

Annex G Insulating Fluids Subcommittee

October 26, 2016

Vancouver, BC, Canada

Chair David Wallach

Vice-Chair Jerry Murphy

Secretary C. Patrick McShane

G.1 Introductions, Roll Call of Members for Quorum, Meeting Agenda Approval, F13 Minutes Approval, and Chair's Comments

G.1.1 Chair's comments:

- a. Shared the scope statement of the SCIF
- b. Reminded WG and TF Chairs that their meeting minutes are due for submittal to the SCIF Secretary within 15 days of their meetings. In turn, the SCIF minutes are due on Dec 4.

G.1.2 Roll Call of SC members: (Quorum requirement: 25 minimum)

- a. 29 Members signed in. Quorum was achieved
- b. 60 Guests of which 9 requested membership:
- c. Paul (Randy) Cox, Roger Hayes, Michel Veillette, Kwasi Yeboah, Dominique Bolliger, Marcos Ferreira, Victor Garcia, Thomas Golner, Jinesh Malde.
- d. The roster sign-in has attendance of 89, vs. Cloud-in Hand electronic badge reader spreadsheet count of 82.

G.1.3 Agenda Approval:

- a. The motion was Approved without objection

G.1.4 Corrections and Approval of minutes from Spring 2016 meeting in Atlanta, GA:

- a. SC A correction was made by the Secretary, noting that the number of guest requesting membership at the S16 meeting were inadvertently left out of the minutes. The minutes were approval with the pending correction completion. It will only be corrected in the individual minutes, not the main.

G.1.5 Technical Presentation

- a. “Where Does the Air Go?” by Don Platts
- b. Don showed a video of test risk of air bubble taking a sample while tank has a negative value. Simulated tank pressure of values between -100k Pa to +175k Pa
- c. Different valve types impact probability and quantity of possible air ingress. The valve types tested were Ball, Gate, and Globe.
- d. Conclusion: Recommend Globe Valves for oil sampling and avoid negative tank pressure during sampling procedure.
- e. The presentation will not be posted within IEEE TC site. However, Don plans to release a paper in the near future. If interested in receiving a copy, people should make a request directly to Don Platts or Dave Hanson.

G.1.6 WG & TF Reports Presented at the SC Meeting

G.1.6.1 C57.104 – IEEE Guide for the Interpretation of Gases Generated in Oil – Immersed Transformer (PAR Expiration: 12/31/17)

WG Chair - Claude Beauchemin

The report of the WG Meeting was presented at the SCIF meeting by Claude Beauchemin.

- a. Rick Ladroga had to resign as Chair due to other commitments. Claude is the new Chair, and Susan McNelly is the WG Secretary. Quorum achieved. The meeting included a presentation of work done last 6 months. This WG has been meeting 8 or 9 years, and the PAR will expire next year. More work needs to be done, but it is expected that the 1st draft will be sent to WG roster in a couple of weeks for review and comments. Quick presentation one annex was voted out.
- b. During New Discussion, Tom Prevost made motion to remove sample section, but includes warning. After that, figure relative gas generation during fault Question difference for generation transformer. Most data comes from lab, not utility, be surprise of errors of info sheet provided by sampler.

See *Appendix I* for the Minutes (unapproved) of C57.104 WG Meeting as Submitted.

G.1.6.2 IEEE C57.147 Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers

WG Chair: Patrick McShane, Vice-Chair: Clair Claiborne, Secretary: Jim Graham

The WG Report at the Sub-Committee Meeting: Presented by Patrick McShane:

- a. **Since** A two-year extension of the PAR was approved in June this year. The PAR now expires in December 2016.
- b. PC57.147 Draft 3.0 is currently in comment resolution. 126 balloters of which 87% approved the draft. There are 240 comments being addressed by the BRC.

