9.12 Dielectric Test Subcommittee – Loren B. Wagenaar; Chair, Stephen Antosz, Secretary

The Dielectric Test Subcommittee (DTSC) met on Wednesday, October 23, 2002, at 1:30 p.m., in Oklahoma City, OK at the Renaissance Hotel & Cox Business Services Convention Center, with 57 members and 60 guests present. 22 of the guests requested membership on the Subcommittee. See the last page of these minutes for attendance lists.

9.12.1 Chair's Remarks

After introduction of the attendees, the Chair reviewed some of the highlights of the Administrative Subcommittee meeting held on October 20, 2002.

1) Chairmen of WGs and SCs should draft Secretaries or Co-Chairs to their group who can chair the meetings on their behalf when they could not attend for personal or professionally related reasons. This will also avoid canceling such meetings.
2) Each WG and SC is asked to send an updated roster of their members to Loren.
3) There is some early discussion about how to maintain a Central Roster or (Master Contact List) at the Main Committee level to avoid having to do this at the lower levels.
4) Next meeting dates and locations are as follows: March 16-20, 2003 in Raleigh, North Carolina; and October 5-9, 2003 in Pittsburgh, Pennsylvania. Potential hosts for future meetings should contact Greg Anderson (gwanderson@ieee.org).
5) There was discussion that some people feel the Main Committee meeting on Thursday is too administrative and not technical enough in content, and is not a very valuable use of time. One idea is to do the recognition awards at the Tuesday luncheon.
6) There was much discussion on ASC C57; too much to describe here at the Dielectric Test SC meeting. See the web site for complete notes.
7) Minutes of the Vancouver meeting are available on the IEEE Committee Web Site.

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 held on April 17, 2002 in Vancouver, BC, Canada were approved as written.

9.12.2 Working Group Reports

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

18 members and 68 guests attended the meeting.

Minutes of the previous meeting April 15, 2002 in Vancouver, BC, Canada were approved.

Discussions continued on the Guide for the Detection and Location of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers and Reactors. Sections on integrating results with data from oil analysis, characteristics of acoustic signals and differences between C57.127 and the draft of the Guide were reviewed.

It was the consensus of the WG that we are ready to apply for a PAR for this guide, which will replace C57.127 IEEE Trial-Use Guide for the Detection of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers.

9.12.2.2 Working Group on Revision of Low Frequency Dielectric Tests Mark Perkins, Chair; Loren Wagenaar Acting Chair

The working group met Monday, October 21, 2002 at 3:15 PM. Mark Perkins was unable to attend and Loren chaired the meeting.

The reaffirmation of C57.113 was successful. Following are the results:

102 people in ballot pool
88 responded (86 %)
83 affirmative (94 % of those responding)
2 negative (2 %)
3 abstentions (3 %)

Some comments:

- Must start work on next revision of C57.113 right away
- References and calibration procedures are not up to date
- Guide does not harmonize with IEC 270

Mark will be looking for a chairman to chair this TF. Must be someone who is familiar with the PD equipment. Any volunteers are asked to contact Mark.

Old Business: The revision to temperature correction factors is not yet done; survey will be sent out in the Fall.

9.12.2.3 Working Group on Revision of Impulse Tests – Pierre Riffon, Chair

The WG met on October 22, 2002 from 3:15 pm to 4:30 pm. Twelve members and fifteen guests attended the meeting. Three guests requested membership.

The minutes of the Vancouver meeting were approved as written.

The first technical subject on the Agenda was to discuss the proposal for modifications to clause 10.3.1.1 b) of C57.12.90. This proposal has been also discussed in length during the previous meetings. The proposal consists of specifying a minimum available energy from the impulse generator during impulse tests for cases where the tail time duration of the impulse waveshape is shorter than the minimum allowable limit (e.g. 40 µs).

The proposed value of 12,5 kJ for Category I transformers (≤ 500 kVA) was found somewhat too high for this class of transformers. This value has been chosen to cover 90% of the studied cases. After a lengthy discussion, it has been decided to revise the proposed minimum impulse generator energy values to cover not more than 80 % of the studied cases. This coverage limit will significantly decrease the required value for Category I transformers but will probably slightly affect the energy levels for the other categories.

The proposal suggests that the definition of the 5 transformer categories to be aligned to the those defined in C57.12.00 for short-circuit performance (ONAN vs ONAF ratings).

An informative Annex will be also written for explaining how these values have been derived.

The intent of this concept is to encourage laboratories to use the optimum configuration of their impulse generator. It also informs the industry that a minimum testing installation capability is required for a specific range of transformers.

