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

The Dielectric Test Subcommittee (DTSC) met on Wednesday, October 27, 2004, in Las Vegas, NV with 69 members and 39 guests present. 8 of the guests requested membership in the Subcommittee. See the last page of these minutes for attendance list.

8.6.1 Chairman's Remarks

The Chair reviewed highlights of the Administrative Subcommittee meeting held on Sunday.

1) Everyone was encouraged to sign up and keep their profile information updated on the Association Management System, AMS. It will be the main method of communication.

2) Next meeting date and location is March 13-17, 2005 in Jackson, MS; followed by Oct 23-27, 2005 in Memphis, TN.

3) The minutes of the Spring 2004 meeting in San Diego, CA were approved as written, and are available on the IEEE Transformers Committee Web Site.

4) The IEEE Patent Policy was discussed. There were no patent issues for this SC meeting.

5) There is a wireless router in operation in the meeting rooms for free Internet access to attendees. Instructions are available at the registration table. The equipment is owned by the Transformers Committee and will be moved to future meetings as well.

8.6.2 Working Group Reports

8.6.2.1 Working Group on Acoustic Partial Discharge Tests in Transformers - J.W. Harley, Chair

Attendance: 23 members and 17 guests attended the meeting. Attendees introduced themselves. The minutes from the March 8, 2004 San Diego 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.

- Hem Shertukde stated the equipment of his company was covered by patent #6,178,386 and the software was protected by copyrights. We think the PC57.127 Draft Guide descriptions of workstation and on-line systems are general enough that there are no conflicts with the patent. Contact will be made with the patent holder to confirm this: University of Hartford attorney Charles Condon 860-768-4275. Hem confirmed to the Chair in separate conversation that there is no conflict with the software copyright, which he holds.
- There was discussion about whether to include a patented locator algorithm in the Guide. This works in conjunction with the Three Sensor System patent #6,340,890 in order to make location measurements in low AE signal situations. The Three Sensor System was added as Section 5.7 to the Guide in the last draft and referenced in the bibliography. Both are patented by ABB. The Chair has had discussions with ABB patent attorney Jan Anger about the locator algorithm. The conclusion was that ABB would allow use of the algorithm for a reasonable fee. Mark Perkins was requested to follow with him to confirm this also applies to the Three Sensor System. Mark will also suggest the best way for this material to be included in the Guide. Don Fallon will follow up with the next step as appropriate.

In other discussion:

1. Several names were suggested for assistance in writing a HVDC converter transformer and smoothing reactor section and a reactor section. Anyone with experience with acoustic testing of these devices and that wants to contribute to the document should contact Jack Harley at jack@harleyinc.com.
2. Luis Chiem will send information about a new transducer developed in Australia.
3. Allan Darwin led the group discussion of changes to Sections 2, 4, 9.7, 10, 11 and Annex A, the bibliography. New figures and a number of wording changes were made in the Definitions, Signal Transmission Characteristics and Bibliography sections of the last draft.
4. Barry Ward's group focused on Sections 5, 6 and 7 that cover equipment specifications and field and factory tests.
5. Mark Perkins led the discussion on Section 9, Characterization of AE signals. DSP transportable work station and On-line (continuous) monitoring units were defined in better detail in the last draft.
6. Dirk Russwurm's group reviewed Annexes D & E. These Annexes are old and tend to cover methods necessary for calibration of transducers and equipment that are no longer in use. There will be further discussion about the use of these sections. They may be deleted from the Guide.

8.6.2.2 Working Group on Revision of Low Frequency Tests - Mark Perkins, Chair

The working group met Monday, October 25, 2004 at 11 am. There were 22 members and 21 guests present.

After the introduction of members and guests, the IEEE patent policy was discussed as requested by the committee leadership. The chair then made a request for a volunteer for a secretary of the working group. Ron Daubert later volunteered for this.

The report on the meeting of the task force on revision to C57.113 partial discharge guide was given by Dr. Eberhard Lemke. The first draft of the revised guide, which had been distributed to the task force, contains significant changes over the current guide in an effort to harmonize with IEC 60270. The task force discussed the essential parts of the draft document and agreed to several items:

1. The new document will remain as a guide rather than a recommended practice.

2. Harmonization with IEC 60270 will remain as a goal, but consideration will be given to existing PD measurement systems which may not meet the IEC requirements.

3. A survey will be conducted of subcommittee members to determine the present PD measurement systems in use to support the development of the guide. The proposed survey will first be circulated to the task force members for comments prior to distribution.

