member |
| 11. | Christodoulou | Larry | Guest |
| 12. | Davoudi | Pouneh | Guest |
| 13. | De Oliveira | Herton | Guest |
| 14. | Draper | Zack | Guest |
| 15. | Faur | Florin | Guest |
| 16. | Frimpong | George | Member |
| 17. | Frotscher | Rainer | Guest |
| 18. | Giraldo | Orlando | Guest |
| 19. | Harper | Robert | Member |
| 20. | Holden | Andrew | Guest |
| 21. | Jakob | Karl | Guest |
| 22. | Kaineder | Kurt | Guest |
| 23. | Konta | Ivan | Guest |
| 24. | Kutzleb | Michelle | Guest |
| 25. | Larison | Andrew | Guest |
| 26. | Lewand | Lance | Vice-Chair |
| 27. | Li | Chao | Guest |
| 28. | Lucas, P.E. | Tiffany | Guest |
| 29. | Malde | Jinesh | Member |
| 30. | Mbouombouo | Mama | Guest |
| 31. | McBride | Brian | Guest |
| 32. | Nune | Arturo | Guest |
| 33. | Panesar | Parminder | Member |
| 34. | Patel | Vinay | Guest |
| 35. | Pollaro | Dominic | Guest |
| 36. | Pruente | John | Guest |
| 37. | Sato | Erick | Guest |
| 38. | Sbravati | Alan | Chair |
| 39. | Shingari | Avijit | Guest |
| 40. | Soto | Mauricio | Member |
| 41. | Sparling | Brian | Guest |
| 42. | Stankes | Marcus | Guest |
| 43. | Tillery | Timothy | Guest |
| 44. | Tournoux | Dan | Guest |
| 45. | Vyas | Pragnesh | Guest |
| 46. | Walters | Shelby | Guest |
| 47. | Wang | Evanne | Guest |
| 48. | Weiss | Zachery | Guest |
| 49. | White | Leon | Guest |
| 50. | Whitehead | William | Member |
| 51. | Whitten | Christopher | Guest |
| 52. | Woods | Deanna | Guest |
| 53. | Yazdani | Mana | Guest |
| 54. | Zarnowski | Michael | Guest |
| 55. | Zemanovic | Kyle | Guest |

Chair presented the agenda in the meeting. Since quorum was not met during roll call the agenda was not approved. The Chair presented the patent claim slides. No patent claims mentioned in the meeting. Copyright policy was showed and no comments were received.

Previously circulated agenda

1. Introductions
2. Approval of Agenda
3. Review of Fall 2021 Working Group Minutes

4. Call for Patents … Please read slides before meeting
5. Review of Copyright Policy…. Please read slides before meeting
6. Review of TF1 on Developing a program code/system to analyze data and later build up a database
   6.1 Presentation - Lance Lewand: "Gassing behavior of natural and synthetic esters in laboratory trials of simulated heat runs"
   6.2 Presentation – Zack Draper: "Overview of Normalized Energy Index Method"
7. Review of TF2 on Reviewing the content of the current C57.155
8. New Business
9. Adjourn

**Discussions:**

Task Force(TF) 1 Report:

The Chair mentioned that a virtual meeting took place in March to share the progress made. The Chair had to take over TF Chairmanship as Jon Karas had stepped down due to employment changes and not being in the industry anymore. In the meeting in March, the data fields were discussed.

The Chair highlighted the potential difficulties in data collection and analysis:

a) The service history of ester liquids is not as mature as mineral oil transformers hence not enough data is available for transformers in service for a long time.

b) Skewed data sample may be found based on the different types of applications

The fields of data to be collected was presented to the WG participants. Several comments were made:

- A field should be added to determine if the sample was a routine sample or investigation. Lance Lewand mentioned that the information would not be easy to find in labs.
- A field should be added on transformer design limits i.e. operating temperate of transformer.
- There should be information on when sample was tested and when the lab testing took place. Comment was made that although the information would be helpful, it is not often collected by the technicians sampling the liquid from the transformers.
- There might be a need to see if there are outliers based on the percentage confidence. Chair mentioned that the data will have to be analyzed for outliers.
- It would be interesting to know if samples received may be from failure or if a transformer saw an event. Chair mentioned that for Table 1, it would involve information on DGA on transformers that are normal in-service.

