Annex G Insulating Fluids Subcommittee

April 5, 2017
New Orleans, LA

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 Opening Remarks:

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.

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

a. 34 Members signed in. Quorum was achieved.

b. 72 Guests attended, of which 10 requested or re-requested membership: Jason Attard, Don Dorris, Attila Gyore, Kumar Mani, Donald Platts, Alan Sbravati, Igor Simonov, Fabian Stacy, Kevin Sullivan, Michael Thibault.

c. By their attendance, the following will be listed as WG Members: Attila Gyore, Jinesh Malde, Kumar Mani.

d. 3 attendees signed the roster, but not registered via electronic sign-in, and 6 registered electronically but without signing roster sheets.

G.1.3 Agenda Approval:

a. The motion was Approved unanimously, without objection

G.1.4 Approval of minutes from the F16 meeting in Vancouver, BC, Canada:

a. The motion to approve was made by Susan McNelly and seconded by Jim Thompson.

The motion was approval unanimously.

G.1.5 WG & TF Reports Presented at the SC Meeting

G.1.5.1 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. Attendance at the meeting was 120, a relatively large crowd for the WG. Par expired is about to expire, and the WG will request an extension. Last meeting 3.0 for comments, 20 contributions, released Draft 3.1 for straw ballot on March 10th. 202 comments received, but few negatives,

b. 500,000 reports were used. Still have to merge another same amount. There is some issue of spread of data, which have look closely at. Need to decide which form of the tables to use, how many criteria to use. Some explanation wording needs to be completed. Draft will be updated for an email straw ballot to WG sometime this summer.

c. Attendee question: Can you explain PAR Extension? Response: The WG voted to take a step back. Had to recirculate the straw ballot. The PAR will expire end of this year. A PAR extension is not likely unless the document is out for ballot or at least approved to go to ballot before the end of the year.

d. The call for potential Essential Patents resulted in one attendee indicating he may have an essential patent claim.

e. Need to get moving all or nothing to meet next year deadline. Expect to receive a request vote on final draft.

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

G.1.5.2 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. No WG Meeting was held at S17. The work of the WG is completed.
b. Since the last meeting, a revised Draft based on the BRC changes to the initial voting draft and discussion at the F16 meeting was sent to WG Members for a straw vote. The BRC meet on Monday to discuss and vote on comments received from that straw vote. Almost all comments were addressed before time ran out. The few remaining comment resolution will be done via correspondence and conference, allowing the recirculating draft be sent to IEEE SA within the next couple of months.
c. PC57.147 did receive an extension last year, now valid until 12/31/18.

G.1.5.3 TF on Consolidation of Insulating Liquid (Fluid) Guides

Chair: Tom Prevost

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

a. There was a quorum

b. Patrick McShane gave an update on the revision of PD57.147. He expects the recirculation ballot will be issued early summer.

c. Tom noted that two insulating liquid Guides, C57.111 (silicone) and C57.121 (Less-Flammable Hydrocarbon) both have expiration of December 31, 2019. The plan is to get both guides incorporated into the Consolidated Guide before they expire. Even if they are withdrawn as active Guides, the publication of them will still be available. This would be a better application of resources to focus on the consolidated guide.

d. He reported that the bulk of the TF meeting focused on the wording for the Title, Scope, and Purpose. He showed the draft proposed by the TF to the SCIF members for motions and discussion. The following drafts were approved by the SCIF:

   a. **Title:** Guide for Acceptance and Maintenance of Insulating Liquids in Transformers and Related Equipment

   b. Scope: This guide provides acceptance and maintenance criteria for insulating liquids used in transformers, tap changers, regulators, and reactors.

   c. Purpose:

   To assist the user of the equipment in evaluating insulating liquids:

   - As received from insulating liquid supplier prior to processing and/or filling into equipment,
   - As received in new equipment filled prior to energization,
   - In service-aged equipment.

   This guide also discusses the following topics related to insulating liquids:

   - Test methods and their significance,
   - Methods of handling and storage,
   - Mixtures of insulating liquids,
   - Re-processing, re-claiming and replacement

   This guide does not cover dissolved gas analysis of insulating liquids, which is covered by other IEEE Guides.

e. A motion was made to approve to submit a PAR request based on the wording above.

f. The probable Guide number to be assigned upon approval of the PAR will be C57.166.

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

Old Business

a. Gas Insulated Transformers: A question was raised by a user at the F16 Vancouver meeting that SF6 insulating gas has not been considered for a Guide under the SCIF. At that meeting, it was noted that there has not been a significant demand for this insulation system for transformer application to date in North America. The topic was included in the Subcommittee meeting of April 2. The decision has been made not to pursue.

b. C57.12.00 Revision - Unresolved Ballot Comment regarding the types of listed insulating liquids. Patrick McShane made a presentation on the issue, including a background summary and proposed recommendations. The recommendations accepted unanimously as follows:

- Support C57.12.00 WG decision to continue limiting inclusion of insulating liquids to those that have a published ASTM Acceptance Standard.
- Respond to C57.12.00 of this SCIF position, and make a recommendation for their next revision to include all insulating liquids that have ASTM documentation at that time.
- Once operating experience is obtained for all types of insulating liquids that have a published ASTM Acceptance Std., such liquid types Guides should be developed by the SCIF for inclusion in the C57 series of Insulating Liquid Guides or preferably, incorporated in the future Consolidated Guide for which a PAR will be requested 2nd Quarter 2017.

