

7.3. Insulating Fluids Subcommittee (R.K. Ladroga, Chair; S.J. McNelly, Vice-Chair)

7.3.1. Introduction/Attendance

The Insulating Fluids Subcommittee meeting in Charlotte, North Carolina on Wednesday, March 19, 2008 was called to order at 11:05 am by Chair Richard Ladroga. Vice Chair/Secretary Susan McNelly was also present. There were 27 members and 53 guests present. The following 7 guests requested membership:

Claude Beauchemin	Hali Jackson
Don Cherry	Shawn Luo
Mark Danko	Bob Rasor
David Harris	

Meeting Agenda

1. Introductions
2. Patents
3. Fall 2007 Minutes Approval
4. WG Reports
 - a. WG C57.147 – Natural Based Ester Fluids – Patrick McShane
 - b. TF DGA in Natural Based Ester Fluids – Paul Bowman
 - c. WG C57.139 – DGA in LTCs – Fredi Jakob
 - d. WG C57.104 – DGA in Oil Immersed Transformers – Richard Ladroga
 - e. TF Guide for Retrofill of Natural Ester Fluids – Jim Graham
 - f. C57.130 - IEEE Trial-Use Guide for Dissolved Gas Analysis During Factory Temperature Rise Tests
5. New Business
6. Old Business
7. Adjourn

Introductions of the meeting participants were made.

7.3.2. Approval of Meeting Minutes and Patent Disclosure

As required in IEEE SA Standard Boards by-law, Section 6.3.2, the IEEE patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. No new disclosures were forthcoming.

The Minutes of the Fall 2007 Minneapolis, Minnesota meeting were approved as written.

7.3.3. Current Subcommittee Business

7.3.3.1. C57.147 - IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers

**Tuesday, March 18, 2008
Charlotte, North Carolina**

The WG meeting was called to order at 8:00 am, on Tuesday, March 18, 2008 by the working group Chair, Patrick McShane. Vice Chair, Clair Claiborne, and Secretary, Susan McNelly were also present. There were 12 members present and 49 guests, with 6 guests requesting membership. Since the Guide has been balloted, no additional membership requests will be entertained.

Meeting Agenda

1. Introductions
2. Patents
3. Approval of Fall 2007 Minutes

4. Update on Status of Recirculation
5. New Business
6. Adjourn

As required in IEEE SA Standard Boards by-law, Section 6.3.2, the IEEE patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. No new disclosures were forthcoming.

The minutes for the Fall 2007 meeting in Minneapolis, Minnesota were approved as submitted and recorded on the website.

Update:

Patrick indicated that the recirculation ballot had closed and that there were two editorial comments and one negative ballot received. The negative ballot was in regards to Annex B of the Guide. An excerpt from the guide is provided below.

B6 Relative Cooling Performance Properties

Four cooling performance properties of the dielectric coolant are often used for transformer design. These include viscosity, coefficient of expansion, thermal conductivity, and heat capacity. As viscosity is the most significant, limits are listed within the main section of this guide. However, for thermal design optimization, it is useful to have the values of the other three properties. Specific typical values of thermal properties for each brand of fluid should be obtained from the fluid manufacturer

The negative comment was submitted by Don Platts and is included below:

“This clause points out that there are issues to be dealt with in terms of cooling performance. There are no details provided, it merely states that there are issues.¹ That is not helpful to any of the readers, whether user or manufacturer. Since this guide discusses retrofills in several locations, this annex clause should discuss the increased temperatures to be expected after a retrofill.² There is sufficient experience in the industry to document this, at least in general terms.³ If there is a significant impact on the oil and winding temperatures then the topic of retrofill should be expanded in the guide, not an annex. Then this issue, and all of the others, should be addressed in detail.”

Comments by Chair to initiate discussion:

There appears no obligation for action, as the section in question was not challenged in the first balloting nor was the wording changed from the initial ballot wording.

While there is some merit in the comment, our discussion is whether or not it is sufficiently important to cause further delay in issuing the Guide.

1. The draft does acknowledge the issue and makes a recommendation for action.
2. Increase temperature is implied by discussion in Section 4.8 (main body) and the current wording of Annex Section B6.
3. There is little field data on field retrofill temperature rise delta. The data available is essentially limited to a few comparative heat runs of new units, and outputs from design programs using the key fluid thermal properties listed in current annex section B6.