Two presentations were made to the working group:

- First presentation was by Zach Draper on "Overview of Normalized Energy Index Method" The presentation was focused on Normalized Energy Intensity (NEI) and how it would be useful for ester standard. The advantages of NEI were presented along with example on how to calculate the energy it would take to break the molecule to produce the gases. Zach also explained what would be needed to calculate the heats of formations of different types of ester liquids.

- Second presentation was by Lance Lewand on "Gassing behavior of natural and synthetic esters in laboratory trials of simulated heat runs". The testing was performed on mineral oil, natural ester, and synthetic ester liquids on gas generation. The data presented was to compare the gas generation in the liquids with and without transformer construction material. The gas patterns were analyzed under different test temperatures.

Josue Rodriguez was going to present on the comparison between existing C57.155 and C57.104 however that was moved to the next meeting.

The working group is still in early stages to discuss about the data to collect and how to collect but will eventually be looking for volunteers to work on the different sections.

**Old Business:**

No old business was discussed in the meeting.

**New Business:**

No new business was brought forward by the participants in the meeting.

**Adjournment:**

Meeting was adjourned at 4:28pm.

Jinesh Malde, Secretary

Alan Sbravati, Chair

# *Appendix VI*

# Task Force C57.139 – Guide for Interpretation of Gases Generated in Liquid Type Load Tap Changers

**Tuesday, March 29, 2022**
**4:45 PM to 5:50 PM (mountain time)**
**Hyatt Regency Denver Colorado**

**Minutes of Task Force Meeting**

Chair Rainer Frotscher
Vice Chair John Pruente
Secretary Paul Boman
Meeting took place on March 29, 2022, from 4:45 PM to 5:50 PM
Total attendance record: 33, members: 7, Guests: 26, with 11 attendees requesting membership.

| First Name | Last Name | Meeting Request for Membership / Member |
|---|---|---|
| Paul Su | Boman | Secretary |
| Larry | Christodoulou | S22 |
| Rainer | Frotscher | Chair |
| Michelle | Kutzleb | S22 |
| Olivier | Lejay | x |
| John | Pruente | Vice-Chair |
| Scott | Reed | x |
| Jonathan | Sinclair | S22 |
| Paul | Su | Guest |
| Ed | teNyenhuis | x |
| Christopher | Whitten | x |
| Axel | Kraemer | Guest |
| Bernhard | Kurth | Guest |
| Sebastian | Rehkopf | Guest |
| Chao | Li | Guest |
| Mario | Alonso | S22 |
| Parminder | Panesar | S22 |
| Arturo | Nunez | S22 |
| Tim | Rinks | Guest |
| Perry | Reeder | S22 |
| Matthew | Webb | S22 |
| Tiffany | Lucas | Guest |

| | | |
|---|---|---|
| Daniel | Tournouy | Guest |
| Allen | Clarke | Guest |
| Florin | Faur | S22 |
| Hugo | Flores | S22 |
| Jennie | Aldenlid | Guest |
| Niklas | Gustanusson | S22 |
| Zachary | Hutchinson | Guest |
| Nathan | Jacob | Guest |
| Tom | Matson | Guest |
| David | Bureke | Guest |
| Hampton | Steele | Guest |

**Agenda**

Topics:

- Welcome
- Agenda Approval
- Introduction of Chair, Vice Chair and Secretary
- Membership in C57.139: current members / call for WG members / Paper rosters
- IEEE SA Copyright Policy / Call for Patent Claims
- Approval of Meeting Minutes
- Actual State of PAR
- Approved Title, Scope and Purpose (after changes initiated by NesCom)
- Possible Improvements on Guide – Discussion and Definition of Work Items
- DGA Limit Values for major LTC classes - Paths to set up an LTC DGA database