The second technical subject on the agenda was to discuss the proposal for modifications to clause 10.3.1.3 of C57.12.90 (chopped wave tests). The proposal consists of specifying a circuit configuration during chopped-wave impulse tests.

The proposal specifies a maximum distance of the chopping device from the terminal of the test object. The proposed maximum distance is one lead length of the height of the transformer, the height being defined as the sum of the bushing and tank heights. The proposal does also prohibit the use of a series resistor in the chopping circuit if the overswing in the opposite polarity is equal to or less than 30%. If the overswing is greater than 30%, it will be permissible to use a series connected resistor in the chopping circuit in order to reduce the magnitude of the overswing in the reverse polarity.

After discussion, it has been agreed upon that the resistor shall limit the overswing in the reverse polarity in between 25% and 35%.

This proposal does not specify any chopping time since this could be difficult to measure with an appropriate accuracy. This proposal will ensure that the same severity, e.g. steepness of the voltage collapse, is applied throughout the industry during chopped wave tests.

Contrary to what is specified in IEEE Std. 4-1995, the WG agreed that limiting the undershoot to 30% for power transformers protected by surge arresters seems to be an adequate value because the voltage excursion produced during tests is higher than the maximum theoretical voltage swing that can be produced in service.

The time-to-chop tolerance proposed (-0 µs, +2 µs) has to be slightly increased in order to be in line with the actual tolerance.

Both proposals will be revised according to the comments received and will be discussed during the next meeting.

On New Business, the overshoot on the lightning impulse peak has to be addressed. This subject should also be put on the Agenda of the WG responsible of the revision of the Impulse Test Guide.

Pierre requested an extra time slot at the next meeting, as he always goes over-time.

The meeting adjourned at 4:40 pm on October 22, 2002.

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

This meeting took place on Monday, October 21st at 1:45 PM, with 40 Attendees, of which 11 where members and 29 where guests. 10 of the guests requested membership; this brings our total working group membership to 30.

Introductions of Members and Guests.

The first order of business was to propose that Joe Melanson become secretary of the working group; this was accepted and seconded by the membership.

Other items of business included:

- Our PAR has been approved and the clock is therefore ticking.
- IEEE “Majordomo” email and “grouper” services have been obtained for this working group. The email list is operational but grouper has yet to be set up. There was some discussion of how we intend to utilize these services.
- An electronic copy of the IEC Transformer Impulse Testing Guide, IEC 60076-4 has been obtained and will be made available to our members.
- There were some questions from the floor as to how much of the guide needs to be revised. It was agreed that the entire standard needs some revision.
- A handout was circulated in which the contents of our current guide were itemized into 7 sub-groups. The membership was asked to volunteer to work on the revision of at least one of those sub-groups. We had a very good response

to this request, 16 people volunteered, many of whom signed up for more than one sub-group.

Sub-Group	1	2	3	4	5	6	7
# Signed up	7	2	6	9	2	4	5

New Business:

Don Kline requested the floor for a brief discussion on the collapse rate of the chopped wave during the chopped wave impulse test. Don was of the opinion that the wording in the impulse testing standards should be changed to more clearly restrict the location of the chopping gap and length of interconnecting leads.

Motion to adjourn made and seconded at 2:40PM. Meeting adjourned.

Art requested two meeting slots for the next meeting, one for discussion of impulse guide and one for report on the activities of the HVTT Subcommittee (See Item 9.12.3.3) Loren will request an additional time slot for this WG at the next meeting.

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

1. The minutes of the Previous meeting on April 16, 2002 were approved as submitted.
2. Membership
3. The agenda was approved as submitted.
4. Old Business

Table – Y connected transformers. Values in table final version?
Vote:

Eliminate algorithms	No votes
Algorithms left in tables	2 votes
Place in appendix	Overwhelming majority

Arrester protection levels. C62.2 values

Only arrester standard referred to?	No votes
In appendix, representative table	Majority

Low freq test comparison to be placed in appendix. IEEE vs IEC values are different but not far apart.
Footnote to indicate where IEC values come from:

Preferred IEC levels are	1.7 normal for enhanced, 1.5 for 1 hour test
Footnote for optional IEC levels.	1.8 normal for enhanced, 1.6 for 1 hour test
	1.7 normal for enhanced, 1.3 for 1 hour test

High freq test comparison – include in appendix

Table for Y connected transformers. For neutral terminal, use "Impedance grounded" instead of "resistance."

