

UNAPPROVED MINUTES (Draft 1, 10-28-08)
SC Insulating Fluids Meeting
October 8, 2008 - Oporto, Portugal

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 Porto, Portugal at noon on Wednesday, October 8, 2008 was called to order at noon by Vice-Chair Susan McNelly. Secretary Patrick McShane was also present. There were 17 members and 21 guests present. The following 5 guests requested membership:

1. Claude Beauchemin
2. Eduardo Garcia
3. Martin Navarro
4. Jim Antweiler
5. Michael Lamb

Meeting Agenda

1. Introductions
2. Patents
3. Spring 2008 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
Particle Count limits
6. Old Business
7. Adjourn

Introductions of the meeting participants were made.

7.3.2. Approval of Meeting Minutes and Patent Disclosure

As required 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 subcommittee. No new disclosures were forthcoming.

The Minutes of the Spring 2008 Charlotte, North Carolina 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

No meeting was held. This standard has successfully gone through the ballot process, approved by the IEEE SA Standards Board, and was published on July 11, 2008. Thus, the WG has been terminated.

7.3.3.2. TF DGA in Natural Based Ester Fluids

Tuesday, October 7, 2008

Task Force Natural Ester Fluid DGA Guide Development

Chairman Paul Boman

Porto Portugal, October 7, 2008 at 10:30 am

Attendance; Total attendees 44, 9 Members, 35 guests with 1 requesting membership

1. Introductions
 - a. John Luksich, Cooper Power Systems was absent from the meeting so Patrick McShane acting secretary for John Luksich
2. Patent Disclosures: None
3. Spring 2007 Charlotte NC Meeting Minutes were approved without comment or discussion.
4. Nov. 2007 IEEE Electrical Insulation Magazine Article "Dissolved Gas Analysis of Alternative Fluids for Power Transformers" was discussed for comparison to recent EPRI testing.
 - a. The ability to diagnose Natural Esters with exception of key gases. Dave Hanson, TJH2b, commented that ethane might be a gas that is being different. Russell Martins mentioned that the University of Manchester study and CIGRE study also showing ethane higher ethane level it with different esters, perhaps due to double bond meeting up with hydrogen, the ethane higher ethane level it with different esters. Mark Scarsborough shows slow build up then levels out for both Hydrogen and Methane.
 - b. Dave Hanson, TJH2b, discussed the DGA results.
 - c. Republished article with corrections or additions copy should be posted on Internet site.
5. EPRI Natural Ester Testing Project Update
 - a. Patrick McShane, Cooper Industries, filling in for Luke van de Zel, showed key slides from the current (through Sept) testing done for EPRI by Power Tech lab.
 - b. Comments regarding DGA results
 - i. The results also show higher methane for most of the tests compared to mineral oil methane levels.
 - ii. Fredi Jacob, Weidmann, No ethylene but high hydrogen gas concentration noted. Speculated that reaction taking place.
 - iii. Several slides titled wet paper, no note for the amount of wetness.

- iv. Natural ester gassing tendency much lower than mineral oil.
 - v. Discussion about partial discharge testing
6. Partial discharge testing thought to have been tested at 20C to 24C
 - a. Recommend to EPRI to test between 50C to 80C.
 7. Natural ester could not determine point when partial discharge advanced to arcing.
 - a. Speculated due to viscosity or gassing tendency
 - b. EPRI expects to complete the current Phase II study this year. They are soliciting from the Industry what studies would be recommended for Phase three, not limited to DGA.
 - i. Partial discharge testing temperature range 50C to 80C
 - ii. Relative solubility to temperature for DGA gasses.
 - iii. Include other manufacturers in project
 - c. The partition coefficients values show some disagreement between IREQ and Power Tech values for the same natural ester (70C).
 8. The partition coefficients values show some disagreement between IREQ and Power Tech values for the same natural ester (70C).
 9. TF chair asked can the differences be significant between different natural esters fluid products?
 10. Clair Claiborne, ABB, showed results of study by IREQ for a different type of natural ester at 70C comparing to the study done earlier on the fluid being tested in the EPRI study.. The values also showed close correlation for most, but not all, gases.
 - a. 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.
 11. Any field experience with abnormal or fault? No committee response
 12. Future plans
 - a. Analysis of EPRI data using current mineral oil tools for presentation to Spring 2009 meeting
 - b. Make determination if enough information is available to issue a recommendation to subcommittee for a while paper or DGA guide.