Adjourn Meeting

**Minutes**

- Established Quorum, 7 members were present out of 13 members in total
- Agenda was unanimously approved by WG
- Call for essential patent Claims: Ed teNyenhuis stated there was one LOA from 2013 by Reinhausen Germany
- Copyright Policy was discussed.
- Fall 2021 TF Meeting Minutes: 1st Motion by Christopher Whitten to accept the Minutes without correction, 2nd by Ed teNyenhuis, with unanimous approval by WG.
- Introduction of WG Officers
- PAR was reviewed, as approved by NesCom, with expiration in December 2026. All work incl. Ballot should be done by end of 2025.
- Chair then started Discussion on:
  a) Vision for Guide
     – Statistical analysis will be moved into main body of Guide (normative)
     – Duval Triangle will be shifted into normative section
     – New annex for classification of all LTC models known worldwide, using the 4 letter IEEE nomenclature.
  b) Limitation and validation for LTC DGA
     – Duval Triangle not applicable to certain tap-changer models (e.g. high speed resistor type LTCs)
     – Approach to identify the typical gas patterns (arcing, sparking and heating) found in LTCs; superposition of patterns => conclusions.
  c) The topical format should align as much as possible with C57.104.
  d) Adopt graphical representation of gas quotients from IEC.

e) Evaluate applicability of carbon oxide gases (no or less cellulose in LTCs).

f) Discuss LTC DGA for alternative liquids; lack of sample data may prevent its inclusion in the Guide.

g) Give advice for online DGA monitoring in LTCs (see CIGRÉ TB 783)

h) A short discussion was conducted on the relevance and benefit of a DGA database for various LTC models. Data must be handled confidentially and supplemented by operational data to be helpful. Possible data sources are TjH2b, Hitachi Power and DeltaX.

Meeting adjourned at 5:50 PM.

# *Appendix VII*

# Working Group C57.130 – Guide for the Use of Dissolved Gas Analysis Applied to Factory Temperature Rise Tests for the Evaluation of Mineral Oil-Immersed Transformers and Reactors

**Tuesday, March 29, 2022**
**11:00 AM – 12:15 PM (mountain time)**
**Hyatt Regency Denver Colorado**

**Minutes of Task Force Meeting**

**Chair** **:** Bruce Forsyth
**Vice-Chair** : Jinesh Malde
**Secretary** **:** Javier Arteaga (appointed after the meeting)

## 1. Call to Order

The meeting was called to order at 11:00 AM on March 29, 2022. The Chair announced that the meeting would be adjourned a few minutes before the regularly scheduled adjournment of 12:15 PM MDT because of a conflict with the next Committee activity.

## 2. Chair's Remarks

### 2.1 Introduction and Attendance Sheets

Attendance rosters were circulated. There were 72 participants present and 50 participants requested voting membership. Since this was the first meeting of the Working Group, voting membership was automatically granted to those who checked the Membership Request box in the attendance roster. Per the Working Group Policies and Procedures, voting membership status will be effective as of the start of the next meeting. Table 1 lists the participants present and requesting voting membership at this meeting. Table 2 lists the guests present at this meeting.

**Table 1: Voting Membership* Attendance**

| Member Name | Affiliation | Role | Present? |
|---|---|---|---|
| Adams, Kayland | Prolec-GE Waukesha | Member* | X |
| Aikens, Tom | Virginia Transformer | Member* | X |
| Almeida, Nabi | Prolec-GE USA | Member* | X |
| Alonso, Mario | Georgia Transformer | Member* | X |
| Ansari, Tauhid | Hitachi Energy | Member* | X |
| Antosz, Stephen | Consultant | Member* | X |
| Arnold, Elise | SGB-Germany | Member* | X |
| Arteaga, Javier | Hitachi Energy | Member* | X |