- c. Several comments received requesting continued service limits table be updated based on data gained since 2008. The Chair made a request to testing laboratories if they would be willing to share NE sample test data. Data was received from 3 test companies, totaling approximately 50,000 samples. Luis Cheim and Claude Beauchemin both stated due to the huge data base, an analysis could not be completed for many months, maybe take over a year. A call for volunteers to analyze the data and make recommendations to the BRC was made. The following agreed to join a task force: Luis Cheim, Claude Beauchemin, Scott Reed, Alan Sbravati, and John Luksich.
- d. A recommendation was made by David Wallach that to avoid excessive delay in the publication of the revision of the Guide, that this WG suggest to the TF of Consolidation of the Guide to take over the proposed data analysis.
- e. Still awaiting input from 5 BRC members in order to finalize Draft 4 for recirculation

See *Appendix II* for the Minutes (unapproved) of C57.147 WG S15 Meeting as Submitted

G.1.6.3 TF on Consolidation of Insulating Liquid (Fluid) Guides

Chair: Tom Prevost

The TF Report given at the Sub-Committee Meeting by Tom Prevost:

- a. The focus of the meeting was to work on the content of the Scope of the consolidated Guide.
 - Option A. Create a Mineral Oil Guide and Guide for all other Insulating Liquids.
 - Option B. Create a Guide that includes all Insulating Liquids for Equipment with the exception Load Tap Changers.
 - Option C. Create a Guide that includes all Insulating Liquids and includes Load Tap Changers
- b. A motion was made by David Sundin and seconded by Luiz Cheim that Option C be selected. The motion carried.
- c. A motion was made by Mark Perkins and seconded by Jim Graham that the Scope should be limited to Transformers, LECs, Regulators, and Reactors. The motion carried.
- d. The Chair stated that “now we have the first line completed. Next we will need to focus on different use parameters.

See *Appendix III* for the S16 Minutes (unapproved) of TF Consolidation of Insulating Liquid Guides as submitted.

Old Business

- a. C57.12.00 Revision – Unresolved Ballot Comments forwarded to the SCIF as follows:

Balloted document: Page 32, 6.6.1, line 13; Standard needs to maintain the sentence "There are other insulating fluids that may be suitable and are commercially available..." from previous version; nowadays, there are other liquids as synthetic esters that are commercially available.

This was rejected as out of scope but could be considered in the future. It was noted that at the time of the revision, neither ASTM specifications nor IEEE Guides for use of other alternative insulating liquids for use in transformers existed.

- b. This issue remains unresolved and needs review and consideration by Insulating Fluids/Working Group. If this suggestion has merit, consider making a suggestion to WG C57.12.00. The Chair assigned Patrick McShane to study the issue and make a recommendation of the next meeting.

G.2 New Business

- a. C57.12 Fredi Jacob stated that he believes while C57.155 DGA of Esters covers many needed aspects, there is more information needed regarding gas evolution vs. the severity of faults.
- b. A question was raised by a user that they are considering gas insulated transformers and wondered if the SCIF has considered working on a guide for insulating gases. The Chair said up to this point there has been no demand but would make some preliminary investigation on the issue

G.3 Adjournment

The motion passed unanimously.

Respectively Submitted, Patrick McShane, Secretary SCIF

Unapproved Minutes from the S16 SCIF WG and TF Meetings

Appendix I – WG C57.104 Minutes

IEEE Guide for the Interpretation of Gases Generated in Oil – Immersed Transformers

C57.104 – IEEE Guide for the Interpretation of Gases Generated in Oil – Immersed Transformers

Tuesday, October 25, 2016

Vancouver, BC Canada

Minutes of WG Meeting

The meeting was called to order at 4:45pm by Chair Claude Beauchemin. Vice-Chair Norm Field, Vice Chair Don Platts, and Secretary Susan McNelly (writer of Minutes) were also present. Claude Beauchemin made an announcement that he will be taking on the role of Chair. He also introduced the two new Vice-Chairs and explained that due to the limited time remaining and the amount of work, he felt it was important to have two vice-chairs with specific duties.

