* 1. **Performance Characteristics Subcommittee –** Chair: Ed teNyenhuis; Vice-Chair: Craig Stiegemeier; Secretary: Sanjib Som

**Introduction / Attendance**

The Performance Characteristics Subcommittee (PCS) met on Wednesday, October 23, 2013 at 3pm with 145 people attending. Of these, 49 were members and 96 were guests. Prior to this meeting, the total membership of PCS was reduced from 108 to 68, as 40 members were not regularly attending meetings. With 72% of the current membership in attendance, a quorum was achieved. The assumption made for removing members was that if they missed 2 of the last 3 meetings (Nashville, Milwaukee & Munich), they lost membership status and were moved to guest status. At the next meeting, they may request membership again and if criteria in effect are met, they will be reinstated as PCS members

There were 10 guests requesting membership at the meeting. For those that requested membership, if they had attended 2 of the last 3 meetings (Milwaukee, Munich & St. Louis), they were granted membership. The new PCS members are:

Emil Bercea

Cheng Cheng

Jinho Kang

David Murray

Brian Penny

Jarrod Prince

Vijay Tendulkar

Sukhdev Walia

Kipp Yule

Krishnamurthy Vijayan also requested membership, but he did not qualify as he did not attend the Milwaukee or Munich meetings.

**Approval of Agenda**

The Chair presented the agenda. This was proposed by Steve Synder to be accepted as presented. Sheldon Kennedy seconded it. It carried by unanimous vote.

**Approval of Last Meeting Minutes**

The chairman presented the minutes of the last meeting in Munich, Germany – March, 2013. This was proposed by Sheldon Kennedy to be accepted as is, which was seconded by Alan Traut. The minutes were passed by unanimous vote.

**Chairman's Remarks**

The chair requested volunteers to lead the below standards that expire in 2018:   
  
C57.105 - IEEE Guide for Application of Transformer Connections in Three-Phase Distribution Systems   
C57.109 - IEEE Guide for Liquid-Immersed Transformers Through-Fault-Current Duration   
C57.110 - IEEE Recommended Practice for Establishing Transformer Capability When Supplying Non-sinusoidal Load Currents   
C57.136 - IEEE Guide for Sound Level Abatement and Determination for Liquid- Immersed Power Transformers and Shunt Reactors Rated Over 500 kVA   
C57.21 - IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA   
  
For C57.110, Rick Marek has agreed to Chair with Co-Chair Raddslaw Szewczyk

Various WG and TF reports were present as detailed later.

**Unfinished (Old) Business**

No old business.

**New Business**

Phil Hopkinson approached the chair to state as below:

“I want to make a motion to the Performance Characteristics Subcommittee that language be placed in IEEE C57.12.00 and IEEE C57.12.01 that states:   
    
“Switching of vacuum and or SF6 breakers may result in transformer failures and needs careful consideration as is identified in IEEE C57.142.”   
    
I am constantly reviewing transformer failures that have the common denominators of:   
    
1.      Breaker on either the source or load side of the transformer.   
2.      Shielded cables on either side of the transformer.   
3.      Light currents within the chopping current of the breaker.   
4.      Very low power factor circuits at the point of switching.   
    
It is always the transformer that fails.  The customer never seems to understand that the C57.142 document exists to describe interaction and asks “Why didn’t you tell me that the transformer is vulnerable”?   
    
The question is appropriate.  In the main document of IEC TC 14 (IEC 60076-1), we spell out the existence of C57.142.  I believe that we need to do it here.“

After this, the following discussion took place. Don Platts opined that this may not fit into C57.12.00 or C57.12.01 since those are for electrical and mechanical characteristics. Another member opined that then we should warn about ferro-resonance, Geo-magnetically induce current, etc. Craig Stiegemeier opined should the profile for the switching impulse be reviewed. Sanjib mentioned that such transients actually caused resonance which cannot be always predicted but bad effects are preventable by RC circuits (snubber). David Buckmaster warned that we should not be sending the wrong message. Phil accepted that the snubber is a good idea because in 18 years when he started recommending snubber there has not been a single failure on those. Dhiru Patel opined that the BIL for design should be changed.

Finally a vote was taken with 14 for, 18 against and 1abstaining. The motion did not pass.

Meeting was adjourned at 4.15 pm.

**Working Group (WG) and Task Force (TF) Reports (all unapproved)**

**10.4.1 PC57.120 LOSS EVALUATION GUIDE FOR DISTRIBUTION AND POWER TRANSFORMERS AND REACTORS**

Tuesday October 22, 2013

Al Traut, Chair, Don Duckett, Vice-Chair, Dave Harris - Secretary

PAR Status: PAR Approved

PAR expiration Date: 12/31/2014

Current Draft Being Worked On: D13

* Attendance
  + 69 Total
  + 17 of 27 Members
  + 49 Guests
  + 3 Guests requesting membership
* The meeting was called to order at 11:00 am on Tuesday, October 22, 2013.
* 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.

