Insulating Fluids Subcommittee
R.K. Ladroga, Chair; Susan McNelly, Secretary

Submitted By Richard Ladroga
Thursday, October 26, 2006

Introduction/Attendance
The Insulating Fluids Subcommittee met in Costa Mesa, California on Wednesday, October 25, 2006 with 13 members and 35 guests present. The following 5 guests requested membership:

Ray Bartnikas
Juan Castellanos
Claire Claiborne
Bill Darovny
Tom Prevost

Approval of Meeting Minutes

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 Costa Mesa, California meeting were approved as written.

Rick Ladroga announced that Frank Gryszkiewicz has stepped down from the position as Chair of the committee to concentrate on health issues.

Introductions were made.

Subcommittee Membership

There were no changes to report in the Subcommittee Roster.

Current Subcommittee Business

1. C57.147 - IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers
   Tuesday, October 24, 2006
   Montréal, Québec

   The WG meeting was called to order at 8:00 am, on Tuesday, October 24, 2006 by the working group Chair, Patrick McShane. Vice Chair, Clair Claiborne and Secretary, Susan McNelly were also present. There were 12 members present and 47 guests, with 2 guests requesting membership.

   Guests requesting membership include:
   Don Chu
   Jeff Tennant

   Meeting Agenda
   1. Call to order and introductions

DGA Data

IEEE Transformers Committee
C57.104 Working Group

October 24, 2006
Montreal, Quebec

The following information is provided for the sole use of the PC57.104 working group. This information can not be used or referenced for any other purpose.

Weidmann-ACTI
Data from all transformers tested October 2002 to August 2006

Sample size = 133,610 Samples

Percentile	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG
98^{th}	557	418	410	456	32	1259	15929	2755
95^{th}	144	152	178	121	5	957	11011	1462
90^{th}	63	76	76	57	1	735	8100	1036

GE
Data from all transformers tested May 1990 to October 2000
Presented at PC57.104 WG Meeting March 2006.

Sample size = 35,249 Samples

Percentile	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG
98th	509	391	258	773	58	1564		3106
95th	166	126	84	189	9.1	1180		1730
90th	79	44	65	67	2	932		1246

C57.104-91 Table 1 Values

Condition	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
1	100	120	65	50	35	350	2500	720
2	101-700	121-400	66-100	51-100	36-50	351-570	2501-4000	721-1920
3	701-1800	401-1000	101-150	101-200	51-80	571-1400	4001-10000	1921-4630
4	>1800	>1000	>150	>200	>80	>1400	>10000	>4630

For discussion Table 1 simplified:

Condition	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
1	100	120	65	50	35	350	2500	720
2	700	400	100	100	50	570	4000	1920
3	1800	1000	150	200	80	1400	10000	4630

* TDCG does not include CO_2 which is not a combustible gas

	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
C57.104-91 Cond. 1	100	120	65	50	35 (1)	350	2500	720
W-ACTI 90%	63	76	76	57	1	735	8100	1036
GE 90%	79	44	65	67	2	932		1246
Note: (Red) values indicate proposed revision from March 21, 2006 WG meeting								

	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
C57.104-91 Cond. 2	700	400	100	100	50 (9)	570	4000	1920
C57.104-91 Cond. 3	1800	1000	150	200	80 (35)	1400	10000	4630
W-ACTI 95%	144	152	178	121	5	957	11011	1462
GE 95%	166	126	84	189	9.1	1180		1730
Note: (Red) values indicate proposed revision from March 21, 2006 WG meeting								

	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
C57.104-91 Cond. 3	1800	1000	150	200	80 (35)	1400	10000	4630
W-ACTI 98%	557	418	410	456	32	1259	15929	2755
GE 98%	509	391	258	773	58	1564		
Note: (Red) values indicate proposed revision from March 21, 2006 WG meeting								