| Member Name | Affiliation | Role | Present? |
|---|---|---|---|
| Beaudoin, Jason | Weidmann Electrical Technology | Member* | X |
| Boettger, William | Boettger Transformer Consulting LLC | Member* | X |
| Bohrn, Josh | Siemens Energy | Member* | X |
| Botti, Michael | Hyosung HICO | Member* | X |
| Bradshaw, Jeremiah | Bureau of Reclamation | Member* | X |
| Calitz, David | Siemens Energy | Member* | X |
| Castellanos, Juan | Prolec GE | Member* | X |
| Chakraborty, Arup | Delta Star Inc. | Member* | X |
| Clarke, Allen | Delta Star Inc. | Member* | X |
| Davis, Eric | Burns & McDonnell | Member* | X |
| Debass, Samson | EPRI | Member* | X |
| Draper, Zachary | Delta-X Research | Member* | X |
| Faur, Florin | Prolec GE Waukesha | Member* | X |
| Forsyth, Bruce | Bruce Forsyth and Associates PLLC | Chair | X |
| Garcia, Eduardo | Siemens Energy | Member* | X |
| Griesacker, Bill | Duquesne Light | Member* | X |
| Hollrah, Derek | Burns & McDonnell | Member* | X |
| Jensen, Nick | Delta Star Inc. | Member* | X |
| Joshi, Akash | Black & Veatch | Member* | X |
| Kazmierczak, Jerzy | Hitachi Energy | Member* | X |
| Kirchenmayer, Egon | Siemens Energy | Member* | X |
| Lewand, Lance | Doble Engineering | Member* | X |
| Malde, Jinesh | M&I Materials Inc. | Vice-Chair | |
| Murray, David | TVA | Member* | X |
| Musgrove, Ryan | Oklahoma Gas & Electric | Member* | X |
| Patel, Nitesh | Hyundai Power Transformer | Member* | X |
| Patel, Sanjay | Royal Smit Transformers | Member* | X |
| Reed, Scott | MVA | Member* | X |
| Sahin, Hakan | Virginia Transformer Corp | Member* | X |
| Sarkar, Amitabh | Virginia Transformer Corp | Member* | X |
| Schrammel, Alfons | Siemens Energy | Member* | X |
| Sinclair, Jonathan | PPL Electric | Member* | X |
| Skinger, Kenneth | Scituate Consulting, Inc. | Member* | X |
| Som, Sanjib | PTTI | Member* | X |
| Staley, Brad | Salt River Project | Member* | X |
| Thompson, Ryan | Burns & McDonnell | Member* | X |
| Tolcachir, Eduardo | Tubos Trans Electric | Member* | X |
| Varghese, Ajith | Prolec GE Waukesha | Member* | X |
| Varnell, Jason | Doble Engineering | Member* | X |
| Wallach, David | Duke Energy | Member* | X |
| Zemanovic, Kyle | Eaton | Member* | X |
| Zibert, Kris | Allgeier Martin | Member* | X |
| Ziparizoski, Zan | Howard Industries | Member* | X |

* Voting Membership will take effect at the beginning of the next meeting.

**Table 2: Guests Present**

| Guest Name | Affiliation |
|---|---|
| Benach, Jeffrey | Megger |
| Byrnes, Ryan | HICO America |
| Carrizales, Juan Alfredo | Prolec GE |
| Christodoulou, Larry | Electric Power Systems |
| Downey, Andy | Prolec GE Waukesha |
| Faherty, Joe | OTC Services |
| Hakim, Shamaun | WEG Transformer USA |
| Havens-Spillers, Bridget | Ameren Missouri |
| Jakob, Karl | Cargill |
| Jordan, Steve | TVA |
| Nesvold, Brady | Xcel Energy |
| Nims, Joe | Allen & Hoshall |
| Pinard, Matt | Weidmann Electrical Technology |
| Powell, Chad | Hitachi Energy |
| Radbrandt, Ulf | Hitachi Energy |
| Rainer, Frostcher | Reinhausen Germany |
| Rehkopf, Sebastian | Maschinenfabrik Reinhausen |
| Sen, Cihangir | Duke Energy |
| Soto, Mauricio | Hitachi Energy |
| Steele, Hampton | TVA |
| Steineman, Andy | Delta Star |
| Wright, Jeffrey | Duquesne Light |

## 2.2 Participant Behavior

The Chair showed and briefly reviewed the IEEE SA slides related to participant behavior in the individual Working Group process. There were no comments.