**Old Business**

Minutes of the Fall 2012 Milwaukee and Spring 2013 Munich meetings were unanimously approved as submitted.

Discussion regarding uncertainty resulted in an action to look into incorporating a statement on uncertainty of the assumptions and impact on the A factor and B factor calculations.

Need to make sure the document reflects the correct designations for cooling classes, eg, ONAN vs OA, etc.

A Task force was formed to prepare the document for ballot and present to the WG at the Spring 2014 meeting in Savannah. Members are Alan Traut, Don Duckett, Wally Binder, Don Platts, Mike Miller, and Ulf Radbrandt

**New Business**

None

Meeting adjourned at 11:55am.

10.4.2 **Working Group on PCS Revisions to C57.12.90**

October 21, 2013, 11:00am-12:15pm

Mark Perkins, Chairman; Craig Stiegemeier, Secretary

1. Introduction of members and guests

Mark Perkins presided over the meeting at Chair. Craig Stiegemeier was secretary. Attendance rosters were circulated for those in attendance to record their presence and confirm their membership or guest status.

An introduction of members was conducted.

A roll call of members was taken, and 37 of the 63 active members of the WG were in attendance. This resulted in a quorum of 59% of the membership, making this meeting “official.”

1. Minutes of the Munich meeting

At the Spring 2013 Munich meeting there was not a quorum present, so the previous meeting minutes were approved by email vote. Information from the Munich meeting is incorporated into the minutes from this St. Louis meeting.

1. Old Business

The main task of the working group was to develop revisions Clause 9.5 - Zero Sequence Testing. At the Munich meeting a draft of the changes to this section was circulated and discussed, and lacking a quorum, it was necessary to conduct a survey of the working group for approval and comments on the draft. The survey was emailed to the working group members and there were 38 of 63 members that returned the survey for a return percentage of 60%. The approval was unanimous with four members returning comments.

* Baitun Yang commented that we should include YYY transformer without delta winding. The group considered this suggestion and decided by vote of the working group to leave the section as it was in the survey.
* During the discussion, the chair presented information regarding figure 25 that a 1997 transactions paper by Chen and Venkata had researched this circuit model and in effect found that moving the Z3 branch from the tee point to terminal 1 was more accurate. The group pointed out that the zero-sequence diagram shown in Figure 1 has been used for many decades and has been published in all of the applicable literature, so making any change would require further research. So the chair agreed to include a copy of the Chen and Venkata paper in the minutes so the members could review and comment.
* Comments by Polo Rodriguez suggesting that the text in sections 9.5.1, 9.5.2 and 9.5.3 could be clarified were discussed. The group voted to leave the text as it had been surveyed.
* Comments by Shamaun were discussed suggesting that the standard stipulate that three measurements be required at different current levels when the zero sequence impedance is expected to be non-linear. Again the group voted to leave the text as it had been surveyed.
* Ajith Varghese suggested that the warning to not exceed the maximum neutral current be added to item b on section 9.5.1. The group unanimously accepted this suggestion.

Having considered all of the comments, the group unanimously agreed to send the changes in zero sequence testing to the working group on continuous revision to C57.12.90.

The chair then mentioned that there was no further new or old business for the working group to consider and asked the group if there was any suggestions for the group to consider. Unless further suggestions come from the review of minutes of this meeting, it will not be necessary for the working group to meet at the next meeting.

1. New Business - There was no new business
2. Attendance roll call – Before the meeting, the Working Group had 67 members, broken down as the following:

63 Members

4 Corresponding Members

>300 Guests

1. Adjournment – Motion made and passed to adjourn at 12:11 pm

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

The PCS Working Group on General Requirements for C57.12.00 met on Monday, Oct.21, 2013 at 4.45PM with **43** members and **77** guests present. As the current Working Group membership stands at **71** members, we did have a quorum and were able to conduct official business. The following **13** guests requested membership, which will become effective only after attending two (2) consecutive meetings:

Ali Naderian Kinectrics

Marnie Roussell Entergy

Soni Mahendrakumar Virginia Transformer Corp.

Roger Verdolin Teshmont Consultants LP

John K. John Virginia Transformer Corp.

Mark Lachman Doble Engineering

Shawn Luo Seattle City Light

Jeewan Puri Transformer Solutions, Inc.

Hemchandra Shertukde University of Hartford

Kiran Vedante ABB Inc.

Emil Bercea ABB Inc.

Cheng Cheng Moloney Electric

Ewald Schweiger Siemens

The Chairman opened the meeting by stating the purpose of the Working Group, that is to address matters pertaining only to performance characteristics in standard C57.12.00. Following introductions and circulation of the attendance sheets, the proposed Agenda was approved (**Raj Ahuja** and **Loren Waagenar**).

As there was not a quorum at the previous meeting held in Munich, the minutes from that meeting could not be approved. However, the unapproved minutes were posted on line and circulated for the membership. No comments were made regarding the records from that meeting.

