10.4 Performance Characteristics Subcommittee – Ed teNyenhuis, Chairman; Craig Stiegemeier, Secretary

Introduction / Attendance

The Performance Characteristics Subcommittee (PCS) met on Wednesday, October 24, 2012 at 3pm with 135 people attending. Of these, 66 were members and were 69 guests. Prior to this meeting, the total membership of PCS was 112 members; therefore, quorum was achieved with 59% of the membership in attendance.

There were 10 guests requesting membership.

Chairman's Remarks

A review of the PCS standard expirations and PAR expirations was reviewed. The majority of the standards do not expire until after 2018.

Administrative Subcommittee Notes

Upcoming IEEE – PES Meetings

- PES General Meeting: July 2013, Vancouver, BC, Canada.
- Next Transformer Committee meetings:
  - Spring 2013, Munich, Germany; hosted by Reinhausen
  - Fall 2013, St. Louis, Missouri; hosted by HJ Enterprises
  - Spring 2014, Savannah, Georgia; hosted by Efacec

Approval of Meeting Minutes

The minutes of the last meeting in Nashville TN were approved as written.

Special Reports

Dielectric Frequency Response – The Chair noted that George Frimpong and his Task Force had finished their work and made recommendations reported at the Nashville meeting.

Frequency Response Analysis (FRA) Guide PC57.149 - Chuck Sweetser reported that all the issues were resolved by Sept. 4th, a month before the deadline for submission to RevCom.

Unfinished (Old) Business

No old business.

New Business

No new business.

Meeting was adjourned at 4.15 pm.

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

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

PAR Status: PAR Approved
PAR expiration Date: 12/31/2014

Current Draft Being Worked On: D12

- Attendance
  - 63 Total
  - 11 of 21 Members
  - 43 Guests
  - 9 Guests requesting membership
- The meeting was called to order at 11:00 am on Tuesday, October 23, 2012.
- Attendance of membership was taken and a quorum was established.

Chair Report

- Al Traut outlined the PAR status and expiration and noted that we need to go to ballot no later than immediately after the Spring 2014 meeting.
- Don Duckett will not be able to attend our meetings in the future but will continue to assist in the development of our document outside of the meetings.
- In light of Don's new status, Al asked for volunteers to serve as Secretary to our WG. Immediately following the meeting Dave Harris volunteered to serve as Secretary of the WG. The Chair also recognized Kendrick Hamilton for taking the minutes of this meeting.
- Bill Bartley gave an explanation of the usage of dollars in IEEE documents.
  - The anti-trust policy for IEEE states that you may not use currency in any documents.
  - The solution to this issue is to use variables in place of currency.
- Don Platts suggested that there will be an issue with posting the spreadsheet to the IEEE website, because since it is not an official IEEE document it is not under the indemnification of IEEE. We may need to email the spreadsheet to our members to avoid this issue

Old Business

- Dave Harris motions to adopt minutes the Spring 2012 Nashville meeting as submitted. Don Platts seconds this motion. Minutes are unanimously approved
- Bill Bartley suggests that the bibliography will be either in the first annex or the last annex, but cannot appear in the middle.
- Comment: The title of "acronyms" and/or "definitions" may be used according to Bill
- Comment: The acronym LM is changed to only L in another place in the document, but both of these occurrences should match. Al will edit the draft accordingly.
- Comment: Al Traut states that we should remove all specific year references from the document and make it generic.
- Comment: Don brings up issue that the basic assumptions and equations to the system capacity chart that is presently in the Figure 1 (Generation Expansion Planning Using Reserve Margin) do not apply to de-regulated utilities. Adam Bromley and Wesley Kurth have volunteered to look into this issue.
- Jeff Schneider asks, "Are these models going to include other types of energy generation like solar and wind?" At this time, with a finite time to finish the document, we will not overtly address those items.

New Business

- The Chair introduced a spreadsheet tool to assist users in performing the calculations specified in the Guide. The spreadsheet is not officially part of the Guide but can serve as a companion to the Guide.

