5.7 Dielectric Tests Subcommittee – Loren Wagenaar, Chair; Thang Hochanh, Vice-Chair; Dennis Marlow, Secretary

The Dielectric Tests Subcommittee (DISC) met on Wednesday, March 14 at 11:00 am with a record 191 persons in attendance. There were 72 of 123 members, and 46 of the 119 guests present were new. 10 of the 73 returning guests requested membership and will have their participation status reviewed prior to acceptance

5.7.1 Chair's Remarks

1. The Chair briefly reviewed highlights of the Administrative Subcommittee meeting held on Sunday afternoon. The main points have already been discussed in the Main Committee meeting on Monday and were not repeated

2. The following meetings of the TC are:
    a) Fall Oct 21-25 2012 – (Hilton Hotel $149)-Milwaukee, WI – hosted by SPX Transformer Solutions
    b) Spring March 17-21,2013 – (Dolce Munich ($190, £142 with breakfast) Munich, Germany – hosted by Reinhausen

   Additional meeting sites are listed on the main committee website.

5.7.2 Quorum and Approval of Minutes

1. The membership list was shown and a show of hands of committee members present showed that a quorum of members were in attendance at the start of the meeting.

2. The minutes of the fall 2011 meeting in Boston were approved without correction.

5.7.3 Working Group Reports

5.7.3.1 Working Group on External Dielectric Clearances, Eric Davis, Chair; Dennis Marlow, Secretary

The WG for the revision to external dielectric clearances met on Monday March 12 at 9:45 with 9 of 24 members and 26 guests present. 3 returning guests requested membership. A quorum was not obtained. All members and guests will have their participation status reviewed before the next survey is issued. The minutes from Toronto will be sent to active members for approval by email.

The results of the 3 questions and comments from the last survey were reviewed. The results of the survey were distributed by email and are posted on the DI SC website

The survey showed that the majority agreed with using the NEMA TR1 clearances values for 230 kV and below. The values should be presented by both voltage and BIL.

A sample table was reviewed in the meeting. The proposed clearance table was reviewed and discussed. The revised clearance table will have format similar to the existing dielectric test tables 4 & 5 in C57.12.00-2012 for consistency. This table will be filled in and distributed for review prior to the next meeting.

We also discussed the clearances for voltages greater than 230 kV. Since the existing literature is clear that clearances above 230 kV are controlled by BSL, we felt that the clearance table should provide a single value based on BSL for 345 kV and above.

We will be sending out background information and a survey to verify that the DI SC agrees with this approach and to determine the appropriate BSL method to be used to determine these clearances.

Meeting adjourned 11:00 am
Respectfully submitted by Dennis Marlow

5.7.3.2 Working Group for Revision of the Distribution Impulse Test Guide C57.138, Recommended Practice for Routine Impulse Test of Distribution Transformers; John Crotty, Chair

The meeting started at 11:00 AM on Tuesday March 13, 2012. Introductions were made of the attendees. There being only 5 of 14 members present a quorum was not obtained and the minutes of the fall 2011 meeting in Boston could not be approved and will be resubmitted for approval at the next meeting.

Old Business: None

New Business:

a) The PAR has been approved
b) A review of the SCOPE was presented to the group. Standard dates in the SCOPE were removed so that it refers to the latest standards. There were no further objections to the SCOPE
c) This guide was reaffirmed in 2005 and the first step will be to review the comments from that reaffirmation
    - 1) “Update the standard with the latest dates”. The Chair recommended to refer to the latest version of the standard. The Chair will review C57.138 and will update the document to refer to the latest versions by the next meeting for review by the members.
    - 2) “Tolerances for voltage reviewed” Technical comment from Marcel Fortin re section 5.1.1

      Comment: There is always a variation in the applied impulse and uncertainties in measurements. To state that the crest value shall be equal to the BIL is excessive and unpractical. A tolerance shall be stated, and due consideration shall be made that this is a production test, not a type test. A type test typical tolerance would be -0, +10%. For production test, a tolerance of -5% would be acceptable.