4. Survey results and comments from task force members will be used to prepare a second draft for the next meeting.

The next item of business in the working group was the recommended changes to the temperature correction of the insulation power factor test. The working group proposal to remove the requirement in C57.12.90 to correct the power factor readings to 20°C was surveyed

at the subcommittee level, and the response was nearly unanimous in favor with only one negative vote. The group reviewed the comments from the survey, which were minor in nature, and agreed on revised wording for inclusion into C57.12.90. A motion will be made at the subcommittee to accept these changes for inclusion in the next ballot of the standard. (note that the revised wording to be forwarded to Subhash Tuli is attached to the minutes).

With a hand vote at the SC meeting, there was unanimous approval to remove the PF temperature correction curve from C57.12.90. Mark will submit wording to Subhash.

The working group then discussed a proposal by Subhash Tuli for low frequency dielectric testing of buried tertiary windings. The majority of members were not in favor of the proposal, and Subhash agreed to draft a new proposal that more clearly states that such testing is not required.

The final item of business was a request by Alan Wilkes that the special test procedures being used on single-phase distribution transformers with a permanently grounded high-voltage winding terminal be incorporated into C57.12.00. It was unclear how this should be done, and Ron Daubert volunteered to provide a clarified recommendation for the next meeting.

The following has been approved by the Working Group for the next Ballot of C57.12.90:

1. Revise Section 10.10.1 item d) The average temperature of the windings and insulating liquid should be between 10°C and 40°C, but preferably as near to 20°C as practicable and the top liquid temperature shall be measured and recorded.

2. In Section 10.10.4 add the following sentences: The power factor shall be reported along with the top oil temperature measured and the bottom oil temperature if available. No temperature correction shall be applied. Temperature correction of the power factor results for trending basis may be applied by the user.

3. Section 10.10.5 would be eliminated.

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

The WG met on October 26, 2004, from 3:15 pm to 4:30 pm. Fifteen members and ten guests attended the meeting. None of the guests requested membership. The IEEE patent requirement policy was added on the agenda. The minutes of the San Diego meeting were approved as written.

The IEEE patent disclosure requirement policy was discussed. Reference to the package received by the meeting attendees at registration was made. None of the members and guests present during the meeting were aware of any patents related to the work of the WG.

The first technical subject on the agenda was to discuss the impulse test procedure on protected or partially protected windings by non-linear devices. Before discussing the normative proposal, Peter Heinzig, vice-chair of the WG, did make a presentation on design and testing aspects of transformers using non-liner devices across windings or within winding sections. After his presentation, a new revised proposal for modification to clause 10.3.2.5 of C57.12.90 was

presented and discussed. This new proposal takes into account the comments received on previous proposal. The main changes from the previous proposal are:

- The intermediate reduced impulse is not anymore required at prescribed test levels. Instead, a test level ranging from 75% to 90 % of the full wave test level has been proposed. The exact test level is let to the manufacturer choice but it shall show the effect of the operation of the non-linear devices on voltage and current waveshapes. After discussion, it has been agreed upon to modify this range from 75% to 100% since some transformer designs may show non-linear device operation in between 90% and 100% of the full wave test level.

- The two full-wave impulses are split apart the chopped-wave impulses. The first one has to be applied before the chopped-wave impulses and the second after the chopped wave tests.

- Notes will also be added to cover cases where the non-linear devices do not operate at the 100% full-wave test level and for cases where they will operate only during the chopped-wave impulses.

- An additional clause forbidding the operation of the non-linear devices under standard switching impulse tests has been agreed upon.

The WG members felt this proposal is quite mature and agreed that this proposal has to be surveyed within the Dielectric Test Subcommittee. This will be done prior to the next meeting.

The second technical subject on the agenda was the review of the negative comments received on the survey made in February 2004 concerning the lightning impulse test procedure for cases where the tail time of the impulse waveshape cannot be obtained. Because the WG meeting was running out of time, the review of the negative comments was not done. Instead, a draft of a new proposal has been presented. This draft is a reworded version of the previous proposal taking into account the negative comments received. The main changes from the previous proposal are:

- The only mandatory requirement is to use the optimum impulse generator connection e.g. maximum available capacitance.

- If by using the optimum impulse generator arrangement, the required minimum tail time of 40 µs is not achieved, loading resistors have to be used in the following preferred order:
    - on non-impulse windings;
    - and if the tail time is still not met, on the grounded end of the impulse winding.

- After discussion, it has been agreed upon that for special cases, loading resistor values exceeding the surge impedance of the connected systems may need to be used. A note covering this case will be added.

- The concept of using a minimum capacitance value or available impulse generator energy has been kept only as a non-mandatory recommended practice. A note has been also added explaining how the available impulse generator energy has to be determined and clearly explains that the available impulse generator energy may be lower than the maximum energy capability of the impulse generator.

- If it is forecasted that the tail time can not be achieved for a particular transformer design and/or because of test equipment limitations, the manufacturer has to notify this deviation at the bidding stage and states the strategy that they will use to obtain the best possible waveshape.