Patent disclosure announcement: The Chair asked if there were any individuals that were aware of any patent claims might be Essential Patent Claims. The following statement was shown on the screen during the meeting:

If any individual believes that Patent Claims might be Essential Patent Claims, that fact should be made known to the entire working group and duly recorded in the minutes of the working group meeting.

There were no patents claims identified. Details on patent information can be found at:

<https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.pdf>

There were 47 of 83 members present. There were 48 guests, and 4 guests requesting membership. A membership quorum was achieved. The WG does plan to meet at the Spring 2017 Transformers Committee Meeting in New Orleans, Louisiana.

The following guests requesting membership are listed below. Those listed with an asterisk will be added to the WG membership. However, to maintain membership, participation in the development of the guide will be reviewed.

Paul Cox*
Jon Garrity
Mickel Saad

Trenton Williams*

List of Meeting Attendees is provided below. Those identified in bold are WG Members in attendance.

Aikens, Tom	Jakob, Fredi	Ray, Jeffrey
Alonso, Mario	John, John	Reed, Scott
Attard, Jason	Joshi, Arvin	Rezai, Hossein
Ayers, Donald	Kampshoff, Ken	Riordan, Kevin
Beauchemin, Claude	Karim, Ibrahim	Roizman, Oleg
Benach, Jeff	Kinner, Robert	Saad, Mickel
Bolliger, Dominique	Kiparizoski, Zan	Sandhu, Surinder
Boman, Paul	Kuppuswamy, Raja	Scarborough, Mark
Brett, John	Lackey, John	Schrammel, Alfons
Brusetti, Robert	Lau, Michael	Sen, Changir
Cantrell, Rick	Livingston, Kerry	Sharifnia, Hamid
Castellanos, Juan	Luo, Shawn	Sheehan, David
Cheim, Luiz	Malde, Jinesh	Shem-Tov, Mark
Chiu, Bill	Martin, Terence	Simonelli, Richard
Christodoulou, Larry	McNelly, Susan	Sparling, Brian
Claiborne, C. Clair	Musgrove, Ryan	Stiegemeier, Craig
Cox, Paul	Mushill, Paul	Sullivan, Kevin
Davydov, Valery	Naderian, Ali	Sweetser, Charles
Diaby, Mohamed	Nims, Joe	Thompson, Robert
Dicks, Michael	Nunez, Arturo	Thompson, Ryan
Dukarm, James	Ocon, Rodrigo	Tozzi, Marco
Duval, Michel	O'Malley, Anastasia	VanderWalt, Alwyn
Ferreira, Marcos	Palakandy, Rahul	Veillette, Michel
Field, Norman	Rajendran	Wallach, David
Fields, Chase	Patel, Poorvi	Wang, Evanne
Foata, Marc	Pellon, Verena	Weber, Brandon
Frimpong, George	Perjanik, Nicholas	Williams, Trenton
Frotscher, Rainer	Pinon, Oscar	Wilson, Barnes
Garrity, Jon	Platts, Donald	Yeboah, Kwasi
Golner, Thomas	Prevost, Thomas	
Graham, James	Pruente, John	
Hayes, Roger	Ramakrishna, Manjunat	
Holden, Andy	Rasco, Jimmy	
	Ratcliffe, Robert	

A motion to approve the Fall 2016 Vancouver Agenda was made by Tom Prevost and seconded by Brian Sparling. There were no objections or additions to the agenda. The agenda was unanimously approved.

Agenda

1. Attendance Roster Circulation
2. Member Roll Call & Quorum Check
3. Patent Call
4. Approval of Agenda
5. Approval of the Spring Atlanta minutes
6. Document Status
7. New Business
8. Adjournment

A motion to approve the Spring 2016 Minutes was made by Brian Sparling and seconded by Tom Prevost. There was no opposition to approval of the minutes.

Document Status

Claude indicated that a draft 3 has been sent out for review. He asked the WG for feedback on whether we are moving in the right direction. A straw ballot will need to be sent out by early next year to be able to move forward.