A motion for adjournment was received from Joe Kelly, S.D. Myers, and seconded by the committee

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

Tuesday, October 7, 2008 Porto, Portugal

Minutes of WG Meeting

Fredi Jakob called the WG meeting to order at 12:05 pm, Tuesday, October 7, 2008. WG Secretary Susan McNelly was also present. There were 17 members and 30 guests present with 4 guests requesting membership.

Guests requesting membership were:

1. Frank Damico
2. H. Jin Sim
3. Clair Claiborne
4. Karsten Viereck

Meeting Agenda:

1. Welcome
2. Introduction
3. Patent Disclosure
4. Approval of Minutes from Spring 2008 Meeting
5. Review of Draft 9.1 of the guide
6. New Business
7. Adjourn

1. Introductions of the participants were made.
 - a. 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.
2. Approval of minutes from the Spring 2008 meeting in Charlotte, North Carolina was requested. The minutes were approved as written.
3. **Review of Draft 9.1 of the guide:**
 - a. Information from Jim Dukarm on the LTC DGA samples was presented by the Chair.
 - b. The following commentary was provided by Jim:
 - i. For the gas concentration norms, the left one is the C0.95 norm as derived in Addendum A. The right one (enclosed in parentheses) is the corresponding outlier rejection limit U. See the text at the end of the gas concentration norm 'recipe' for some discussion of these.
 - ii. In Example 1, both the ethylene/acetylene and the hot-metal/acetylene ratios are normal right up to the last sample shown, where they have extreme values. In this example, the gas concentrations are so low in all but the last sample that the gas ratios would have been meaningless.
 - iii. In all samples, gas concentrations were well below their respective limits.
 - iv. In Example 2, the gas ratios remain low and relatively constant in all samples. The ethylene, total hot metal gas, and acetylene all become noticeably high in the last two samples. Here we notice the usefulness of the advice given in the statistical Addendum where it is stated that if the percent-point limit C0.95 for a combustible gas is drastically higher than the outlier rejection limit U, then U should be considered for use as the caution limit for that gas.
 - c. The following comments from Jack Harley were discussed:

- i. Comment 1: The gas levels discussed at the last meeting were quite high. Explosion level for acetylene in air is 2.5% or 25,000 PPM. Should there be a safety warning about C₂H₂ and the hot metal gases when readings get this high?
 1. TV indicated that it would be good to have a statement in the guide. Tom Prevost indicated that if you do, that you would need to set limits. The guide is for diagnostics. Comment from Dave Hanson was that anytime you are handling the fluid you need to be aware of the concern.
 2. Fredi Jakob asked for a motion. TV Oommen proposed that a safety warning be included. There were inclusive results from the vote. Fredi explained that setting limits would be difficult as individual gas limits would be meaningless. Jack Harley asked the question of whether as the typical user would know that there was a risk of opening a unit with this type of concentration of acetylene. He was in favor of some type of warning.
 3. Fredi indicated that a reference to the sampling guide be made. Beauchemin indicated that he didn't feel this resolved the issue of the safety issue. Fredi asked Jack and Claude to propose some wording for the document. Jin Sim requested that they contact Paul Griffin from Doble for more information.
- ii. Comment 2: What is the effect of gas solubility in oil on the readings? For example, if a field chromatograph is being used in the gas space, will the readings be the same as in the oil? And is there a saturation level for C₂H₂ or the hot metal gases in oil?
 1. Fredi Jakob indicated that the answer to this is no. There won't be any agreement. The answer to the second part of Jack's question is yes, there is a saturation level, but it is very high and would never happen. Jack indicated that the new automated methods of taking samples may be in the head space. Fredi indicated that most look at the gas-in-oil. A total combustible would be the only
- iii. Comment 3: A sample spread sheet showing the formulae in the cells would be very helpful.
 1. Fredi will ask Jim Dukarm w provide the spreadsheet in the document.
- iv. Comment 4: from Vijayakumaran Moorkath:
 1. "This standard is applicable only for oltc operating in mineral oil. There are LTCs operating in silicone oil and also natural ester. Are we planning to have a separate standard for these applications? Further, it is mentioned in cl.1.1.1 Scope, that the evaluation criteria is for mechanical damage or failure. I think the DGA should indicate initiation of dielectric failure of insulation components in diverter switch."
 2. Response from Fredi Jacob: No, we will not be addressing silicone or natural ester fluids in this guide. It is too late to change the scope and they will have different values just as in the main tank. Regarding
- d. The latest draft, 9.1, was reviewed section by section with additional changes identified to be included in the next draft 10. The following items need to still be addressed:

- i. Clause 6.3.1 – Question on where did the code come from. Provide reference.
 - ii. Add THG and Hot Metal Gases to the list of definitions in clause 3.
- e. Fredi reviewed the case histories document.