- Bill Bartley suggests that the working group is going to have to state the source for any numbers or calculations that are carried out in the spreadsheet.
- Steve Shull states that if these methods are collaborative, then we need to reference each of the sources that contributed to this spreadsheet
- The next meeting will be in Munich, Germany in March 2013.
- The meeting was adjourned at 12:01 pm on Tuesday, October 23, 2012

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

1. Introduction of members and guests
   Mark Perkins was not able to attend the meeting due to business commitments. Craig Stiegemeier filled in as Chair and Ramsis Girgis volunteered to take notes
2. Patents - A review of the IEEE-SA Standards Board PatCom requirements was conducted.
3. Approval of minutes of the Nashville meeting
   The Spring 2012 Nashville minutes were reviewed. The only correction suggested was a change in the meeting completion time from 12:14am to 12:14pm. Unanimous approval was made on a motion by Joe Foldi and second by Ramsis Girgis.
4. Old Business
   The main task of the working group was to develop guidance for zero sequence testing. The following figure and comments were offered as a result of discussions at the Nashville meeting:
   - Draft Clause 9.5.3 Zero Sequence Testing on wye-wye transformer

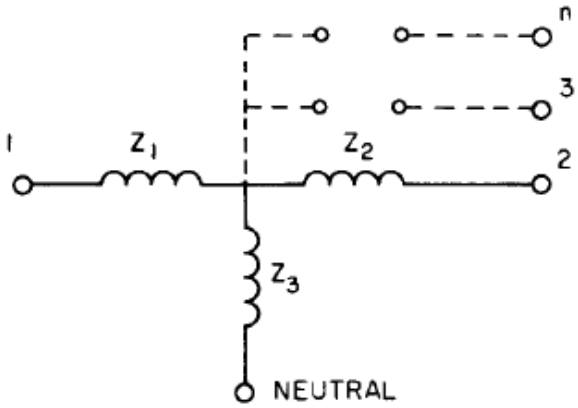

Figure 25—Equivalent zero-phase-sequence network for transformer with two externally available neutrals and 0° phase shift between windings 1 and 2

NOTE—Applies also to autotransformers.

a) Note for wye-wye transformers or autotransformers without a delta tertiary: For 5 leg core form and for shell form transformers, Z3 is very large and the zero sequence impedance is equal to the positive sequence impedance
b) For three leg core form transformers, the Z3 value is typically 5-10 times the Z12 measured value due to the "phantom delta" effect of the tank and/or tank wall

shielding. The Z3 value should be taken into account in short circuit calculations involving the zero sequence impedance. Measurements should be made at different current levels to establish the non-linear curve for all four different measurements. Care should be exercised in performing this test and the current should usually not be more than 20% of nominal since the return flux from the core goes through the tank wall or tank wall shielding and can cause severe overheating at higher current levels.Z3 is very large and the zero sequence impedance is equal to the positive sequence impedance for 5 leg core form and for shell form.

The following notes were taken during a review of the figure and suggested comments:

- Joe Foldi stated that the significance of having the user needs an accurate value of Z0 to use for fault current calculations. Under fault conditions, the core would be saturated. Dr. Ramsis Girgis responded that, under fault conditions, the core would have a higher flux density but likely would not be saturated by the leakage flux caused by the fault current. So, determining Z0 under test conditions typically used by manufacturers should be sufficiently close to the value at fault conditions. The same applies to the claim that Z0 for 5 limb cores is sufficiently close to the Z+ because core saturation under fault conditions is not a possibility.
- It was suggested to make some editing to the proposed text such that one paragraph deals with 3 phase 3 limb cores and the other with 5 limb cores. The following modified notes were developed using the recommendation in the PowerPoint presentation as a starting point:
  - Note for wye-wye transformers or autotransformers without a delta tertiary: For 5 leg core form and for shell form transformers, Z3 is very large and the zero sequence impedance is equal to the positive sequence impedance levels. Z3 is very large and the zero sequence impedance is equal to the positive sequence impedance for 5 leg core form and for shell form
  - For three leg core form transformers, the Z3 value is typically 5-10 times the Z12 measured value due to the "phantom delta" effect of the tank and/or tank wall shielding. The Z3 value should be taken into account in short circuit calculations involving the zero sequence impedance. Measurements should be made at different current levels to establish the non-linear curve for all four different measurements. Care should be exercised in performing this test and the current should usually not be more than 20% of nominal since the return flux from the core goes through the tank wall or tank wall shielding and can cause severe overheating at higher current levels
- The statement in the proposed text regarding the possibility of tank overheating if the applied current is > 20 % of rated current needs to be examined to determine if it accurate. Also, a recommended limit based on the outcome of that investigation should be developed for the allowable current during the Z0 test..
- Dr. Ramsis Girgis stated that the reason manufacturers typically use levels between 10% and 20% of rated current for the Z0 test in a YY with no Delta designs is that the Z0 from the individual windings to the tank is typically is in the range of 4 – 8 times the Z+.