	H_2	CH_4	C_2H_6	C_2H_4	C_2H_2	CO	CO_2	TDCG*
C57.104-91 Cond. 1	100	120	65	50	35 (1)	350	2500	720
W-ACTI 90%	63	76	76	57	1	735	8100	1036
GE 90%	79	44	65	67	2	932		1246
	H_2	**CH_4**	**C_2H_6**	**C_2H_4**	**C_2H_2**	**CO**	**CO_2**	**TDCG***
C57.104-91 Cond. 2	700	400	100	100	50 (9)	570	4000	1920
C57.104-91 Cond. 3	1800	1000	150	200	80 (35)	1400	10000	4630
W-ACTI 95%	144	152	178	121	5	957	11011	1462
GE 95%	166	126	84	189	9.1	1180		1730
	H_2	**CH_4**	**C_2H_6**	**C_2H_4**	**C_2H_2**	**CO**	**CO_2**	**TDCG***
C57.104-91 Cond. 3	1800	1000	150	200	80 (35)	1400	10000	4630
W-ACTI 98%	557	418	410	456	32	1259	15929	2755
GE 98%	509	391	258	773	58	1564		
Note: (Red) values indicate proposed revision from March 21, 2006 WG meeting								

Conclusion:

- For the next revision of C57.104 the proposed acetylene values for table 1 are appropriate.

Comment:

- For the future revision of C57.104
  - More data should be collected
  - The WG should decide on percentile values for condition limits
  - The condition limits should be based on data and percentiles

C57.139

Dissolved Gas Analysis Of Load Tap Changers

Working Group

Data Analysis Update

Data Gathering

- Since the Spring 2006 Meeting, the following data has been supplied.
  - Hartford Steam Boiler - Paul Boman submitted 397 records
  - Duke Energy Carolinas - 2334 records
  - GE - 6371 records. The database is missing LTC type information so categorization is not possible at this time. No follow-up with GE has been initiated as of yet.
- Present count of usable records is ~2,700.
- Conclusion – we need more data

Example

- To demonstrate where we can take the data, we used Duke Energy (Carolinas) McGraw 550 OLTC data as an example.
  - Arcing type
  - No breather
  - Continuous filtration
- 591 records included in the analysis

Definitions

Ratio 1

$$\frac{Ethylene}{Acetylene + Hydrogen}$$

Ratio 2

$$\frac{Ethylene}{Acetylene}$$

Ratio 3

$$\frac{Methane + Ethylene + Ethane}{Acetylene + Hydrogen}$$

Ratio 4

$$\frac{Methane + Ethylene + Ethane}{Acetylene}$$

Ratio 5

$$\frac{Ethane}{Methane}$$

Ratio 6

$$\frac{Ethylene}{Ethane}$$

Gas Content

Average Values, Key Gasses PPM

Methane	Ethane	Ethylene	Acetylene	Hydrogen
CH4	C2H6	C2H4	C2H2	H2
102.795	48.465	245.704	795.983	260.130

Standard Deviation with all ppm levels less than 90th percentile, Key Gasses PPM

Methane	Ethane	Ethylene	Acetylene	Hydrogen
CH4	C2H6	C2H4	C2H2	H2
18.292	17.263	45.911	173.788	48.435

Percentiles, Key Gasses PPM

	Methane	Ethane	Ethylene	Acetylene	Hydrogen
Percentile	CH4	C2H6	C2H4	C2H2	H2
10.00%	1.000	0.000	1.000	1.800	0.000
20.00%	1.000	0.000	3.000	5.900	0.000
30.00%	2.000	1.000	5.000	12.000	11.000
40.00%	4.000	2.000	8.000	20.000	21.000
50.00%	7.000	3.000	14.000	33.000	30.000
60.00%	11.000	5.000	22.000	59.000	49.000
70.00%	24.000	11.000	39.000	113.000	70.000
80.00%	47.000	30.000	85.000	279.000	107.000
90.00%	126.000	132.000	354.000	1044.000	270.000
95.00%	426.000	315.000	1634.000	3597.000	619.000
98.00%	1763.400	550.800	3613.400	10771.200	2351.800