Claude Beuchemin presented a short history of the guide and how that has led to where we are today. For more details, see the presentation and the draft attached at the end of the minutes.

Claude asked if anyone knew the source of the 90% Norms (No hand were raised!). It originated in the early (1972) CEGB (Central Electricity Generating Board, UK) use of DGA.

The first revision occurred in 1991. The analysis and sampling sections were removed and transferred to ASTM. The Halstead graph was introduced. TDCG was introduced. Key gas graphs and Table 1 were also introduced. Numbers for table 1 were carried from the 1978 version with the addition of two higher value sets, probably from the same source. Four conditions describing the transformer status were added.

Use of the 1991 guide with the selected limits resulted in a large amount of false positives, due principally to the too low limits for CO and CO₂. In the early 2000s, an important revision process was undertaken and generated a large amount of new text, but the guide expired in 2005 before that work could be completed.

The guide was re-installed "as is" with minor corrections in 2006 (The actual version, labelled 2008)

Work was immediately started on collection of data to improve the values in the tables, as well as continuing the work for general improvement of the guide. A study presented during a IEEE meeting at that time indicated that approximately half of the DGA were above condition 1 (Caution) and a third were above condition 2 (Warning).

The result of this revision work was presented at this meeting. A draft (3.0) was sent to all the WG members and guests at the beginning of October for comment and review.

The draft guide contains 6 main sections, 9 annexes, 4 tables, and a new flowchart and figures.

A short presentation of the content of each sections and annexes was made.

It is to be noted that the 4 tables in the draft do not contain numbers. The reason is that the TF on data analysis has yet to complete the work. It is to be done before the Straw ballot is issued.

The work remaining to be done was presented as follows:

- Complete text with comments
- Update bibliography with WG suggestions
- Decide if we add recommendation to use on-line monitor on gassing transformer
- Decide if we maintain sampling section
- Finish data analysis and select norms
- Straw ballot
- Ballot
- Ballot resolution
- Prepare a tutorial
- Write a white paper on the data analysis

The floor was open for discussion

Tom Prevost made a motion that the Annex on Sampling be removed and was seconded by Jim Dukarm. Tom indicated that this is more of a guide for interpretation and ASTM is more of a guide for taking the samples and the analysis.

Valery Davydov commented on a presentation he gave in the moisture in insulation WG. From this, the location that the oil sample is taken was found to be very important. Claude commented that this is not exactly what is presently being discussed.

Rainer Frotcher – Indicated that the new guide is much improved and a tremendous amount of work has been done.

Brian Sparling indicated that the guide is meant to be used worldwide, while the ASTM guides are not. He indicated that he refers people to the ASTM document but it is not well known outside of the US and they may not have access to those documents.

Tom Prevost indicated he understood where Brian is coming from, but that if we followed this line of thought in all of our standards and guides, they would be very long. He expressed concerns that by having the information in this guide, then there is a risk

A call for vote was made. There was 1 abstention, 3 negatives, and 43 in favor of the motion. The motion passed.

Claude reviewed the remaining work to be done.

- Complete text with comments needs to be reviewed.
- Update bibliography with WG suggestions
- Decide if we add recommendation to use on line monitor on gassing transformers.

Claude asked if there was a motion to recommend the use of on-line monitors. No motion was made. Clair Claiborne indicated that there are other documents that adequately cover on-line monitoring and did not feel a need to include this in C57.104.

Fredi Jakob indicated a concern with the figure in Section 4. The figure shows a rapid drop in H₂ concentration at low temperatures, followed by a gradual rise with increasing temperature, which is misleading. H₂ generation caused in abundance by partial discharge occurs independent of temperature, and in fact can occur at low temperatures (i.e. normal operating temperatures). This causes the peak in H₂ generation shown at low temperatures in the figure, which is an electrical phenomenon and not a thermal one.

Michel Duval explained the background of the figure. Claude indicated that maybe the temperatures could be removed if that is causing concern with the figure. More discussion will be needed on this topic.