Other Notes:

- * It has been recognized by the SC for Insulating Fluids that there is a probable need for obtaining guidance for retrofilling of Natural Ester fluids, and a task force has been formed for field application of natural esters.
- * Two manufacturers of natural ester dielectric fluids have published papers that cellulose insulation systems have a lower aging rate when impregnated with natural esters that essentially offsets or minimizes the issue of increased temperature rise.

Don Platts was asked for additional comment and indicated that he had no additional comments to what he had already provided. He did acknowledge that he understood that the committee had no obligation to address his negative.

Matt Ceglia from IEEE indicated the correctness of Patrick's discussion point that since there were no comments on Annex B in the original ballot and no changes were made in the recirculated ballot, there was no obligation to reopen the annex for additional recirculation.

However, the Chair opened up the floor for discussion and a vote was taken whether or not to revise Section B6 to address the issues raised by the negative commentor. The overwhelming consensus was not to make the revision, it should be reconsidered during the first revision cycle of the Guide Standard in the future.

Therefore, the WG agreed that the Section B6 wording shall be as written in the now approved recirculation draft as recirculated (Draft 12). The draft will be submitted to IEEE Standard Committee for publication, accepting the two minor editorial comments from the recirculation vote (neither a "disapproval" or negative vote):

Section 8.3 - Test limits for service-aged natural ester fluids, Table 5: Removal of extraneous footnote letters b & c in the cell "dielectric strength".

Section 8.5 Reclaiming: Removal of the year for IEEE Standard 637 to match the format used in the reference section.

There was a question from the floor concerning why density was not included in the key thermal properties listed in Section B6. This issue was discussed at length, with opinion ranging from that density was not needed, to a very minor factor, to relatively important. Due to the lack of consensus, the fact that the main body does set a limit for relative density in Table 2, and the stage of the approval process, density will not be added to Section B6. It was recommended it should be reconsidered during the first revision cycle of the Guide Standard in the future.

Patrick expressed his gratitude to the working group members and all who contributed to the development of the Guide.

There was no new business other than dissolving the WG.

The meeting was adjourned at 8:30 am.

Respectfully Submitted
Patrick McShane
Working Group Chair

Clair Claiborne
Working Group Vice-Chair

Susan McNelly
Working Group Secretary

7.3.3.2. TF DGA in Natural Based Ester Fluids

Tuesday, March 18, 2008
Charlotte, North Carolina

Attendance 79 total attendees, 32 attendees requested membership and 47 attendees were guests

1. Preliminaries

John Luksich, Cooper Power Systems agreed to be the committee secretary.

2. Task do we need a DGA guide for Natural Ester Fluids?

Determine if the current mineral oil insulating fluid evaluation tools are sufficient to evaluate natural ester fluid DGA or if a new guide is required.

3. EPRI Project Presentation by Luke Van der Zil

4. DGA interpretation in natural ester fluids

a. This project looks at one fluid, Nitrogen head space, and thermally upgraded paper. EPRI would like to expand the scope in future projects.

b. First step was to establish the partition coefficients

- Did 10 trials with mineral oils and received similar results as with published data, so confidence in the method is high.
- The coefficients for the natural ester fluid will need to be determined for coil in mockup transformer.

Question: Was a thermal degradation test similar to the Westinghouse test on Octane over a wide temperature range? No

Question: What is the discharge energy used in the partial discharge cell? It has not been constructed yet but plans a range of energy levels when the tests begin.

Question: 300 to 500 pico-coulombs is an expected design criterion for mineral oil transformers so will it also be used for Natural ester fluids? EPRI wants to see how mineral oil differs from natural esters over a wide range of energies

Question: How will this affect the time limitations for the project? Future projects can extend the data gathered by this project.

Question: What is the electrode design and configuration used, Parallel plane, plane and point, etc.? Design has not been determined but considering both

Question: How is the measurement of the temperature done? Thermocouple at the point of heat source in fluid.

Question: Is the fluid flow natural circulation like in a smaller transformer? Fluid flow is pumped through system.

Question: Is the system pressure monitored? Flow volume is low

Question: Is the temperature gradient measured? Temperature gradient surrounding the heat source is not measured but the differential temperature between the simulated hot spot and the transformer hot spot is.