5. New Business - There was no new business
6. Attendance roll call – Before the meeting, the Working Group had 386 members & guests, broken down as the following:

   67 Members
   2 Corresponding Members
   317 Guests

After a review of the attendance rosters and the tallying of those attending, along with a change in membership from "Member" to "Guest" of those who have not attended the past 3 meetings and removal of either "Terminated" membership or participation status, the following is the composition of the Working Group:

67 Members – 38 attending the meeting (57% - a quorum)
2 Corresponding Members
311 Guests – 51 attending the meeting

7. Adjournment - Meeting adjourned at11:55 am

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

The Working Group met at 4:45 PM on Monday, October 22, 2012, with 32 members, and 50 guests present. As the current Working Group membership stands at 72 members, we did not have a quorum. The following eleven (11) guests requested membership, which will become effective only after confirmation of attendance at two (2) consecutive meetings:

Tauhid Ansari	ABB
Scott Digby	Progress Energy
Ali Naderian	Kinectrics
David Ostrander	Ameren
Mahendrakumar Soni	Virginia Transformer
Raj Ahuja	Waukesha Electric
Juan Carlos Cruz Valdes	Prolec GE
Paul Jarman	National Grid
William Solano	ABB
Michael Spurlock	American Electric Power
Hanxin Zhu	BC Hydro

The Chairman reviewed the statement of purpose for the Working Group. As we did not have a quorum, the minutes from the Nashville Meeting could not be approved. The chairman will perform a survey among the Group membership seeking approval of those minutes, and will review the roster to remove members that have not participated in the last three meetings.

Following introductions, the request was made for changes to the agenda. There being none, the presented agenda was followed and the following three (3) items were discussed:

Old Business

A. WG Item 87, Table 15 Short-Circuit Apparent Power of the System
- Discussion on Results from the second survey

Change Requested by: Pierre Riffon – 2006 Ballot Comment
Requested Change: To provide more realistic values for default short circuit currents on Table 15, to avoid unnecessary overdesign.
As agreed in the last meeting, a new version for Table 15 was proposed and a survey conducted among 258 members of the PCS and the WG which delivered 78 responses, 81% affirmative and 5% negative. The comments show two extremes among which to define the default values: either to consider maximum rating of currently available circuit breakers for system short circuit current, or, on the other extreme, to recommend

consideration of an infinite bus. Another comment pertained to the example which suggested a possible pre-fault voltage of 1.05 PU, but one individual suggested 1.10 PU. Those in attendance maintained the 1.05 PU as shown in the survey.
Other comments were related to the need to indicate on the nameplate the design short circuit level of the transformer. In the absence of a quorum, the chairman proposed to make further adjustments based on these comments, and conduct a new survey before the next meeting.

B. WG Item 96, Table 18 Resistance Measurements for All Taps on Power Transformers – Discussion on Survey Results

Change Requested by: Joe Foldi – 2009 Ballot Comment
Requested Change: Resistance measurements should be done on all taps for Power Transformers, as a very important quality verification. Currently, Table 18 calls for resistance measurement of all windings only on the rated voltage tap and at the tap extremes of the first unit of a new design.
A "study group" put forth modified wording for the resistance measurements in Table 18. Their proposal was surveyed within PCS and the WG, with these results: 259 Invitations sent, 58 Responses (22.4%), among them 62% Affirmatives and 24% Negatives.
The proposed wording modifies Table 18, by leaving Resistance Measurements requirements unchanged for Distribution Transformers, and stating for Power transformers: "routine test on all DETC voltage taps and all LTC tap leads". With the addition of a note stating that: "In case a Series Transformer is used, temporary provisions shall be made for measurements on all LTC tap leads of the internal circuit."
As many of the responses from the survey showed misunderstanding of proposed changes, Joe Foldi explained in detail all background information for his proposal.

The comments collected from the survey were discussed among the meeting attendees. In view of some participants, the text on Table 18 should remain as is, leaving the proposed resistance measurements on all taps as a manufacturer's QA test, to be specified by users only for the case of complex units. On the other side of the issue, some people felt the test should be specified in Table 18 to be performed on as many positions as required to assure good contact of all tap leads from the windings to the tap changer. Many of the arguments previously presented in the Nashville meeting were brought up again by the participants. Concerns related to the timing for the test, the heating effects of DC test currents, the possibility of capturing bad contacts during heat run, the criteria to interpret differences among phases, etc., make it more a diagnostic test rather than a routine test.
The chairman closed the discussion with the conclusion that a more succinct text was required from Joe Foldi, and then a new survey will be conducted before the next meeting.