Discussion on Old Business topics

WG Item **87**, Approval of a New Version for Table 15 in C57.12.00, Short Circuit Apparent Power of System to be Used Unless Otherwise Specified. (Addresses negative comment from 2006 ballot.)

A Task Force studied the Table and provided new recommended short circuit power values, and explanatory text. The item had already been subjected to survey twice, the last time with 81% approval. The Chairman proposed to send the new proposed Table and text to the Standards Committee as part of a new version of C57.12.00. The motion was presented and supported by **Mark Perkins** and **Bruce Forsyth**. The Working Group approved the motion with **25** Members in Favor and **4** Members Opposed.

WG Item **96**, Request for “Routine” Resistance Measurements on Class II Power Transformers with LTC in all tap positions. The proposal was made by Joe Foldi (negative ballot from 2009) and has been a subject of discussion for the last three meetings, and in a small study group consisting of Joe and Tauhid Ansari. Joe was not present as he could not attend this TC meeting, but he and Tauhid were able to send new text for the proposal. There was a lot of lively discussion on this proposal that was finally brought to a motion. The motion was made to adopt the proposed text with further review of specific language for final version in the standard. **Kenneth Skinger** and **Tauhid Ansari** were first and second for this motion. The motion was rejected with **14** Members in Favor and **19** Members Opposed.

WG Item **97**, Operational Test of LTC Equipment in All Tap Positions, a proposal made by Joe Foldi (negative ballot from 2009). From discussions at the Munich meeting, Joe and Tauhid developed new text with two additions which were presented to the Working Group as a part of the discussion topics for the meeting. DGA monitoring requirements were discussed and questioned by several participants. Paul Jarman explained similarities of LTC test with present requirements in IEC standards. It was also stated that some users already request this test for their large transformers. After much discussion this item was tabled for additional review prior to the next meeting.

WG Item **99**, Clarification of Measurement Error on Transformer Ratio While Checking LTC Units with Preventative Auto in Bridging Position. This issue was first raised in the C57.12.90 working group meeting in 2010. Discussions were held in two prior meetings, and Raj Ahuja agreed to take this under consideration and present a proposal for the WG to consider. The proposed new paragraph, which would be inserted in C57.12.00 Section 9.1 Tolerances for ratio, follows:

“For transformers with reactance type tap changers, the turns ratio at bridging tap position is the mean average of the two adjacent non-bridging tap positions, since the Preventive autotransformer/Reactor provides the center tap. When measuring the ratio by small voltage application used by ratio meter, at bridging tap position the excitation current/burden drawn by reactor affects the output voltage and the ratio value displayed by the instrument. For example, if the measured ratio at 12R is 4.0 and at 14R tap is 4.2, at tap position 13R (bridging tap position) the ratio measured should be 4.1, but in actuality the ratio measurement display may be 4.15 which can become out of tolerance if ratio at 12 R is at 0.4% Tolerance.”

After discussion, a motion was made to adopt this new text subject to the outcome of a survey within the subcommittee for editorial changes. Motion by **Vinay Mehrotra** and seconded by **Eduardo Garcia**.

The motion was approved with **27** Members in Favor and **1** Opposed.

As time was expiring, the meeting adjourned at 5:55 PM with **Richard Amos** and **Loren Wagenaar,** as first and second in this motion.

* + 1. **WG for IEEE Standard Requirements, Terminology, and Test Procedures; for Neutral Grounding Devices, PC57.32;**

Sheldon P. Kennedy – Chair, Tom Melle - Vice Chair

The Neutral Grounding Devices working group was called to order at 4:45 PM on October 22, 2013.

Agenda reviewed and approved.

1. Quorum was established from new membership survey – 12 working group members were present with 24 guests.

2. Minutes from last meeting approved. Motion by Devki Sharma. Second by Peter Balma. Ballot Results, Unanimous.

3 New draft document in Word 2007 format. Please do not save in different versions as changing formats has destroyed template macro function in the past. Tom Melle (vice chair) is maintaining the official draft document.

4. Mike Sharp reported that the Grounding Reactors section does not need any further changes.

5. Klaus Pointner reported that the Ground Fault Neutralizers does not need any further changes.

6. Sergio Panetta reported that no further changes are needed for the Grounding Resistor and Combined Devices sections.

7. Sheldon Kennedy reported that the grounding transformer section still is in need of further work.

As reported at the last meeting the existing IEC and IEEE temperature calculation methods for liquid filled transformers give different results for the same design. The IEC method always gave higher temperatures for the cases studied. The results of the two methods do not show a constant relationship to each other.

8. The IEC method is straight forward based on physics. It is documented in IEC 60076-5 clause 4.

9. The existing IEEE method contains constants and factors that are not documented as to meaning or source. Efforts to reproduce the table information have not been successful.

10. The existing liquid filled transformer table is based on 55 degree rise insulation systems. Modern designs are built with 65 degree rise materials. The 55 degree rise information could be kept as is and a note added acknowledging that this is a conservative practice

11. The existing Dry type transformer classes not consistent with current practice and materials. The standard should at least cover the modern IEEE insulation classes. Sheldon Kennedy sent a short write-up on thermal capability to WG members before this meeting.