The SCIF Chair will forward the recommendations to Steve Synder of WG C57.12.00.

A copy of the presentation at the SCIF meeting is attached. (See Annex III)

G.2 New Business

None was presented.

G.3 Next SCIF Meeting:

November 1, 2017 – Louisville, KY

G.4 Adjournment

The motion passed unanimously.

Respectively Submitted, Patrick McShane, Secretary SCIF

Unapproved Minutes from the S17 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, April 4, 2017

New Orleans, Louisiana, USA

Minutes of WG Meeting

The meeting was called to order at 4:45pm by Chair Claude Beauchemin. Vice-Chair Don Platts and Secretary Susan McNelly (writer of Minutes) was also present. Vice-Chair Norm Field was not present.

There were 60 of 85 members present (based on the summation of both the paper and RFID rosters). There were 60 guests, and 10 guests requesting membership. A membership quorum was achieved. The WG plans to meet at the Fall 2017 Transformers Committee Meeting in Louisville, Kentucky.

The following guests requesting membership were:

Jason Attard	Verena Pellon
Donald Ayers	Ion Radu
Don Dorris	Mickel Saad
Ryan Fields	Drew Welton
Stacey Kessler	William Whitehead

Since the document is in late stage of completion, new requests for membership will not be entertained without significant contribution to the remaining work.

Agenda:

1. Attendance Roster Circulation
2. Member Roll Call & Quorum Check
3. Approval of the Fall 2016, Vancouver minutes
4. Document Status – Straw Ballot 3.1
    a. Review of major comments
    b. Discuss Tables and Table content
    c. Next step
5. New Business
6. Adjournment

Introductions of the Vice Chair and Secretary were made. Attendees were asked to introduce themselves and indicate their affiliations when making comments or asking questions.

A call for essential patent claims was made. Donald Lamontagne from APS indicated that he may have an essential patent claim. He provided the following information following the meeting:

> Patent 7,747,417, Column 10, line 43 through Column 11, line 53, and Figures 9 and 10 describe the Piecewise Linear Approximation process for DGA.
>
> The draft guide section 6.1.1, 6.1.5, and Annex B; particularly Page 37, Figure B.1 "Multi-points rate example" is a Piecewise Linear Approximation.

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

Jason Attard
Donald Ayers
Claude Beauchemin
Jeffrey Benach
Kevin Biggie
William Boettger
Paul Boman
Stephan Brauer
Robert Brusetti
Edward Casserly
Juan Castellanos
Stuart Chambers
Jonathan Cheatham
Luiz Cheim
Larry Christodoulou
Paul Cox
James Cross
Frank Damico
Timothy Daniels
Mohamed Diaby
William Dietrich
Scott Digby
Don Dorris
James Dukarm
Thomas Golner
James Graham
Attila Gyore
Roger Hayes
Thang Hochanh
Michael Horning
Fredi Jakob
John John
Ted Johnstone
Ken Kampshoff
Gael Kennedy
Stacey Kessler
Dong-Soo Kim
Young Kim
Zan Kiparizoski
Brad Kittrell
Raja Kuppuswamy
Donald Lamontagne
Michael Lau
Benjamin Leece
Raka Levi
Jinesh Malde
Kumar Mani
Terence Martin
Nicholas Perjanik
Branimir Petosic
Donald Platts
Homero Portillo
Thomas Prevost
John Pruente
Ion Radu
Robert Rasor
Leslie Recksiedler
Scott Reed
Hossein Rezai
Diego Robalino
Oleg Roizman
Mickel Saad
Joseph Saliba
Alaor Scardazzi
Pugazhenthi Selvaraj
Masoud Sharifi
Richard Simonelli
Brian Sparling
Erin Spiewak
Thomas Spitzer
Gregory Stem
Craig Stiegemeier

Hakim Dulac	Douglas McCullough	Kevin Sullivan
Brandon Dupuis	Joseph McGuire	Charles Sweetser
Michel Duval	James McIver	Susmitha Tarlapally
Roger Fenton	Susan McNelly	Marc Taylor
Marcos Ferreira	Emilio Morales-Cruz	James Thompson
Ryan Fields	Jerry Murphy	Robert Thompson
George Forrest	Paul Mushill	Ryan Thompson
Bruce Forsyth	Ali Naderian	Alwyn VanderWalt
George Frimpong	Kristopher Neild	Michel Veillette
Rainer Frotscher	Joe Nims	David Wallach
Shawn Galbraith	Jayme Nunes, Jr	Evanne Wang
Lorne Gara	Anastasia O'Malley	Matthew Weisensee
Eduardo Garcia	Jow Ortiz	Drew Welton
James Gardner	Vijay Pargaonkar	Peter Werelius
Sylvain Gelinas	Poorvi Patel	William Whitehead
Jeffrey Golarz	Verena Pellon	Malia Zaman

A motion to approve the Spring 2017 New Orleans Agenda was made by Jerry Murphy and seconded by Brian Sparling. There were no objections or additions to the agenda.

A motion to approve the Fall 2016 Vancouver Meeting Minutes was made by Dave Wallach and seconded by Jerry Murphy. There were no objections or additions to the agenda.

Straw Ballot 3.1 – Status/Results

Claude discussed the ballot process and next steps for the document. IEEE indicates that the document must be stable when it is submitted to the ballot process. Stable is defined as 2/3 of the quorum present at the WG agreeing that the document is ready to move forward.