C. WG Item 97, Table 18 Operational Tests of LTC Equipment - Discussion on Survey Results

Change Requested by: Joe Foldi – 2009 Ballot Comment
Requested Change: Describe in Table 18 the requirements for the operational tests on the LTC equipment under full voltage (during No-Load test) and under full current (during Load loss test). The details of the LTC operational test should be described in C57.12.90, but the requirement for it added here in C57.12.00.
As for the previous two items, a "study group" put forth modified wording for the operational test requirements for the LTC in C57.12.00, Table 18. This proposal was surveyed within PCS and the WG with these results: 259 surveys sent, 58 responses (22.4%), 58.6% Affirmative and 24.1% Negative. The survey proposal and results were discussed during the meeting.

It was clear from the survey responses that there was some confusion about the proposal. With a lot of good discussion during the meeting, several manufacturers have offered to provide more input to Joe Foldi as to practical ways to conduct these tests. Some of the comments collected during the discussion made reference to practical limitations of test laboratories to supply reactive power along the whole range of taps because of potentially large impedance swings. An adjustment of the test current to as low as 60% might be necessary to prevent overloads during the test.
The chairman closed the discussion with the conclusion that more work is required to the proposal. Joe Foldi will refine his proposal based upon the new information, and a new survey will be conducted before the next meeting.

New Business
As time expired, no new business items were discussed.
The meeting adjourned at 6:00 PM.

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

The Neutral Grounding Devices working group was called to order at 3:15 PM on October 23, 2012. There were 23 attendees present.

1. Quorum was established from new membership survey - 11 working group members were present with 12 guests.
2. Minutes from last meeting approved
3. New officers for the working group are:
   Chair: Sheldon Kennedy
   Vice Chair: Tom Melle
   Secretary: Fred Elliott
4. Don Ayers presented a comparison of IEC and IEEE 32 methods for calculating short time heating in a grounding transformer resulting from system faults. A decision on which approach to use in the new document will be tabled until after the working group participants have had time to review the two approaches in more detail.
5. Peter Balma located some early papers discussing grounding transformer ratings and calculations. The papers will be scanned and posted on the transformers committee website for review by the working group participants.
6. The 1972 version of IEEE 32 is available in electronic form from IEEE SA store.
7. Development of the new PC57.32 needs to move quickly because of the December 31, 2015 deadline for completion.
8. The existing draft 11 of PC57.32 will be posted on the transformers committee website.
9. Guidelines for development of PC57.32 discussed in the meeting include:
   a. Referencing definitions and general information that is not critical to the devices being specified.
   b. Consolidating information about the different types of devices in separate sections.
   c. Minimizing the use of large tables covering all devices.
10. The prior decision to exclude neutral grounding capacitors was confirmed. These devices appear to no longer be used.
11. Volunteers to work on the various sections of the document are:
    a. Reactors – Mike Sharp (with possible assistance from Richard Dudley).

b. Ground fault neutralizers – Klaus Pointner (with possible assistance from Klaus Papp)
c. Grounding Transformers - Don Ayers, Sheldon Kennedy, Fred Elliott
d. Resistors – Sergio Panetta, Peter Balma
e. Combination Devices – Sergio Panetta, Peter Balma

The meeting adjourned at 4:20 pm.

10.4.5 WG on Tertiary/Stabilization Windings PC57.158 – Enrique Betancourt, Chairman; Steve Snyder, Secretary

The Chair called the WG meeting to order at 9:45 am on October 22, 2012. There were 18 members in the meeting, out of 32 counting members, therefore we had a quorum. 47 Guests attended also, and 9 of them requested membership.

Andre Schorr	Von Roll Transformers
Dharam Vir	SPX
James P. Campbell	Dominion
Jim McIver	Siemens
Joseph Foldi	F&A Inc.
Marnie Rousell	Entergy
Michael Spurlock	AEP
Peter Zhao	Hydro One
Vijay B. Tendulkar	Onyx Power

The Minutes from the Nashville meeting were presented and approved.

1. Old Business

1.1 PAR Application.
The Chair presented the details of the WG PAR application, which was approved last May by NESCOM, and opened the floor for comments and discussions.
Betrand Poulin commented that TV requirements should be decided by systems people and not by transformer people - the Chair clarified that from his discussion with system people, they only need zero sequence impedance details. So we can develop our guide, and of course need support from system people.
Paul Mushill commented that, sometimes even if utilities do not specify TV, manufacturer provide it and this has to be considered in the system studies - The Chair clarified that the Guide will cover criteria for requirement of buried TV.
Betrand Poulin suggested that our Guide should include how transformer behaves with or without TV – The Chair clarified that the Guide would include how TV affects performance of transformer and also performance of system.
Prof. Xose Lopez-Fernandez suggested that the Guide should include how to determine size of buried TV - The Chair clarified that Guide will cover this.

