7.6 Dielectric Test Subcommittee – Loren B. Wagenaar, Chairman; Stephen Antosz, Secretary

The Dielectric Test Subcommittee (DTSC) met on Wednesday, October 25, 2006, in Montreal, Canada with 55 members and 73 guests present. 6 of the guests requested membership and are welcomed into the Subcommittee. See the last page of these minutes for attendance list.

7.6.1 Chairman's Remarks

1) The Chair reviewed highlights of the Administrative Subcommittee meeting held on Sunday:
   a) The next meetings: Mar 11-15, 2007 in Dallas, TX; Oct 14-18, 2007 in Minneapolis, MN.
   b) There was discussion on the MyBallot system. It is now permissible for a PAR to be signed by the appropriate WG Chair instead of the SC Chair. This change was made since the WG Chair is more familiar with the details of the work at the WG level.
   c) The Administrative Subcommittee would like all WG & TF Chairs to know that they can schedule working meetings at the General Meetings.
   d) Ernst Hanique announced that he has changed jobs and will no longer be participating in Transformer Committee activities. Ernst was a valuable contributor to past DTSC projects, and he will be missed. Thanks and good luck to Ernst in his future endeavors.
   e) This past Sunday's tour of IREQ laboratory turned out to be an embarrassing blemish for the Transformers Committee. 117 people signed up to attend, but there were 33 no-shows. In the future, if you sign up for an event, please notify the organizer if you do not intend to participate
2) The minutes of the Spring 2006 meeting in Costa Mesa, CA were approved as written, and are available on the IEEE Transformers Committee Web Site.

7.6.2 Working Group Reports

7.6.2.1 Working Group on Acoustic Partial Discharge Tests in Transformers - J.W. Harley, Chair; Alan Darwin, Secretary

Attendance: 14 members and 38 guests. Attendees introduced themselves. The minutes from the 20 March 2006 Costa Mesa meeting were approved.

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

The main discussion was about the balloting and subsequent need for revisions to PC57.127 Draft Guide for the Detection and Location of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers and Reactors.

1. The Guide was balloted between June 29 and July 29, 2006. There were 95 eligible people in the ballot group. There were 77 votes received, which is 81% returned, so the ballot met the 75% returned ballot requirement. The ballot also met the 75% affirmation requirement.

The response was 68 affirmative votes and one negative vote with comments for 99% affirmative. There were eight abstention votes for 10% abstention.

2. The comments associated with the one negative vote were all editorial in nature. The voter agreed to change to a positive vote if his suggested revisions are made. This has been done except there may be difficulty in improvement of one of the figures. The possibility of enhancing the figure will be discussed with the IEEE editor.

3. The most important revisions in response to voter comments were (a) clarification of wave propagation in the transformer tank wall and (b) addition of characteristics of core to wall PD to Table 4 Comparison of electrical and acoustic PD signals. As the result of the discussion of acoustic waves, WG members will add a definition for burst count and use of this information and add the use of oscillation count information to that definition.

4. Other technical and legal comments and two added subclauses and references were discussed at the WG meeting

The consensus of the Working Group is that the PC57.127 Guide will be ready for recirculation ballot when the above changes are made. This will be done in the near future.

7.6.2.2 Working Group on Revision of Low Frequency Tests – Bertrand Poulin, Chair

The meeting was held on Monday October 23rd at 11h00 am. After the usual introduction and display of IEEE's Patent policy, the minutes of the previous meeting were approved as written.

Next, Dr. Lemke presented his report on the task force meeting for the revision of C57.113 (IEEE Guide for Electrical Measurements of Partial Discharges in Transformers). The minutes of this meeting are found in Appendix 1. The main topics are:

I. The process of revision of the guide is going well. Comments and suggestions after draft 4 were incorporated in draft 5, circulated in the last several weeks and reviewed at the meeting.
II. The main topic of the discussion was focused on the fact, that by the harmonization of the IEEE Guide C57.113 with the standard IEC 60270, aspects of copyright permissions have to be taken into consideration. See the minutes attached below for more details.
III. As the document has reached a point where it will soon be ready for balloting, a PAR has been initiated. The submittal of the PAR has been delayed for administrative reasons, but the issues have been resolved and it will be submitted soon.