Juan Castellanos – Asked if we are planning to segregate the data by type of transformer. Claude indicated that there is not enough information in the database to support this.

Claude closed by requesting that the WG members provide their comments within the next couple of weeks if not sooner.

The meeting was adjourned at 6:00PM

Claude Beauchemin
WG Chair

Norm Field
WG Vice-Chair

Don Platts
WG Vice-Chair

Susan McNelly
WG Secretary

Appendix II – WG PC57.147 Minutes

Guide for Acceptance and Maintenance of Natural Ester Insulating Liquid in Transformers

March 21, 2016 ATLANTA, GA

Chair: Patrick McShane, Vice-Chair: Clair Claiborne, Secretary: Jim Graham

- Call to Order was made at 3:15 PM.
- Introductions/Membership Attendance/Quorum Check
- Attendance
 - 18 of 30 members present, quorum was achieved
 - 84 guests
 - total attendance = 102
- A motion to approve the agenda motion passed.
- A motion to approve the Spring 2016 meeting minutes was passed.
- A call for essential patents was made. No new patent issues were raised.
- Chair's Remarks, Patrick McShane:
 - A two-year extension of the PAR was approved in June this year. The PAR now expires in December 2016.
- Old Business
 - PC57.147 Draft 3.0 is currently in comment resolution. 126 balloters of which 87% approved the draft. There are 240 comments being addressed by the BRC.
 - Several comments received requesting continued service limits table be updated based on data gained since 2008. The Chair made a request to testing laboratories if they would be willing to share NE sample test data. Data was received from 3 test companies, totaling approximately 50,000 samples.
 - Still awaiting input from 5 BRC members in order to finalize Draft 4 for recirculation
- New Business: Discussion of Ballot Comments of special interests:
 - Essential Patent Claims LoA: Negative vote received due to lack of LoA. Susan McNelly said the discussion is out of the hands of the WG, to be addressed by IEEE SA during their approval process.
 - “Allowable free breathing exposure: Statement in draft that would take 5 7 years exposure before free breathing could become a practical issue was challenged, stating a lack of references. Alan Sbravati discussed test and field case history results of service aged ester fluid exposed to atmosphere for a long period. A technical paper presented by Alan will be made available to the BRC.

- Comment requesting the addition of corrosive sulfur to acceptance value Table 2. Discussion included that NEs naturally lack content of corrosive sulfur. Some supported inclusion due to possible contamination.
 - Several comments requested validation and expansion of values in the service aged NE limits.
A task force comprising Luis Cheim, Claude Beauchemin, Scott Reed, Alan Sbravati, and John Luksich was formed to analyze data on service aged fluids received from three laboratories. Luis and Claude both stated due to the huge data base, an analysis could not be completed for many months, maybe over a year.
A motion by Dave Wallach to defer analysis of the service aged fluids to the consolidated fluids guide task force was passed. The data analysis will not be done within this working group. If the TF on Consolidation agrees, the gentlemen list above agreed to volunteer. The Chair stated that with this decision, the next recirculation balloting could occur even before end of this year.
 - There was discussion of allowable fluid temperature limit should be for vacuum processing. Concerns included loss of inhibitors and boiling of NE at the current temperature limit in the draft.
 - There was discussion of whether or not corrosiveness values for ester fluid should be established.
 - There was discussion on issue of some Medium/Large OEMs that use vapor dryout, fill with MO, test with MO, and then field fill with NE. There seemed to be a consensus that factory testing with the NE.
- The meeting adjourned by acclimation at 3:30 pm.

Respectively submitted, Jim Graham, Secretary

Chair Post Meeting Notes: The need for the WG to meet in S17 is probably very low. When Draft 4 is finalized by the BRC, it will be sent to the WG members for review, prior to submittal to IEEE SA recirculation vote. Nick Perjanik was inadvertently left of the list, but he is also a member of the BRC. Action: Summarize issue of Lab data analysis and forward names of volunteers to TF Consolidation Chair Tom Prevost.