The meeting was adjourned at 1:15 pm.

Fredi Jacob

Chair

Susan McNelly
Secretary

7.3.3.4. C57.104 – IEEE Guide for the Interpretation of Gases Generated in Oil – Immersed Transformers
Tuesday, October 7, 2008
Porto, Portugal

The meeting was called to order by Vice Chair/Secretary, Susan McNelly at 3:00 pm on Tuesday, October 7, 2008. Chair Rick Ladroga was not able to attend. There were 28 members, 35 guests, and 7 guests requesting membership.

Guests requesting membership were:

1. Van Nhi Nguyen
 2. Cui Yuanzhong
 3. Larry Weathington
 4. Robert Ganser
 5. George Kennedy
 6. Robert Thompson
 7. Frank Damico
1. Approval of minutes from the Spring 2008 meeting in Charlotte, North Carolina was requested. The minutes were approved as written.
 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. There were no responses to the request for disclosure.
 3. Due to a late start, introductions of attendees were not made.
 4. **Update on status of recent ballot on C57.104:**
 - a. PC57.104 was approved as a revision standard by the IEEE-SA Standards Board on 26 September 2008. Thanks are extended to the WG and the ballot resolution committee (Ladroga, Prevost, McNelly, & Beauchemin) for helping get this document through the approval process.
 5. **New Guide:** A new PAR request will need to be filed to start over with an immediate revision to the guide to address the remaining issues that have been raised as soon as the ballot process with the existing document is complete. Tom Prevost indicated that before a PAR can be submitted there will be a large effort required to determine the Scope and

Purpose paragraphs for the new guide. The goal will therefore be to have a draft of the project scope and purpose sent out prior to the next meeting for review and comment.

6. Status reports from Task Forces:

a. Framework

Jim Dukarm - Chair
Tim Raymond
Dave Hanson
Jim Graham

No further progress until a more detail direction from the scope and purpose can be made.

b. Data:

Norman Field – Chair	Claude Beauchemin
Dave Hanson	Jim Dukarm
Paul Boman	Dave Wallach
Paul Mushill	Jim Graham
Bob Ganser Jr	Joe Kelly
Tom Prevost	

- i. Norman Field called in with a presentation on the data that has been collected to date (22000 records). After the meeting, Matt Kennedy from Doble indicated that he had previously submitted 48000 records, but that he would forward that data to Norman. The presentation provided by Norman is included below.
- ii. During the Charlotte, NC meeting five additional people offered to help:
 - Shawn Galbraith - Brian Sparling
 - Matthew Lawrence - Shuzhen Xu
 - Andre Lux
- iii. Norman indicated that if these 5 or any others would like to become TF members to please contact him at norman.field@wicor.com.

c. Data solicitation:

- i. Each TF member received a solicitation for transformer DGA data
- ii. In addition, a list of “Essential” transformer information to accompany the DGA data was proposed
- iii. To date, one member has provided feedback and DGA data. TF Chair will follow-up with all TF members shortly after Porto meeting.
- iv. “Essential” Transformer Data:

-Type (GSU, SubStn, Auto, etc.)	- Manufacturer
-No. of phases	- Year of Manufacture
-MVA	- Serial Number
-HV Voltage / BIL	- Oil Volume
-Rated temperature rise	- Oil Preservation System
-Coolant type (Mineral oil, Silicone fluid, etc.)	
-Reason for sampling	

**** The above is open to suggestion ****

- v. Fluid Sample Info to Accompany DGA:
 - Date Sampled
 - Fluid Temperature
 - Date DGA Performed

d. Data received:

- i. Dave Wallach of Duke Energy has provided transformer DGA data along with all “essential” data fields
–32,000+ DGA samples
–3,400+ transformers
- ii. This data is available to the C57.104 Working Group.

e. Data Analysis:

- i. For comparison to the infamous Table 1 of C57.104, the data population was analyzed with respect to percentile values.
- ii. The Duke Energy dataset was filtered as follows:
–Removed mobile transformers
–Removed xfmr with top rating < 10,000 kVA
–Reason for sampling was provided for most samples. As such, removed DGA samples:
 - Taken immediately after degassing
 - Taken due to a “Trip” or “Equipment Failed” alert(Remember: This DGA population is meant to represent xfmr in service without a failure.)
- iii. The filtered Duke Energy dataset represented
–22,000+ DGA samples
–1,500+ transformers
- iv. Each gas (H₂, CH₄, C₂H₆, C₂H₄, C₂H₂, CO, and CO₂) has a probability distribution that follows a LOG-NORMAL distribution.
- v. For this reason, the data was analyzed using the method described in the latest Draft of C57.139 – Interpretation of LTC DGA.
- vi. Summary of Dissolved Gas Percentile Points