The rest of the meeting was devoted to the review and discuss a proposal for modifications to C57.12.90, sections 10.5 to 10.11 related to low frequency dielectric testing. Most of the proposed changes have little technical content except the following items:

- For the induced test, it is suggested to measure the pd level before the enhancement and after the enhancement. It is proposed that a maximum increase of 150 pC between these two measurements be added as a new criteria. If not met, a new enhancement must be made.

- 10.8.2 Induced test on class 2 power transformers – test procedure. For the case of transformers with an OD rating (cooling mode where the oil is forced directly in the windings by pumps), it is suggested to have the pumps running for the duration of the induced test. This applies to the first unit of a design (design test).

- And last, at a previous meeting, before the change in chairmanship of the WG, it had already been agreed that in section 10.10.5, the table for temperature correction of power factor measurements would be removed as it does not apply to all transformers and actually may introduce more errors than correction. Evidence of that has been presented at a previous meeting. Mark Perkins will forward the agreed proposal to the chairman.

Among the editorial changes, since C57.113 is being revised and will adopt new definitions, the wording in C57.12.90 will reflect these changes as well in an effort to keep the two documents in sync. In particular, the term “apparent charge level” will be promoted in lieu of “partial discharge level” in order to emphasize the fact that what we are measuring is an apparent charge and not an actual partial discharge.

Appendix 1 - Minutes of the Task Force Meeting
Electrical Partial Discharge Measurement C57.113
Chairman - Eberhard Lemke

1. Introduction
The Chairman opened the meeting at 8:00 a.m. and welcomed the members and guests. There were 32 attendees present, 17 of them TF members and 15 guests.

2. IEEE Patent Policy
The IEEE Patent Policy was discussed based on the submitted transparencies. There were no patent issues to be discussed.

3. Approval of Agenda
The tentative agenda was approved as submitted.

4. Approval of Minutes of the previous Meeting
The minutes of the previous TF meeting in Costa Mesa, CA were approved as written.

5. Activities for revision the IEEE Guide C57.113
The comments and suggestions from Draft No. 4 were incorporated in the recent Draft No. 5A, which was circulated prior this meeting and reviewed today. The main topic of the discussion was focused on the fact, that by the harmonization of the IEEE Guide C57.113 with the standard IEC 60270, aspects of copyright permissions have to be taken into consideration.

In order to eliminate possible conflicts the TF members agreed to change the wording and the technical content of paragraph 3, DEFINITIONS.

A new definition of the PD quantity “Apparent charge” was introduced, which is based on the physical background and more closely follows the definition given in the relevant IEC standard. In addition definitions for the “Calibrating charge” and the “Scale factor” were introduced, which cover the technical content of IEC 60270 and can be easily applied in actual practice. Finally the complex wording of IEC “Largest repeatedly occurring PD magnitude” was replaced by the simple term “Apparent charge level”.

6. Future work
The comments and suggestions made during the discussion will be incorporated into the next Draft after which the document will be ready for balloting by the TF members. Furthermore a PAR will be initiated which is requested for C57.113 to become a “Recommended Practice” rather than a “Guide”.

7.6.2.3 Working Group on Revision of Impulse Tests – Pierre Riffon, Chair; Peter Heinzig, Vice-Chair

The WG met on October 24, 2005, from 3:15 pm to 4:30 pm. Fourteen members and twenty-six guests attended the meeting. The agenda was accepted as written. The minutes of the Costa Mesa meeting were approved as written.

The IEEE patent disclosure requirement policy was discussed. Reference to the package posted on the IEEE Transformers Committee Web site was made. None of the members and guests present during the meeting were aware of any patents related to the work of this WG.