1.2 As next Agenda Item, the Chair presented a proposed Table of Contents and elaborated on how the guide is intended to benefit the users, system engineers, maintenance personnel, manufacturers and consultants.
Shamaun Hakim suggested that the guide should include how to calculate the fault current for different conditions of fault - The Chair said that requirements C57.12.00 is adequate but additional details can be considered in the guide.

K.Vijayan suggested that we should also consider situations when units with a TV and without a TV are paralleled – The Chair said, this can be addressed in the guide.
Sam Oritti suggested that details of possible design and construction aspects of TV can be added in guide. Also how TV current can be used for protection relay operation can be added.
Brian Penny suggested that test requirements need to be covered in the guide. - The Chair said we would consider some recommendations on this. Also some recommendations on terminals to be brought out and requirement of grounding would be included in the guide.

1.3 As next Agenda Item, the Chair elaborated on further work planned for this WG.
So far there have been received 15 technical papers. He wanted to know how to share this with other members.
Ed teNyenhuis suggested getting permission from the authors to share these.
Steve Antosz suggested that papers can be placed in IEEE website with password protection.
The Chair called for volunteers to lead development of the (preliminary) seven chapters of our Guide. Following attendees volunteered to participate in development of the different topics: Steve Anthony, Jagdish Burde, Krzystof Kulasek, Profr. Hemchandra Sherktukde, David Harris, Ajit Varghese, Profr. Xose Lopez-Fernandez.
The groups will be completed by invitation to the members to participate, based on their background and areas of interest. In order to facilitate the process, the Chair will provide each group with a chapter scope, as well as a cross reference of available literature.

1.4 As last Agenda Item, Prof. Dr. Xose López-Fernandez made a presentation of his paper on the topic on Tertiary Stabilizing Windings presented at an International Conference for Electrical Machines this year, dealing with the subjects of: Part1 on TV Sizing Requirements. Part2 Effect on tank over-heating in the absence of TV.

2. New Business - Brian Penny volunteered to become Secretary of the WG.

There being no new business, the meeting was adjourned at 11:00 am.

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

The WG met at 1:45 PM on Monday, October 22, 2012 with a total of 57 in attendance. Of those in attendance, there were 13 Members, 3 Corresponding Members, and 41 Guests. The membership had been rationalized prior to the meeting to 28 members. With the addition of members and corresponding members, 16 of 28 members were present. A quorum was present. Nine guests requested TF membership. After the introductions of attendees and circulation of attendance sheets the unofficial minutes of the spring 2012 Nashville meeting were presented. At meeting time, a request for any corrections was raised without the knowledge of the number of corresponding members in attendance. Since no objections were raised to the minutes' correction request, the Nashville fall 2012 meeting minutes will stand as approved.

Prior to the meeting, the Chairman circulated updates to Clause 13 of C57.12.90, a proposed meeting agenda, and the Unapproved Nashville meeting minutes. Two members returned comments that will be addressed by the Chairman via email.

After the nominal introductions, and circulation of meeting rosters, the next item on the Agenda was the summary review of the prior agreements of the TF. This important review tracks the TF progress and helps to focus on new unresolved topics needed for incorporation into the Standard.

The review highlighted the following agreements:

- Making the Wall sound reflection correction
  Per IEC but limit correction to 4 dB and test room cases to 4 rather than 7
- Using the "Sound Intensity Method"
  As a second method to be considered with the sound pressure method
  Use newly developed correction for $4 < (Lp - Li) < 6$ dB
  Consider the sound intensity method invalid for $(Lp - Li) > 6$ dB - Use, instead, the Sound Pressure method with the identified correction
- Measuring Load Noise
  When requested by purchaser
  Can measure at current 60 % < I rated < 130 % and correct per IEC
- Changing the ONAF measuring contour
  Per IEC, 2 m all around transformer
- Determination of Total Noise level of a transformer
  By adding Load and No Load noise levels, Per IEC

Next item on the agenda was a report provided by Dr. Chris Ploetner on the status of the work by the IEC WG revising the IEC transformer noise measurement Standard and the application Guide. The report highlighted the following:

- The IEC WG is trying to deal concurrently with the same issues in both documents.
- Needed to align the Sound Pressure and Sound Intensity methods. A set of simple application rules was targeted without losing accuracy.
- Attempting to harmonize with the corresponding IEEE Standard as much as possible.
- Standardizing on a 1 meter ONAN measuring contour and 2 m for ONAF.
- Formula for calculation of measuring surface "S" unified.
- Sound wall reflection correction is clarified but the limits and the maximum allowed value kept same.
- The walk – around procedure during test is now the standard.
- New templates are implemented in the test report for the "Sound Pressure" and "Sound intensity" methods
- The height of the measuring surface will be from the bottom of the transformer rather than from the floor to minimize the effect of floor reflections
- The 1/3 Octave band will be the Standard going forward. The rational is that most sound measuring equipment is capable of making these measurements and, at the same time, one gets more detailed transformer noise measurements.
- In the Application Guide, the effect of current harmonics is explained. Voltage harmonics are typically small and have a small effect on transformer noise because harmonics in the flux are of a much lower magnitudes than those in the voltage wave – shape.
- A special attention is paid in the Application Guide to explain the use of partial sound panels.

The next item on the agenda was addressing proposed additions / changes to the text of clause 13 as agreed upon in the spring 2012 TF meeting. The proposed wording presented was not contested.

Some of those attending the meeting questioned the need to use the proposed corrections. The chairman explained that the goal of these corrections to the measurements, when using the Sound Pressure method, is to correct for the errors introduced in the measurements by ambient noise, sound wall reflections, and near field effects.

The chairman also explained that the basis for specifying a sound level for a transformer is to satisfy a limit on the sound level at nearby residential areas. The concept of applying the corrections to the noise measurements, when using the sound pressure method, simulate what would be measured in the field; where, there is no sound wall reflections and where the near – field reactive sound power does not propagate far from the transformer region.

In responding to a question by Robert Mayer of SDG&E, the chairman emphasized that the sound wall reflection correction is made based on a standard formula that has the surface area of the transformer, the test room area, and the sound absorbing coefficient of the walls, as parameters that produce the proper correction for the specific test room and specific transformer. This correction, for a certain size transformer, can be 0.5 dB for a sound room to 2 – 3 dB in a typical test room in the factory to account for the higher sound reflections in such test rooms. This is similar to the ambient noise correction whose magnitude depends on the difference between the transformer noise level and that of the ambient noise. This correction can be in a range of 0 – 1.6 dB. The 1 dB near – field correction applies in all cases.

Responding to questions by Paul Morakinyo of PSE&G, the chairman stated that:
1. Customers can ask for either the Sound Intensity method or the Sound pressure method to be used.
2. The sound intensity method is more accurate as long as the proposed conditions are met and the proposed corrections are made.
3. The proposed corrections in either of the two methods apply to, the total dB (A) and the individual frequencies, 1/3 Octaves, and Full Octaves.

The Chairman reiterated that the goal of developing measuring standards is to allow performing measurements that are accurate and represent the true performance of the transformer using the technology improvements achieved along with state – of – the – art measuring equipment. The chairman stated that the proposed improvements in the IEEE Noise measurement Standard have been presented and explained in detail in previous TF meetings and the basis for these have been published in 3 IEEE papers. It was suggested by Steve Antosz that these papers be added to the IEEE Standards web site so that it is available to all.

A question was raised on how these corrections might impact the NEMA standard TR1 noise limits. The chairman responded that in general today's transformers have no load noise levels several dB (s) below, or much below, the NEMA levels. The NEMA levels represent those of transformers designed with cores using regular grain oriented steel, no step – lap joints, and operating at the highest rated flux densities allowed.

The plan was to discuss the new section on the "Determination of total Noise level of a transformer" and to discuss two items submitted by TF members before the TF meeting.

However, time of the TF meeting was up. These items are postponed to the spring meeting in Munich.

Meeting adjourned at 3:00 PM.

10.4.7 WG on Wind Trubine Generator Transformers. PC57.12.16, – David Buckmaster, Chairman; Vice Chair: Phil Hopkinson; Secretary: Steve Griffith

The Working Group on Wind Power Transformers was called to order at 9:30 AM. There were 109 attendees, 45 members, 64 guests. A quorum was present.

1. Chairman Remarks - Introduction of WG board members:
   Chairman: Dave Buckmaster
   Vice-chairman: Phil Hopkinson
   New Secretary: Steve Griffith

A remark was made that committee members who volunteered to assist with this document should follow-up on their commitments. It was also mentioned that this would now be a joint standard with the IEC document.