	H2	CH4	C2H6	C2H4	C2H2	CO	CO2
Median	49	22	16	5	1	349	2303
80th Percentile	314	168	181	35	1	805	5480
90th Percentile	599	342	419	69	1	1077	7407
98th Percentile	2867	1896	3229	359	1	2178	15371

f. Further work:

- i. More DGA data is needed. *(note from Susan McNelly – After the meeting adjourned, Matt Kennedy from Doble indicated that he had previously provided 48000 data samples for use. The information was apparently misplaced and he will resend the information directly to Norman Field.)*
- ii. Jim Dukarm is working on developing statistically meaningful methods to diagnose gassing rates.

g. Comments after the presentation:

- i. Tom Prevost indicated that the phenomenon of oil-to-paper ratios need to be addressed since transformer size has been an issue during past discussion on revisions to the guide. Norman indicated that the oil quantity is easy to obtain, however the paper quantity would be difficult to obtain.
- ii. TV Oommen asked if there was a way to sort out the data to determine what quantity of units in the data set had faults and what type. Norman indicated that this information was available for the data submitted to date.

- iii. Claude Beauchemin asked if the type of preservation system is known. Norman indicated that this information is available and will be important, especially for the CO and CO₂ ratio. Robert Thompson commented that until recently the Duke units above 10MVA were all free breathing conservator units.
- iv. Robert Thompson asked if the moisture levels were captured in the data. Norman indicated that the information was available, but that it was not used to filter the data.
- v. Catherine Hurley requested that a form for the required data be provided on the web so that additional data provided would include all of the needed information.

h. Case Studies:

Brian Sparling –Chair	Jim Graham
Kent Haggerty	Paul Boman
Dave Wallach	Bob Ganser Jr.
Dave Hanson	Paul Mushill
Tim Raymond	Joe Kelly
Norman Field	

No report at this time.

i. Diagnostic Methods

Tim Raymond – Chair	Lance Lewand
Michel Duval	Joe Kelly
Jerry Corkran	Norman Field

No report at this time.

The meeting was adjourned at 3:40 pm.

Susan McNelly
WG Vice Chair and Secretary

7.3.3.5. TF Guide for Field Application of Natural Ester Fluids

Tuesday 10-7-08 4:15 – 5:30

Jim Graham Chair

Patrick McShane (Acting Secretary)

Introductions and Attendance Sheets

Patent Disclosure – None Disclosed

Approval of Task Force Report from 18 March, 2008 Meeting – Approved

Document Title: Guide for Field Application of Natural Ester Fluids

Chairman: James Graham

Vice Chairman: Jerry Murphy

PAR Status: In development

Current Standard Copyright: ☒ IEEE ☐ NEMA ☐ OTHER

Current Draft Being Worked On: Draft 1 **Dated:** March 2008

Meeting Date: 10/07/2008 **Time:** 4:15 – 5:30 PM

Attendance: There were 5 members, 27 guests, and 5 guests requesting membership.

1. The meeting was called to order at 4:25 PM, introductions were made, and an attendance roster was circulated. The chair asked the group if there were any patents that needed to be disclosed. None were announced to the group. The task force report from the Spring 2008 meeting was reviewed and approved.
2. The task force schedule was discussed briefly. There was a short discussion regarding the type of document the task force should recommend, a standard vs. a guide. The task force members will be polled for a consensus decision prior to submitting a recommendation to the subcommittee. The intent is to submit a PAR for subcommittee and main committee consideration prior to the next transformer committee meeting.
3. The proposed scope and purpose were presented and reviewed for additional comments. Most of the comments centered on the types of equipment to be covered by the document. The consensus is to revise the scope to include a broad range of equipment without listing specific types.
4. The need for a condition assessment guide to help to determine if it is reasonable to retro fill a mineral oil immersed piece of equipment with natural ester fluid. The chair took this under advisement.
5. It was suggested the document include a statement regarding the proper disposal of the fluid at the end of its useful life, but defer to appropriate regulatory agencies for specifics.
6. Other topics discussed to consider in the guide, included
 - a. NE fluid applications (the do's and don'ts of using NE fluid)
 - b. New equipment fluid filling procedures
 - c. Retro filling procedures
 - d. Post fill procedures for both new filling and retro filling
 - e. Cold start issues
 - f. Radiator and cooler issues
 - g. Operational impacts related to field testing
 - h. Transportation and storage requirements for natural ester fluids
7. A call for volunteers was issued to research existing documents relating to mineral oil and alternative fluids for possible reference. Russell Martin CIGRE TF Chair offered to share documents on alternative fluids they have found. Martin Alsina Navarro, Siemens Brazil has a collection on alternate fluids to share.