      Suggestion: Reword the first sentence as follow:
      The full-wave impulse shall have a crest value **of not less than 95% of** the rated BIL of the terminal …
      The standard already refers to C57.12.90 in section 5.1.2. Many members suggested we follow C57.12.90. Tolerance s section5.1.2 needs to be reviewed. Probably we need to vote on removing section 5.1.2 and refer to only C57.12.90. Further discussion is needed on this subject

- 4) Rf should be corrected to RT. Chair will update the figures.
- 5) Review the figures for the generator design from the latest generator design
- 8) A technical comment was received from Marcel Fortin re section 7.3.1 fig 24 "Are these vacuum tubes still available?"
  Some members suggested that vacuum tubes may not be available now. We may obtain a used one. Members were not sure if the analog section is even needed in the standard. This will be reviewed before the next meeting by the members.

Meeting adjourned .Respectfully submitted by John Crotty

5.7.3.3 Working Group on Revision of Low Frequency Tests; Bertrand Poulin, Chair; Bill Griesacker, Secretary March 13, 2012, 1:45 pm

1. There were 62 attendees, 20 members and 42 guests; there were more than 50 % of the working group members present at the meeting, therefore there was a quorum present at the meeting.

2. The minutes from the fall 2012 meeting in Boston, MA were brought to the table; the minutes were approved.

3. TF – PD in Bushings: Thang Hochanh presented the minutes for the Task force for PD in PTs, CTs and Bushings. A first part of a draft has been sent to a limited number of participants to the TF. Comments have been received and more are expected. These will be circulated in the upcoming months. The administrative work for requesting a PAR will be initiated as soon as the Scope and Purpose of the document are finalized by the TF and WG Chairmen.

4. The topic of induced testing on 69 kV transformers was discussed. The results of a modified survey were presented by the Chairman. The proposal was to apply a Class II induced test to power transformers with a high voltage rating of 69 kV and above and a maximum nameplate rating of 15 MVA and above for three-phase transformers or 10 MVA for single-phase transformers. The results were as follows:

Summary of responses		
Sent	117	
No of responses	105	%
Approve	82	78.1
Approve with comments	15	14.3
Disapprove	2	1.9
Abstain	6	5.7
Return rate		89.7
Approval rate		98.0

The approval rate was almost unanimous. Several responses were originally received as negative. The reason for voting negative was always related to not applying the proposed test to all 69 kV transformers. After brief discussions with the Chairman, voters changed their vote to approve with comments provided that this is only a first step in the

direction of revising testing of smaller 69 kV transformers later in time. The next step in this topic is to review applicable IEEE standards and propose appropriate changes to incorporate the proposed test. Loren Wagenaar and Subhash Tuli volunteered to do this task.

Questions were raised about 69 kV transformers below the specified MVA limits? The Chairman's answer was that this will be discussed in the future, once this first step is fully approved and incorporated into the Standards.

One question was asked about how this survey fits with the discussions about redefining Class I and Class II transformers. The SC Chairman responded that this topic would be discussed and handled at the SC level.

A proposal was made to have pd tests for transformers at lower voltage classes (15 kV, 25 kV…) be made mandatory as type test. Also, pd test levels should be included in dielectric test tables.

A proposal was made by Hemchandra Shertukde to add acoustic detection of pd with correlated levels with electric pd detection. Mr. Shertukde promised to send literature showing the relevance of the measurements.

5. Old business

   The question of tap changer position during induced test need to be surveyed within the DI Test SC. The Chairman agreed to conduct the survey before the next meeting.

The meeting adjourned at 3:00 p.m. Respectfully submitted by Bertrand Poulin

6.

