

**Performance Characteristics Subcommittee  
Unapproved Meeting Minutes – Nashville TN – March 14, 2012**

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

**Introduction / Attendance**

The Performance Characteristics Subcommittee (PCS) met on Wednesday, March 14, 2012 at 3pm with 60 members and 77 guests present. Prior to this meeting, the total membership of PCS was 103 members; therefore, we did have in excess of 50% of the membership, meeting the requirements for a quorum.

There were 10 guests requesting membership.

**Chairman's Remarks**

Craig Stiegemeier was unable to attend so Steve Snyder was acting secretary for the meeting.

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

- IEEE/PES T&D Conference and Exposition, May 7, 2012, Orlando, FL
- PES General Meeting: July 2012, San Diego, California.
- PES General Meeting: July 2013, Vancouver, BC, Canada.
- Next Transformer Committee meetings:
  - Fall 2012, Milwaukee, Wisconsin; hosted by Waukesha
  - Spring 2013, Munich, Germany; hosted by Reinhausen
  - Fall 2013, St. Louis, Missouri; hosted by HJ Enterprises
  - Spring 2014, Savannah, Georgia; hosted by Efacec

**Approval of Meeting Minutes**

The minutes of the last meeting in Boston MA were approved as written.

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

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

There were 13 of the 22 Members in attendance and 52 Guests with 4 Guests requesting membership.

The present PAR is approved and expires on 12/31/2014. The present draft being worked on is D11.

Attendance of membership was taken and a quorum was established.

The minutes of the Spring 2011 San Diego meeting and the Fall 2011 Boston meeting were approved as submitted.

Comment from D. Platts – We should consider modifying this document to recognize that not all utilities are vertically integrated. We should provide a means for non-generating utilities to determine loss evaluation factors.

Comment from S. Shull – We should merge Annex C on transformer losses into the body of the document. There was general agreement to do that.

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Comment from B. Klaponski – We should consider making a spreadsheet available through the Transformer Committee website for users to perform these calculations in accordance with this guide.

We reviewed draft D11 and made the following assignments to review these clauses and make a recommendation before the Milwaukee meeting. A. Traut to post D11 on the website and email to those listed below.

- B. Farris – Clause 2
- J. Murphy – Clause 3
- M. Miller – Clauses 4.1 and 4.2
- D. Platts, W. Binder, S. Shull – Clauses 4.3 and 4.4

There was no other new business. The WG adjourned at 12:05 pm.

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

1. Introduction of members and guests

2. Membership review - The chairman reviewed changes to the membership of the working group since the last meeting. After these changes, the Working Group now has 77 Members, 2 Corresponding Members and 257 Guests. Any Member missing the last two Working Group meetings has been moved from Member to Guest status.

A review of the current roster of members was presented to the attendees. After the review, a roll call found that 39 members were present at the meeting, constituting a quorum of 51% of the Working Group membership. The attendance sheets showed that there were actually 42 members present and 50 guests, constituting a quorum of 55%.

3. Approval of minutes from the Fall 2011 Boston meeting - The Chair noted that the minutes from the Boston meeting were distributed to the Working Group before the meeting by E-mail as well as on the Committee website. After a call for comments or corrections and receiving none, Hem Shertukde made a motion to approve the Boston minutes, Steve Snyder seconded the motion, and the minutes were approved by the membership as written.

4. Old Business

- Revision of Section 6 and 7 - The final revised sections 6 and 7, as approved by survey and vote of the last meeting were submitted to the working group on continuous revision of C57.12.90. These will be included on the ballot of the test code, which Steve Antosz reports will happen in about 1.5 to 2 years.
- Revision of Section 8 - Comments from the last meeting on section 8 were agreed to apply mostly to the loss measurement guide, rather than section 8. As a result, the minutes of the Boston meeting, which summarize these comments will be forwarded to the Performance Characteristics subcommittee to be included on the next revision of the guide.

5. New Business - Zero Sequence Impedance measurement on wye wye transformers or autotransformers without a delta tertiary.