The meeting adjourned at 5:30.

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 Oporto for this Guide. IEEE Std 637 –The Reaffirmation approved by SA Board 9/27/2007, which expires on 12/31/12.

7.3.4. Old Business

None

7.3.5. New Business

Item 1: Patrick McShane brought up the fact that it has recently come to his attention that some Medium and Large Power OEM have specification on limits for particulate in dielectric coolants, as received and in oil in new transformers. However, there appear no known standard limits set for transformer fluids by ASTM, IEC, or IEEE. After discussion, a motion was made and passed to form a Task Force to investigate the issue and determine if there is a need to develop a standard for particulate limits for new fluid, as received in new equipment, and continued use. Mark Scarsbough volunteered to chair the TF.

Item 2: Bob Rasor of SDMyers proposed to create a new TF to study moisture levels as related to transformer power factor readings. While C57.106 has limits on moisture level (in ppm) for mineral oil, and by extension C57.152, they do not address temperatures and relative saturation. This issue came up in the C57.152 WG (Field Test Guide) meeting and was also discussed in a paper presented by Jin Sim in a TF under the Insulation Life SC at this Fall 2008 Transformer Committee Meeting. This task force recommended that the issue belonged with the Insulating Fluids SC not the Insulation Life SC. Tom Prevost made a motion that a TF be created under the Dielectric Fluids SC to review this issue. The motion carried and a call for volunteers was made. The following meeting attendees volunteered to serve on the TF:

- Claude Beauchemin,
- Paul Boman
- Matt Kennedy
- Hali Moleski
- Don Platts
- Bob Rasor

Item 3: William Bartley advised that C57.111 Guide for Silicone was due to expire and withdrawn on 12/21/08. A request for WG volunteers was made. There were no volunteers. (PostScript: After the meeting Paul Boman volunteered to be the WG Chair and Paul has begun the reaffirmation process)

Item 4: The need for an Ad Hoc committee was discussed regarding the determination of what, if any, existing and current TC standards projects need revision to include (or specifically to exclude) alternative dielectric fluids. Another issue is to determine that all TC standards have consistent references to each type of insulating fluid. (PostScript: Immediately following the SC meeting, an informal Ad Hoc meeting was held by several interested parties. At the recommendation of Tom Prevost, volunteers were assigned to review all transformer standards to determine and list those that include references to specific, or in general, to dielectric fluids. A report on the findings and recommended action is to be written and presented at the next meeting of the TC Standards Committee.)

7.3.6. Adjournment

The Subcommittee adjourned at 4pm.

Next Meeting:

The Insulating Fluids Subcommittee and its Working Groups will next meet in Miami, Florida in March 2008.

Respectfully Submitted

Richard Ladroga
Fluids SC Chair

Susan McNelly
Fluids SC Vice-Chair

Patrick McShane
Fluids SC Secretary

Annex to Insulating Fluids SC Report F08

Draft 7

TASK FORCE TITLE:

Guide for Field Application of Natural Ester Fluids

SCOPE:

This guide recommends procedures for the field use of natural ester fluids in liquid-immersed equipment.

This shall include but not be limited to distribution transformers; regulating transformers; generator step up and unit auxiliary transformers; network & submersible transformers; phase-shifting transformers; voltage regulators; shunt reactors; and associated components requiring insulating fluids.

This guide is not intended to determine the suitability of this fluid in specific transformers.

PURPOSE:

The purpose of this guide is to provide users of liquid immersed equipment with information for the application of natural ester fluids as an insulating medium. This will include field procedures for filling new equipment and retrofilling existing equipment with natural ester fluid.

NEED:

The use of natural ester fluids as an insulating medium in liquid-immersed equipment is increasing. Detailed knowledge of the handling and testing of natural ester fluids is not widespread among users.

STAKEHOLDERS:

Stakeholders in this project include utilities, industrial, government agencies & commercial users, transformer & component manufacturers, field service organizations, repair facilities, remanufacturers, and suppliers of natural ester fluids.