The first technical subject on the agenda was the review of the survey made within the WG membership on September 19, 2006 concerning the revised proposal on lightning impulse test procedure for cases where the tail time of the impulse waveshape can not be obtained. A total of 91 surveys have been sent and only 17 surveys were returned. Out of these 17 returned surveys, 16 were affirmative (94,1%), none were negative (0 %) and one abstained (5,9%). The various editorial and technical comments received were reviewed during the WG meeting and accepted by the WG membership. These comments will be implemented in the next revision of the proposal. These comments do not change the technical content of the proposal. The revised proposal will be sent to Stephen Antosz for the next revision of C57.12.90.

The second technical subject was an old business and was related to modifications to clause 10.2.2.1 of C57.12.90 (Switching impulse tests). As agreed upon during the Memphis meeting, only negative impulse waves will be specified. A note will be added saying that reduced level positive polarity waves need to be used to bias the core between 100% shots in order to avoid core saturation. This proposal will be surveyed within the DTSC prior to the next meeting.

The third technical subject was also an old business and was related to modifications to clause 10.3.1.3 of C57.12.90 (Chopped-wave tests). This proposal has been also discussed in 2004 during the San Diego meeting. This proposal gives a more consistent and uniform testing method. A tolerance is now given to the maximum time to chop. Clear prescriptions are now given for the location of the chopping gap as well as the amplitude of the underswing of opposite polarity. Discussion regarding the virtual front time during chopped wave test has lengthily discussed. The virtual front time during chopped-wave test does not necessarily need to be the same as during the full test but should remain within the prescribed tolerances. The text will be modified to take into account the particularity. A revised proposal will be surveyed within the DTSC prior to the next meeting.

Because the WG meeting was running out of time, the remaining subjects of the agenda were not discussed and will be postponed to the next WG meeting.

7.6.2.4 Working Group for Revision of the Impulse Test Guides C57.98 and C57.138 – Art Molden, Chair; Joe Melanson, Secretary

The meeting opened at 3:15PM on Monday October 23, 2006 with 34 attendees present of whom 14 were members, 20 were guests. The group introductions were made. The 2005 fall minutes were approved. The 2006 spring minutes were approved.

The ANSI patent policy slides were presented to our membership. The group had an opportunity to identify any patent conflicts and none were disclosed. There were no comments regarding the slides.

Art Molden opened the meeting with a discussion of a proposal to replace Clause 7 of Draft 1.0 of our guide with a new Clause 7 procedure to determine the required impulse generator "size"

Pierre Riffon commented that the new Clause 7 provided a clear and simple presentation of a method to determine the IG capacitance required to obtain the tail duration when testing low impedance windings. However, Pierre indicated that he thought that the "minimum energy" concept would best serve the original intention to provide a recommended minimum impulse test capability for given transformer ratings. Art proposed that the latest "minimum energy" table would therefore be included with some additional explanatory text that he and Pierre would produce in collaboration; Pierre agreed.

Under "new business" Bertrand Poulin commented that the decision to use external resistors on non-impulsed terminals during an impulse test should only be made after consultation with the transformer design department. These external "loading" resistors are sometime used to help extend the tail of the impulse wave when the available test equipment capacitance is limited. Bertrand suggested that the effect of the loading resistors on the internal voltage distribution of the transformer should first be verified by the designer before the resistors are used in a test. Art asked Bertrand to submit a paragraph to this effect and Bertrand agreed to do so.

Pierre Riffon commented that any external loading resistors used should be limited to those values as stated in the latest revision of C57.12.90 and that the values referenced in our guide were not the current values. Art Molden will correct the reference to these values in the next draft of our guide.

A motion was made to accept that, with the inclusion of the above three items and with completion of the editorial work on the revision as it now stands, the guide would be ready for a first circulation within the DTSC. The motion was proposed by Bertrand Poulin and accepted by the members.

Art Molden asked if there was any discussion or questions relating to the C57.138 Routine Impulse Guide for Distribution Transformers. No comments or questions were raised and the topic was closed.

7.6.2.5 Working Group on Liquid-Filled Transformers Dielectric Test Tables – Phil Hopkinson, Chair; Scott Choinski, Secretary

There were 46 attendees, 23 members, and 23 guests with 2 requesting membership. Reviewed the agenda for the meeting, and the IEEE patent policy. The Minutes from the March 21, 2006, meeting in Costa Mesa, California were approved.

