10.4 Performance Characteristics Subcommittee – Stephen Antosz, Chairman; Ed teNyenhuis, Vice-Chair; Craig Stiegemeier, Secretary

Introduction / Attendance

The Performance Characteristics Subcommittee (PCS) met on Wednesday, November2, 2011 at 3pm with 60 members present. Prior to this meeting, the total membership of PCS was 94 members; therefore, we did have in excess of 50% of the membership, meeting the requirements for a quorum.

Chairman's Remarks

Administrative Subcommittee Notes

a) Upcoming IEEE – PES Meetings
- IEEE/PES T&D Conference and Exposition, May 7, 2012, Orlando, FL
- PES General Meeting: July 2012, San Diego, California.
- PES General Meeting: July 2013, Vancouver, BC, Canada.
- Next Transformer Committee meetings:
  - Spring 2012, March 11 – 15, – Nashville, Tennessee; Renaissance Nashville Hotel; hosted by Baron USA, Inc.
  - Fall 2012, Milwaukee, Wisconsin; hosted by Waukesha
  - Spring 2013, Munich, Germany; hosted by Reinhausen
  - Fall 2013, St. Louis, Missouri; hosted by HJ Enterprises
  - Spring 2014, Savannah, Georgia; hosted by Efacec

b) New meeting format – tentative
Purpose is to free up meeting slots and add value to Main Committee announcements and awards.

- Move some Thursday Main meeting activities to Monday morning and/or Mon/Tues lunches
- Move out non-core activities (IEC, NEMA)
- Move tutorials to Thursday morning

Approval of Meeting Minutes

The minutes of the last meeting in San Diego, California were approved as written.

Working Group (WG) and Task Force (TF) Reports

10.4.1 WG on Loss Evaluation Guide C57.120 – Don Duckett, Chair; Alan Traut, Vice-Chair

Attendance: 45 Total. 11 of 22 Members present. 34 Guests

The meeting was called to order at 11:00am on Tuesday November 1, 2011.

Attendance of membership was taken and a quorum was not established. The minutes of the Spring 2011 San Diego meeting were tabled due to lack of quorum.

Don Duckett made a presentation on "Financial Math" discussing the basics of engineering economic calculations and the basic equations for utility loss evaluation A and B factors. Don also presented a spreadsheet tool to make these basic calculations. These will be made available on the website. Don also demonstrated a computer program that considers uncertainty in the inputs and the resulting range of variation in the A and B factors.

A discussion of uncertainty followed with the direction that the guide will address all forms of quantifying uncertainty, including Band of Equivalence or BOE.

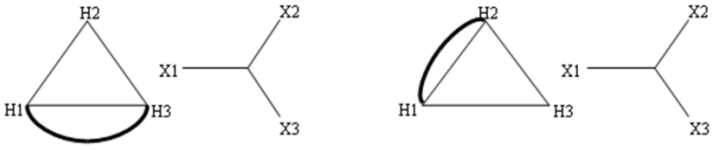
The first draft D11 was reviewed and will be on the website following this meeting. A more detailed review will take place at the next meeting in Nashville.

10.4.2 PCS WG on "Test Code C57.12.90" – Mark Perkins, Chairman; Craig Stiegemeier, Secretary

1. Introduction of members and guests
2. Membership review
   Craig Stiegemeier reviewed recent changes to the Working Group roster. After these changes, the Working Group now has 71 Members, 1 Corresponding Member and 257 Guests. Any Member missing the last two Working Group meetings has been moved from Member to Guest status.
   A review of the current roster of members was presented to the attendees. After the review, a roll call found that 39 members were present at the meeting, constituting a quorum of 55% of the Working Group membership.
3. Approval of minutes from the Spring San Diego meeting
   The Chair noted that the minutes from the San Diego meeting were distributed to the Working Group before the meeting by E-mail as well as on the Committee website. After a call for comments or corrections and receiving none, David Wallach made a motion to approve the San Diego minutes, Robert Thompson seconded the motion, and the minutes were approved by the membership as written.
4. Old Business
   Revision of Section 6 and 7. Final survey resulted in 59 members approving, one abstaining and with 3 members approving with comments. The chair presented a review of the 3 comments received on Sections 6 and 7. Following are those comments:
   - Robert Thompson commented that the Wye-Zigzag illustration should show H1 connected to X1. The Chair noted that this comment will be incorporated into a revision of the comments
   - Jennifer Yu offered the following comment: "The portion directly above Figure 9 could be explained in more detailed text, for example, apply voltage between H1-H2 terminals, and measure voltage between X1-X2 terminals. This would make it much clearer to read and understand, instead of some symbols." A discussion of this comment was held. Bertrand Poulin noted a recent test floor experience. Baitun Yang of PA Transformer questioned the practice of creating a virtual neutral. Kipp Yule noted that there could be some confusion when using the Phase A, B and C designation, which is similar to the following comment from Barry Ward. The Working Group agreed that the comments surrounding the figure were adequate to explain the concept.
   - Barry Ward offered the following comment: "Paragraph 7.1.4: I think the diagram should show which phases are A, B and C. I've used the following diagram in a recent document which you are welcome to have if you want." The Chair suggested

that this would not impact the survey and may make the figure clearer to understand. Thompson made motion, Joe Melanson seconded the motion, and 39 members approved, no one disagreed with making the change to this figure.