Ratios

McGraw 550CS LTC, Sealed with continuous online filtration

Number of records 561

Average Values, Ratios

R1	R2	R3	R4	R5	R6
0.365	0.788	0.807	2.961	0.592	4.391

Standard Deviation, Ratios less than 90th percentile

R1	R2	R3	R4	R5	R6
0.097	0.132	0.203	0.389	0.341	4.050

Percentiles, Ratios

Percentile	R1	R2	R3	R4	R5	R6
10.00%	0.043	0.160	0.088	0.233	0.000	0.000
20.00%	0.098	0.211	0.176	0.296	0.000	0.000
30.00%	0.127	0.235	0.222	0.337	0.146	0.143
40.00%	0.152	0.253	0.249	0.387	0.250	0.905
50.00%	0.180	0.286	0.283	0.450	0.375	2.500
60.00%	0.207	0.323	0.345	0.537	0.500	4.167
70.00%	0.244	0.373	0.438	0.667	0.600	7.000
80.00%	0.297	0.474	0.597	1.011	0.878	9.750
90.00%	0.429	0.769	1.330	2.714	1.286	11.885
95.00%	0.690	1.786	2.759	8.064	2.000	13.541
98.00%	1.898	4.366	8.529	21.289	3.089	15.629

Ratios

- Mc Graw 550 example
  - Ratios do not pick up sum of hot metal gasses

2. Approval of Spring 2006, Costa Mesa WG minutes and patent announcement
3. Review outstanding issues in the latest C57.147 Draft Guide
    a. Status of Clause 4.7 – Impact of green tint on ASTM D1500 color test and interpretation.
    b. Status of permission from Doble on their reporting of DGA
    c. Status of Task Force on Section 4.14, Oxidation Inhibitors
    d. Status of Task Force on Clause 4.15
    e. Status of permission from Doble to include their data on Gassing Tendency for Clause 4.17.

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 Spring 2006 meeting were approved as submitted and recorded on the website.

Review of outstanding issues:

Question on how to contact the Nationally Recognized Testing Laboratory (NRTL) was asked. This is a listing of laboratories, not an entity. OSHA would be able to provide information on these laboratories. A note will be added to the guide indicating this.

Status of Clause 4.7 – Impact of green tint on ASTM D1500 color test and interpretation was questioned at the Costa Mesa Meeting. It has been confirmed that this does not impact the test results.

Status of permission from Doble on their reporting of DGA. - Permission was granted.

Clause 4.13 – Suggestion was made to add a note that head space monitors may need to be recalibrated or that the solubility coefficient may need to be changed for calculation. Perhaps include a coefficient index in the guide. Comment was made that the differences are small and may not be worth discussing. Under thermal stress Natural Ester fluids produce more gas and under electrical stress produce less gas. Thanks to Doble for allowing us to use their information in the Annex.

Status of Task Force on Section 4.14, Oxidation Inhibitors – Section was rewritten indicating that oxidation stability can be an issue, particularly with thin films. Added a note to contact the manufacturer regarding detection and maintenance of antioxidants and recommended exposure prevention.

ASTM has formed a task force to develop a method that allows people to differentiate the range of oxidation stability in natural esters and the effectiveness of the inhibitors.

Clause 5 – Added a reference to Table 5 “limits for continued use” to the recently added Annex B.4: suggested key property values for natural ester fluid field samples to “trigger further investigation”. .

Clause 6 – Added “Equipment with residual ester fluid should be sealed from continuous air exchange and contaminates” to this clause.

Table 1 – Added back in reference to Clause 4.6, which was inadvertently dropped.

Table 5 – There is not enough experience to come up with appropriate values, a reference to Annex B.4 was added to note b to provide guidance rather than firm values.

Clause 9.1 – Added “For units with pressure gauges, constant periodic readings of zero gauge pressure is a strong indication of a head space leak,” was added. Suggestion was made to add “or some other problem that should be investigated” to the end of the statement

Annex B – Discussed additions as a result of Doble providing permission to use information in the guide.

Question was asked what the Fluids A and B are. Doble will provide an average algorithm to allow only one natural ester fluid column to be shown rather that two shown in Draft 9.