Revised tables were sent out for review after the last meeting. Very good comments were received from Bipin Patel, and were reviewed:

A. General

1. Tables on pages 8 and 9 do not indicate that the voltage levels are in **kV. OK-PJH**
2. Title on Page 9, "Class 2 Power Transformers, - Highest Winding Voltage" – Delete, "For Highest Winding Voltage". It is understood by the definition in C57.12.00. If you have to keep it, you may want to change "Winding Voltage" to "Voltage Winding".**OK-PJH**
3. The C57.12.00 – 2000 leaves a voltage gap between Class I and Class II transformers for 70kV to 114kV ratings. I know that these voltages are not recognized as standard nominal voltages. The first table on Page 9 is titled, "Class **2** (instead of **II**), < = 72.5kV Nominal System Voltage" , is this acceptable? Also, there is no 72.5 kV **nominal**

system voltage per IEE voltage classification. Per C57.12.00, don't you think instead of "72.5 kV" we should use "69 kV" for defining Class II Power Transformers in all titles in the table on Page 9? I am sure this has been thoroughly debated and agreed to be acceptable. **Change to Class II-PJH**

4. Table 4 of C57.12.00 – 2000 shows relationship between Nominal system voltages and available BIL ratings. This information is duplicated in the tables here with Note 3 on Page 8 that indicates this table should be used to select BIL ratings for all three classes of transformers. Is Table 4 going to be left alone? If so, do we need to repeat them here? I am sure this has been already debated. **No plans to keep table 4-PJH**

A. Page 8

1. Note 1 – Remove *-**Agree PJH**
2. Note 3 – There is no Class 2 transformer covered on this page. Also need to use I and II instead of 1 and 2. **Agree PJH**
3. Note 5 – The note appears confusing. There are applied levels shown for Gr Y and Imp Y connections. This means there could be unGr Y. If someone purchases a wye-connected transformer and whether specifies it to be designed for ungrouded system application or not, what applied test level will be applicable. Can supplier read a number off the table? The answer to this question will help me or other users to know how the note should be read. Not knowing this answer I can not suggest any changes. I hope you see what I am trying to say. **Need to Clarify PJH**
4. Note 7 – Here is my suggestion for rewording the note – " For Y-Y connected transformers with a common, solidly grounded neutral the neutral bushing may be selected in accordance with low voltage winding rating."**OK if it fits space PJH**
5. Note 10 – The way the note reads to me the term "Single phase" refers to all three categories of transformers. If so, I will rewrite it as, " Single phase distribution**, power,** and regulating transformers for - - - - - so on". I also suggest that " voltage ratings between terminals" be replaced with " **terminal voltage ratings**" or better yet "**voltage ratings**". And one more change – modify the last sentence as, "The test voltage for such transformers, **when operated in a three phase connection**, are - - - needed for their **individual** voltage rating." **Investigate PJH**
6. Note 11 – Replace, " voltage between terminals" with "rated terminal voltage". **Investigate PJH**

B. Page 9 Investigate PJH

1. Need to repeat Note 3 appropriately for this table.
2. Similar or identical notes on both pages (page 8 and Page 9) will serve better if numbered the same and in the same sequence as much possible. For example, Note 4 on Page 8 and Note 1 on Page 9.
3. Under the title,"Induced Test" modify ">72.5 kV" to ">=72.5 kV".
4. Note 3 – same comment as for Note 5 on Page 8.
5. Note 4 – same comment as for Note 7 on Page 8.
6. Note 6 – same comment as for Note 11 on Page 8.

C. Page 10 Investigate PJH

1. Delete "1.2x50 u-sec". It's part of test code.And if you include here then what about switching impulse details in the same manner? I also suggest we replace "BIL" in the first column with "Full Wave" to be consistent with the heading of the other two columns and add "BIL" underneath "kV Crest" in line with "1.1*BIL".