2. Minutes of the Spring 2012 meeting were accepted as written

3. Open Issues
   • Task force report on IEC Plenary meeting in Manchester, UK- at that meeting it was confirmed that this would be a joint standard with the IEC. A working group has been set up. The next stage will be a call for US experts.
   • Stress Enhancement Points/Gas Analysis- there was no report as it was noted that Mr. Bartnikas was not present. This was the 2nd consecutive meeting which he wasn't in attendance. He will be adjusted on the roster to a non-participating member.
   • The chairman noted the issues below that need to be included in this document
      Factory tests including partial discharge during induced tests
      Importance of gas in oil tests and interpretation
      Loading expectations and impact on nameplate rating
      Harmonics, their sources and impact on specifications
      Loss Evaluation techniques to reflect proper importance for relationship between load loss and no load losses
      Proper BIL for both the transformer and the accessories
      Overvoltage due to switching, lightning and proper protection
      Arc-Flash Protection by switching sequences or other

4. New Business
   • Mr. Hopkinson lead a presentation on core grounding/or screening- it was agreed that there needs to be a section of the document that addresses this. Mr. Hopkinson to provide a draft section by March 1st, 2013

5. Next Steps
   • The table of contents was presented for the IEC 60076-16 Standard. The chairman solicited volunteers to serve on a task force to draft/update sections of this document. The chairman noted that drafts on the sections need to be completed by March 1st, 2013.
      1. It was agreed that Section 1 did not require any updates
      2. The normative references in Section 2 have already been provided

3. The terms and definitions in Section 3 are not needed at this time
4. Mr. Ayers volunteered to be the chair for task force to update Section 4; Mr. Field volunteered to assist on this section. It was mentioned that there should be IEC experts involved in this section.
ACTION: Mr. Breckenridge to forward the list of IEC experts to the committee secretary
5. Mr. Navarro volunteered to be the chair for the task force to update Section 5; Mr. Patel, Mr. Parkinson, & Ms. Tarlapally volunteered to assist on this section.
6. Mr. Buckmaster volunteered to be the chair for the task force to update Section 6.
7. Mr. Tuli volunteered to be the chair for the task force to update Section 7; Mr. Stretch and Mr. Garber volunteered to assist.

6. Open forum discussion and Q&A
   There were no additional questions

7. Next meeting

Next in person meeting will be at the Spring IEEE Transformer Committee meetings in Munich Germany during the week of March 17-21st, 2013.

8. Adjournment
   The meeting was adjourned @ 10:40AM

10.4.8 - WG on "Distributed Photo Voltaic (DPV) Grid Transformers" PC57.159, Chairman Hemchandra Shertukde; Vice Chairman: Mathieu Sauzay; Secretary: Sasha Levin

The Working Group met in the Mitchell room of the Hilton Milwaukee City Center Hotel. This is the first meeting of the WG. The meeting was called to order at 8:00 am by Chairman Hemchandra Shertukde.

The meeting was convened with 37 participants present, 17 participants requested and granted membership. 3 non-present people asked for the membership plus one person would like to be a corresponding member.

Old Business
Nashville's meeting minutes were approved.

New business
1. After introduction and roster distribution, Chairman updated the WG on the background of formation of WG PC57.159 as a result of the work of the previous TF. The PAR application, including WG scope has been reviewed.

2. The chairman informed the TF Position Paper has been submitted for publication either in the IEEE transaction or conference. The editors requested the revision of the paper as for matching IEEE standard for publications. M. Navarro volunteered to help with this (action).

3. The WG PC57.159 documents placed and will be placed on the IEEE web-site under Performance Characteristics SC and will be organized as a separate WG PC 57.159 web-page (action).

4. WG then reviewed the contribution to the Guide Chapters received from the assigned Chapter's Task Forces (specifically Chapter 2 and 6). H. Shertukde reviewed data on the invertors received from the manufacturer of invertors.

5. S. Levin presented the matrix table combining the topics of interests, identified in the Position Paper and additional input; characterization of the topics as for the uniqueness and relevance to the DPV-PGS application and sorting of the topics in the Guide's Chapters. This matrix intends to help the Chapter TF leaders with the list of the identified topics.