Question: Partial discharge intensity will affect the production of gases but will ratios will be similar? Agree, this is part of the test.

Question: How many in the group have natural ester fluids in transformers (addressed to committee)?

Recent incident involving 230kV transformer with soybean natural ester fluid was presented by Paul Boman.

A CIGRE task force compared synthetic ester and mineral oil fluids. It found the gas patterns are similar.

Ostwald Absorption Coefficients: Claire Claiborne, ABB stated that most of the Olin fluid type Ostwald coefficients are similar to mineral oil and soybean fluid types but the acetylene is double the mineral oil.

Statement Stan Lundgride; Carbon dioxide gas concentration varies due to absorption into the cellulose material and diffusion into the headspace due to temperature changes.

Summary and expectations defined

The draft of the framework will be sent out shortly for review and comment.

A motion for adjournment was received from Joe Kelly and seconded by the committee

Paul Bowman
TF Chair

7.3.3.3. C57.139 - Draft IEEE Guide for Dissolved Gas Analysis Of Load Tap Changers

**Tuesday, March 18, 2008
Charlotte, North Carolina**

Fredi Jakob called the WG meeting to order at 11:00 am, Tuesday, March 18, 2008. WG Secretary Susan McNelly was also present. There were 30 members and 45 guests present with 8 guests requesting membership.

Guests requesting membership were:

Claude Beauchemin
Jonathan Cheatham
Beth Dumas
Jack Harley
David Harris
Josh Herz
Wayne Johnson
Arturo Nunez

Agenda:

1. Welcome and Introduction
2. Patent considerations
3. Approval of Fall 2007 minutes
4. Goals
 - A. Decisions on Type Table
 - B. Decision on Tutorial
 - C. Draft to IEEE for review
 - D. Draft ready to Ballot
5. Draft Review
 - A. Type Table, Dave Wallach
 - B. Tutorial Review
 - C. Report on Utility Feedback, Jim Dukarm
 - D. Guide Appendix, Statistical Tool
6. Summary
7. New Business
8. Adjourn

Introductions of the participants were made.

The IEEE Patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. There were no responses to the request for disclosure.

Approval of minutes from the Fall 2007 meeting in Minneapolis, Minnesota was requested. The minutes were approved as written.

Goals:

Type Table: We need to make a decision on the Type Table. Dave Wallach presented the status of the Type Table to the group.

Type Table

OLTC CONTACT TYPE		
ARCRES	Arcing Switch Resistive (Arcing contacts are tap -changer contacts where switching arcs occur in oil during a normal tap change operation bridging through resistors.)	
ARCREACT	Arcing Switch Reactive (Arcing contacts are tap -changer contacts where switching arcs occur in oil during a normal tap change operation bridging through a reactance)	
VAC	Vacuum (Vacuum contacts have the switching arc contained in a vacuum bottle)	
OLTC TYPE		
↓	T	Switch with separate tap selector
	S	Tap selector also makes/breaks
VENTING		
↓	S	Sealed Tank (exclude presence of pressure relief device)
	U	Uni-direction al (vents on pressure)
	B	Bi-directional (vents and breathes freely through dessicant breather)
	F	Free (vents and breathes freely to atmosphere)

Tutorial: The rewrite of the tutorial was read. Fredi asked for comments on the rewrite.

Comment that there is some cellulose in the LTC, maybe just not as much. This will be revised in the tutorial section.

It was discussed whether the term LTC should be replaced with the term OLTC. Since this would require a change in the scope, this would also require a revised PAR.

If the tutorial is left in the main body, it needs to be considered normative. If it is in the Annex, it would be considered informative. Tom Prevost indicated his preference at least this first time around would be to leave it in the main body. Rick Ladroga indicated that he would be tempted to go the other direction due to the liability.

A consensus vote was taken to determine where the tutorial should reside. The overwhelming response was to leave it in the main body.

Fredi, Jim, and Xushen will work on further revisions to the tutorial.

Jim Dukarm gave an overview of the data received from utilities for actual LTC models. Jim indicated that in 95% of the cases they came up with very acceptable values. Jim has not yet gotten actual feedback from the utilities on the results.

There was a discussion regarding the inclusion of case studies in the Guide. It may be possible to get one such case study, which has already been completed written up and into the present draft Guide before ballot.