All members and guests present consider this draft proposal as a good compromise and could be acceptable to those individuals having cast negative ballots on the survey. Because this draft proposal has not been yet circulated to the WG membership prior to the meeting, an informal survey on this revised proposal within the WG will be done prior to the next meeting.

At the SC meeting, Subhash asked for a discussion about the required polarity during switching surge testing. Pierre responded that he will try to add this as an agenda item for next meeting.

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

The meeting started at 3:15PM on Monday October 25th, with 47 attendees present of which 15 were members and 5 were guests requesting membership. The Minutes of the last meeting in San Diego were approved.

An extensively revised version of the present Guide had been made available to the members and some comments were forthcoming regarding those revisions:

- With regard to impulse testing of units that include non linear devices Joe Melanson raised a question about the sequence of the applied impulse voltage applications referenced in the guide; the sequence and numbers of reduced voltage applications is also a topic being discussed by Pierre Riffon's group in the Revision of Impulse Tests. Art Molden indicated that the sequence included in our guide would be reviewed so as to agree with the sequence proposed by Pierre and his group members.

- Alvin Kopp questioned the practicality of using "Method 1" of clause 2.4 of the guide, this clause references alternate methods of impulse testing low impedance windings, Method 1 allows all terminals of a winding that are of the same BIL rating be tied together for the impulse test. Several other members also questioned the efficacy of this method and agreed with a suggestion that this Method be removed from the list of alternate tests. Pierre Riffon noted that for some larger distribution class transformers with low voltage foil type windings Method 1 was sometimes the only method that could be used to obtain an impulse wave tail of the required duration. It was therefore decided to retain Method 1 in the list but to include wording to suggest its use be as a last resort, only to be used when other methods failed to extend the tail time.

- The group had discussions about the polarity to be used for switching impulse tests. The subject was brought up by Subhash Tuli in reference to the option included in our guide for tests to be of either positive or negative polarity. The question was whether or not the reference to the "positive" polarity test on transformers should be eliminated in keeping with the similar IEC documented test practices. Pierre Riffon indicated that in his experience positive SI was sometimes used to provide a test of the clearance between the transformer bushings. Bertrand Poulin and Ernst Hanique pointed out that the use of positive polarity SI required much greater clearances be used between transformer bushings, and that this was more a test of the bushing electrode geometry than of the transformer. Negative polarity will be the preferred polarity recommended in the guide.

- A question was raised about experiences with the application of switching impulse tests by inducing the SI from the LV windings. Bertrand Poulin pointed out that one disadvantage of using this method was that, should there be a failure of the transformer major insulation during this test, the HV SIL voltage would be applied to the LV windings and to the test equipment connected to the LV terminals. This could result in dangerous over voltages being applied to the impulse test and measurement equipment.

- Steve Beckman asked if any manufacturers really did go looking for "smoke and bubbles" in their transformers as a means of failure detection during an impulse test, as suggested in clause 2.5 of the guide. The manufacturers replied that they almost never let the smoke out of their products and that, as a general rule, they also recommended that the users did not let the smoke out. However, on those rare occasions when they did let some smoke out, they knew that they had and didn't need to go looking for it. One or two consultants in the group that had themselves been involved with manufacturing operations in their past, proffered that, smoke and bubbles were pretty reliable indications of failure, and that they provided an invaluable correlation between discrepancies on the impulse records and "thunks" emanating from a transformer tank. The group concluded that smoke detectors were not yet a reliable means of impulse failure detection but that smoke location would continue to be used for the correlation of failure locations.

- An item of new business was proposed by Thang Hochanh of Hydro Quebec. As a means of comparing the relative sensitivity of transfer function software programs currently being used in North America Thang would like to obtain impulse records from those members that utilize such software. Anyone interested in this project please contact Thang or the Chair.

8.6.2.5 Task Force on Liquid-Filled Transformers Dielectric Test Table – Phil Hopkinson, Chair; Scott Choinski, Secretary

The Task Force on Dielectric Test Tables, Liquid-Filled was called to order at 1:45 PM. There were 44 attendees, 28 members, 1 requesting membership and 16 guests. Reviewed the agenda for the meeting, and the IEEE patent policy. The Minutes from the March 9, 2004, meeting in San Diego, California were approved.

Reviewed Rev. 8 of ANSI C57.12.00 Dielectric Test Tables in kV Liquid Filled Transformers Y-Connected and for Delta-Connected

- Motion: Modify table to remove all bold BILs and replace with minimums and alternates. Passed 40-3.

- Motion: Restrict to 2 BIL columns. 1st is for minimum advisable, 2nd is for alternate. Failed for lack of second.

- Membership polled:
  Separate tables for Wye and Delta – received 10 votes
  Single table for Wye and Delta with footnotes denoting differences – received 16 votes.

- Members agreed unanimously that Induced levels for Wye and Delta should be the same.