6. The following technical discussion then took place revolving around the question of what technical problems are specific for DPV-PGS transformers and what information is available within WG:

- A. Mukerji noted that he is not sure that we can work on all Chapters in parallel as the WG first needs to be advised what topics are specific for the application and need to be addressed in the Guide.
- S. Sarkar supported this opinion and proposed to have a tutorial for the WG where the specifics of such systems can be described to the WG. The Chairman asked J. Schneider, J. Yu, E. Betancourt, J. Memtora to prepare this tutorial for the presentation to WG at Spring IEEE TC meeting.
- J. Mentora commented on the specific issues when 2 secondary windings in one transformer feed 2 invertors: the criteria of voltage differences need to be defined, otherwise this can result in the problem with a core saturation and eddy losses (add to the topic list – action).
- J. Schneider – adequate impedance is important in case of the multiple secondary windings design. Some application aspects are still in the development and need to be reflected in the Guide, e. g. the latest trend to keep the DPV-PGS transformers energized in the night.
- E. Betancourt – the adequate impedance of the transformer can mitigate the problem of the voltage differences mentioned above.
- J. Yu informed that there is an observation of the premature failure of solar power transformers without clear root cause. Jennifer continues working with her Renewable Power department to identify the possible issues for the WG consideration.
  One of the issues that surfaced is "White Cloud" effect – abrupt energy spike related to the solar activity.
  We encouraged all participants to collect relevant information and look for the experts (users, specifiers) to share the experience.
- J. Sim – IEC did a survey of end users on the frequency of the "energize / de-energize" operations in solar power systems and found that there are much more operations in these systems compare to the recommended in a standards. Review of IEC 60007? (action).
- J. Roach heads the Task Force on Chapter 5 "Transformer diagnostics, monitoring and maintenance". He and N. Field commented that more research and input from OEMs and end users are necessary to decide whether some additional and/or special actions are required and beneficial for these transformers. John also commented that the transformers are often supplied as a part of the inverter package with very limited transformer specification. We need to see how the results of our work can reach the right audience in this case.
- S. Kennedy confirmed his agreement to lead the TF on Chapter 3 "Transformer construction", but relies on the members of his TF for active participation.

With no new business the Meeting adjourned at 9:15 AM.

10.4.9 TF to Investigate the Interaction between Substation Transients and Transformers in HV and EHV applications – Chairman Jim McBride

Task Force Meeting took place on Tuesday at 4:45pm

56 people in attendance
15 requesting membership

The below goals for the group were reviewed. There were no significant changes to these items.

Goal:
Prepare a TF report on the need to revise the C57.142 guide to extend to HV and EHV applications.

Deliverables:
TF report and recommendation on forming a WG to revise the Guide (or not)

TF Objectives
- Establish the present target voltage class range of the C57.142 guide
- Gather field data, reports and literature on HV and EHV failures related to substation transients and transformer interaction
- Get input from the other technical committees concerning the interactions between substation transients and transformers at HV and EHV applications
- Review IEC and CIGRE standards
- Recommend if there is sufficient need to revise the guide and if WG should be formed.
- Recommend high level changes to the guide (if it should be revised)
- Prepare final report to the SC and present work in SC or tutorial session

There was discussion of whether GIS systems were included in the C57.142 document. Based on your scope including HV and UHV systems this work would possible fall into the scope of the TF defined above. The group recognizes the fact that high frequency transients definitely exist in GIS equipment. No particular failures associated with these transients were noted during the meeting. As we investigate failures experienced by users, this information will be requested in order to evaluate whether GIS interactions may be important information for inclusion in the scope of the work.

Jim McBride presented slides showing transients measured from lightning and switching events on 765kV and 500kV systems where high frequency transient monitors are present. The information presented indicated that transients with frequency content up to 2MHz are present on these systems. The long term effect of these transients has not been investigated. However, the signal levels present on the system were at sufficient levels to provide good FRA characterizations to frequencies up to 2MHz.

Art De Rio presented slides showing evidence of arcing damage between cotton insulated draw leads and the inner wall of the transformer bushing. This arcing damage indicates that high frequency transients at the transformer terminals have caused significant voltage

across the draw lead insulation to produce arcing between the draw lead and the inner tube of the bushing. The bushing shown was a 230kV 900kV BIL draw lead bushing.

It was suggested that we survey utilities for information on any suspected cases of transient damage at HV and EHV levels.

Scott Digby presented a case where failures have been experienced with shunt reactors on the tertiary of 500kV autotransformers. The problem seemed to be related to the transients from the vacuum breaker used to connect the reactor to the system. Analysis indicates that the failures are associated with the transients produced by switching the reactors. Although failures of the reactors have been experienced, failure of the transformer winding associated with these events has not been typical with the events. Initial mitigation was to place snubbers on the breaker switched end of the reactors. No additional switching related failures have been experienced.

It was noted that neither of these two interactions have been included in the existing version of C57.142.

One member was asking about providing tutorial information on how to mitigate transient induced over voltages, which in my view is jumping the gun a bit and beyond our scope at the moment. It could well be included in the scope of a working group if one was to be formed.

Meeting was adjourned 5:40 pm.