Jim also discussed Annex A, which provides a practical means of developing OLTC norms.

Fredi asked for a show of hands for proceeding with the guide without waiting for feedback from the utilities. There was overwhelming support.

Joe Kelly indicated that he prefers a ratio approach rather than a statistical approach. Fredi responded that most people don't have the ability to analyze the data themselves.

Joe Kelly asked if we were going to use the term hot metal or heating gases. Hot metal will be used.

The meeting was adjourned at 12:03 pm.

Fredi Jakob
Chair

Susan McNelly
Secretary

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

**Tuesday, March 18, 2008
Charlotte, North Carolina**

The meeting was called to order by Rick Ladroga at 1:50 pm on Tuesday, March 18, 2008. Vice Chair and Secretary Susan McNelly was also in attendance. There were 43 members, 51 guests, and 13 guests requesting membership.

Guests requesting membership were:

Don Angell	Wayne Johnson
Rick Cantrell	John Lackey
Beth Dumas	Shawn Luo
Shawn Galbraith	Joe Nims
Rodolfo Garcia	Arturo Nunez
David Harris	Craig Stiegemeier
Josh Herz	

Introductions of attendees were made.

The IEEE Patent disclosure requirements were discussed and a request was made for disclosure of any patents that may be related to the work of the WG. There were no responses to the request for disclosure.

Approval of minutes from the Fall 2007 meeting in Minneapolis, Minnesota was requested. The minutes were approved as written.

Update on status of recent ballot on C57.104:

- Ballot issued last fall, comments received (97 % Positive, 3% Negative, 115 Affirmative Votes, 3 Negative, 170 Total Comments- Mostly editorial, minimal amount of technical)
- Ballot Resolution Committee consisting of Tom Prevost, Sue McNelly, Claude Beauchemin, Brian Sparling, and Rich Ladroga met several times during the interim period (Telcon) and also met for 4 hours last evening to resolve comments. Approximately 170 comments were satisfactorily addressed by the Resolution Committee.
- Will go out for a recirculation ballot shortly after this meeting.

C57.104 – NEW GUIDE:

Goal of the new Guide is to take a different approach. This will be more tutorial in nature and will be more comprehensive. The reality is that many people are misapplying the guide. Rick indicated that he would like the focus to be more informative and tutorial in nature.

Task Force Presentations

- Jim Dukarm – Framework Structure TF

Jim presented an initial framework for the new Guide with Overview, Scope, Limitations, References, and Definitions sections. The following is the initial framework outline developed by the Framework TF.

1. Overview
 - 1.1 Scope
 - 1.2 Limitations
2. References
3. Definitions
4. The Nature, Purpose, and Application of Dissolved-Gas Analysis
 - 4.1 The nature of Dissolved-Gas Analysis
 - 4.2 The Purpose of DGA
 - 4.3 The Application of DGA
 - 4.3.1 Detection and diagnosis of abnormalities
 - 4.3.2 Risk assessment

- 4.3.3 Risk classification by DGA
 - 4.3.3.1 Risk management strategies
- 4.3.4 Measurement verification and quality assurance
- 4.4 DGA contexts
- 5. DGA Norms
 - 5.1 Variables and norms for fault detection and risk classification
 - 5.1.1 Minimum interpretation limits for gas concentrations
 - 5.1.2 Baselines for increments
 - 5.1.3 Time windows and baselines for rates of change
 - 5.1.4 Limits for combustible gas increments
 - 5.1.5 Limits for combustible gas rates of increase
 - 5.1.6 CO₂/CO
 - 5.1.7 Acetylene/Hydrogen
 - 5.1.8 Oxygen/Nitrogen
 - 5.2 Derivation, use, and maintenance of DGA norms
- 6. DGA Data Interpretation
 - 6.1 Data Quality Review
 - 6.1.1 Transcription and Typographical errors
 - 6.1.2 Missing or duplicated data
 - 6.1.3 Mis-identified or swapped sample
 - 6.1.4 Sample mis-handling
 - 6.1.4.1 Air exposure
 - 6.1.4.2 Air contamination
 - 6.1.4.3 Cross contamination
 - 6.1.5 Wildly inconsistent values
 - 6.1.6 Chronically absent or low hydrogen
 - 6.1.7 Inconsistent O₂/N₂ ratio
 - 6.2 Interpretation of DGA Data
 - 6.2.1 Initial Sample
 - 6.2.2 Periodic Screening
 - 6.2.3 Surveillance
 - 6.2.4 Monitoring
 - 6.2.5 Quality assurance and verification

- Tom Prevost – Data TF

Norman Field Volunteered to take over as chair of the Data TF. No presentation from this TF was done at this meeting.