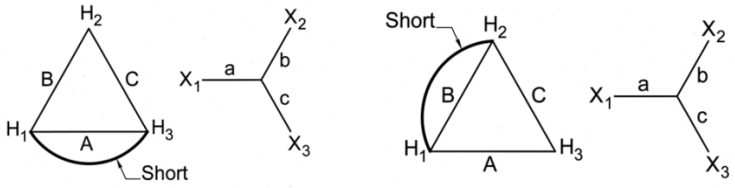
Change Recommended by Barry Ward



For B phase and C Phase, short H1 to H3
(B Phase) – Apply H1-H2 Measure X1 – X2
(C Phase) – Apply H2-H3 Measure X1 – X3

For A Phase, short H1 to H2
(A Phase) – Apply H3-H1 Measure X2 – X1

Figure 9. Connections for Ratio Test on a Transformer with Inaccessible Neutral



- Any other Old Business?

There was no other old business

5. New Business
   - Revision of Section 8 – No Load Loss Measurements
     - Voltage waveform issues with no load loss measurement
     - Use of Capacitors for wave shape improvement

The Chair suggested that the standard is up to date for most cases as long as it is followed correctly.

Connections are properly made
Voltage is properly set
Average voltage reading voltmeter is used

The Chair suggested that the effect of waveform distortion could be addressed better with a revision of the standard. He suggested that a better approach may be to update the guide. Ramsis Girgis commented that Section 8 has a number of different figures showing how to make the no-load loss measurement connections. Waveform may be a different situation. The primary concern is determination if the waveform deviates significantly from a sine wave. Bertrand Poulin suggested that there is missing guidance, but he suggests that the clarification should go into the guide, and not the standard.

The waveform could be improved by:

- Inducing to a different winding
- Using a stiffer (higher MVA) source
- Applying a capacitor to the source terminals (not to be used on a generator due to self-excitation concerns)

These all basically lower the source impedance at the higher harmonic frequencies. The last method is likely the one which most users are least familiar. The chair then presented some information from technical literature demonstrating the benefits of capacitors for correcting a badly distorted voltage waveform when a transformer was tested at 115% excitation voltage.

Arnold Carlos commented on the need for 115% over-excitation. Marcel Fortin made comments around the need for accurate measurements to address harmonic issues in wind applications. Bertrand Poulin emphasized that a simple 5% correction factor limit is not adequate to assure the wave is as clean as possible. Ramsis Girgis emphasized that a correct measurement of exciting current was what is needed.

It was asked if anyone requires measurement of no-load loss and excitation current at voltages greater than 110%. Mike Spurlock of AEP noted that they required the measurements up to 120% over excitation which is used by their system analysts. He agreed that their desire is to have a waveform be as close as possible to a sine wave. He favors something that would go into the standard or guide to suggest an approach so manufacturers get as close as possible to ideal.

Steve Antosz suggested that this falls under C57.123 loss measurement guide, and it really doesn't fall into the work undertaken by this working group. Bertrand Poulin believes that some of this should go into the test code and some into the guide. If the guide is changed first, then the test code will have something to refer to. These minutes request that the guide be updated. It was published in 2009, and is not due to be updated for some time.

The Chair committed to reviewing the 5% correction paragraph to make it clearer at the next meeting.

Bipin Patel has offered to conduct an independent review section 8 and come back with comments. The Chair asked for volunteer(s) to come forward with their comments in reviewing Section 8.

Shamaun Hakim wants to see that measurements occur with the LTC in the bridging position to correctly measure the average losses and to help confirm proper operation/connection of the LTC. Joseph Melanson suggested that core loss should be measured in 15 raise for any transformer that has an LTC. Jim Harlowe noted that this concern was addressed in the voltage regulator standard (C57.15) and resolved through a no load loss measurement taken at 4 positions that would include bridging positions for reactive tap changers. The chair suggested that the issue of tap changer positions for no-load loss measurement of transformers with reactance type tap changers should be brought to the attention of the Working group on PCS revisions to C57.12.00 for discussion and inclusion in the standard.

Ramsis Girgis suggested that we bring the Overexcitation Task Force recommendations up at the next meeting for review by this group. Craig Stiegemeier committed to get those suggestions to the Chair.