## 2.3 Essential Patent Claims

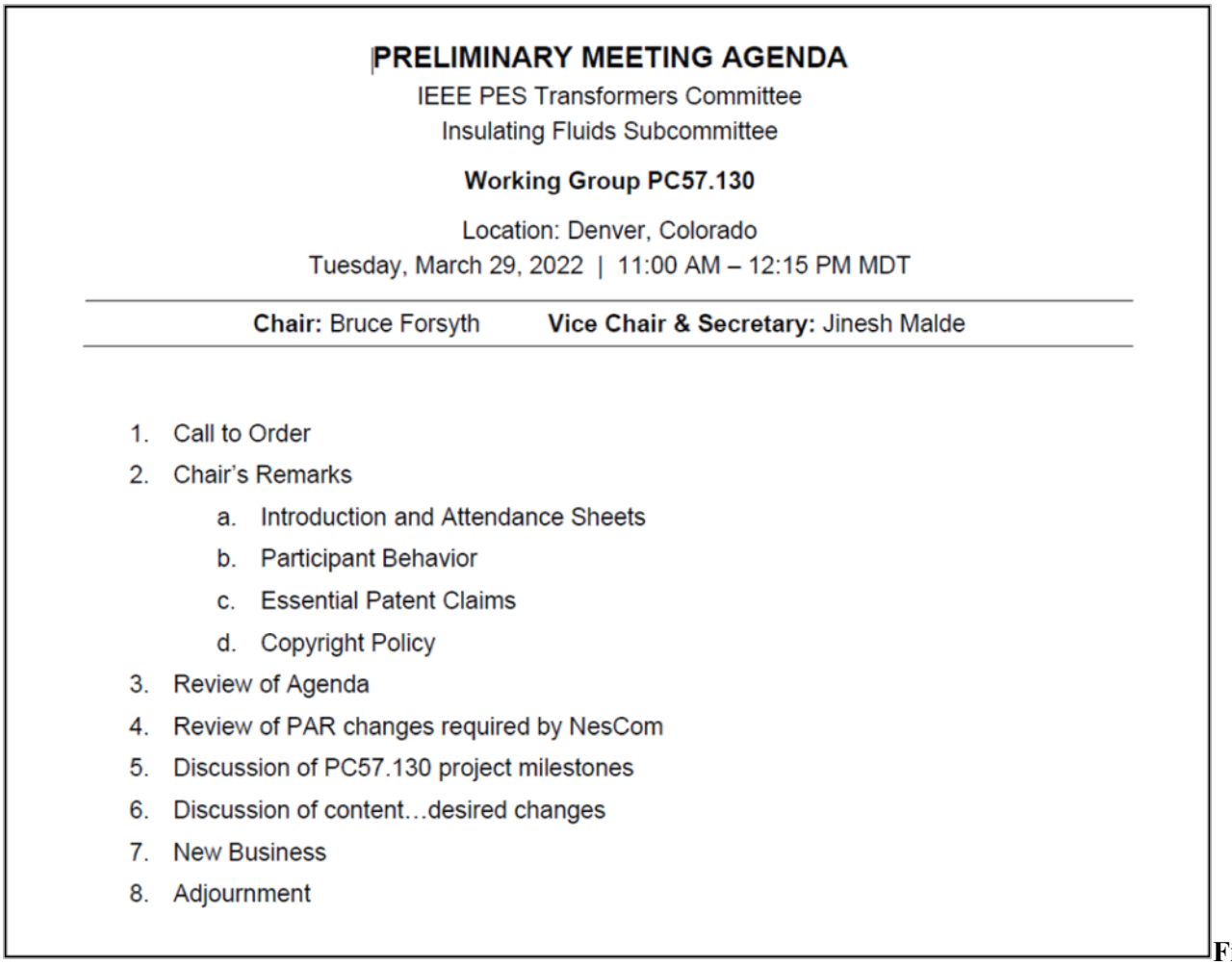
The Chair showed and briefly reviewed the IEEE SA slides related to Essential Patent Claims. The Chair provided an opportunity for participants to identify patent claim(s) or patent application claim(s) and/or the holder of patent claim(s) or patent application claim(s) of which the participant is personally aware and that may be essential for the use of this standard. No claims were made.