12. Other transformer documents that address short circuit use an all heat stored calculation for short circuit temperature calculation. The conductor temperature limits used are 250 degrees C for copper and 200 degrees C for aluminum. Temperatures above these values create high risk of conductor annealing.

13. Motion: Don Ayers made a motion to adopt the current IEC method and put the old method into an informative annex. Klaus Pointner seconded the motion. The vote results were 2 yes votes and 2 No Votes. There was also 1 abstention. This motion failed.

14. Motion Sergio Panetta made a motion to use the IEEE all heat stored calculation with the IEC method as an alternate method, Don Ayers seconded the motion. The vote was 2 yes and 2 no. The motion failed.

15. Motion: Mike Sharp made a motion to use the IEEE all heat stored method with the existing tables moved to an informative annex. Klaus Pointner seconded the motion. The vote was 8 yes and 0 no.neg 0 (Unanimous)

16. Motion: Don Ayers mad a motion to use the conductor temperature limits of 250 degrees C for copper and 200 degrees C for aluminum. Mike Sharp seconded the motion. The vote was 9 yes and 0 no. The motion passed.

17. Draft update: Tom Melle reported that the current draft has the individual sections mostly complete in the prior IEEE template. He also had the old IEEE 32 document is the new template. It was agreed to continue with the current draft rather than starting over with the old IEEE 32.

18. Schedule: Issue draft 12 for review by the end of 2013. Complete draft and have ready for a Subcommittee Survey by the Spring 2014 Meeting. If this is successful, we will go for a ballot. This document must be approved by the end of 2015.

19. The test sections should rely on references to the general C57 equipment standards as much as practical instead of reproducing all of the test information in this document.

20. The use of metric and US customary units will need to be reviewed for compliance with IEEE policy.

**10.4.5 (3/2013 not received) WG on Tertiary/Stabilization Windings PC57.158 – Enrique Betancourt, Chairman; Steve Snyder, Secretary**

The Chair Enrique Betancourt called the WG meeting to order at 9:30 am on October 21, 2013, Secretary Brian Penny was also present. A statement was made as to the Working Group’s purpose for preparing this Guide for publication.

Introductions and a member roll call were taken. As of this meeting the Working Group consists of **43** regular members and **2** corresponding members. **21** Members were counted in attendance thus a quorum was not attained. Additionally there were **48** guests with **8** of them requesting membership in the Working Group.

Frank Damico TAMINI Transformers

Shawn Luo Seattle City Light

Tamyres Machado Junior Siemens

Subhas Sarkar Virginia Transformer

Michael Shannon Rea Magnet Wire

Andy Speegle Entergy Services

Kiran Vedante ABB

Sukhdev Walia Brookfield Renewable Power

There were no comments on the minutes from the Munich meeting which were not submitted for approval as a quorum was not attained. Approval of these minutes will be addresses by the Chair via e-mail communication with the WG members.

1. **Old Business**

Contributions for the sections listed below of the first draft were received from the following individuals.

* (Fundamentals for) Short circuit Analysis of Transformers with Tertiary Windings – Jagdesh Burde
* Function of the Stabilizing and Tertiary Winding – Brian Penny
* Application of Stabilizing and Tertiary Windings – Stephen Anthony
* Testing of Tertiary Windings – Ajit Varghesse

The following sections listed are currently awaiting contributions to be submitted by volunteers.

* Overview on Application of Transformers with Stabilizing Windings- A Systems Perspective
* Behavior (performance) of Transformers with Stabilizing / Tertiary Windings under Short Circuit- Adequacy of Current Standards
* Behavior under Transient and Continuous Unbalance Conditions on Main Windings
* Behavior of Transformers and Autotransformers without Stabilizing / Tertiary Windings
* Specification of Transformers with and without Stabilizing Windings

The chair plans to complete the Overview, Scope and the Background Information sections plus reformat the section numbering sequence in accordance with IEEE requirements. A partial list of references and how they will be formatted was provided in Annex A - Bibliography.

The WG has now available a page within the IEEE TC PCS web site, which will be used as a repository for password protected reference materials and for development of the Guide. Based on the requirement to have this document completed by March 2016, it is necessary for the WG to follow a timetable with detailed milestones to begin the process of reviewing submissions, reorganizing, reformatting and eliminating redundant information from our present rough first draft version to the final version of the document. WG participants are highly encouraged to post and review revisions of the document via the website in order to speed up the development of the Guide to meet the timetable’s schedule. The Chair will investigate with officials of the Committee if a Standard Timetable with generic milestones is available as reference for our work.

A brief overview of the Guide in its current state was presented which led to a series of discussions on the items to be addressed in this document. A comment by Frank Damico on whether special transformers should be included in addition to Y-Y and auto connected. David Ostrander on addressing the requirement for a stabilizing winding from the transformer manufacturer’s point of view and Jim McIver questioned how the systems engineer requirements will be covered in the document. The Chair explained that both of these issues could be addressed in the overview section.