Clause B.4 in Annex B – Discussed the table values and title. Will need to clear up the title to the Clause and Table. Suggestion was made to have the Power Factor test to be also shown for the test done at 100C rather than just at 25C. The question is what should the value be? The value would be very high and would vary. Doble will check their data base for values at 100C and provide feedback on whether it would make sense to include.

A motion was made to make changes agreed on today. A draft will be sent out for straw ballot to the full Subcommittee. Unless there is a significant rejection, we will proceed to ballot what is designated as Draft 10.

A request was made to consider an annex or a separate guide for retrofilling mineral oil units with natural esters. The Chair stated that a guide on retrofilling is beyond the scope of the Par for this proposed guide. (This is a matter for the Subcommittee to address) However, a table showing typical key property values vs. various ratios of mixture of natural esters and conventional mineral oil will be considered.

A request was made to consider a DGA guide for natural esters, such as C57.104 for mineral oil and C57.xxx for silicone oil. The Chair stated that a guide on DGA is beyond the scope of the Par for this proposed guide. (This is a matter for the Subcommittee to address).

The meeting was adjourned at 9:20am.

Respectfully Submitted
Patrick McShane
Working Group Chair

Clair Claiborne
Working Group Vice-Chair

Susan McNelly
Working Group Secretary

2. C57.106 – IEEE Guide for Acceptance and Maintenance of Insulating Oil in Equipment

   October 24, 2006

   From: Chair and Vice Chair of Working Group to Revise C57.106 (PC57.106)
   To: IEEE Transformer Committee and IEEE Insulating Fluids Subcommittee

   The Working Group for the revision of the IEEE Guide for Acceptance and Maintenance of Insulating Oil in Equipment (or IEEEC57.106) met at Montreal, Quebec, Canada on Tuesday October 24, 2006. The meeting was chaired by T.V. Oommen. There were 2 members and 24 guests. A request for any patent disclosures received no response. The Working Group history for the last eight meetings was briefly reviewed as follows.

   As a result of the April 2002 Vancouver meeting, T.V. Oommen and Jim Thompson co-chaired the first Study Group in Oklahoma City on October 23, 2002. The PAR was approved from December 2002 until December 2006. After the Oklahoma meeting there were seven consecutive Working Group meetings, all at Transformer Committee Meetings. PDF files of the power point presentations for those meetings are presently posted on the Transformer Committee webpage (Go to http://www.transformerscommittee.org and then go to the links Insulating Fluids and C57.106).

   T.V. then gave the results for PC57.106/D6 recirculation ballot conducted from October 6, 2006 through October 16, 2006 as follows. The ballot received 113 affirmative votes and 6 negative votes with comments including one negative vote with comments on the recirculation ballot (Note on the one re-circulation comment: This comment submitted on the recirculated draft was determined to be a restatement of the previous negative comment and considered un-resolvable), 2 negative votes without comments and 2 abstention votes. The result was a 95% affirmative rate.

   T.V. reported that based on the efforts made to resolve the negative comments on the initial ballot, and the determination that the single negative ballot comment in the recirculation ballot was a restatement of the initial ballot negative comment and was unresolvable, then in obligation to the majority of the 95 % affirmative votes on the recirculation ballot - the PC57.106/D6 document was submitted to RevCom for approval at the December 2006 meeting.

   Respectfully submitted,

   Jim Thompson, Chair PC57.106 Working Group
   TV Oommen, Vice Chair PC57.106 Working Group

3. C57.139 - Draft IEEE Guide for Dissolved Gas Analysis Of Load Tap Changers
   Tuesday, October 24, 2006
   Montréal, Québec
   Minutes of WG Meeting

   Fredi Jakob called the WG meeting to order at 11:05 am, Tuesday, October 24, 2006. WG Secretary Susan McNelly was also present. There were 18 members and 40 guests present with 7 guests requesting membership.