5. There was no new business.
6. In the absence of additional business, the meeting was adjourned at 2:40 PM.

Phil requested a "manipulatable" electronic version of the table, as the one he has is in Adobe Acrobat format. Loren will get this and pass it on to Phil, who will then modify it and pass it out for comments prior to the Raleigh meeting.

9.12.3 Liaison Reports

9.12.3.1 Surge Protection Devices – Bob Degeneff

Bob Degeneff was not at this meeting; there was no activity, and there was no report.

9.12.3.2 IEC TC14/WG24 – Phil Hopkinson

The last meeting of IEC TC14 was held in Rome, Italy during the week of September 23, 2002. It was reported that the revision of IEC 60076-3 (Insulation levels and dielectric tests) had been approved and the document is being published.

Some work by Haas Nordman was done to put requirements for thermally upgraded paper. The group was asked if anyone knew of any related documents or IEEE requirements for thermally upgraded paper to forward on to the Chairman.

Phil also reported on the European perspective of the switching surge and resonance phenomenon currently under discussion in Bob Degeneff's WG on Switching Transients Induced by Transformer/Breaker Interaction. This phenomenon involves gas insulated and vacuum breakers with or without the use of shielded cable. Siemens reported that a 400 kV transformer connected to a cable had failed because of this phenomenon. Amplification factors approaching 1000 were observed. The problem was solved when the cable was removed, Pauwels reported that measurements performed at RPI indicate that the first and second resonant frequencies are the ones that cause the damage. From experience with transformers that have failed due to this phenomenon, Phil agrees with some of these observations and disagrees on others.

Snubbers seem to be the answer in most cases. Both IEEE and IEC recommend them. Measurements on systems with and without snubbers indicate that snubbers reduce the voltages by half, perhaps more in some cases.

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

The last meeting was held at the facilities of Florida Power and Light in West Palm Beach, Florida on October 14th and 15th, 2002. He was not able to attend the meeting and since the meeting took place just last week, the Minutes of the meeting are not yet available. Discussion of the revisions to Standard 4 was the main topic on the agenda,

and the next meeting of this group will be during February 10th and 11th, 2003 in Lake Placid, NY. Art plans to attend the next meeting and will provide a more detailed report at our meeting in the spring of 2003.

9.12.4 Old Business

9.12.4.1 Phase to Ground Clearances – Loren Wagenaar

Loren reviewed what had been done since the Spring 1999 meeting, and sent it to Subhash and Bill Chiu for comments. General observations and discussion:

- Although the original discussion was about the inclusion of phase-ground clearances in IEEE standards, discussion soon shifted to whether the values given for phase-phase clearances are adequate.
- NESC was established by utilities and is mandatory in most states. It has ph-ph and ph-grd.
- Bipin Patel asked how do NESC distances compare – IEC is highest, NESC in between, and IEEE is lowest.
- Don Platts pointed out the reference in NESC is Rule 235 B 3A, Table 235-4.
- Fred Elliott clarified that NESC has tables for lines and substations.
- Dan Perco suggested generation of some rules for application of phase-to-ground clearances as pertains to bushings.
- The motion was made and seconded to survey the DTSC to use the NESC tables in C57.12.00. All in favor … none opposed. Loren will do this.

9.12.5 New Business

9.12.5.1 A volunteer is needed as a liaison to the Performance Characteristics Subcommittee's WG on Frequency Response Testing. Rowland James will forward a list of the FRA WG members, and Loren will solicit a liaison.

9.12.5.2 Dan Perco discussed the following information regarding core megger tests:

"I have recently been involved with issues concerning core ground insulation. IEEE standard C57.12.00 requires a 500-volt DC test for class II transformers. This same test is listed as an "other" test for class I transformers. There are no acceptance criteria given for this test in this standard. IEEE standard C57.12.90 does not provide any information on how or when the test should be done."

"Some users specify that grounding resistors of up to 250 ohms be connected between the core and ground. This is done to limit the core ground current in the event of a core ground fault. I recently witnessed recurrent surge generator tests on a 500 KV coreform single-phase generator transformer. The results indicated that impulse voltages in excess of 100 kV appeared across the resistor during the 1425 kV impulse test on the H1 terminal. This is far and above the resistor or core ground insulation rating. The design of this transformer is typical of many others in this respect. I therefore expect similar results for other types and manufacturers of transformers."

"I think that transformer users that specify core ground resistors are in danger of a serious service failure. The factory impulse test is normally performed with the core directly grounded. The transformer is consequently not tested with the voltage the core insulation experiences in service. The core ground insulation will probably fail during a system impulse and cause the transformer to be removed from service."