Even though system requirements drive the need for stabilizing windings, in form of zero sequence impedance and protection facilities, it was stated that from experience it is typically not the systems engineers calling for the use of stabilizing windings on transformer purchases. Sanjay Patel told of one user who does not use stabilizing windings but provides a performance requirement in their specification; this is an example of the user needs to define zero-sequence impedance performance requirements in order for the manufacturer to understand how to design the stabilizing winding to deal with system issues.

Listed are additional items suggested to be considered in the Guide.

* Consideration of 5 leg core designs where saturation of the three main limbs by zero sequence voltage drives full flux through return limbs
* It is very common application to use internal reactors to limit the short circuit current for low impedance stabilizing windings, what is the effect on these internal reactors
* Clarification on how to account for high short circuit currents when the leads are brought out of the stabilizing winding
* Utility vs. industrial transformer applications – unbalanced loads and ungrounded Y

The Chair request volunteers to follow-up on the following items.

* Review stabilizing winding requirements for shell form core designs - Xose Lopez-Fernandez & Mathieu Sauzay
* Review of recommendations for the specification and testing of stabilizing windings - Ajit Varghesse
* Annex B - Symmetrical Components – No volunteer

Prior to the meeting, Saurabh Gosh stepped back from his position as the Co-Chair of the WG. WG Secretary Brian Penny has agreed to assume this responsibility. Jim McIver has volunteered to take over the responsibilities of the WG Secretary.

1. **New Business**

No new business was presented before the working group.

The meeting was adjourned at 10:40 am.

Respectfully submitted,

Enrique Betancourt Brian Penny

WG Chair Secretary

**10.4.6 TF on Revision of Section 13 of C57.12.90, Sound Level Measurement**

# Unofficial Minutes of Fall 2013 Meeting in St. Louis, MO

The TF met at 1:45 PM on Monday, October 21, 2013, with a total of 85 in attendance. This breaks downs to 13 Members, 8 Corresponding Members, and 64 Guests. Seven guests requested membership. Prior to the meeting, the membership had been adjusted to 25 members and an agenda with the unapproved minutes were circulated to all members and corresponding members for review.

At the start of the meeting, a request for corrections or comments to the unapproved minutes of the spring 2013 Munich meeting was made without objection. An updated agenda with a few more items added was presented. A quorum had been established after reviewing the signup rosters. The spring 2013 TF meeting minutes stand approved.

After introductions, Chairman Dr. Ramsis Girgis presided over the technical portion of the meeting. Per the usual practice of this Task Force, a summary review of all the prior agreements made in the TF was presented to assure the group doesn’t regress into repeating discussion. This helps maintain focus on completion of unfinished clauses. The basic review included:

* Making the following corrections when using the “Sound Pressure Method”:
  + Wall sound reflection correction
    - Per the IEC formula, but limit the correction to 4 dB instead of 7 dB and limit # of test room cases to 4 instead of 7
  + Near-field correction
    - 1 dB for ONAN contour, no correction for the ONAF contour
* Using the “Sound Intensity Measuring Method”
  + As an alternate method
  + Use newly developed correction for 4 < (Lp – Li ) < 6 dB
  + Consider method invalid for (Lp – Li) > 6
    - In this case, use the “Sound Pressure Method” with appropriate corrections
* Measuring Load Noise
  + Measure when requested by purchaser
  + Can measure at current 60 % < I rated < 130 % and correct accordingly; in line w / IEC
* Changing the ONAF measuring contour
  + 2 m all around transformer; in line with IEC
* Determination of Total Noise level of a transformer
  + Adding Load and No Load noise levels logarithmically; in line w / IEC

The next item on the agenda was the continuation of addressing new proposed additions and changes to the text of clause 13.

First item of discussion was clauses 13.3.1 and 13.3.4 dealing with the tap position to be used for measuring no load noise. Per the decision made at the Munich TF meeting, a text that mainly used the section of the IEC Standard that refers to this matter was reviewed in the meeting. The purpose was to consider the following cases that were brought up in this, and the Munich meetings:

* Transformers with Preventive Autos where the no load noise could be higher at tap positions other than the nominal position; including cases where Tap windings may contain different turns per tap.
* Designs with series (booster) transformers, where the excitation of the transformer is highest at tap extremes
* Variable flux designs where no load noise is highest at a tap at, or near, a tap extreme

The text presented dealt with these cases. It was suggested that the main statement of “Measuring no load noise at the principal tap, unless otherwise specified”; which outlines the requirement, is kept the same; with the different cases of possible higher no load noise levels at tap positions other than the nominal be stated under it. It was agreed that the text should be clear that the tap position to be tested on be agreed upon by both the manufacturer and the purchaser and it should be stated in the test report. This could include testing the transformer at the highest noise producing tap position. The agreement would also include which measurement to use for the guarantee.

It was agreed that the chairman will modify the proposed text according to results of above discussion and will send it for review to those who attended the TF meeting.