After the meeting, Dinesh Sankarakurup approached the Chair, suggesting that we look at how well the voltage is balances as one of the checks when performing the no-load loss test. This will be reviewed at a future Working Group meeting.

10.4.3 PCS TF on Dielectric Frequency Response – George Frimpong, Chairman; Poorvi Patel, Secretary

1. Meeting Attendance
The TF on DFR met on Monday, October 31st, 2011, at 1:45 PM. A role call showed 13 members and 53 guests in attendance. Three guests requested membership.

2. Approval of previous meeting minutes
There was a quorum of members present and the minutes of meeting from the Spring 2011 meeting in San Diego California were approved with changes.

3. Presentations of task reports
Four groups were formed during the San Diego to handle various aspects of the project. These groups presented progress reports at this meeting.
 Subtask 1 – Literature Survey George Frimpong presented a list of abstracts from papers related to the modeling and estimation of moisture in transformers using DFR and other dielectric response methods. In all a total of 25 key papers have been identified, some of which deal with verification of DFR for moisture estimation.
o Mary Foster from Omicron suggested the inclusion of the CIGRE **Working Group D1.01 (TF 14), Report 414 on Dielectric Response Diagnoses for Transformer Windings, 2010**.
 Subtask 2 – DFR Method Description Peter Werelius presented the material that has been put together to explain the basics of the DFR method.
 Subtask 3 – Verification/Validation Tom Prevost and Diego Robalino presented case studies on transformers for which DFR measurements and other moisture determining measurements (dew point and Karl Fischer on paper samples) were performed. Tom requested anyone who has cases of DFR moisture measurements in conjunction with other moisture measurements to send these to him and Diego for review and inclusion in the task force report. For completeness we ask also for cases where DFR did not work in estimating moisture in the solid insulation. Tom presented a list of information to include with the cases.
o The chair clarified that the task force will focus only on cases related to moisture determination in power transformer solid insulation.
o A table to address DFR measurement parameters and to quantify their diagnostic value was presented. The table will be reviewed by the subgroup before the next meeting.
 Next Step for Subtask 3
o Complete draft of this section by end of January 2012 and distribute among subtask members for comment
 Subtask 4 - Mario Locarno presented a review of existing IEEE, CIGRE and IEC documents that have a relation to moisture estimation in transformer solid insulation. In all about 20 documents were found that mention moisture estimation or DFR.

4. Comments and Questions:
 A comment was made by one of the guests that the effect of several parameters that may affect moisture estimation using DFR must be addressed in detail by the task force, these being**:**
o Effects of aging (e.g. low molecular weight acids)
o Effects of temperatures
o Effects of design parameters
o Validation on older transformers

o Reliability of the databases used for analysis

 The chair responded that the scope of the task force was to find if there is enough validation that DFR can be used to determine moisture content of solid insulation in transformers. If the recommendation is to develop a guide, all the limitations would have to be addressed by the ensuing working group.

 Project Time Table:

 Before Spring 2012 Meeting –

i. Complete draft report and circulate among TF members for comment

ii. Complete final draft report

 Spring 2012 Meeting – Review final draft and obtain comments

 After Spring 2012 Meeting – Address comments and submit final report to PCS Chair

 Chair asked for comments on content and outline of preliminary draft TF report that was sent to the group. No comments were made.

10.4.4 PCS WG on "General Requirements C57.12.00" – Steve Snyder, Chairman; Enrique Betancourt, Secretary

The Working Group met at 3:15 PM on Monday, October 31, 2011, with **31** members and **62** guests present. As the current Working Group membership stands at **61** members, we did have a quorum at the meeting. The following **(18)** guests requested membership, which will become effective only after confirmation of attendance at two (2) consecutive meetings :

James Graham	Pike Energy Solutions
Jose Izquierdo	Siemens Servicios S.A de C.V
David Murray	Tennessee Valley Authority
Sanjib Som	Siemens Energy
Sergiy Razuvayev	Delta Star Inc.
Kirk Robbins	Exelon Nuclear
Tauhid Ansari	ABB Inc.
Amitav Mukerji	ABB Inc.
Oscar Pinon Garcia	WEG
Joshua Verdell	ERMCO
Terence Martin	GridSense
Jagdish Burde	Virginia Transformer
Bill Chiu	Southern California Edison
Michael Craven	Patterson & Dewar Engineers
David Harris	Waukesha Electric Systems
Jill Holmes	Bureau of Reclamation
Tom Melle	Waukesha Electric Systems
John Herron	High Volt - Reinhausen

Following introductions, the minutes of the April 11 San Diego Meeting were approved.The meeting agenda was presented.The meeting began with reports from the two Task Force chairmen on the **old business** items as follows :

WG Item 82, C57.12.00 - 2000 Section 7.1.4.4 Stabilizing Windings

The Task Force on Stabilizing Windings met earlier the same day. This group has been working now for three years to resolve the subject of default kVA rating for stabilizing

windings. A new clause was prepared by the group for inclusion in C57.12.00, and the text was surveyed among the Performance Characteristics and Insulation Life Subcommittees prior to this meeting. With the results of this survey producing only affirmative responses and few minor comments, we deem the work of this task force to be completed and the new clause will be submitted for the next ballot of C57.12.00.

