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

The Dielectric Test Subcommittee (DTSC) met on Wednesday, March 19, 2003, at 1:30 p.m., in Raleigh, NC with 73 members and 51 guests present. 16 of the guests requested membership on the Subcommittee. See the last page of these minutes for attendance lists.

7.9.1 Chairman's Remarks

After introduction of the attendees, the Chair reviewed some of the highlights of the Administrative Subcommittee meeting held on March 16, 2003.

1) The test case for metrification, C57.34, three-phase pad-mounts, resulted in significant unrest among balloters and a mixed reaction from different bodies within IEEE. The preference among users seems to be to allow dual dimensions. The IEEE Standards Board is meeting this week and will be reviewing this issue

2) Minutes due to Don Fallon and Sue McNally on May 9.

3) Next meeting dates and locations are as follows: October 5-9, 2003 in Pittsburgh, Pennsylvania. Potential hosts for future meetings should contact Greg Anderson (gwanderson@ieee.org).

4) Minutes of the Oklahoma City meeting are available on the IEEE Committee Web Site.

5) The O& P (Operations & Procedures) Manual for the committee will be revised. Since balloting is now done with balloting pools, there is no longer such a thing as a "voting member" of the committee. This is one of the items that will be changed. Another is recognition of corresponding members.

6) Eric Davis has been attending the WG on website development as a representative of the subcommittee. Eric and Loren will be working together to establish a website for the subcommittee. It is Loren's intent that future minutes and other correspondence be posted on the website instead of sending out voluminous e-mails for these purposes.

Note: Individuals who wish to receive invitations to ballot on IEEE Standards have the responsibility to make sure their correct e-mail address is on file with IEEE. Status can be checked on the following website, or adjacent related websites:
http://standards.ieee.org/db/balloting/ballotform.html

The minutes of the meeting on October 23, 2002 in Oklahoma City were approved as written.

7.9.2 Working Group Reports

7.9.2.1 Working Group on Partial Discharge Tests in Transformers J.W. Harley, Chair

38 members and 36 guests attended the meeting.

Minutes of the previous meeting October 21, 2002 in Oklahoma City, OK were approved.

Announcements included:

- Arturo Nunez is WG Secretary
- Panel discussion: Detection and Location of Acoustic Emissions from Partial Discharges will be this afternoon
- The IEEE-SA Standards Board on February 13, 2003 approved the project "PC57.127-Guide for the Detection and Location of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers and Reactors" until December 31, 2007.

Under the leadership of Alan Darwin, Mark Perkins, Hem Shertukde and Barry Ward, the WG edited sections of the Guide including continuous monitoring systems, characterization of acoustic emission signals and calibration.

The WG also presented a panel session on the Detection and Location of Acoustic Emissions from Partial Discharge. Presenters were Andreas Garnitschnig of VA Tech Elin, Chair Jack Harley, Hem Shertukde of Diagnostic Devices, Steve Skinner and Wes Clark of Idaho Power, and Barry Ward of EPRI.

7.9.2.2 Working Group on Revision of Low Frequency Dielectric Tests Mark Perkins, Chair

The WG met with 21 members and 29 guests in attendance. 5 people requested membership. The minutes of the OK City meeting were approved as written.

The first item of business was a presentation and discussion on temperature correction of the power factor test. Actual case study data demonstrated that the real variation of power factor vs temperature can be in the opposite direction as the ANSI or other correction factors.

The Chairman presented a chart of calculated temperature correction factors developed using dielectric frequency response software and showed how this matched field and factory data.

The consensus of the WG was that the power factor test in the factory should not be corrected to a reference temperature, but only the measured value and the average oil temperature reported. The WG will develop temperature correction curves based on calculated parameters (% moisture in insulation, oil conductivity, and % paper in oil in the insulation structure). These curves will be for field comparison purpose and will be forwarded to the appropriate WG.

The Chairman then reported that C57.113 on Partial Discharge was reaffirmed and that a Task Force will be organized to begin work that will ultimately result in a revision of the document. A Chairman will be selected and membership solicited at the Subcommittee meeting.

It was announced that when the next revision of C57.12.90 is published (probably before the next meeting) apparent charge will be the standard method for measurement of partial discharge rather than RIV. The Chairman also indicated that a common partial discharge system used in many factories will need to be operated in an analog detector mode rather than digital mode to conform to C57.113. Users needing more details can contact the Chairman.

The meeting adjourned at 12:15 PM.

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

The WG met on March 18, 2003, from 3:15 pm to 4:30 pm. 14 members and 20 guests attended the meeting. 2 guests requested membership.

The minutes of the Oklahoma City meeting were approved as written. The agenda has been approved as written. Mr. Peter Heinzig has been nominated as the vice-chair of the WG.