One of the meeting attendees asked whether this Clause 13 could include comments and limits allowed for differences between measured noise levels of transformers at the factory versus what is measured in the field. The chairman commented that this is outside the scope of this Standard. He added that there is an IEEE paper, co – authored by him that has been recently submitted for presentation at the upcoming T&D conference, dealing with sources and magnitudes of these differences.

The next item presented and agreed upon in the TF meeting was the “Determination of the Total Noise level of transformers”. A numerical example is also included in this section of Clause 13 for clarification.

Four additional text modifications to Clause 13 were presented. These are:

1. Load noise to be measured at the ONAF contour with no fans running. This simplifies the calculation of the total noise level of the transformer and also load noise is typically a contributor to the total noise of the transformer only at high loading conditions when fans are running.
2. Removing the text in the present section 13.5.4 that allows arithmetic summation of Sound Pressure level measurements made around the transformer to obtain the “Average noise level of the transformer”. First, the arithmetic sum is not accurate enough. It is also unnecessary since performing the more accurate logarithmic summation is a simple task.
3. Removing section 13.5.6 which describes the computation of the A-weighted sound power level of the transformer using 1/3 Octave and narrow band Sound pressure measurements. The reason is that this is not what is typically done. What is done is what is described in section 13.5.5; where the A-weighted sound power level of the transformer is computed using the measured average dB (A) level of the Sound Pressure of the transformer.
4. Updates to section 13.7 “Presentation of Results” as a result of introducing the new corrections when using the “Sound Pressure Method”, Using the “Sound Intensity Method”, and measuring Load noise.
5. Modifications to Appendix – B as a result of introducing measuring Load noise.

At the end of the meeting, the chairman acknowledged the help by his associate Mr. Mats Bernesjo for his help with putting together the material of the presentation. He also acknowledged TF members from Siemens, Smit, Alstom, and ABB who provided tested values of Load noise data for over 180 medium and large power transformers. This data will be presented in the spring of 2014 TF meeting as part of developing Reference Levels of Load noise versus MVA that would be equivalent to the NEMA levels for no load noise.

The plan is to finalize a draft of the revised Clause 13 and to send it for review by those who attended the TF meeting and discuss the feedback in the spring meeting.

The meeting was adjourned at 3:00 PM.

* + 1. **WG P60076-16 Standard Requirements for Wind Power Generator Transformers**

Chairman: David Buckmaster; Vice Chair: Phil Hopkinson: Secretary: Donald Ayers

The Working Group on Wind Power Transformers was called to order at 9:32 a.m. CST on Tuesday, March 22, 2013 at The Renaissance Hotel, Landmark 4 Salon, St. Louis, Missouri. There were 130 attendees, 30 members present of a membership of 52 and 90 guests. A quorum was present. Jodi Haasz, IEEE liason, indicated that she must be removed from the member rolls due to her position.

The following guests have requested membership on the Working Group:

Susmitha Tarlapally, ABB, Jefferson City, MO

Gary King, Howard Industries, Laurel, MS

Jeewan Puri, Transformer Solutions, Inc., Matthews, NC from corresponding member

Edwin Brush, BBF & Associates, New Harbor, ME

Rogelio Martinez, GE Nogales Dry Transformers, Nogales, Mexico

Ali Naderian, Kinectrics, Toronto, ON, Canada

Baitun Yang, Pennsylvania Transformer, Canonsburg, PA

Hemchandra Shertukde, University of Hartford, Hartford, CT

Kevin Sullivan, Duke Energy, Lake Mary, FL

Aniruddha Narawane, ABB Inc., Jefferson City, MO

The following guest requested corresponding membership on the Working Group:

Kiran Vedante, ABB Inc., St. Louis, MO

The agenda for the meeting was approved by all members.

The minutes from both the Fall 2012 meeting and the Spring 2013 meeting were approved by all members present,

Jody Haasz, IEEE, made a presentation on the methodology of creating a dual logo standard with IEC. The presentation will be placed on the Working Group’s web site.

Chairman, Dave Buckmaster, requested a volunteer to amend the IEC forward to the document to include IEEE reference. Jody Haasz stated that a joint IEEE-IEC committee had already agreed to the dual logo standard language.

Previously edited IEC document sections were forwarded to Tom Breckenridge the IEC WG Chair (Convener) for comments to be finalized during their first scheduled meeting in London in late November.

Chairman, Dave Buckmaster, stated that the paper pertaining to Dissolved Gas in Oil Interpretation from GE does not fall within purview of this standard. However a request for amendment will need to be forwarded to C57.104 Working Group.

Phil Hopkinson, HVolt, Inc., made a presentation on the causes of gassing in Wind Farm transformers, particularly Hydrogen gas generation. He also presented a couple of solutions that can be implemented to prevent the gas generation. The presentation will be placed on the Working Group’s web site. General consensus of the attendees was that the information presented should be included in the final document in some form.