Claude indicated that the Guide will expire at the end of next year. The PAR for the WG will expire at the end of 2017. A PAR extension would need to be requested before the October 16 deadline date.

Due to the above deadlines, there is a very tight timeline to finish up work on the document to get it out for ballot. A PAR extension is not likely unless the document is out for ballot or approved to go to ballot before the end of the year.

Preliminary Review

- Draft 3.0 distributed before Vancouver meeting.
- Comments send by email with email exchanges up to February 2017
- Draft updated and edited to D3.1
  - Update Figure 1
  - Fill Table 1 to 4 with data from DB2
  - New Case history
  - Delete annex on sampling
  - General editing
- All necessary scrip for data reduction written and tested
- Run on 500 000 DGA to give a first set of values

- Similar project run in parallel on a second DB of same size

Straw Ballot 3.1

- Draft 3.1 distributed to all WG members (83) March 10, 2017
- 23 responses (including chair)
- 203 comments (one too late for the review)
  - Approve: 12
  - Approve with reserve: 2
  - Disapprove: 2
  - "In-Between" 2
  - Abstention 5 (Did not mention anything about it)

  (But comments look favorable!)
- All comments reviewed from March 25 to April 1, by S. McNelly and C. Beauchemin, with M. Duval inputs on selected comments
- Of 202 comments:
  - 174 (86.1%) accepted (several with modifications) and implemented
  - 19 Refused (9.4%)
  - 10 without action
  - 5 are editorial requiring more time to implement
  - 2 associated with the negative
  - 3 Various
- Redlined version (Draft 3.2) distributed to WG members April 1, 2017
- Most notable changes:
  - Simplified Table 3
  - New layout for Table 1 and 2
  - MVA divided now at 10 MVA

Simplification of table 3 from D3.1:

Maximum µL/L (ppm) variation between consecutive samples for DGA below Table 1				
Period:	**< 1 month**	**1 Month - 1.5 Year**	**1.5 - 2.5 Years**	**>= 2.5 Years**
H_2	**10**	**20**		**25**
CH_4	**10**	**15**		
C_2H_6	**5**	**10**		
C_2H_4	**5**	**10**		**15**
C_2H_2	**0**			**1**
CO	**90**	**200**		**400**
CO_2	**800**	**1500**	**2000**	**3000**

Simplification of table 3 to D3.2:

Maximum µL/L (ppm) variation between consecutive samples for DGA below Table 1	
H_2	20
CH_4	15
C_2H_6	10
C_2H_4	
C_2H_2	Any increase
CO	300
CO_2	2000

Simplification of Table 1 and 2 from D3.1:

Table 1 90 Peccentile in function of O_2/N_2		
	O_2/N_2 <= 0.2	O_2/N_2 > 0.2
H_2	100	45
CH_4	90	20
C_2H_6	90	15
C_2H_4	70	50
C_2H_2	1	2
CO	800	500
CO_2	8000	5000

Table 1 a) to d) 90 Peccentile in fuction of O_2/N_2, Age and MVA				
Gas / Years	All Age	1-10	10-30	> 30
Table 1a) O_2/N_2 <= 0.2 and <= 50 MVA				
H_2	90	90		125
CH_4	80	35	75	100
C_2H_6	100	20	75	150
C_2H_4	60	15	50	80
C_2H_2	1	0	2	1
CO	800	800		
CO_2	7000	4000	7000	
Table 1b) O_2/N_2 <= 0.2 and > 50MVA				
H_2	70	35	50	90
CH_4	110	35	100	150
C_2H_6	100	20	100	150
C_2H_4	70	25	70	100
C_2H_2	2	2		1
CO	750	750		
CO_2	6000	4000	6000	
Table 1c) O_2/N_2 > 0.2 and <= 50MVA				
H_2	40	30	35	50
CH_4	10	10		15
C_2H_6	10	5	10	
C_2H_4	50	15	50	
C_2H_2	2	2		
CO	500	500		
CO_2	4000	2000	4000	5500
Table 1d) O_2/N_2 > 0.2 and > 50MVA				
H_2	40	40		
CH_4	35	60	25	
C_2H_6	20	20		
C_2H_4	100	100		
C_2H_2	3	2	3	4
CO	700	700		
CO_2	6000	4000	7000	

Simplification of Table 1 and 2 from D3.2:

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))						
Table 1a) O_2/N_2 <= 0.2						
Gas	**Rating and Age Unknow**	**MVA**	**Transformer Age (Years)**			
			Unknow	**1-10**	**10-30**	**> 30**
H_2	**100**	***< 10***	**150**	225	125	150
		> 10	**70**	30	50	100
CH_4	**90**	***< 10***	**125**	100	90	150
		> 10	**90**	20		100
C_2H_6	**90**	***< 10***	**150**	50	70	300
		> 10	**100**	15	90	125
C_2H_4	**70**	***< 10***	**70**	30	60	100
		> 10	**50**	15	50	80
C_2H_2	**1**	***< 10***	**1**	0	2	1
		> 10		1		
CO	**800**	***< 10***	**900**	800	1100	900
		> 10	**700**	600	800	600
CO_2	**8000**	***< 10***	**9000**	5000	10000	9000
		> 10	**6000**	3000	6000	6000
Table 1b) O_2/N_2 > 0.2						
Gas	**Rating and Age Unknow**	**MVA**	**Transformer Age (Years)**			
			Unknow	**1-10**	**10-30**	**> 30**
H_2	**45**	***< 10***	**40**	50	30	40
		> 10		40		50
CH_4	**20**	***< 10***	**10**	10		
		> 10	**20**	40	20	
C_2H_6	**15**	***< 10***	**9**	6		10
		> 10	**15**	15		
C_2H_4	**50**	***< 10***	**40**	20	30	40
		> 10	**80**	80	90	70
C_2H_2	**2**	***< 10***	**2**	2		
		> 10	**3**	2	3	4
CO	**500**	***< 10***	**450**	450	500	400
		> 10	**600**	600	700	600
CO_2	**5000**	***< 10***	**4500**	3000	3500	4500
		> 10	**5500**	4000	6000	6000