The main subject on the agenda was to review a new proposal regarding the minimum impulse generator energy level to be met during lightning impulse tests for cases where the 50% tail time is shorter than the minimum allowable value of 40 µs. Minimum requirements within the transformer industry have to be given in order to get a fair competition between manufacturers and to ensure users that transformers are adequately tested. This subject has been discussed since 1998.

This new proposal was based on the following parameters:

- A minimum tail time of 40 µs.
- Energy values were determined to cover 80% of studied cases.

New calculations have been performed according to Oklahoma City meeting decisions.

The new proposed energy levels are much lower than proposed during the last meeting. In addition, a formula is now given for the calculation of the minimum impulse generator energy needed to obtain a minimum tail time of 40 µs. This formula is function of the BIL, winding rated voltage, generator efficiency, leakage impedance and MVA rating.

After a lively discussion, a new proposal has to be worked out considering the following decisions taken during the meeting:

- Category IV (10 MVA to 600 MVA, single phase rating) has to be split in at least three sub-categories (IVa, IVb and IVc) because this is a too wide power range. This will give lower energy requirements for mid-band of that power range.
- Transformers classified as Class I (highest system voltage rating ≤ 69 kV) has to be treated separately. Lower requirements have to be specified for that transformer class.
- Reconsider the minimum energy value for the class covering the highest MVA ratings (part of the actual class IVb). The proposed value of 100 kJ seems to be too restrictive.

A new proposal considering the least of the values given in the table or calculated from the formula will be presented. This will considerably reduce the minimum energy requirement for most of transformer ratings.

All WG members were requested to evaluate the proposal and to provide feedback to the WG chair via Email prior to the next meeting (Email address: *riffon.pierre@hydro.qc.ca*).

The meeting adjourned at 4:30 pm on March 18, 2003.

7.9.2.4 Working Group for Revision of the Impulse Test Guide C57.98 – Art Molden, Chair; Joe Melanson, Secretary; Pierre Riffon, Acting Secretary

Attendees: 46, of which 15 where members and 31 where guests. The minutes of the meetings of April and October 2002 were approved.

Reference material for this working group is being made available via an IEEE “grouper” site and comments and communication are circulated using our majordomo WG email list. Both these services are operating smoothly and without comment!

So far, none of the individual contributions to the revision of this guide have been made available to the membership group. Members were therefore encouraged to provide clause revisions for group discussion.

It was reported by the WG chair that the next revision of IEEE Standard 4 will include revisions to certain measurement procedures that would be of interest to this WG:

1) A method of defining the "effective" peak voltage of a lightning impulse that contains overshoot, the so called "k factor" method, will be included as an alternative to the presently used methodology.

2) The reference to a 50% undershoot magnitude for chopped waves will be removed and a statement will be added to the effect that, undershoot magnitude must be specified by the appropriate technical committee.

A handout was provided that highlighted the main items contained in the "Minimum IG Energy" proposal that is being discussed in the WG for Revision of Impulse Tests. This minimum energy proposal relates the ability of an impulse generator to produce the required minimum tail time of 40 us, to its available stored energy and the kVA rating of a transformer. There is overlap here in the scope of this project and that of The Revision of Impulse Tests. Various comments were made by the members, regarding alternative methods that could be used to achieve the same result and the efficacy of these methods were discussed but no consensus was achieved.

The meeting adjourned at 4:30 pm

7.9.2.5 Task Force on Liquid-Filled Transformers Dielectric Test Table – Phil Hopkinson, Chair

The Working Group met on Tuesday, March 18 at 1:45 PM with 21 members and 33 guests present. The Chairman presented a draft version of section 5 on ratings from C57.12.00, which included three tables to replace the existing five tables. The new tables will be; wye connected, delta connected, and high frequency relationship.

There was much discussion on these topics. The Chairman will consolidate and make the agreed upon modifications and distribute to the working group for additional feedback. More discussion will be had at the next meeting in Pittsburgh.

The meeting adjourned at 3:00 PM.

7.9.3 Liaison Reports

7.9.3.1 Surge Protection Devices – Bob Degeneff

Nothing to report.

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

The meting took place in Lake Placid NY during February 10th and 11th. There were nine members present.

Much of the meeting was taken up with discussion of various drafts of revised sections of Standard 4. There were three items discussed that would be of particular interest to the Transformers Committee members, and these were:

- Round Robins
- Measurement of lightning impulse (LI) voltages that contain overshoot
- Measurement of chopped wave (CW) parameters.

Round Robins

This item has been on the agenda for quite some time and I've reported that the project is soon to be underway on more than one occasion. Well, it is soon to be underway and for those of you who may have forgotten what this project is all about, here is a short synopsis.