Jeewan Puri agreed to head up a task group to propose how to include the information from Phil Hopkinson’s presentation as well as several other subjects into the standard, most likely in an Annex. The subjects to also be considered are: (1) Transient voltages caused by interaction between breakers and transformers; (2) Switch and DETC contact carbonization, (3) Low Oil level exposure of live parts.

The meeting was adjourned at 10:50 a.m. CST.

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

AGENDA

1. Introduction

2. Roster and Quorum Verification

3. Approval of the Munich Meeting Minutes

4. Review of the Draft of the Guide:

- Topic Leaders and Contribution

- Content – Chapters and Topics

5. Timeline of the IEEE Guide preparation for ballot.

6. New Business

The Working Group met in the Landmark 7 room of Renaissance Grand Hotel St. Louis. This was a third meeting of the WG.

The meeting was called to order at 8:00 am by Chairman Hemchandra Shertukde.

The meeting was convened with 51 participants present, 15 of them are members (that constitutes a quorum out of 29 current members in the roster plus 3 absent corresponding members), 8 participants requested a membership.

Old Business

Munich Meeting Minutes were approved.

New business

Meeting Agenda was approved.

Chairman has described the current status of the Guide, commented on the slow progress with contributions and asked the Secretary S, Levin to make a more detailed review of the Draft 1.1. of the Guide.

1. Section 3 Definitions.

C. Johnson recommended to review IEEE C57.12.80 – **S. Levin** will do this (**ACTION**).

2. Section 4. Background and specifics of the typical DPV Power Generation Systems in relation to a transformer application.

S. Sarkar wanted to have a clear idea on the harmonic content in relation to IEEE C57.18.10. This topic is will be covered in Section 5. E. Betancourt commented that there is no harmonics content over 5% that needs to be considered. G. Anderson referred to the

published paper where the effect of the individual harmonics on the insulation was studied. **S. Levin** to request the work from Greg and to distribute to the WG (**ACTION**).

J. Mamtora commented on the potential problems when two windings on the same core have some voltage difference. This aspect will be addressed in Section 6. Also J. Mamtora thinks that we need to involve inverter manufacturers in the work of WG.

S. Walia informed that there is a number of different configurations / technologies of DPV systems that they see in the field and these systems can have different performance. **S. Walia** will provide the information about an experience his company has with those different systems (**ACTION**).

S. Sarkar asked about what is known on the possible asyncronization of the inverters. E. Betancourt commented that there are no requirements to consider this situation in the known to him specification.

**E. Betancourt** will propose the material to be included in the Guide based on the presentation about specification he provided to the WG (**ACTION**).

Enrique also mentioned the requirements for the mutual impedance between the portions of the windings that can be seen in some specifications. This needs to be included in the Section 5.

V. Tendulkar commented that the switching frequency harmonics significantly vary depending on the configuration of the system and inverter manufacturer. He also noticed that the systems under consideration often include reactors and the harmonics content can be different in this case. **Vijay** will review the topics and materials in the current Draft of the Guide and provide his input (**ACTION**).

**J. Yu** agreed to continue leading the Section 4 (**ACTION**). **Jennifer** talked about a variety of configurations of DPV systems and she will contact a developer(s) in obtaining more information on those configurations and other topics of Chapter 4 (**ACTION**).

E. Betancourt noticed that we need to review the recent publications and recent development in the field of the DPV PGS – it can be significant changes in this system going forward. There are some groups in CIGRE that study similar topics (e.g. group on the study of the effect of the multi-directional power flow on transformers. **Sasha** will request additional information on those groups from Enrique (**ACTION**).

**H. Sherdukte and V. Tendulkar** will review available information on the progress in DPV PGS (**ACTION**). **Vijay** will also review available specifications and decide what material can be used in a work of our WG (**ACTION**).

3. Section 5. Transformer parameters selection and transformer design.

**S. Kennedy** will continue leading the work on this section (**ACTION**).

J. Cheng described a variety of winding design configurations he’s seen over time. Sometimes the specified requirements are not explained, e.g. the different BIL tests were requested for the cases with or without connected ground shield with no specific reason described. **John** will review the material he has and provide input for the work of our WG (**ACTION**).

G. Anderson mentioned that the very wide variation of temperatures can be an issue for these types of transformers: desert-like location, day/night operation – this can create mechanical forces and thermal cycling.

Regarding a variety of requirements for impedance, V. Tendulkar mentioned the issues related to the specific filters location in the DPV systems and combination of reactor and transformer functions with the required high transformer impedance.

J. Mamtora raised the question about no-load loss and efficiency of the transformers as related to switch off the grid operation for the loss savings. J. Verner commented that in her organization transformers are not switched off even though the period of power generation can be relatively short (4.5 hours). The practical examples of the operation of these transformers need to be obtained.

**H. Sherdukte** to provide the available information on the optimization of the performance of the DPV PGS transformers (**ACTION**).

**C. Johnson** will review the available information and experience in the field of the dry-type transformers for this application and decide what information would benefit the development of the Guide (**ACTION**).