Owing to the strong interest expressed by the participants, the Task Force has requested to be upgraded to a Working Group specifically to develop an application guide for tertiary and stabilizing windings. The Title, Scope and Purpose for this new document were discussed and have been submitted for review and approval of the Committee Officers.

WG Item 87, C57.12.00 -2002 Table 18 Short-circuit apparent power of the system to be used unless otherwise specified.
A Task Force was formed at the Fall 2010 meeting to review short circuit currents listed in Table 18, in response to a comment from the 2006 ballot. The chairman, Bruce Forsyth, presented a new set of proposed figures for the table. There was intensive discussion on the validity of the new numbers, as some are higher and others lower than the original ones. One point of controversy was the criterion of limiting maximum short circuit currents to maximum ratings of existing circuit breakers. Following a lot of discussion, the chairman proposed sending the new proposed Table 18 for survey within the membership of the Performance Characteristics Subcommittee and this Working Group, to collect a more general view.

Under new business, the WG began discussions on these issues :

WG Item 96, C57.12.00 -2010 Table 18 Routine, design, and other tests
Requested Change (J.Foldi) : “Resistance measurements should be done on all taps for Power Transformers.” Currently, Table 18 only calls for resistance measurements on nominal and extreme taps. First it was discussed among the participants if, for reversing LTC´s, it is necessary to cover the full range of taps. Secondly, the necessity of including QA tests within the standard was questioned. After much discussion, it was agreed that we will conduct a survey within the Working Group with a clearly defined document describing the requested test and the ramifications of the proposed change. Joe Foldi will assist the chairman in preparing the document.

WG Item 97, C57.12.00 -2010 Table 18 Routine, design, and other tests
Requested Change (J.Foldi): “Could the details of the operational tests on the LTC equipment under full voltage (during No-Load test) and under full current (during Load loss test) be described here ? The details of the LTC operational test should be described in C57.12.90, but the requirement for the test itself needs to be added here.”
Before the discussion within the group, Joe explained in detail his request: for LTCs, inclusion of electrical as well as mechanical tests, as it is specified in IEC standards. Once again we concluded that an explanatory document needs to be prepared and surveyed among the Working Group before engaging in detailed discussion. Joe Foldi will assist the chairman in preparing this document.

WG Item 98, C57.12.00 -2010 Title and Scope
Requested Change (Kimberly Mosley) : The title of Standard C57.12.00 suggests a scope covering regulating transformers. The body of the document limits its discussion of regulating transformers to load tap changing with a vague mention of other types. Ferroresonant regulating transformers are not discussed and the document either should

cite these as specialty transformers not included in the scope or reference an applicable standard, or include some discussion.

The chairman reported that the Standards WG commented during ballot resolution that there are many "specialty" transformers, and it would be inaccurate to single out just one (such as ferroresonant transformers) as an exclusion. After a brief discussion, the Working Group agreed with this response by a vote of 29 to 2, and the subject is considered closed.

10.4.5 WG on "IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices", PC57.32 – Sheldon Kennedy, Chairman; Fred Elliott, Vice-Chair

The Neutral Grounding Devices working group was called to order at 3:20 PM on November 1, 2011. There were 19 attendees: 11 members and 8 guests, Copies of the previous meeting minutes were distributed.

1. Introductions were made.
2. The agenda for the meeting was reviewed and it was determined that a quorum was present. The minutes from the San Diego meeting on April 12, 2011, were approved without comment.
3. The status of the project was reviewed. A straw ballot of the Performance Characteristics Subcommittee had been made, and determined that sufficient consensus for the document to move to sponsor ballot had not been accomplished. The content of the technical comments received will require additional work to revise the document. Unfortunately, there is insufficient time to complete this before the expiration of the PAR at the end of the year. Since the PAR had been extended three times, it is not possible to request an additional extension. Therefore, the PAR will expire, and a request for a new PAR has been submitted for the December NesCom meeting.
4. Further, it was determined that new officers would be needed to continue the project under the new PAR. Sheldon Kennedy volunteered to be the Chair, and Fred Elliot to be the Vice Chair/Secretary.
5. Since there was a quorum present, it was decided to continue the work on the standard. The working group proceeded to review comments received during the straw ballot.
    - The major concern raised during the ballot was the inconsistency in requirements between the common clauses and the specific grounding device clauses; and that the information for any particular device was spread throughout the document. After discussion of these issues, a motion was made to include all of the information needed to describe the characteristics and testing of a particular neutral device in its own section. After discussion the motion was approved.
    - Discussion then continued on the testing requirements for each neutral grounding device and as to whether this should be in a common section or with each device. After continued debate the working group decided that it was too early to determine if the testing could be combined, and decided to wait until the individual device sections were written including the testing information needed.
    - The following members agreed to review the various device sections and rewrite as required:
        a. Reactors – Mike Sharp
        b. Ground Fault Neutralizers Klaus Pointner
        c. Grounding Transformers Don, Ayers, Fred Elliot, Sheldon Kennedy