## 2.4 Copyright Policy

The Chair showed and briefly reviewed the IEEE slides related to Copyright Policy. There were no comments.

### 3. Review of Agenda

The proposed agenda (see Figure 1) was shown. The Chair asked if there were any requested changes to the agenda. None were requested and as such the agenda was considered approved.



**PRELIMINARY MEETING AGENDA**

IEEE PES Transformers Committee
Insulating Fluids Subcommittee

**Working Group PC57.130**

Location: Denver, Colorado
Tuesday, March 29, 2022 | 11:00 AM – 12:15 PM MDT

**Chair:** Bruce Forsyth **Vice Chair & Secretary:** Jinesh Malde

1. Call to Order
2. Chair's Remarks
   a. Introduction and Attendance Sheets
   b. Participant Behavior
   c. Essential Patent Claims
   d. Copyright Policy
3. Review of Agenda
4. Review of PAR changes required by NesCom
5. Discussion of PC57.130 project milestones
6. Discussion of content…desired changes
7. New Business
8. Adjournment

**Figure 1: Proposed Agenda**

### 4. Review of PAR Changes Required by NesCom

The Chair reviewed the PAR that was originally submitted to NesCom as well as the final PAR that was approved by NesCom. Only a few changes were were requested by NesCom.

The approved Scope is as follows:

> *"This document defines evaluation procedures and guidelines for acceptable levels of gases generated in conventional mineral oil-filled transformers and reactors during factory temperature rise tests."*

The approved Purpose is as follows:

*"The purpose of this Guide is to provide guidance in the application of dissolved gas analysis (DGA) to transformers and reactors subjected to factory temperature rise tests. This document consists of evaluation procedures and guidelines for acceptable levels of gases generated in conventional mineral-oil filled transformers and reactors during factory temperature rise tests."*

**5. Discussion of PC57.130 Project Milestones**

The Chair reviewed the basic milestones for the project as follows:

- Identify revision needs; form TF groups……March 2022 – Oct 2022
- Document development.....Mid 2022 – Fall 2024
- Submit to SC for sponsor ballot approval.....Fall 2024
- Begin Sponsor ballot process (several steps).....Late 2024
- Ballot resolution & re-ballot.....Early 2025 – Mid 2025
- Submission of approved document.....Fall 2025

It was noted that the PAR expires at the end of 2026, but since the current document expires at the end of 2025 it is necessary to accelerate the work and finish before the end of 2025.

**6. Content Discussion**

The Chair opened the floor to discussions related to improvements that should be considered by the Working Group to improve the Guide. The basic structure of the existing document was reviewed, with focus on Table 2 that provides gas generation rate limits for hydrogen ($H_2$), carbon monoxide (CO), carbon dioxide ($CO_2$), and the combined total of methane ($CH_4$), ethane ($C_2H_6$), and ethylene ($C_2H_4$). The combine total of the latter three is referred to as the hydrocarbon component. The following bullets summarize the suggestions made.