- Most problematic issues
  - Complexity of procedure
  - Low number of samples supporting table 1 and 2 finest divisions
  - TIME !!!

Some data and complexity issue

- One negative based on complexity of the procedure
  - Several comments on the same
  - Majority make no comments on this topic

Below are some ideas presented by Claude for simplification of the tables

Split with O2/N2, age and MVA D3.2

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))						
Table 1a) O_2/N_2 <= 0.2						
Gas	**Rating and Age Unknow**	**MVA**	**Transformer Age (Years)**			
			Unknow	**1-10**	**10-30**	**> 30**
H_2	**100**	***< 10***	**150**	225	125	150
		> 10	**70**	30	50	100
CH_4	**90**	***< 10***	**125**	100	90	150
		> 10	**90**	20		100
C_2H_6	**90**	***< 10***	**150**	50	70	300
		> 10	**100**	15	90	125
C_2H_4	**70**	***< 10***	**70**	30	60	100
		> 10	**50**	15	50	80
C_2H_2	**1**	***< 10***	**1**	0	2	1
		> 10		1		
CO	**800**	***< 10***	**900**	800	1100	900
		> 10	**700**	600	800	600
CO_2	**8000**	***< 10***	**9000**	5000	10000	9000
		> 10	**6000**	3000	6000	6000
Table 1b) O_2/N_2 > 0.2						
Gas	**Rating and Age Unknow**	**MVA**	**Transformer Age (Years)**			
			Unknow	**1-10**	**10-30**	**> 30**
H_2	**45**	***< 10***	**40**	50	30	40
		> 10		40		50
CH_4	**20**	***< 10***	**10**	10		
		> 10	**20**	40	20	
C_2H_6	**15**	***< 10***	**9**	6		10
		> 10	**15**	15		
C_2H_4	**50**	***< 10***	**40**	20	30	40
		> 10	**80**	80	90	70
C_2H_2	**2**	***< 10***	**2**	2		
		> 10	**3**	2	3	4
CO	**500**	***< 10***	**450**	450	500	400
		> 10	**600**	600	700	600
CO_2	**5000**	***< 10***	**4500**	3000	3500	4500
		> 10	**5500**	4000	6000	6000

Split with O2/N2, age and MVA D3.2 (partial)

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))						
Table 1a) O_2/N_2 <= 0.2						
Gas	Rating and Age Unknow	MVA	Transformer Age (Years)			
			Unknow	1-10	10-30	> 30
H_2	100	< 10	150	225	125	150
		> 10	70	30	50	100
CH_4	90	< 10	125	100	90	150
		> 10	90	20		100
C_2H_6	90	< 10	150	50	70	300
		> 10	100	15	90	125
C_2H_4	70	< 10	70	30	60	100
		> 10	50	15	50	80
C_2H_2	1	< 10	1	0	2	1
		> 10		1		
CO	800	< 10	900	800	1100	900
		> 10	700	600	800	600
CO_2	8000	< 10	9000	5000	10000	9000
		> 10	6000	3000	6000	6000

Split with O2/N2, age and MVA: Remove 1 column (Partial)

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))					
Table 1a) O_2/N_2 <= 0.2					
Gas	MVA	Transformer Age (Years)			
		Unknow	1-10	10-30	> 30
H_2	Unknow	100	70		100
	< 10	150	225	125	150
	> 10	70	30	50	100
CH_4	Unknow	90	30	80	100
	< 10	125	100	90	150
	> 10	90	20		100
C_2H_6	Unknow	90	20	80	150
	< 10	150	50	70	300
	> 10	100	15	90	125
C_2H_4	Unknow	70	15	50	80
	< 10	70	30	60	100
	> 10	50	15	50	80
C_2H_2	Unknow	1	0	1	
	< 10			2	1
	> 10		1		
CO	Unknow	800	700	900	700
	< 10	900	800	1100	900
	> 10	700	600	800	600
CO_2	Unknow	8000	4000	7000	8000
	< 10	9000	5000	10000	9000
	> 10	6000	3000	6000	6000

Split on O2/N2 and Age: Remove 1 criteria

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))				
Table 1a) O_2/N_2 <= 0.2				
Gas	Transformer Age (Years)			
	Unknow	1-10	10-30	> 30
H_2	100	70		100
CH_4	90	30	80	100
C_2H_6	90	20	80	150
C_2H_4	70	20	50	80
C_2H_2	1	0	1	
CO	800	700	900	700
CO_2	8000	4000	8000	
Table 1b) O_2/N_2 > 0.2 (all values in uL/L (ppm))				
Gas	Transformer Age (Years)			
	Unknow	1-10	10-30	> 30
H_2	45	50	40	50
CH_4	20	30	20	15
C_2H_6	15	10	15	
C_2H_4	50	50	80	60
C_2H_2	2	2		
CO	500	600		
CO_2	5000	3500	6000	