d. Resistors – Sergio Panetta
e. Combination Devices – Sergio Panetta

- Input on all devices is required by January 15, 2012.
- The latest draft of the standard will be posted on the transformers Committee website, and copies of the comments from the straw ballot will be mailed to all members.

10.4.6 TF on Tertiary/Stabilization WIndings – Enrique Betancourt, Chairman; Steve Snyder, Secretary

The Group met at 8:00 AM on Monday, October 31, 2011 with **17** members and **55** guests present. The current Working Group membership stands at **34** members (2 of them Corresponding Members), therefore we did have a quorum. Seven (**7**) guests requested membership:

Benjamin Lopez	Prolec GE
Doug McCullough	Maxima-Hyundai
Emilio Morales	EFACEC
John K. John	Virginia Transformer Corp.
Robert F. Tillman	Southern Co. Services
Stephen Anthony	PEPCO
Van Nhi Nguyen	Hydro Quebec

Next, an excerpt from the minutes of the Spring Meeting of WG "Continuous Revision of C57.12.00", which included detailed report of our TF previous meeting, were reviewed by the Group and approved as representative of our previous activity.

Old Business

A. Survey on the new Clause for C57.12.00, related to thermal requirements for Stabilizing Windings

The group has been working for three years to resolve the subject of default kVA rating for stabilizing windings. A new clause was prepared by the group for inclusion in C57.12.00, and the following text was surveyed among the Performance Characteristics and Insulation Life Subcommittees prior to this meeting.

"5.11.1.2 Thermal Rating for Stabilizing Windings (buried tertiary)
In addition to the short circuit duty (see 7.1.4.4), stabilizing windings shall be designed to withstand the transient and continuous thermal duty as specified by the user and in accordance with the allowable temperature limits of 5.11.1.

In the event no continuous thermal duty for the stabilizing winding can be established from the user's specification, the manufacturer shall design the stabilizing winding considering the circulating current in that winding, resulting from a full single phase load in the largest main secondary winding. The manufacturer shall determine kVA rating for the stabilizing winding based on the transformer's equivalent circuit for single phase loading condition.

The manufacturer shall calculate values of average and hottest-spot temperatures for the stabilizing winding to verify compliance with allowable temperatures. Initial conditions for these calculations shall be based on the transformer operating at its maximum continuous rating, before switching to the loading conditions described above in the first or second paragraph, whichever is applicable."

Note: "Transformer" is a general term for two winding transformers and autotransformers

Forty (**40**) responses were received from the group surveyed, all of them "APPROVED". Three of them included recommendations to further clarify the text. Based on those results, the work of this TF was deemed to be completed, and the new clause will be submitted for the next ballot of C57.12.00.

New Business

A. Formation of a new Working Group to develop an Application Guide for Tertiary and Stabilizing Windings

Based on the strong interest expressed by the participants, the Task Force has requested to be upgraded to a Working Group, specifically to develop an application guide for tertiary and stabilizing windings. A first draft for the Title, Scope and Purpose of this new document was previously discussed and submitted for review of the Committee Officers. During this meeting, further adjustments were made:

TITLE
"Guide for the application of tertiary and stabilizing windings in power transformers."

SCOPE
Liquid immersed power transformers, as covered by C57.12.00. Main focus on wye-wye connected transformers and autotransformers, provided with delta connected windings.

PURPOSE
To provide users with a conceptual framework and recommendations for specification, application and performance evaluation of tertiary and stabilizing windings.

This guide will cover tertiary and stabilizing winding applications to Wind Farm Collector Transformers, Primary Distribution Transformers, and Network Tie Transformers and Autotransformers, with following remarks:

- We do not intend to address the general case of Multiwinding transformers; only the specific case of Y-Y connected transformers or autotransformers.
- Double primary, or double secondary Y-Y transformers are included within the Scope.
- An initial, critical question to solve is if a Stabilizing Winding (or Tertiary Winding for the same purpose) is required for an specific application of Y-Y connected transformers – Considering impact on, and user's needs of zero sequence performance.
- If a SW/TW is required, what parameters are recommended?