2. Switching impulse is a line to ground application per the requirements of IEEE standard and the test code. So, I think we should delete “Phase to ground specified” from the note at the bottom of the page.

D. Page 11
I assume the table shown here is for information and not part of the standard. **True PJH**

Other comments and changes to the tables:

Pierre Riffon proposed removing the definition of Class I and Class II from the tables. Straw poll of TF supported (20 for, 1 opposed) and proposal was accepted.

Table Ia, - Delete the values for Gr Y for Distribution Transformers. Note 6, change to “Distribution Transformers and Class I shall be not less than 2.0 times nominal system”

Add a note for Shock wave testing for Class I and Distribution Transformers

Note 7, replace “bushing” with “neutral insulation”

Add note for no routine impulse tests for Class I

Remove yellow bands from Class II tables

Order the notes so they are in the same order for both tables

Change µ-sec to µs

It was inquired if anyone still used 350, 450 and 550 as minimum BiL levels for Class II, and there are.

7.6.3 Liaison Reports

7.6.3.1 Status of C57.12.00 – Dong Kim; and C57.12.90 – Stephen Antosz

Both documents have been approved by RevCom and the Standards Board at their September meetings and will be published soon, hopefully before the end of 2006, pending IEEE Editorial final reviews.

7.6.3.2 High Voltage Test Techniques (HVTT), IEEE Standard 4 - Arthur Molden

Editorial work on the new revision of High Voltage Testing Techniques, IEEE Standard 4 continues. We had a meeting in June during the summer session of the Power Engineering Society here in Montreal and we will meet again in mid November in Lake Placid NY. It is hoped that the first draft of this revision will be ready later this year.

7.6.3.3 Surge Protection Devices – Bob Degeneff

No report.

7.6.4 Old Business

7.6.4.1 Switching Impulse Test Configuration

At the last meeting, a standard test set-up was discussed regarding phase-phase and/or phase-ground voltages and that the intended test configuration must be known at time of design to

account for the varying stresses. Figures 36 & 37 of C57.98 show that the same voltages are applied whether applied phase to phase or phase to ground. The Chair has reviewed these figures and thinks they are OK, but they do need minor modification to clarify the intent. The Chair will undertake this task.

7.6.4.2 Core Testing

Several years ago Dan Perco submitted a comment about core testing. This issue was never fully discussed. The Chair will forward this request to Bertrand Poulin for consideration by the Low Frequency Test WG.

7.6.4.3 Phase-to-Phase Clearances

The Chair mentioned that there are some lingering questions regarding this issue. The Chair will investigate and report at the next meeting.

7.6.5 New Business

7.6.5.1.1 Impulse Tests on Neutral Terminals – Subhash Tuli

Subhash said that impulse testing on neutral terminals is currently not covered in C57.12.00 or C57.12.90, and suggested investigation and discussion about future implementation. Much discussion ensued on this and related topics:

Phil Hopkinson said that the definition of Routine and Design tests are not well defined and need clarified. Specifically, when is Chopped Wave test to be done.

Joe Foldi pointed out that Chopped Wave is part of the impulse series (RW, CW, CW, FW) and is therefore included when Impulse Tests are required.

There was discussion about what Impulse Tests should be required for Distribution xfmrs.

There was discussion about making Impulse Tests routine for Class 1 transformers. Jin Sim asked if the Standards should really differentiate between Class 1 and Class 2 transformers (presumably as this applies to impulse testing). Should the definition of Class 1 transformers be changed? The issue to include 69 kV as Class 2 came up in the past, but was tabled.

The Chair mentioned that there was a survey several years ago regarding impulse testing of distribution units. However, results were not overwhelming one way or the other, and not enough people responded to the survey, so the subject was dropped.

Chair's note: The minutes of the Spring 2005 meeting indicates the following:

A survey was conducted within the DTSC covering two ongoing issues:

- Whether to apply impulse tests to all power transformers – 18 affirmative, 16 negative and 3 abstentions (48.6 %, 43.2 % and 8.1, respectively).
- Whether to extend the coverage of Class II transformers down to 69 kV – 22 affirmative, 12 negative, and 3 abstentions (59.5 %, 32.4 % and 8.1 %, respectively).