Split on O2/N2 only: Remove 2 Criteria

Table 1 90 Peccentile in function of O_2/N_2		
	O_2/N_2 <= 0.2	O_2/N_2 > 0.2
H_2	100	45
CH_4	90	20
C_2H_6	90	15
C_2H_4	70	50
C_2H_2	1	2
CO	800	500
CO_2	8000	5000

Reduce the Number of Gas

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))					
Table 1a) O_2/N_2 <= 0.2					
Gas	MVA	Transformer Age (Years)			
		Unknow	1-10	10-30	> 30
H_2	***Unknow***	**100**	70		100
	< 10	**150**	225	125	150
	> 10	**70**	30	50	100
CH_4	***Unknow***	**90**	30	80	100
	< 10	**125**	100	90	150
	> 10	**90**	20		100
C_2H_6	***Unknow***	**90**	20	80	150
	< 10	**150**	50	70	300
	> 10	**100**	15	90	125
C_2H_4	***Unknow***	**70**	15	50	80
	< 10	**70**	30	60	100
	> 10	**50**	15	50	80
C_2H_2	Unknow	1	0	1	
	< 10			2	1
	> 10		1		

Effect of selecting 10 VS 50 MVA break point

- 50 MVA does not correspond to a “natural” division in transformer
- 10 MVA correspond to different class
- However, the amount of DGA data available is limited
- Some large differences between the two large DB we have in hand

Use 10 MVA as break point

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))						
Table 1a) O_2/N_2 <= 0.2						
Gas	All	MVA	Transformer Age (Years)			
			All Age	1-10	10-30	> 30
H_2	100	< 50	90			125
		> 50	70	35	50	90
CH_4	90	< 50	80	35	75	100
		> 50	110		100	150
C_2H_6	90	< 50	100	20	75	150
		> 50			100	
C_2H_4	70	< 50	60	15	50	80
		> 50	70	25	70	100
C_2H_2	1	< 50	1	0	2	1
		> 50	2	2	0	
CO	800	< 50	800			
		> 50	750			
CO_2	8000	< 50	7000	4000	7000	
		> 50	6000		6000	
Table 1b) O_2/N_2 > 0.2						
Gas	All	MVA	Transformer Age (Years)			
			All Age	1-10	10-30	> 30
H_2	45	< 50	40	30	35	50
		> 50	40			
CH_4	20	< 50	10			15
		> 50	35	60	25	
C_2H_6	15	< 50	10	5	10	
		> 50	20			
C_2H_4	50	< 50	50	15	50	
		> 50	100			
C_2H_2	2	< 50	2			
		> 50	3	2	3	4
CO	500	< 50	500			
		> 50	700			
CO_2	5000	< 50	4000	2000	4000	5500
		> 50	6000	4000	7000	7000

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm))						
Table 1a) O_2/N_2 <= 0.2						
Gas	**All**	**MVA**	**Transformer Age (Years)**			
			All Age	**1-10**	**10-30**	**> 30**
H_2	**100**	***< 10***	**150**	225	125	150
		> 10	**70**	30	50	100
CH_4	**90**	***< 10***	**125**	100	90	150
		> 10	**90**	20		100
C_2H_6	**90**	***< 10***	**150**	50	70	300
		> 10	**100**	15	90	125
C_2H_4	**70**	***< 10***	**70**	30	60	100
		> 10	**50**	15	50	80
C_2H_2	**1**	***< 10***	**1**	0	2	1
		> 10	**1**	1		
CO	**800**	***< 10***	**900**	800	1100	900
		> 10	**700**	600	800	600
CO_2	**8000**	***< 10***	**9000**	5000	10000	9000
		> 10	**6000**	3000	6000	6000
Table 1b) O_2/N_2 > 0.2 (all values in uL/L (ppm))						
Gas	**All**	**MVA**	**Transformer Age (Years)**			
			All Age	**1-10**	**10-30**	**> 30**
H_2	**45**	***< 10***	**40**	50	30	40
		> 10	**40**	40		50
CH_4	**20**	***< 10***	**10**	10		
		> 10	**20**	40	20	
C_2H_6	**15**	***< 10***	**9**	6		10
		> 10	**15**	15		
C_2H_4	**50**	***< 10***	**40**	20	30	40
		> 10	**80**	80	90	70
C_2H_2	**2**	***< 10***	**2**	2		
		> 10	**3**	2	3	4
CO	**500**	***< 10***	**450**	450	500	400
		> 10	**600**	600	700	600
CO_2	**5000**	***< 10***	**4500**	3000	3500	4500
		> 10	**5500**	4000	6000	6000