8.6.3 Liaison Reports

8.6.3.1 Surge Protection Devices – Bob Degeneff

No activity. Nothing to report.

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

The last meeting was held at the facility of Florida Power and Light, West Palm Beach, FL on April 14th and 15th, 2004. Editorial work on the revised document continues. There is to be another meeting later this year, possibly at the premises oh Hubble/Hipotronics in Brewster NY.

8.6.4 Old Business

8.6.4.1 Phase to Ground Clearances – Loren Wagenaar

Nothing to report. Will continue this activity next time.

8.6.4.2 Continuation of Discussion of Class 1 and Class 2 Testing

Should C57.12.00 be changed so that Impulse Testing is a ROUTINE test on Class 1 transformers? It is already ROUTINE for Class 2 and for Distribution Transformers. After some discussion there were 2 hand votes of the people present:

1. Should Class 1 transformers receive Impulse Testing as a ROUTINE? 36-Yes; 23-No
2. If Yes, should a Task Force be formed? 42-Yes; 2-No

This is not such a simple issue to be decided too quickly; it would be a significant change. Loren will investigate and report back at the next meeting. A survey of the entire Diel Test SC membership may be conducted.

8.6.5 New Business

8.6.5.1 Steep Front Test Levels

Subhash Tuli suggested consideration to add back to C57.12.00 the test levels for steep front impulse test levels. Some discussion ensued; this topic seems to come up again and again every few years. The collective memory was that this was voted on before and the levels have been removed and are left out on purpose. If they are put in C57.12.00, it may imply (or promote) this test and that is not what the industry wants to do.

The test is listed as an OTHER test in Table 19. Maybe this should even be removed too. No final decision was made on this last point.

Members Present

1. Aho, David
2. Ahuja, Raj
3. Antosz, Stephen
4. Arpino, Carlo
5. Artiega, Javier
6. Barker, Ron
7. Barnard, David
8. Beckman, Stephen
9. Bello, Oscar
10. Boettger, Bill
11. Bolliger, Alain
12. Britton, Jeffrey
13. Bush, Carl
14. Caruso, Charles
15. Chiu, Bill
16. Choinski, Scott
17. Colopy, Craig
18. Corkran, Jerry
19. Crouse, John
20. Darwin, Alan
21. Daubert, Ron
22. Degeneff, Bob
23. Dudley, Richard
24. Fallon, Donald
25. Fausch, Reto
26. Foldi, Joe
27. Franchel,Michael
28. Garcia, Eduardo
29. Garnitschnig, Andreas
30. Ghafourian, Ali
31. Gianakouros, Harry
32. Goodwin, David
33. Griesacker, Bill
34. Gruber, Myron
35. Hanique, Ernst
36. Hartgrove, Bob
37. Heinzig, Peter
38. Henning, Bill
39. Herron, John
40. Hochanh, Thang
41. Hopkinson, Philip
42. Kennedy, Sheldon
43. Khalin, Vladimir
44. Lackey, John
45. Lemke, Eberhard
46. Marlow, Dennis
47. Matthews, John
48. Melanson, Joe
49. Miller, Kent
50. Molden, Arthur
51. Perkins, Mark
52. Platts, Don
53. Poulin, Bertrand

Guests Present

1. Dilip Shah
2. Jesse Patton
3. Juan Luis Thierry
4. Edwin Jauch
5. Charlie Smith
6. Bo Blackmon
7. Bob Grunert
8. Randy Rensi
9. Clair Claiborne
10. Ibrahim Shteyh *
11. Juan Castellanos
12. Andy Steineman *
13. Martin Navarro
14. Sam Mehta
15. Steve Northrup *
16. Sten Andersson
17. Jan Hajek
18. Ramon Garcia *
19. Josh Herz
20. George Tolbert
21. Vallamkonda Sankar
22. Prit Singh
23. Saurabh Ghosh *
24. Guy Morrissette
25. Girolamo Rosselli
26. Mahesh Sampat *
27. John Haufler
28. Hossein Rezas
29. Alan Wilks
30. David Dunlap
31. Tamyres Machado *
32. Eduardo Gomez-Hennig *
33. Valery Davydov
34. Van Nhi Nguyen
35. Samuel Oriti
36. Sau-Lie Lee
37. Sangbong Park
38. Jose Grijuela
39. Alvin Kopp

* Requested Membership.

54. Preininger, Gustav
55. Raymond, Tim
56. Riffon, Pierre
57. Rossetti, John
58. Russwurm, Dirk
59. Schappell, Steven
60. Shertukde, Hemchandra
61. Snyder, Steve
62. Speegle, Andy
63. Spitzer, Tommy
64. Tuli, Subhash
65. Veitch, Robert
66. Wagenaar, Loren
67. Williams, Michael
68. Zhao, Peter
69. Ziomek, Waldemar