   Guests requesting membership were:

Ray Bartnikas
Juan Castellanos
James Dukarm
George Frimpong
Charles Garner
Tom Prevost
Frank Wolf

Agenda:

1. Welcome and Introduction
2. Patent considerations
3. Approval of Spring 2006 minutes
4. Dave Wallach presentation on DGA results
5. Update on Doble LTC Activities
6. Draft 8 and comments
7. Adjourn

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 Spring 2006 meeting in Costa Mesa, CA was requested. The minutes were approved as written.
Presentation by Dave Wallach (attached):


F06-DJWSlides.pdf

Dave provided a lot of data points for a particular model of LTC. We would like to have a discussion on what would be a reasonable approach to determine threshold values.

Dave also provided an update on data received from other sources. He has received data from Hartford Steam Boiler, Duke Energy Carolinas, and GE (missing LTC type info, need to follow up with GE). Present count of usable records is 2700.

Using data from a McGraw 550 OLTC as an example, Dave calculated six different ratios. Dave provided a summary of results. A copy of Dave's presentation is included in these minutes.

Fredi commented that the 90th percentile selection may be too low. For thresholds, the gases have to be at least at a certain level to have confidence in the ratios. Should the 90th percentile values be used as the threshold gas levels?

Fredi suggested that we possibly need to reverse the process and look at only the problem units and set values based on those units. However, this further lowers the number of usable records. Without adequate data, we can't do more than a purely statistical approach.

Jim Dukarm discussed the statistical approach method. You want to be able to put all of your resources towards the problem units. You need to be able to distinguish the lower risk from the higher risk units. This will then allow you to focus resources at the higher risk units.

Fredi and Dave will formulate an approach. The concensus was a two table approach. The first test will tell you whether you need to increase the testing interval to look at the rate of increase. Also Jim Dukarm will look into providing a Weibull distribution for the data available from Dave for the next meeting.

A question was asked as to what constitutes a failure. Fredi indicated we are not talking about mechanical failures, but rather issues such as coking of the contacts, basically a situation or problem that can be detected by means of a DGA.

Update on Doble LTC Activities (Lance Lewand):

Doble started to accumulated data back in the 1990s and started working on the guide in about 1997.

Doble was able to take a manufacturer and apply a model and provides limits to go by.

Previous work is based on >50000 data points. They recognized that several models were not covered. Current work is to update information on about 5 new models. As more DGA information is received on new models it will be updated.

Before adjourning, Fredi asked if there were any volunteers to help him review Draft 8 and comments on it. Jim Dukarm and Tim Raymond volunteered to help.

The meeting was adjourned at 12:15 pm.

Fredi Jakob
Chair

4. C57.104 – IEEE Guide for the Interpretation of Gases Generated in Oil – Immersed Transformers
Tuesday, October 24, 2006
Montréal, Québec

The meeting was called to order by Richard Ladroga at 1:50 pm, Tuesday, October 24, 2006. The Vice-Chair, William Bartley and Secretary, Susan McNelly were also present. There were 22 members, 53 guests, and 8 guests requesting membership.

Guests requesting membership were:

Claude Beauchemin
Jerry Corkran
John Crouse
Dieter Dohnal
Jim McIver
Paul Mushill
Jerry Murphy
Dan Perco

Approval of minutes from the Spring 2006 meeting in Costa Mesa, CA was requested. The minutes were approved as written.

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.

Rick went over the history of the Guide for the benefit of those not present at the Costa Mesa meeting. The PAR for revision was established in 1996, and was extended in 2000, 2002, and 2004. There were some significant negative ballots during the balloting process. Due to the comments that were outstanding, a decision was made in Memphis to withdraw the standard. A decision to withdraw the 1991 Guide was made at the same time because of the disagreement over the values and to stress the importance of moving ahead. Therefore, at this time, there is no approved guide available.

A new PAR has been filed to start over with the guide. A proposal was made to make minor changes to the 1991 Guide that would allow it to be put out for use, and then start an immediate new revision to cover the issues that were raised during the recent ballot.

C57.104-1991 – Proposed changes to get document approved as a temporary measure while a full revision is restarted.

Section 4.4 - Evaluation of Transformer condition using individual and TDCG concentrations. Rick recommended that we add “or if it has recently experienced a change in dissolved gas levels.” to the first paragraph of this clause. Also add “or if the gas levels have experienced a recent change” to the second paragraph of this clause.