Use 10 MVA as break point: Data validity

Number of points DB1 (Total: 518195)									
	All MVA	1-10 Years	10-30 years	> 30 Years		% of DB			
Low O2 < 10 MVA		625	2459	4099			0.1	0.5	0.8
Low O2 > 10 MVA		6221	19694	9989			1.2	3.8	1.9
High O2 < 10 MVA		437	947	4452			0.1	0.2	0.9
High O2 > 10 MVA		4387	4931	3870			0.8	1.0	0.7
Number of point DB2 (Total: 539742)									
	All MVA	1-10 Years	10-30 years	> 30 Years		% of DB			
Low O2 < 10 MVA	33444	3646	6681	7842		6.2	0.7	1.2	1.5
Low O2 > 10 MVA	65900	7475	16337	22024		12.2	1.4	3.0	4.1
High O2 < 10 MVA	22676	1840	5696	10519		4.2	0.3	1.1	1.9
High O2 > 10 MVA	44153	11820	13579	12575		8.2	2.2	2.5	2.3

Difference between 2 Data Bases

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm)) DB1/DB2						
Table 1a) O_2/N_2 <= 0.2						
Gas	All	MVA	Transformer Age (Years)			
			All Age	1-10	10-30	> 30
H_2	101 / 97	< 10	NA	230 / 232	200 / 116	190 / 144
		> 10	NA	69 / 29	163 / 53	250 / 95
CH_4	103 / 92	< 10	NA	56 / 95	106 / 87	94 / 162
		> 10	NA	48 / 23	115 / 89	155 / 108
C_2H_6	125 / 93	< 10	NA	27 / 45.5	81 / 68	140 / 279
		> 10	NA	38 / 13	149 / 89	189 / 120
C_2H_4	57 / 66	< 10	NA	17 / 29	53 / 61	79 / 95
		> 10	NA	15 / 13	40 / 52	68 / 82
C_2H_2	0.5 / 1	< 10	NA	0 / 0	0.5 / 2	01-Jan
		> 10	NA	0 / 1	0.4 / 2	1.8 / 1
CO	817 / 839	< 10	NA	794 / 760	878 / 1079	822 / 881
		> 10	NA	571 / 640	631 / 798	792 / 625
CO_2	8652 /8369	< 10	NA	4956 / 4844	9687 / 9771	9158 / 9170
		> 10	NA	2877 / 3121	4867 / 5766	7066 / 6214

Table 1b) O_2/N_2 > 0.2 (all values in uL/L (ppm))						
Gas	All	MVA	Transformer Age (Years)			
			All Age	1-10	10-30	> 30
H_2	66 / 45	< 10	NA	107 / 54	105 / 29	123 / 44
		> 10	NA	52 / 40	120 / 40	172 / 49
CH_4	32 / 19	< 10	NA	15 / 12	16 / 11	15 / 10
		> 10	NA	18 / 41	27 / 22	23 / 20
C_2H_6	21 / 13	< 10	NA	8 / 6	13 / 6	16 / 10
		> 10	NA	9 / 15	22 / 15	21 / 16
C_2H_4	71 / 51	< 10	NA	13 / 20	30 / 32	49 / 44
		> 10	NA	12 / 76	57 / 94	41 / 73
C_2H_2	5 / 2	< 10	NA	0 / 2	1 / 2	1 / 2
		> 10	NA	0 / 2	2 / 3	4 / 4
CO	566 / 492	< 10	NA	527 / 454	505 / 515	546 / 411
		> 10	NA	447 / 610	562 / 676	543 / 621
CO_2	5362 /4733	< 10	NA	3532 / 3082	5347 / 3622	5764 / 4666
		> 10	NA	2022 / 3800	4106 / 6420	5283 / 6430

Differences between the two databases

Low O2	% Delta from average of the two DB				
Gas	All Data	MVA	1-10	10-30	> 30
H_2	-4	< 10	-1	53	28
		> 10	82	102	90
CH_4	-11	< 10	-70	20	-53
		> 10	70	25	36
C_2H_6	-29	< 10	-51	17	-66
		> 10	98	50	45
C_2H_4	15	< 10	-52	-14	-18
		> 10	14	-26	-21
C_2H_2	67	< 10	0	-120	0
		> 10	-200	-133	57
CO	3	< 10	4	-21	-7
		> 10	-11	-23	24
CO_2	-3	< 10	2	-1	0
		> 10	-8	-17	12

High O2	% Delta from average of the two DB				
Gas	All data	MVA	1-10	10-30	> 30
H_2	-38	< 10	66	115	95
		> 10	26	100	111
CH_4	-51	< 10	22	37	40
		> 10	-78	20	14
C_2H_6	-47	< 10	29	74	46
		> 10	-50	38	27
C_2H_4	-33	< 10	-42	-6	11
		> 10	-145	-49	-56
C_2H_2	-86	< 10	0	-67	-67
		> 10	-200	-40	0
CO	0	< 10	15	-2	28
		> 10	-31	-18	-13
CO_2	0	< 10	13	38	19
		> 10	-61	-44	-20

Number of points DB1 (Total: 518195)								
	Age NA	1-10 Years	10-30 years	> 30 Years		% of DB		
Low O2 < 10 MVA		625	2459	4099		0.1	0.5	0.8
Low O2 > 10 MVA		6221	19694	9989		1.2	3.8	1.9
High O2 < 10 MVA		437	947	4452		0.1	0.2	0.9
High O2 > 10 MVA		4387	4931	3870		0.8	1.0	0.7
Number of point DB2 (Total: 539742)								
	Age NA	1-10 Years	10-30 years	> 30 Years		% of DB		
Low O2 < 10 MVA	33444	3646	6681	7842	6.2	0.7	1.2	1.5
Low O2 > 10 MVA	65900	7475	16337	22024	12.2	1.4	3.0	4.1
High O2 < 10 MVA	22676	1840	5696	10519	4.2	0.3	1.1	1.9
High O2 > 10 MVA	44153	11820	13579	12575	8.2	2.2	2.5	2.3
Number of point DB3 (Total: 268764)								
	Age NA	1-10 Years	10-30 years	> 30 Years		% of DB		
Low O2 < 10 MVA	133487	22587	37986	11521	49.7	8.4	14.1	4.3
Low O2 > 10 MVA	53848	9870	16165	7055	10.0	1.8	3.0	1.3
High O2 < 10 MVA	63314	11027	12379	6277	11.7	2.0	2.3	1.2
High O2 > 10 MVA	16085	4362	5789	1936	3.0	0.8	1.1	0.4