Expecting a positive response from the Administrative Committee, the WG made decision to start preliminary work, and volunteers agreed to gather information on following subjects:

1. Survey on literature on Tertiary and Stabilizing Windings, identifying recommendations applicable to transformers within the scope.
2. Investigation on system requirements associated to Zero Sequence performance of transformers: Literature and Utility Practice
3. Investigation on impact of SWs and TWs regarding reported issues and transformers performance (zero sequence flux effects)

10.4.7 TF on "Audible Sound Revision to Clause 13", C57.12.90 – Ramsis Girgis, Chairman

The TF met at 11:00 am on Monday, October 31, 2011 with a total of 63 in attendance, 18 members and 45 guests, 3 guests requested membershipe TF.

First, the minutes of the San Diego meeting were approved as written. The chairman then presented an overview of the agreed – upon additions / changes to section 13 of C57.12.90. This was followed by a detailed review of the new proposed text in this section of the Standard.

The 1st item discussed was "the correction for sound wall reflections'. The following comments / suggestions were made:

- The word "adopted", in the Note in the section referencing to IEC as the source of this correction, should be replaced by the word "based upon".
- The comment about the need for agreement between the purchaser and the manufacturer on the suggested environmental corrections should be replaced by one where the agreement is needed if wanting to use an alternate method of correction. Subsequent to the meeting, the chairman did not think there is actually a need for such a statement as this is already implied and it also applies to all of the Standards requirements. This will be discussed again in the spring meeting.
- Regarding the sufficiency of using 4 values for the Average Acoustic absorption coefficient in IEEE vs. 5 values in the revised IEC Standard, and 7 in the original IEC standard, a TF member suggested that IEC recommends measuring that coefficient. The chairman responded that the approximation involved in limiting the # of these values is small and actually much smaller than the impact of other factors in noise level measurement. Another member of this TF and the IEC WG suggested that the IEC solutions tend to be more theoretical while IEEE takes a more practical approach with very small errors.
- A question whether there is a need to have a comment regarding the placement of the transformer under test in the test room and its impact on the sound reflection error, e.g. when placing the transformer in a corner of the test room. The chairman answered that the IEEE standard already requires a minimum of 3 m distance to the nearest wall.
- The chairman mentioned that since the IEEE Standard will be allowing a maximum of 4 dB for the wall sound reflection correction "K", that Figure 31, which includes the curve to use to obtain the value of "K", will be adjusted to extend the vertical axis up to 4 dB.

Next item discussed was "load noise". The following comments / suggestions were made:

- The chairman said that he intentionally used the paragraph on "Load loss measurement" in section 9 of this Standard for load noise, in spite of the fact that the corresponding IEC paragraph reads better. This he did in order to minimize negative ballots. Editing of those sections may be made in a future revision.
- A question as to why use the top rating and not the bottom rating of the transformer for measuring load noise; as Transformers are typically operated at their bottom rating at night when noise level limits are lowest. The chairman answered that load noise of transformers at their bottom rating (60 %) is typically very low (9 dB lower than at their top rating) and becomes hard to measure with sufficient accuracy at the factory. Hence, the chairman suggested changing the bottom boundary of the validity of the load noise measurement conversion range from 70 % to 60 %.

- The chairman explained that the reason for using the load noise current conversion range from 70 % to 130 % is to allow measuring load noise at
  1. Higher current when load noise is too low to measure at full rated current
  2. Lower current if test equipment does not allow testing at higher currents. High load noise of the booth transformer can be one reason for that as it can not be corrected for in the "Sound Pressure Measuring method" since it is not part of the ambient noise.

  The chairman suggested that the condition of needing to test the transformer for load noise at higher than rated current, because of higher ambient noise, needs to be added to the start of that paragraph.
- A question whether the Load noise relationship to current is correct for both the 'A – weighting' as well as the full Octave, 1/3rd Octave, and Narrow – Band. The chairman answered "Yes" since Load noise is almost always dominated by the double power frequency component. Significant harmonics appear only when magnetic shielding used is overloaded. The same can happen when measuring the A – weighted level using the Sound Pressure method when the ambient has high level of higher harmonics. The Intensity Method is the preferred method for measuring load noise in general and in this case specifically.
- Donald Chu, of ConEd, stated that the total noise level of a transformer, when in operation in the field, may not be at the rated load. The chairman understands the background of this statement and promised to explain it and discuss it with the TF at the Spring meeting when dealing with the subsection of section 13 dealing with the "Determination of the total noise level of a transformer"

Next item discussed was the "Sound Intensity Measuring Method". The following comments / suggestions were made:

- Adding a statement that the alternative is to use the "Sound Pressure method" if the condition, stated regarding the invalidity of the "Sound Intensity method", occurred. Under those conditions, the "Sound Pressure method" would not be valid either but, at least, it results in penalizing the transformer manufacturer for not having proper environmental conditions.
- Adding text that provides guidance to manufacturers on how to allow for proper environmental conditions. The chairman suggested adding such information in a separate noise testing Guide. However, subsequent to the meeting, Steve Antosz (PCS Chairman) reminded the chairman that the TF originally decided there was no need for a separate Guide, and that whatever guidance to be given should be included in section 13. The Chairman agreed but Steve suggested that we may think it through again whether there is a need of such a Guide.