- Two reference measuring systems are to be circulated amongst participating test laboratories in North America, a 200 kV, 60 Hz ac voltage measuring system and a 200 kV lightning impulse VOLTAGE measuring system. Participants will be required to compare the reference system with their own "regular" system in a predetermined series of comparison tests. A copy of the comparison test results are then to be provided to the members of HVTT. Both NIST and NRC are slated to participate in this project so on completion of the project each participant will receive a comparison of their "regular" system with those of the National Laboratories.

- The two systems will be circulated independently and participants can elect to take part in one or both comparisons.

- Participants will be expected to follow, very carefully, the required test protocols and to complete the comparisons within a week of receiving the system. The work involved in performing the comparisons is expected to be about a half a day for ac and a full day for impulse. All prospective participants should therefore be prepared to schedule the required comparison testing time into their operating schedule.

One more time, will all those interested in becoming a participant in this Round Robin please contact either Jim McBride at Jim@jmxservices.com or myself at A.Molden@ieee.org.

LI impulse waves with overshoot and CW parameters

These topics were reported on at the meeting of the WG for Revision of Transformer Impulse Tests. The next revision of Standard 4 will include an alternative procedure for determining the "effective" amplitude of an LI that includes overshoot on the voltage peak,
The present criteria (500 kHz/ 1 us half period and 5 % magnitude) that are used to determine the peak voltage of a LI containing overshoot, result in some creative and controversial measurements of impulse voltage records. In an attempt to resolve these difficulties various institutions around the world have been attempting to redefine the overshoot criteria. Based on the results of a study of the breakdown of insulation samples that were subjected to LI voltages with controlled amounts of overshoot, new criteria have been proposed. The new criteria relate a magnitude factor "k" of the overshoot to its frequency, in a smooth continuous function across the frequency band. A Procedure for implementing this "k factor method" will be proposed.

The reference in Standard 4 to modification of the CW circuit so as to limit the undershoot if it exceeds 50% will be removed and replaced by a statement to the effect that the amount of undershoot should be specified by the relevant technical committees.

Also, regarding chopped waves, it was recognized that during tests on low impedance windings the voltage collapse of a chopped wave might be damped to such a degree that there is no undershoot. Such damped voltage collapse could yield extraordinary long "time to chop" results when measured using the 70% and 10% points of the collapse as the measurement criteria. Any alternative means of making such measurements if required, should be specified by the relevant technical committees.

The meeting adjourned at lunchtime on February 11th.

7.9.3.3 Performance Characteristics Subcommittee TF on Frequency Response Testing – Rowland James

Discussed the initial draft of the Guide related to how the various methods, sweep, impulse, and enhanced, will be combined and included in the FRA Testing Guide. General wording was discussed to ensure consistency. A brief discussion regarding termination impedance, 50 Ohms or 10 Ohms, resulted in showing that 50 Ohms was more common and accepted as a standard for network analyzer measurements. Both impedances will still be considered.

For the sake of efficiency in producing a complete draft of the Guide, the chairman proposed that a detailed outline of the Guide is produced and reviewed for input from the TF members and then additional material is requested from the different members in their areas of expertise.

There is concern for adapting a versatile data format.

7.9.4 Old Business

7.9.4.1 Phase to Ground Clearances – Loren Wagenaar

A brief presentation was made by Loren. Previous discussions have centered on the fact that NESC (National Electric Safety Code), which is concerned only with the safety of workers working in substations, specifies phase to ground voltages. There are two pertinent rules for phase to ground clearances:

The first rule specifies that the nearest exposed part shall have a clearance to ground according with tables provided in the NESC. These are based on impulse and switching surge voltages appearing on terminals. If used, protection provided by arresters is taken into account.

The second rule specifies that all indeterminate voltages, i.e., the bottom surface of an exposed bushing or arrester porcelain, shall be 2.6 m (8.5 feet) above ground level.

Pierre Riffon commented that it is not within our scope to place these safety requirements within product standards; however, we are concerned with phase to ground clearances based on minimum physical clearances, which Pierre called "insulation coordination" clearances. These clearances affect the reliability of the transformer as well as transformer costs.

Bertrand Poulin commented that Canadian Standard CAN/CSA-C99-M90 gives external phase to ground clearances as a function of BIL. These are almost the same as given in IEC 76-3, except that they cover higher BILs.

It was also noted that phase to phase clearances have no effect on the safety of workers, and these clearances are not covered by the NESC. However, the subcommittee has an interest from an insulation coordination aspect. Bertrand Poulin commented that the present phase to phase clearances given in Table 13 of C57.12.00 are not adequate for all cases.

See the website for more additional detail.

There are several issues that should be discussed before a definite proposal can be made. To this end, Loren will circulate a survey within the subcommittee. These issues include:

1) Do we need to differentiate in C57.12.00 between the safety clearances presently given in the NESC (IEEE C2) and the insulation clearances?