"Even when the core is directly grounded, the service voltages for 69 kV and above transformers will exceed the 500-volt IEEE test requirement. This means that these transformers are also in danger of a serious service fault. Most transformer manufacturing facilities that I've visited already have megger test equipment suitable for tests at 2500 volts or even 5000 volts. Many users already specify megger tests with a voltage exceeding the 500 volts in IEEE."

"I think the IEEE C57.12.00 and C57.12.90 standard core ground tests should be reviewed in light of the above and changed to eliminate the possibility of a transformer service failure. I don't have empirical data on the maximum service voltage on the core ground insulation. Maybe some of the manufacturers do. In the absence of such data, I would recommend an increase in the voltage level of the core ground test to 2500 for transformers having HV windings 69 kV and above. I think that this is still not adequate in some cases. There should be a warning too that this test assumes the core is directly grounded in service. The test can be refined as more data becomes available. The impulse test connections should also be reviewed to consider the core ground service condition."

The SC meeting adjourned at 10:30 AM.

Minutes respectfully submitted by Stephen Antosz, Secretary.

Dielectric Test Subcommittee – Meeting Minutes
October 23, 2002 – Oklahoma City, OK

Members Present

1. Ahuja, Rajendra
2. Antosz, Stephen
3. Arpino, Carlo
4. Arteaga, Javier
5. Barker, Ron
6. Betancourt, Enrique
7. Boettger, Bill
8. Bosiger, John
9. Bush, Carl
10. Chiu, Bill
11. Christini, J. Mark
12. Crouse, John
13. Daubert, Ron
14. Elliott, Fred
15. Fallon, Donald
16. Field, Norman
17. Ferreira, Marcos
18. Foldi, Joe
19. Forsythe, Bruce
20. Fyvie, Jim
21. Griesacker, Bill
22. Gruber, Myron
23. Hanique, Ernst
24. Hartgrove, Bob
25. Hayes, Roger
26. Heinzig, Peter
27. Henning, Bill
28. Hochanh, Thang
29. Hopkinson, Philip
30. Huff, Tim
31. Hughes, Bert
32. James, Rowland
33. Lackey, John
34. Leuenberger, Boyd
35. Lowe, Donald
36. Machado, Tamyres
37. Matthews, John
38. Melanson, Joe
39. Molden, Arthur
40. Patel, Bipin
41. Perco, Dan
42. Platts, Don
43. Poulin, Bertrand
44. Preininger, Gustav
45. Puri, Jeewan
46. Riffon, Pierre
47. Rossetti, John
48. Sharma, Devki
49. Shertudke, Hemchandra
50. Sim, Jin
51. Snyder, Steve
52. Stiegemeier, Craig
53. Tuli, Subhash
54. Wagenaar, Loren
55. Watson, Joe
56. Whearty, Bob
57. Ziomek, Waldemar

Guests Present

1. Dudley, Richard *
2. Khalin, Vladimir *
3. Lau, Mike
4. Riboud, Jean-Christophe
5. Kalra, C.J.
6. Darwin, Alan *
7. Gianakouros, Harry *
8. Payne, Paulette
9. Thompson, Robert *
10. Marlow, Dennis *
11. Nicholas, Ray *
12. Raymond, Tim *
13. Nunez, Arturo *
14. Jarman, Paul
15. Castellanoj, Juan
16. Speegle, Andy *
17. Marek, Rick
18. Davis, Larry *
19. McBride, Jim *
20. Patni, Prem
21. Kennedy, Gael
22. Kennedy, Sheldon *
23. Haggerty, Kent
24. Bustamante, Tony
25. Drexler, Charlie
26. Zhao, Peter
27. Jafarnia, Mostafa
28. Goodwin, David
29. Rensi, Randy
30. Hammers, Jack
31. Henry, George
32. Jostrand, Pat
33. Roussell, Marmie
34. Nguyen, Vuong
35. Haufler, John
36. Ray, Jeff
37. Bello, Oscar *
38. Patel, Dhiru *
39. Swinderman, Craig
40. Fairris, Bruce
41. Berlerz, Zalya
42. Galloway, Dudley
43. Baur, Martin
44. Brettschneider, Stephan *
45. Spitzer, Tommy *
46. Carlos, Arnold *
47. Tennant, Jeff *
48. Toda, Katsutoshi
49. von Genningen, Richard
50. Anderegg, Don
51. Keithly, Dave
52. Garnitschnig, Andreas
53. Kranich, Neil
54. Rivers, Mark
55. Van Nhi Nguyen
56. Taylor, Robyn *
57. Aguirre, Samuel
58. Fridman, Harry *
59. Graifer, Alexander
60. Borst, John *

*22 Requested membership