Next item discussed was the new 2 m all around sound measuring contour for ONAF noise measurements. There were no comments on this item.

Other items brought up and discussed:

- Jeewan Puri brought up the idea of correcting for near – field effects; which was originally suggested by the chairman in the previous meeting of the TF in San Diego. The correction is to be made when measuring using the "Sound Pressure method". Jeewan suggested a 2 dB correction, referring to earlier work done by the Chairman and his ABB team. The chairman supported this request and stated that this effect is typically between 1.0 and 1.5 dB; depending on the measuring contour. However, the chairman suggested that this idea is better revisited when discussing the section on the "Determination of the total noise level of a transformer". This is because a change may

then be considered for the ONAN measuring contour in the revised section 13; as previously discussed.
- A better title than "Transformer Operating Conditions" is needed.

Because of shortage of time, the final item; dealing with the "Determination of the total noise level of a transformer", will be discussed at the spring meeting.
The plan is to send the TF members and guests, shortly after the Boston meeting, the revised section 13 with modifications per the recommendations and decisions made at the Boston meeting for review and feedback. More reviews are planned for the period between now and the spring meeting, such that a final draft of the revised section 13 of C57.12.90 can be sent for Survey among the TF and PCS Subcommittee members after the spring meeting.

10.4.8 WG on Wind Trubine Generator Transformers. PC57.12.16, – David Buckmaster, Chairman; Vice Chair: Phil Hopkinson; Secretary:Scott Choinski

The Task Force on Wind Power Transformers was called to order at 9:30 AM. This was the first meeting of the WG, which replaced a TF. Membership on the WG are those attending this first meeting and request membership, and those that responded to a call confirming membership earlier this year. There were 106 attendees, 57 members, 49 guests. The minutes from the final TF meeting held April 12, 2011, was accepted as written.

Chair Remarks

1. Introduction of WG board members
   Mr. Buckmaster introduced the officers of the WG
   Chairman: Dave Buckmaster
   Vice-chairman: Phil Hopkinson
   Secretary: Scott Choinski
   Saurabh Ghosh was appointed as an Alternate Vice-chairman
   It is intended to appoint a 2nd Vice-chairman from the IEC for joint work on the standard.

   Paul Jarman, Chairman of IEC TC14, reported that IEC 60076-16 was published in August. TC14 will send a notice to all National Committees seeking approval for an immediate revision to the document, which is unusual for an IEC standard. The justification is a joint revision with IEEE.

   Paul Jarman and Dave Buckmaster will meet after this meeting to review IEC 60076-16 and discuss what is missing in the document from the IEEE perspective. Dave Buckmaster volunteered to prepare a list of these issues to submit to Paul Jarman by Christmas.

2. Discussion of Name, Purpose & Scope

   Reviewed the title, purpose and scope of the proposed document. This is what is on the PAR, and it is on the NESCOM agenda. A 6 month delay has been requested for PAR approval to allow the IEC to go through its process to approve starting a revision to IEC 60076-16. The scope had been modified to change 38 kV to 34.5 kV.

   Title:Standard requirements for Wind Turbine Generator Transformers

Scope:This standard establishes requirements for Liquid Immersed, or Dry Type transformers with at least one set of terminals rated ≤ 34.5 kV with a capacity rating ≤ 100000kVA suitable for Step-Up operation to be used to transform the voltage from the Wind Turbine generator to the system voltage of the collector grid.

Purpose:The purpose is to enable manufacturers and users in specifying, designing, and manufacturing transformers used for Wind Turbine Generator duty.

3. Key dates in the PAR
   Expect final draft August 2014 Project completion May 2015

4. Brief discussion of IEC 60076-16
   - Published by IEC August 2011. Most WG members have not seen the published document yet.
   - Jodi Haasz to request a copy for WG use. It will be placed on the Transformer Committee website in a password protected area. Reviewed the copyright rules for the IEC document. Contact Chair or Secretary for access to the document.

5. Working Group collaboration with IEC for a dual logo document
   It is intended for a joint revision of IEC 60076-16 with IEC. If the IEC does not agree to a revision, then this WG will move on with a stand-alone document. The IEC document would be used as a starting point.

   An adoption of the IEC document by the US may not be a good option. There are many issues to address in the IEC document for it to be acceptable to IEEE.