5.7.3.3.1 TF on Partial Discharge in Bushings and PTs/CTs, Chair Thang Hochanh; Arturo Del Rio, Secretary

The task force on Partial Discharge in Bushings and PTs/CTs met on Monday March 12th, 2012, at 4:45pm with 37 attendees. Of those, 12 members and 25 guests with 6 guests requesting membership.

- The meeting was opened with attendance sheets and introductions.
- The minutes for the F11 Boston meeting were presented.
- The TF Chair presented a draft version of the guide which was distributed by e-mail prior to the meeting.
- The scope for the guide was presented and adjusted based on feedback from the group. It is the intention to present the scope in the application for the PAR, keeping in mind that the document will be a guide. At this time the scope reads: **“this guide describes the test procedure for the measurement of PD and electrical PD detection, occurring in bushings and instrument transformers during dielectric tests in AC and DC (bushings) applications”.**

- Several editorial and contents changes were recommended and the meeting was dedicated to discussions on the body of the document.
- The TF work will not cover acoustic PD detection.
- It was pointed out that the guide should cover both narrow and wide band measurements. A specification of frequency range should be included in the guide.
- It was discussed whether interpretation of PD patterns should be included in the guide. Even if PRPD (phase resolve PD) patterns are not available from many TF members, it was concluded that PRPD patterns will be included in the guide, particularly basic patterns.
- The linearity and validity of the calibration between 50% and 200% of the calibration value was discussed. This may be related to the calibrator only. If a switched calibrator is used, the change of capacitance vs. pico-Coulomb output may affect the result of the calibration.
- The uncertainty of the tests should be considered during the test as there are several factors contributing to it including the calibration, test equipment, detecting equipment, etc.
- A revised draft will be circulated shortly for comments. Members are encouraged to send their comments and suggestions to the TF Chair.
- Meeting was adjourned at 5:50 pm.

Minutes by: Arturo Del Rio.
Nashville, March 13 2012.

5.7.3.3.2 TF on Electrical Partial Discharge Measurements Guide, C57.113, Eberhard Lemke Chair

The TF did not meet as the document was published on August 20, 2010.

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

The WG met on March 13, 2012, from 3:15 pm to 4:30 pm. Fifteen members (15) members and seventy (70) guests attended the meeting. Required quorum was met. Nine (9) guests requested membership. The meeting was chaired by Pierre Riffon, chair of the WG.

Because of the last minute cancellation of the Boston WG meeting due to lack of quorum, WG Chairman did review the WG membership. The membership for the Nashville meeting was decreased from 57 members to 27 members. By revising the membership, chances of getting the required quorum are much better. Strict rules for keeping WG membership has been introduced by the WG Chair. Members shall have attended the last meeting or shall have replied to the two last surveys. For guests requesting membership, they will become member only if they have participated to the last three surveys. The Chairman will keep a close control on the WG membership.

The agenda has been reviewed and one New Business was added. The agenda has been approved as modified.

Minutes of the San Diego and Boston meetings were approved as written.

The first technical item of business was to discuss the results and comments received from the survey made within the WG on clause 5.10.7.2 of IEEE C57.12.00. The aim proposal was to add a simple reference to Table 18 which defines the conditions for performing a switching impulse test. Even if the survey approval rate was 95,9%, discussions at the WG meeting showed that this change is not required and WG members agreed to withdraw this proposal.

A negative vote from Bertrand Poulin pointed out an error in the last paragraph of this clause. The word "greater" shall be changed to "lower". This paragraph refers to cases where when performing switching surge to the HV winding at the rated BSL level, if the resulting induced switching surge on the LV winding is lower than its rated BSL value. Then, additional tests are not required since the switching impulse applied on the HV winding is controlling the resulting induced voltages on the other windings. A revised proposal taking into account Bertrand Poulin's proposal will be surveyed within the WG and the Dielectric Tests SC prior to the next meeting.