In addition, he proposed to change the limits of the C2H2 to a value of 1, adding to Note 1 for Table 1, “or that the unit has experienced recent or sudden changes in gas levels,” and add a new Note 2.

Comment – Tom Prevost – Referring back to minutes of previous meeting, the values in Table 1 are not what was proposed in the last minutes. The values from the last minutes were as follows:

Proposed Acetylene C2H2 limits:

Condition 1: 1 ppm
Condition 2: 2 - 9 ppm
Condition 3: 10 - 35 ppm
Condition 4: >35 ppm

Comment – Fredi Jakob – The addition to Note 1, assumes that you have already taken a sample, when this table applies only to the first sample.

Tom Prevost and Fredi Jakob put together a presentation on DGA Data (attached below).

F06-W-ACTI_DGAdata.pdf

The data provided in the presentation was from Oct 2002 to Aug 2006 with a sample size of approximately 133,000 samples. Using this data, and looking at Table 1 and concentrating on Acetylene, the table was simplified into 3 conditions. From experience and supported by the data, a value of 1 for Condition 1 seems reasonable.

The values for Conditions 2, 3 and 4 proposed at the last meeting are also fairly well supported by the data.

Comment – Do we know how many of the samples were from actual transformers that had a problem. The response was no.

Comment – What was the basis for the percentiles chosen? Response – One of the goals was to compare to data provided by Brian Sparling at the last meeting. A 2% failure rate lines up with the 90 and 95 percentile values. We need to focus on the Acetylene values, as they were the contention in the last draft not being approved. This would allow us to get a standard out and available and then allow us a more reasonable time to start work on a full revision.

Comment – Don Fallon – The ballot for the standard needs to be packaged with an explanation of what we are trying to do and that an immediate revision effort will then be started.

The proposed new Note 2 would need to be revised as well to not indicate a value of 1ppm of acetylene.

In view of the comments, a concensus vote indicated that based on the supporting data, the values that were proposed at the last meeting be used. In addition, regarding the changes to the notes, it was the concensus to not revise the notes, only the acetylene values.

Rick proposed that we have some Task Forces start working on statistical methods and case studies. The group agreed that case studies would be very useful.

Rick also asked for volunteers to work on the framework for the next revision and data for use in the next revision.
The meeting was adjourned at 3:05 pm.

Richard Ladroga
WG Chair

William Bartley
WG Vice Chair

New Business

Patrick McShane mentioned that C57.121 –IEEE Guide for Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers standard is due to die unless action is taken to update

Bill Bartley indicated that the Arc Furnace TF, C57.17, Draft Requirements for Arc Furnace Transformers, under the Power Transformer SC is requesting a liaison from the Fluids SC. There is an informative annex in the C57.17 standard on DGA interpretation for which they would like a liaison from the Fluids SC. There was discussion on whether the C57.104 guide should be updated to include specific information for the DGA values for arc furnace transformers rather than have it in the Arc Furnace standard. The general feeling from the SC was that it would be cleaner to keep this within the C57.104 standard, otherwise it will open the door to other types of transformers having DGA interpretation information spread out among various standards and guides. There was discussion regarding the availability of data for arc furnace transformers, could a general note be added, indicating that the numbers may be different for arc furnace transformers than for other types of transformers. Bill Bartley and Rick Ladroga will set up a meeting to discuss with Tom Lundquist the Chair of the Power Transformer SC.

Patrick indicated that in light of the pending ballot of C57.147 Guide for Natural Ester Fluids, the next likely issues that will need to be address will be DGA and retrofill guides for the use of Natural Ester fluids. Rick will look into setting up a Task Force to look into whether these are issues that warrant the creation of a new WG to develop a guide or guides for these topics.

Adjournment

The Subcommittee adjourned at 12:08 pm.

Next Meeting

The Insulating Fluids Subcommittee and its Working Groups will next meet in Dallas, Texas during the period of March 11 – 15, 2007.

Respectfully Submitted

Richard Ladroga
Fluids SC Chair