Unapproved Minutes from the S16 SCIF WG and TF meetings

***Appendix III – TF Insulating Liquids Guides Consolidation
Minutes***

Chairman Tom Prevost
Secretary Scott Reed

The meeting was called to order at 9:35 am by Chair Tom Prevost.

There were 25 of 50 members present. There were 36 guests, 15 guests requesting membership and 76 visitors requesting to become a guest. A membership quorum was achieved. Guests attending the WG meeting for the first time who request membership or who have not attended 2 meetings in a row (including the present meeting), will be deferred until the next meeting attended.

Agenda

- 1) Introductions
- 2) Approval of agenda
- 3) Approval of March 2016 minutes
- 4) Review of current document status
 - a. C57.147 “Guide for Acceptance and Maintenance of Natural Ester Insulating Fluids in Transformers and Other Electrical Equipment”
 - i. In Revision process, PC57.147
 - ii. PAR opened 6-Feb-2012
 - iii. PAR Expiration 31-Dec-2016
 - iv. Ballot Status
- 5) New Document:
 - a. Title
 - b. Scope
 - c. Purpose
- 6) Establishment of Task Forces
 - a. Editorial
 - b. Test methods
 - c. Mineral Oil
 - d. High Molecular Weight Hydrocarbons
 - e. Silicon
 - f. Natural ester
 - g. Synthetic Ester
 - h. Others?
- 7) New Business

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

A motion to approve the Spring 2016 Agenda was made Jim Graham . Patrick McShane seconded the motion. There were no objections to the approval of the Agenda.

Next, a motion was made by David Sundin and seconded by Mario Lacarno to approve the Spring 2016 Atlanta meeting minutes. There were no objections to the approval of the minutes.

Chairman Tom posted the Patent Claim. No notifications or comments were received.

Chair's Remarks:

As a review of the current document status:

-Patrick McShane announced that C57.147 will have the Par extended to 2018 because there were 220 comments to the last ballot.

A presentation was given by Chairman Tom Prevost to discuss the Scope, Title and Purpose and he referenced the Scopes of C57.106 and C57.147. In response, Rainer Frotscher gave a presentation suggesting to separate this guide into two separate guides—one for less flammable and one for flammable insulating fluids.

Three options were proposed by the chair on what the Scope of this WG should be:

Option A. Create a Mineral Oil Guide and Guide for all other Insulating Fluids.

Option B. Create a Guide that includes all Insulating Fluids for Equipment with the exception Load Tap Changers.

Option C. Create a Guide that includes all Insulating Fluids and includes Load Tap Changers.

A motion was made for Option C by David Sundin and seconded by Luiz Cheim. The motion carried.

Next, it was discussed which equipment should be included as part of this Scope. A motion was made that this Scope should be for Transformers, LTC, Regulators and Reactors by Mark Perkins and seconded by Jim Graham. The motion carried.

Finally, after discussion whether to include Bushings as part of this Scope, Jim Graham made a motion to exclude Bushings as part of Option C. Rich Simonelli seconded the motion and the motion carried.

The chairmen summarized the discussion of the scope as follows. Only the applicable equipment has been agreed to so far:

This guide applies to insulating liquids used in transformers, tap changers, regulators and reactors. Agree 10-24-16

The guide discusses the following:

- Analytical tests and their significance for the evaluation of mineral insulating oil.
- The evaluation of new, unused mineral insulating oil before and after filling into equipment.

- Methods of handling and storage of mineral insulating oil.
- The evaluation of service-aged mineral insulating oil.
- Health and environmental care procedures for mineral insulating oil.

The characteristics of the liquids discussed in this guide do not include liquids that is in factory fill lines, nor does this guide cover reclaimed oil installed in new equipment. The qualities of such oil, if used, should be agreed upon by the manufacturer and the user of the equipment.

The next meeting we will discuss the remaining bullet points in the scope and more specifically the following bullet:

- The evaluation of new, unused mineral insulating oil before and after filling into equipment.

No New Business was discussed and the meeting was adjourned at 10:47 am.