The second technical item of business was to discuss the results and comments received from the survey made within the WG and Dielectric Tests SC on clause 10.3.2.5 of IEEE C57.12.90 (clause related to the impulse test sequence to be used for windings equipped with protective devices which are an integral part of a transformer). The purpose of the proposal was to align the number of full impulses to the same number as agreed upon for the normal cases (three full impulses). The average approval rate was 88%. Comments received were reviewed during the meeting. Three negatives were received and discussed during the meeting. None of them were accepted. The proposal will be sent to Steven Antosz for inclusion in the next ballot of C57.12.90.

On new business, introduction of impulse tests as routine tests for all power transformers (Class 1 and Class II) has been slightly discussed. A survey will be sent to the WG membership. This survey will be based on the same basic proposal as discussed within the WG on Low Frequency Tests e.g. requiring Class II testing regime for all transformers having a rated voltage of 69 kV and a **maximum nameplate** rated power of 15 MVA (3ϕ) or 10 MVA (1ϕ). For other Class I transformers, alternative routine impulse test using only full waves will be proposed and surveyed. This will ensure that all transformers from distribution levels to power transformers will be subjected to a routine impulse test.

The meeting adjourned at 4:30 pm on March 13, 2012. Pierre Riffon P. Eng WG Chair.

5.7.4 Liaison Reports

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

As some of you may already know Standard 4 has just finished its first ballot. The ballot results were very positive, of 267 eligible voters there were 207 votes received: 180 affirmative: 9 negative and 18 abstentions, that's a 95% affirmative vote. Not bad for a first ballot on this document. There is therefore, still a little work to be done by the working group but we fully expect the standard to be ready for publication in the very near future. There has been a lot of extra material added to the new revision and it is now more aligned with the IEC 60060 series of standards.

The working group members toiled long and hard on this revision but, what we achieved pales in comparison to what was achieved by our Secretary Jeff Britton who almost single handedly editing and formatting the entire document. I'd like to take this opportunity as Liaison between our Committee and HVTT, to thank Jeff for his efforts and to congratulate him for providing the "spit and polish" that makes this revision what I'm sure we will all find to be the most informative revision of this standard to date. Please join in a round of applause for Jeff.

Art Molden 03/14/2012

5.7.4.2 PCS TF on Dielectric Frequency Response Testing – George Frimpong Chair

1. **Meeting Attendance**
   The TF on DFR met on Monday, March 12, 2012, at 3:15 PM. 16 members (out of 25) and 45 guests were present.

2. **Approval of previous meeting minutes**
   The minutes of meeting from the Fall 2011 meeting in Boston, MA were approved as written.

3. **Presentations of task reports**
   - George Frimpong presented task force objectives and a summary of the findings of the four sub groups formed to address the objectives. All objectives set for the task force have been met.
   - Diego Robalino presented the work by sub group 3 - verification and validation of DFR for moisture estimation. This involved a review of over 29 articles, 19 of which dealt with some comparison of moisture estimation using dielectric response measurements to another form of estimation of moisture (e.g. Karl Fischer titration or moisture equilibrium curves). The measurements involved several transformers and other small scale transformer models and showed quite good agreement between dielectric response measurement and Karl Fischer titration of solid insulation samples from the same transformer. There were three articles that had dielectric response measurements that did not correspond to the comparison moisture measurement used.
   - George Frimpong presented how DFR issues submitted by M. Lachman were addressed in the report. No comments were received after the presentation.

4. **Discussion to recommend to PCS to form working group to develop guide:**
   - The chair asked for a discussion to recommend to the performance characteristics subcommittee to form a working group to develop a guide for the use of DFR for estimation of moisture in solid insulation of transformers
   - Mark Perkins indicated the best way to quickly generate data on moisture in solid insulation that could eventually be used in other IEEE documents is by developing a guide that will help in the generation of the correct data.
   - A motion was proposed by Tom Prevost to recommend to form a working group to work on a guide and this was seconded by Peter Werelius
   - We took a vote and 16 of 16 members present voted to approve the motion

5. Next Steps
The next step is to complete the task force report and send it to the task force for comment. After a final review the report will be sent to the PCS chair with a recommendation to form a working group. It was suggested that PCS should transfer the topic to the Dielectric Tests

subcommittee since the basis of this test is essentially power factor measurement over several frequencies.