Several hand votes were taken, but due to uncertainty in what the specific motion was, these votes are not valid and therefore will not be tallied here.

After all this discussion … nothing was decided. The most likely course of short-term action will be to resurrect the recent past survey, modify it to address the growing chorus of related issues, and send it out again to the Sub-Committee for comment and proposed path forward.

7.6.6 Meeting Adjourned

The meeting abruptly adjourned at 10:50 a.m. as the time in the time slot had expired.

Attendance at this meeting of the Dielectric Test Subcommittee

Members Present

1. David Aho
2. Raj Ahuja
3. Stephen Antosz
4. Barry Beaster
5. Oscar Bello
6. Enrique Betancourt
7. Bill Boettger
8. Scott Choinski
9. Donald Chu
10. Craig Colopy
11. Jerry Corkran
12. John Crouse
13. Alan Darwin
14. Eric Davis
15. Fred Elliott
16. Don Fallon
17. Joe Foldi
18. Mike Franchek
19. Eduardo Garcia
20. Ali Ghafourian
21. Eduardo Gomez-Hennig
22. Bill Griesacker
23. Myron Gruber
24. Jack Harley
25. Roger Hayes
26. Peter Heinzig
27. Thang Hochanh
28. Philip Hopkinson
29. Vladimir Khalin
30. Eberhard Lemke
31. Tamyres MachadoJunior
32. John Matthews
33. Jim McBride
34. Sue McNelly
35. Joe Melanson
36. Kent Miller
37. Art Molden
38. Mark Perkins
39. Bertrand Poulin
40. Tim Raymond
41. Jean-Christophe Riboud
42. Pierre Riffon
43. Ewald Schweiger
44. Douglas Scull
45. Devki Sharma
46. Jin Sim
47. Steve Snyder
48. Thomas Spitzer
49. Mike Spurlock
50. Andrew Steineman
51. Craig Stiegemeier
52. Subhash Tuli
53. Loren Wagenaar
54. Jim Zhang
55. Peter Zhao

Guests Present

1. Alvaro Cancino
2. Hanxin Zhu
3. Vallamkonda Sankar
4. James Borowitz
5. Gylfi Olafsson **
6. Kent Brown
7. J. Arturo, Del Rio
8. Vinay Mehrota
9. James Graham
10. Jim Templeton
11. Steve Wolter
12. Prem Patni
13. Flavio Neuls
14. Mark Hammer
15. Juan Luis Thierry **
16. Steve Jordan
17. Dwight Parkinson
18. Kevin de la Houssaye
19. Paul Millward
20. Clair Claiborne
21. Clarence Bell
22. Miguel Oliva
23. Rainer Baumschlager
24. Bob Grumert
25. Jim Antweiler
26. Wayne Johnson
27. David Wallach
28. Joe Kelly
29. C.J. Kalra
30. Juan Castellanos
31. Tom Bassett
32. Mike Lau
33. Kipp Yule
34. Sergiy Razuvayez
35. Robert Veitch
36. Jerry Jones
37. Bruce Fairris
38. Donald Ayers
39. Juergen Gerth
40. Randall Kyle
41. Charles Garner **
42. Mike Craven
43. Tom Breckenridge
44. Terry Drees
45. Mary Foster
46. James Garner
47. Terry Rennich
48. David Marble
49. Mike Thomas
50. John Stein
51. Dong Kim **
52. Jane Ann Verner
53. Dan de la Cruz
54. Mike Lamb
55. Peter Balma
56. Reiner Krump
57. Alex Rojas
58. Bob Ganser
59. Dieter Dohnal **
60. Jerry Allen
61. Valeriu Tatu **
62. Ulf Radbrandt
63. Chungduck Ko
64. Pavel Ionita
65. Patrick Picher
66. Paul Jarman
67. Jermel Miller
68. Rudy Ogayanov
69. Alan Wilks
70. Alexander Kraetge
71. Terry Martin
72. Arnold Carlos
73. Samuel Oriti

** Requested Membership.