- Tom Lundquist - DGA in Arc Furnace Transformers TF

Presented a summary of information gathered from three laboratories.

Fredi Jacob asked if Jim Dukarm could do a statistical analysis rather than set values.

- Brian Sparling – Case Studies (Q – Existing – SDM, ABB, DOBLE, WEIDMANN, etc) TF

The draft of the framework will be sent out shortly for review and comment.

The meeting was adjourned at 3:07 pm.

Rick Ladroga
WG Chair

Susan McNelly

WG Vice Chair and Secretary

7.3.3.5. TF Guide for Field Application of Natural Ester Fluids

Tuesday, March 18, 2008
Charlotte, North Carolina

Jim Graham called the meeting to order, introductions were made, and an attendance roster was circulated requesting those wanting membership to indicate this on the roster. Jim reviewed the IEEE Patent Policy and asked the group if there were any patents that needed to be disclosed. None were announced to the group.

Jim presented a draft document leading a discussion on what were the purpose, scope and need for a guide.

It was noted that there is a separate task force looking at creating a guide for DGA of natural ester fluids. EPRI is working on DGA of natural ester fluids as reported by an EPRI member.

There was a discussion about what transformers were to be included and it was decided that all transformers should be included along with key liquid-immersed auxiliary equipment and devices.

It was questioned why this was strictly for natural ester fluids. The discussion was about the various other fluids and attempts to create a guide and how this fluid differs from other fluids including synthetic ester fluids. There was no conclusive objection and the scope will be maintained for natural ester fluids.

There following topics were discussed to consider in the guide including:

- There is no loading guide for natural ester fluids
- Temperature rise considerations may not fit into C57.12.00
- key liquid-immersed auxiliary equipment and devices including LTCs, regulators, network transformers (not network protectors) and bushings
- Retro filling procedures
- Cold start issues
- Medium to long term storage
- Issues related to radiators and coolers
- Operational impacts related to field testing
- Disposal of fluid at end of life

It was discussed there is a need for a Guide for Condition Assessment for transformers to determine if reasonable to retro fill a transformer.

The issue is should this task force be concerned about fluid issues and spin off design issues to other sub committees related specifically to testing, insulation, distribution and power transformers.

The meeting was adjourned at 4:30pm.

Jim Graham
Chair

7.3.3.6. C57.130 - IEEE Trial-Use Guide for Dissolved Gas Analysis During Factory Temperature Rise Tests for the Evaluation of Oil-Immersed Transformers and Reactors

There was no WG meeting for this Guide at the Charlotte, North Carolina meeting. A request for a PAR extension for this Guide was granted. The PAR expires the end of 2009. Tom Prevost would like to form a ballot resolution committee to resolve the outstanding ballot comments. Kent Haggerty, Dave Wallach, Juan Castellanos, Rick Ladroga, and Tom Prevost have volunteered to serve on the ballot resolution committee. There were 60 total comments with about 10 negatives that will need to be addressed.

Joe Kelly indicated that in the meantime there have been Canadian and IEC documents that have been created that may be helpful in resolving the negatives.

7.3.3.7. 637 - IEEE Guide For Reclamation of Insulating Oil and Criteria For Its Use

No meeting was held in Charlotte for this Guide. IEEE Std 637 – 1985 Guide. Chair Jim Thompson indicated that the Guide was reaffirmed in October of 2007. He will be proceeding with a PAR request after the Charlotte meeting.

7.3.4. Old Business

None

7.3.5. New Business

None

7.3.6. Adjournment

The Subcommittee adjourned at 11:40 am.

Next Meeting:

The Insulating Fluids Subcommittee and its Working Groups will next meet in Oporto, Portugal during the period of October 5-9, 2008.

Respectfully Submitted

Richard Ladroga
Fluids SC Chair

Susan McNelly
Fluids SC Vice-Chair