6. What other sub-committees or working groups may be affected by this group's work
   - Insulating Fluids (C57.104)
   - Tap Changers (C57.131)
   - Bushings (C57.19)
   - Others? No other committees were identified.

Open forum discussion and task assignments

A. Normative reference research and cross reference – Phil Hopkinson volunteered
B. Transient Switching C57.142 Verbiage to address – Jeewan Puri volunteered
C. NFPA 70E Compliance for Arc Flash – Dave Buckmaster volunteered.
D. TF to study failure mechanisms. May not be warranted at this time.
E. Stress enhancement points/gas analysis – Ray Bartnikas to submit a proposal
F. Others – No other tasks identified

10.4.9 WG on "Guide for the Application and Interpretation of Frequency Response Analysis for Oil Immersed Transformers", PC57.149 – Chairman; Charles Sweetser

WG PC57.149 met for the development of the Frequency Response Analysis (FRA) Guide in Boston, MA on October 31, 2011 at 11:00 AM. There were 96 people in attendance. Only 14 of our 32 members were in attendance, and a quorum was NOT established.

The first order of business was to show the slides regarding patents, assurances and inappropriate behavior.The minutes from the Houston, TX 2010 and Toronto meetings were not approved. This will be addressed at the next meeting.

This meeting focused on the ballot results of the FRA Guide. The ballot closed on September 10, 2011. The ballot results are as follows:

Number of Ballots:	136
Response Rate:	83%
Approval Rate:	88%
Abstention Rate:	7%

The ballot produced 266 comments. The breakdown is as follows:

Category	Must be Satisfied	# Comments
Editorial	YES	38
General	YES	5
Technical	YES	50
TOTAL		93
Editorial	NO	115
General	NO	32
Technical	NO	26
TOTAL		173

A ballot resolution group was established. The following members accepted the ballot resolution responsibilities for following categories:

Category	Must be Satisfied	WG Member
Editorial	YES	Charles Sweetser
General	YES	Peter Werelius/Mario Locarno
Technical	YES	Peter Werelius/Mario Locarno
Editorial	NO	Charles Sweetser
General	NO	Peter Balma
Technical	NO	Kirk Robbins/Hemchandra Shertukde

The common ballot results were reviewed; 4 topics were identified as being most difficult:

1.) Frequency Range covered in guide, but not specified
2.) Dynamic Range, Resolution and Accuracy not being specified
3.) Applied Voltage not being specified
4.) Statements related to insulation degradation and clamping pressure. The balloter stated that these issues are outside the diagnostic ability of FRA.

The ballot resolution group has been directed to solve these issues.

10.4.10 Special Reports

- Status of Semiconductor Rectifier Transformers C57.18.10 S. Kennedy

  The Task Force has been retired from an active Task Force to allow more meeting room for Working Groups with PAR's. The Chair sent the final meeting minutes of the Toronto meeting to the membership.

  This TF was to work on a few special items while we still have the group together.

  We have a proposal for a clause on electrostatic ground shields.

  We have decided on a way forward for a method to show phase shifted secondary windings with multi-pulse secondary windings such as 18 pulse, 24 pulse, 36 pulse, 48 pulse and 54 pulse are becoming a great part of the motor drive transformer applications, as well as higher current rectifier transformers. The Task Force decided to just propose general discussions of phase shifting windings and not give any of the exact phase shifts that are being used in industry. This seemed the best way to accomplish this.

  There was a discussion about determining the losses in specific regions due to harmonics. IEC has tackled this subject already in an Annex and this should be done in our next revision, as well. An example of the response of the windings to the 5^{th}, 7^{th}, 11^{th}, and 13^{th} harmonic, for instance, is much different than the fundamental current when we examine the leakage fields and loss densities with finite element methods.

  This concluded the specific items the Task Force was commissioned to accomplish. The Chair will try to do continued work offline to help do some organization of the standard to get it into the proper format of the styles manual. The chair has asked any members who would like to volunteer to assist in this effort to contact him.

  Status of PC57.142 Switching Transients Induced by Transformer /Breaker Interaction.
  R. Degeneff --- No Report

10.4.11 Old Unfinished Business

Discuss formation of a new TF to extend the work of the Switching Transients WG into higher voltage applications. There was no new discussion on this topic. It will be dropped unless someone expresses an interest to take it on.

10.4.12 New Business

- V. Sankar and K. Vijayan presentation regarding the requirements in C57.12.00 & C57.12.10 for lower tap voltages and reduced currents to be shown on the nameplate. A presentation was made; discussion ensued, followed by a hand vote of the members to make no change to the Standard regarding this issue and drop the subject.
- Hem Shertukde. Task Force on Photovoltaic Transformers.
  This TF will be moved from Power Transformers Subcommittee to the Performance Characteristics starting st the next meeting.
- Bill Chiu. Class I – Class II elimination. --- To be continued at the next meeting.