If a working group is authorized at the subcommittee level, the chair recommended that Peter Werelius serve as the chair of that working group. This is based on Peter's vast experience and knowledge of DFR measurements and analysis.

6. Adjournment
The meeting was adjourned at 4:00 PM

George Frimpong, Chair

5.7.5 Old Business

5.7.5.1 Phil Hopkinson reported on the status of comment resolution on the dielectric tables in C57.12.00. He has recruited Subhash Tuli to resolve the outstanding issues
He noted that the test tables were based on expected deviations of the neutral during faults for different types of grounding. He thanked Bipin Patel and Subhash Tuli for their help in preparing the test tables.

5.7.5.2 Front of Wave Test Survey results. A survey of the SC was made regarding comments made by Joe Melanson proposing changes to Annex A in C57.12.00. The following are the results of that survey:

Proposal 1:	Modify table sub header….	not accepted
Proposal 2:	Modify last sentence of text…	not accepted
Proposal 3:	Remove the Rate of Rise column in the table:	accepted
Proposal 4:	Add the "time to flashover" tolerances: ….	accepted

This Annex will remain informative and is included for historical purposes. Based on the results of the survey and comments received, a new version of Annex A incorporating changes to the text will be drawn up and re-surveyed as a single proposal within the DI SC. It was noted that the 1980 version of Table 4 of C57.12.00, which at the time included the front-of-wave test levels, included power transformer BILs from 95 through 1175 kV, whereas Annex A of the 2010 revision includes distribution and power transformers from 30 through 1175 kV BIL. Since comments from the survey indicate a strong preference for historical preference, the table will contain only the levels included in the 1980 version

The DI SC Chair will advise the WG Chair for revision to C57.12.00 Annex A for inclusion in the next ballot

5.7.5.3 Revision of C57.127-2007, Guide for the Detection of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers. T
The Standards SC indicates that under the new rules this does not have to be revised until the end of 2018. The Admin SC has approved for this standard to be revised and Jack Harley has agreed to Chair this WG. There is ample time to revise this document in a timely fashion and it will be scheduled appropriately.

5.7.5.4 Tutorial on IEEE 4 Revision. In view of the several changes made in the latest revision of IEEE 4, Art Molden has suggested that a tutorial be given to the TC and he and Tom Prevost will gather a team of presenters and prepare the presentation. Tom Prevost, the

Tutorial co-coordinator will confirm a date for this tutorial which most likely will be at the next meeting. Tom Prevost also requested to the SC for other topics at future tutorials.

5.7.5.5 Class I/Class II Classification for Transformers.

The Chair initiated a discussion regarding requirements for the following tests for transformers presently tested as class I transformers as indicated in Table 18, C57.12.00-2010:

- Winding insulation resistance
- Core insulation resistance
- Insulation power factor and capacitance
- Low frequency withstand tests on auxiliary devices, control and CT circuits

There were various comments from the floor regarding a MVA limit, voltage class 69 kV or below and whether the transformer was for distribution or transmission service. Kipp Yule indicated that IEC and ANSI installation guides require these acceptance tests during installation

A Proposal was made by Don Platts and seconded for the following:

"**That all Class I transformers have the above 4 tests performed as routine tests and that table 18 C57.12.00-20xx be changed ."**

The vote was unanimous in favor of this proposal. No negatives.

The DI SC Chair will advise the WG Chair for revision to C57.12.00 for inclusion of these changes to table 18 in the next ballot

5.7.6 New Business

None

5.5.7 Meeting adjourned 12.10 PM. Minutes respectfully submitted by Dennis Marlow