With 3 databases: Similarities and Differences

Table 1 90 Peccentile in function of O_2/N_2 (all values in uL/L (ppm)) DB1/DB2/DB3						
Table 1a) O_2/N_2 <= 0.2						
Gas	All	MVA	Transformer Age (Years)			
			All Age	1-10	10-30	> 30
H_2	101/97/79	< 10	NA	230/232/889	200/116/64	190/144/53
		> 10	NA	69/29/34	163/53/38	250/95/38
CH_4	103/92/99	< 10	NA	56/95/280	106/87/85	94/162/91
		> 10	NA	48/23/33	115/89/79	155/108/124
C_2H_6	125/93/89	< 10	NA	27/45.5/90	81/68/70	140/279/102
		> 10	NA	38/13/14	149/89/69	189/120/125
C_2H_4	57/66/60	< 10	NA	17/29/28	53/61/48	79/95/91
		> 10	NA	15/13/10	40/52/35	68/82/84
C_2H_2	0.5 /1/0	< 10	NA	0/0/3	0.5/2/0	1 / 1 / 0
		> 10	NA	0 / 1 / 0	0.4 / 2 / 0	1.8 / 1 / 0
CO	817/839/1023	< 10	NA	794/760/963	878 / 1079/1232	822/881/1039
		> 10	NA	571/640/766	631/798/923	792/625/629
CO_2	8652/8369/10847	< 10	NA	4956/4844/5090	9687/9771/11311	9158/9170/14042
		> 10	NA	2877/3121/4200	4867/5766/6212	7066/6214/8240

Separated DB Network Transformers

	min	max
kVA RANGE	31.5	2500
kV RANGE	2.4	33
Total samples	32302	
Total transformers	19265	

	H2	CH4	C2H6	C2H4	C2H2	CO	CO2
90th %	2460	522	160	36	0	567	5670
95th %	8471	1610	403	64	0	690	8870

Claude discussed the simplification of Table 3 (Maximum uL/L variation between samples), which was reduced from 4 columns down to 1.

The effect of selecting 10 vs 50MVA break point. The data are not similar enough to remove the break point. Also there is a question of data validity using 10MVA as a break point due to a smaller data pool. With a smaller data pool, there are more differences that appear between the two separate data pools.

Claude asked for comments on Table 1 and 2. Don Platts indicated that a lot of work has been done by the TF. He indicated that only 23 of 84 members responded to the survey. He also indicated that confidence in the numbers is an issue. Don indicated that Dave Hanson ran an analysis of a separate set of data and depending on which version of the table was used, 30% of the data base fell into Condition 3. Depending on which data base was used, the results varied greatly. Don suggested that the WG members need to take a close look at the document and provide feedback.

Claude acknowledged that the document is not perfect. He indicated it is a work in progress. He asked whether the flaws are enough that it prevent us moving forward and risking the document being withdrawn.

Luis Cheim indicated that the statistics won't change. Either we throw the database away or we trust the numbers. He indicated the data is the data and it is indicating that the existing numbers (actual 2008 version) don't make sense. He indicated that the results are in line with analysis that IEC has done and that he believes we are moving in the right direction. Regarding the vote, it is important that the group reanalyze the document and then vote. Maybe in the process the conditions needs to be revised.

Tom Prevost indicated that the point is the numbers will be used to guide people on what to do with their equipment. Erin Speiwak indicated that it is likely that the NESCOM could be convinced to grant a PAR extension. Tom indicated that it is important that the information presented be sent to the members for adequate review.

Kumar Mani – indicated that it would be helpful to have a separate column for wind transformers.

Claude commented that even if the data for that group is good and solid, is it worth having it in the main body for a very small percentage of the population.

Jim Thompson indicated he had a negative ballot, but would be happy to relook at it if a revised document is sent out. Claude indicated that the data in the published Guide dates back to 1972 and was based on a data pool from the UK. It was based on a very limited sample of data.

Matt Weisensee– He indicated that the results are going to be too low to be relevant to his company and they will have to rely on their own data (network transformers with High gas levels).

Claude asked for a show of hands who felt comfortable to release the document for ballot. There was no show of hands.

Claude indicated that a new straw ballot will be circulated with more time to allow people to more thoroughly review the document. A place for approve or disapprove will be included in the ballot comment form.

Tom Prevost asked if the wind transformer data will be removed from the data base due to the differences noted.

Jim Dukarm asked if the numbers would be the real numbers in what is sent out for review.

Don Platts asked that the members focus on the Technical rather than Editorial comments in the review of the next document.