2) Do we refer to NESC table or add tables for the safety clearances?

3) Do we need to establish insulation coordination clearances for inclusion in C57.12.00?

4) Are changes necessary for the phase to phase clearance given in Table 13 of C57.12.00?

5) If so, should the values be in better harmony with IEC and CSA Standards?

6) Should EHV system voltages be tied to switching impulse voltages instead of system voltages?

7.9.5 New Business

7.9.5.1 Core Megger testing. This subject was introduced at the last meeting by Dan Perco.

Robert Veitch commented that core ground resistors had been shown not to be a good practice. Loren Wagenaar added that AEP spec does not allow resistors, but they have added them temporarily in order to control currents on transformers rather than have a non-intended core ground.

This item will be referred to the WG on Power Frequency Tests. Wayne Hansen indicated that he will be sending further comments to the chair.

7.9.5.2 C57.138. Impulse testing on Distribution Transformers (Recommended Practice) needs reaffirmed. It seems to be up to date. Unanimous by a vote of hands that the reaffirmation ballot will be sent through the pool process.

7.9.5.3 Subhash Tuli sent about 40 emails last week on the ballots for C57.12.00 and C57.12.90 pertaining to issues that need addressed by DTSC. The Chairman will review these and refer them to the proper working groups.

Members Present

1. Ahuja, Rajendra
2. Antosz, Stephen
3. Arpino, Carlo
4. Bello, Oscar
5. Betancourt, Enrique
6. Boettger, Bill
7. Bolliger, Alain
8. Borst, John
9. Bush, Carl
10. Cash, Don
11. Christini, J. Mark
12. Chu, Donald
13. Colopy Craig
14. Corkran, Jerry
15. Crouse, John
16. Darwin, Alan
17. Daubert, Ron
18. Davis, Eric
19. Degeneff, Bob
20. Dudley, Richard
21. Eckholz, Klaus
22. Fallon, Donald
23. Foldi, Joe
24. Forsythe, Bruce
25. Fyvie, Jim
26. Garcia, Eduardo
27. Gardner, James
28. Griesacker, Bill
29. Hanique, Ernst
30. Hartgrove, Bob
31. Hayes, Roger
32. Heinzig, Peter
33. Henning, Bill
34. Hochanh, Thang
35. Holland, John
36. Hopkinson, Philip
37. Huff, Tim
38. James, Rowland
39. Kennedy, Sheldon
40. Khalin, Vladimir
41. Leuenberger, Boyd
42. Lowe, Donald
43. Matthews, John
44. McBride, Jim
45. Miller, Kent
46. Molden, Arthur
47. Triomphant, Ngnegueu
48. Patel, Sanjay
49. Perkins, Mark
50. Platts, Don
51. Poulin, Bertrand
52. Preininger, Gustav
53. Puri, Jeewan

Guests Present

1. Mike Hornins
2. Kent Haggerty *
3. Naeem Ahmad
4. Florian Costa *
5. Harold Moore *
6. John Riner
7. Andreas Garnitschnig *
8. Hossein Rezai
9. Jitendra Mamtora
10. Mark Rivers *
11. Jim McIver *
12. John Herron *
13. Andre Bourgault
14. Mototaka Sato
15. Susan McNelly *
16. Robert Ganser *
17. Craig Swinderman
18. Raman Subramanian *
19. V. C. Jhonsa
20. Stephen Beckman *
21. Scott Choinski
22. Dong Kim *
23. Wayne Bodie
24. Anthony Washington
25. Brent Hayman
26. Tom Bassett
27. Herman Vogel
28. Scott Digby
29. JM Braun
30. H. S. Shim
31. David Goodwin
32. Min Jea Lee *
33. S. V. Kulkarri
34. Wayne Hansen *
35. Pentti Mahonen
36. Jerry Murphy
37. Paul Buchanan
38. Dana Basel
39. Samuel Oriti
40. Alvaro Cancino
41. Mike Lau
42. Marion Jaroszewski
43. Barker Edwards
44. Tom Lundquist
45. Albert Walls *
46. Tom Harbaugh *
47. Juan Castellanos
48. David Wallach
49. Paul Boman
50. Clair Claiborne
51. Samuel Khaled

* Requested Membership.

54. Raymond, Tim
55. Riffon, Pierre
56. Rossetti, John
57. Russwurm, Dirk
58. Schweiger, Ewald
59. Sharma, Devki
60. Shertudke, Hemchandra
61. Sim, Jin
62. Snyder, Steve
63. Speegle, Andy
64. Stiegemeier, Craig
65. Taylor, Robyn
66. Thompson, Robert
67. Tuli, Subhash
68. Veitch, Robert
69. Wagenaar, Loren
70. Watson, Joe
71. Weffer, Felipe
72. Whearty, Bob
73. Ziomek, Waldemar