- **Ester liquids**. Should the scope be expanded to include ester liquids? There was general agreement in favor of expanding the scope to include ester liquids. The Chair noted this would require a PAR revision. There was some question as to whether sufficient data exists to develop limits for ester liquids (both natural and synthetic). After some discussion it was agree that a Task Force will be formed to investigate the feasibility of expanding the scope of the document to include ester liquids. Lance Lewand agreed to chair the TF and to report back to the WG no later than the Fall 2022 meeting. Several people volunteered to participate in the TF, including Jeremiah Bradshaw, Javier Arteaga, Sanjay Patel, and Elise Arnold. Any other interested participants are asked to contact Lance Lewand directly.

- **Gassing during overload tests**. A participant asked whether any generation limits are included for overload tests, and if not, should the document be expanded to include such limits.

- **Gassing during other tests**. A participant asked if the document should be expanded to provide gas generation limits for other tests, such as dielectric tests. A comment was made that the current document focuses only on gasses generated during temperature rise tests performed in accordance with IEEE Std C57.12.90™.

- **Are the existing limits still valid?** A participant asked whether industry experience since the current document was published still supports the generation limits contained in Table 2.

- **Is the fundamental approach still valid?** A participant asked whether the basic approach of analyzing generation rates as described in the current document is still considered the best approach. There was general agreement that the approach is acceptable, and if the document is expanded to include ester liquids new tables similar to Table 2 should be introduced as necessary.

- **Does the document apply to full current and full voltage tests on load tap changers (LTC)?** A question was asked related to LTCs, but it was generally agreed the gas generation limits described in the current document are for temperature rise tests on the main transformer only and do not apply to special load current or voltage tests that focus on LTC operation.

- **Guidelines for reporting methods and duration of temperature rise test.** A participant recommended guidelines be introduced to document the specific procedure(s) followed during the temperature rise tests. Specifically, the participant recommended documenting whether any overloads or cooling restrictions were employed to shorten the duration of the temperature rise test.

- **Consideration for higher temperature transformers.** A discussion took place regarding the applicability of the Guide to transformers with non-standard temperature rise ratings (e.g., 75 °C rise). A participant mentioned it is the absolute temperature that we should discuss and not temperature rises since ambient temperature is frequently a consideration in the application of higher temperature rise designs. More specifically, he stated it is the absolute temperature within the transformer that is of concern, not necessarily the temperature rise rating.

- **Separation of gasses from hydrocarbon component.** A few comments were made suggesting there may be data supporting the separation of one or more gas from the hydrocarbon group (methane, ethane, ethylene). Specifically, it was suggested that methane should be separated for mineral oil and ethane may need to be separated for natural esters due to their relative concentrations with respect to the other gasses.

- **Data supporting the original values in Table 2.** There were a few comments about the data that was used to generate the existing limits in Table 2. Specifically, what was the source of the data and is it still available? The Chair stated he will reach out to the officers of the original documents to inquire about the original data.

- **Should columns be added to Table 2 with limits for various cooling modes (e.g., ONAN, ONAF, etc.**). A participant felt adding columns to Table 2 with separate limits for different cooling modes would be beneficial. Another participant stated it is not possible to determine during which cooling mode gasses are produced using the current temperature rise test methods. Specifically, current methods may run a temperature rise test at rated MVA, then immediately move to the maximum MVA. Unless separate tests are performed, perhaps with degassed oil for each, it is not possible to know when the gasses were generated.

- **Adding recommended actions.** The current Guide lists gas generation rate limits with three condition levels (Condition I - No problem detected; Condition II - Possible problem; Condition III - Likely problem). A participant stated it would be beneficial to expand the Guide to provide recommendations regarding investigative steps to take for conditions II and III.

**7. Unfinished Business**

No unfinished business topics were raised for discussion.

**8. New Business**

No new business topics were raised for discussion.

**9. Adjournment**

Because of a scheduling conflict for the next Committee activity, the Chair adjourned the meeting at 12:10 PM MDT.

Prepared and submitted by,

Bruce Forsyth
Chair

April 4, 2022