**J. Prince** volunteered to review available information and provide input in the development of the Guide (**ACTION**).

**B. Jensen** has requested the membership in WG and informed that he has some previous experience with the small scale PV systems and would like to contribute to the work of the WG (**ACTION**).

1. Section 6. Transformer general requirements, construction and protection.

**E. Betancourt** will lead the work on this section (**ACTION**).

**E. Betancourt** will find a specialist on the arc-flash specifics and protection within his organization and will ask on development this topic for the Guide (**ACTION**).

Discussion on ground fault: recommendation on the grounding and grounding transformer need to be included. **S. Kennedy and V. Tendulkar** will work on this topic of the Guide (**ACTION**).

It was recommended that the specific consideration of the public safety will not be included in the guide, but recommendation on the useful warning signs can be included.

1. Section 7. Transformer test and commissioning.

**D. Ayers** will continue lead the development of this section (**ACTION**).

D. Ayers commented that after polling other members of his group, they do not, at the moment, see any specifics as for the factory tests of DPV PGS transformers.

The reference will be made to the appropriate standards (IEEE C57.12.01, C57.12.90, C57.12.91).

Some specifics of the necessary thermal test including harmonics may be considered, if deem necessary.

**D. Ayers** will review available standards on the transformer commissioning and look at whether any other groups in IEEE Transformer Committee are working on this topic currently (**ACTION**). Comment was made that the available standards might be related only to the power transformers of the higher voltage classes.

1. Section 8. Transformer diagnostics, monitoring and maintenance.

N. Field commented that **J. Roach** continues leading the development of this section (**ACTION**). Norm asked for the input on the current practices and the field test results from the end users.

J. Yu commented that the only additional diagnostic measure compare to the regular distribution transformers (that she knows about) is DGA. It needs to be noticed that DPV PGS transformers often can have ester fluid insulation. **N. Field** to contact J. Yu to discuss whether more information on the field diagnostics can be obtained and the difference between DPV PGS transformers and regular distribution transformers can be detected (**ACTION**).

**H. Sherdukte** to provide information on the PD investigation performed on the West Coast (**ACTION**).

**J. Verner** will contact the end users to obtain information on what diagnostics, monitoring and maintenance are typical for these transformers and whether there are any specific issues and/or problems identified (**ACTION**).

1. Section 9. Transformer specification.

**M. Sauzay** is leading this section (**ACTION**).

Identified important aspects of the transformers under consideration will be recommended for inclusion in the specification.

M. Sauzay asked all section leaders and section TF members to identify what they think needs to be included in the transformer specification.

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

Chairman: Hemchandra Shertukde

Vice Chairman: Mathieu Sauzay

Secretary: Sasha Levin

**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 3:14pm in Landmark 7.

The chair opened the meeting with a brief introduction to the objectives and goals of the task force.

The below goals for the group were reviewed for those not present at our first two meetings.

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

Attendees introduced themselves and stated their affiliations.

80 people in attendance

23 members present (quorum was reached).

The proposed agenda and meeting minutes from the Munich meeting were approved unanimously.

The transients survey has been uploaded to the Survey Monkey website. Rod Sauls has interfaced with the Switchgear Committee leadership to let them know the transients work is being performed and that the transients survey will be circulated to the Switchgear committee. The current chairman of the Switchgear Committee is Ted Olsen.

Bob Degeneff made a presentation on the work that is ongoing within CIGRE. A brochure is being published on the mitigation of switching transients caused by the system interactions between transformers, switching devices. Bob has been involved with the group that is producing this brochure. There are several examples in this brochure. Approximately eight of the ten examples in this brochure are related to high voltage interactions. Bob will hopefully be able to present something on this work at our next meeting.

Bertrand Poulin gave a presentation on GSU transformers in back feed mode. Bertrand presented cases where failures have occurred on GSU transformers in back feed mode. There are significant resonant frequencies that occur in the three phase circuit connection on these transformers. Bertrand presented graphical plots produced from an extensive high frequency model he has developed for this interaction case. He indicated that classical models of a power transformer proved insufficient for analysis of failures. Bertrand showed cases demonstrating this model's accuracy and the effect on the system frequency response to varying different components of the transformer. He demonstrated that damaging voltages can occur with excitations near the resonant frequencies of this circuit.

The chairman presented three phase terminal voltage transients obtained from the energization of a 230 / 20 kV 60 MVA transformer through a circuit switcher. This energization produced many restrikes and re-ignitions on the H terminals of the transformer. This switching operation produced approximately 1 us rise times on the H terminals of the transformer. These transients excited resonant frequencies in the transformer at 44 kHz and 500 kHz which were recorded on the X terminals of the transformer.

The chairman presented a second case study on transient related shunt reactor failures. He summarized this failure investigation performed by Catherine Brady of Progress Energy this past year. A paper on this work was sent to the participants of the task force. This material was presented to inform the task force participants of this work. This work will used to finalize the objectives of the task force.

The meeting was adjourned at 4:35 pm.