The meeting was adjourned at 6:00PM

Claude Beauchemin
WG Chair

Don Platts
WG Vice-Chair

Norm Fields
WG Vice-Chair (not present)

Susan McNelly
WG Secretary

Appendix II – TF Insulating Liquids Guides Consolidation Minutes

Chairman Tom Prevost
Secretary Scott Reed

Task Force on Consolidation of Insulating Liquid Guides
Monday, April 3, 2017
9:30 – 10:45 AM
Grand Ballroom D
Astoria Crowne Plaza Hotel, New Orleans, LA

Chairman Tom Prevost
Secretary Scott Reed

The meeting was called to order at 9:39 am by Chair Tom Prevost.

There were 28 of 50 members present. There were 44 guests and 54 visitors. 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) Quorum
3) Approval of agenda
4) Approval of Fall 2016 minutes
5) Call for patents
6) 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
    b. C57.111 "Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers"
        i. Revision Due Date 12/31/2019
    c. C57.121 "Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluid in Transformers"
        i. Revision Due Date 12/31/2019
        ii. Revision project planned, no PAR submitted
7) New Document:
    a. Title

b. Scope
c. Purpose

8) 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?

9) New Business
10) Adjourn

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

There was unanimous approval of the Agenda.

There was a unanimous approval to the Fall 2016 Vancouver meeting 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 he intends to send the Draft C57.147 out for recirculation.

-Chairman Tom Prevost shared that he has talked to the SA about C57.111 and C57.121 and they may be withdrawn as a reference but will still be available as a reference.

Next, Chairman Prevost open the floor to discuss the Title and Scope as part of the requirement to form a PAR.

After consideration of various proposals, Patrick McShane made a motion and Jim Graham seconded the motion for the title called, 'Guide for Acceptance and Maintenance of Insulating Liquids in Transformers and Related Equipment.' The motion carried unanimously.

Regarding the Scope and Purpose, Chairman Prevost outlined the following parameters:

1. Analytical tests and their significance for the evaluation of insulating liquids.
2. The evaluation of insulating liquids as received, before and after filling into equipment.
3, Methods of handling and storage of insulating liquids.
4. The evaluation of service-aged insulating liquids.
5. Health and environmental care procedures for insulating liquids.

There was discussion about retrofilling and mixing of insulating liquids, so Mark Perkins made a motion and Diego Robalino seconded the motion to add to the scope, 'Mixing of Fluids.' The motion carried.

As such the Task Force finalized the Scope and the Purpose as listed below:

Scope:
This guide provides acceptance and maintenance criteria for insulating liquids used in transformers, tap changers, regulators and reactors.

Purpose:
To assist the user of the equipment in evaluating insulating liquids:

- As received from insulating liquid supplier prior to processing and/or filling into equipment.
- Received in new equipment filled prior to energization.
- In service-aged equipment.

This guide also discusses the following related in insulating liquids:

- Test methods and their significance
- Methods of handling and storage
- Mixtures of insulating liquids
- Re-processing, re-claiming and replacement

This guide does not cover dissolved gas analysis of insulating liquids, which is covered by other IEEE Standard Guides.

No New Business was discussed and the meeting was adjourned at 10:49 am.

Unapproved Minutes from the S16 SCIF WG and TF meetings

Appendix III – Presentation on Comment Referral to SCIF from WG C57.12.00.

Comment forwarded S16:

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.

Background:

Section 6.6.1 Insulating Liquids:
Transformer shall be filled with a suitable insulating liquid such as the following:

a) M*ineral Oil*. "New, …… shall meet …..ASTM D3487."

Note: C57.106 provides information concerning the acceptance & maintenance of m.o. transformers

b) Less-flammable hydrocarbon fluid. "New,…..shall meet…..ASTM D222."

Note: C57.121 provides information …… of less-flammable hydrocarbon fluid in transformers

c) Silicone insulating fluid. "New, ……. shall meet…..ASTM D225."

Note: C57.111 provides information concerning …… of silicone insulating fluid in transformers

d) Natural Ester Insulating Liquid. "New, …… shall meet….ASTM D6871."

Note: C57.147 provides information concerning of natural ester insulating liquid in transformers

•C57.12.00 -A comment was submitted during recirculation ballot, but was deemed out of scope. It is not clear why. Matt Ceglia stated that during re-ballot process, a comment might be a non-modifiable part of the draft, aka "out of scope". Since the comment pertains to insulating liquids, the advisement was submitted to the SCIF Chair.

•Per Jim Graham, the purpose is that if the SCIF considers the comment has merit, it can make a suggestion to the next revision of C57.12.00 WG to accept the comment.

•At the time of the balloting of C57.12.00, no ASTM Acceptance Standard nor IEEE Guide for synthetic esters insulating liquids existed.

•ASTM has formed a WG to establish one.

•The TF on Consolidation of Insulating Liquid Guides is considering including synthetic esters, dependent on the availability of an ASTM Acceptance

Recommendation:

•Support C57.12.00 WG decision to continue limiting inclusion of insulating liquids to those that have a published ASTM Acceptance Standard.

•Respond to C57.12.00 of this SCIF position, and make a recommendation for their next revision to include all insulating liquids that have ASTM documentation at that time.

•Once operating experience is obtained for all types of insulating liquids that have a published ASTM Acceptance Std., such liquid types Guides should be developed by the SCIF for inclusion in the C57 series of Insulating Liquid Guides or preferably, incorporated in the future Consolidated Guide which is very close to being ready for a PAR request.