The chairman reviewed a motion from V Sankar and K. Vijayan that the working group review section 9.5.3 on zero sequence measurements as it applies to three leg core form transformers with wye wye connected windings. This was based on discussions with a customer where there was confusion on how to represent the Z3 branch as shown in Figure

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25 for such transformers. They presented sections from Blume (Table III item 6) and from the Westinghouse Transmission and Distribution reference book Table 5 that the customer was using to argue that the Z3 branch can be ignored.

The chair then discussed section 9.3.5 and the four tests that are to be made on such transformers in order to develop the equivalent zero sequence network shown in Figure 25. He also discussed the need to make measurements at multiple voltage/current levels since the circuit is non-linear and a curve is needed to determine the specific zero sequence impedance values required for a specific fault current or imbalance loading condition. He then summarized some possible additions that could be made to section 9.3.5 to clarify this situation including:

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 and 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..

Warning should be given regarding overheating of the tank or tank wall shielding.

State that the tanks acts as a one turn phantom tertiary and the Z3 impedance is to this tertiary.

The question was asked if anyone was actually using wye wye transformers with three leg cores or autotransformers without delta tertiaries. The response from several members was that many manufacturers have manufactured such transformers and a number of users specify such transformers for their system.

It was suggested that we coordinate with the task force on stabilizing windings since this same type of subject is being discussed there. The chair agreed to contact the task force chair and make arrangements.

Since there was agreement that section 9.5.3 should have a note included with the information in italics above, a motion was made for the working group to prepare such a note. The chair will present this at the next meeting for review.

The chair asked if there was any other new business items to discuss.

It was requested that the group consider revising the required tolerance on ratio for transformers with reactance type load tap changers. The chair advised that the topic of tolerances is in C57.12.00 not C57.12.90, so it was agreed to forward this question to Steve Snyder.

Phil Hopkinson suggested that a warning be included in the standard on transformer connections regarding potential problems of wye wye or autotransformers without tertiaries when there are unbalanced loads on the system. This question will be referred to the PC subcommittee for consideration since it is outside the scope of our working group.

6. Adjournment - A motion was made, seconded and passed to adjourn the meeting at 12:14am.

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

1. Meeting Attendance - The TF on DFR met on Monday, March 12, 2012, at 3:15 PM. 16 members (out of 25) and 61 guests were present.

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

3. Presentations of task reports

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

4. Discussion to recommend to PCS to form working group to develop guide:

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

5. Next Steps

The next step is to complete the task force report and send it to the task force for comment. After a final review the report will be sent to the PCS chair with a recommendation to form a working group. It was suggested that PCS should transfer the topic to the Dielectric Tests subcommittee since the basis of this test is essentially power factor measurement over several frequencies.

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

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

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

The Working Group met at 4:45 PM on Monday, March 12, 2012, with 34 members and 65 guests present. As the current Working Group membership stands at 66 members, we did have a quorum for the meeting. The following six (6) guests requested membership, which will become effective only after confirmation of attendance at two (2) consecutive meetings:

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David Ostrander	Ameren
Sergiy Razuvayev	Delta Star Inc.
Bruce Fairris	Nashville Electric Service
Juan Carlos Cruz Valdes	Prolec GE
Babanna Suresh	Southwest Electric Company
Mahendrakumar Soni	Virginia Transformer

Following introductions, the minutes of the October 31 Boston meeting were approved. The meeting agenda as presented was approved with no changes.

**Old Business**

**WG Item 87, Table 15 Short-Circuit Apparent Power of the System  
- Discussion on Survey Results**

A proposal to modify Table 18, Short-circuit apparent power of the system, was surveyed among PCS and the WG. The results of that survey were reviewed. The response rate was about 31%, with 84% affirmative, 7% negative, and 9% abstention, with several good comments. The next step is to make slight revisions to the table accommodating some of the comments, and then to go out for survey again, per the Working Group request. The chairman will work with the Task Force chairman, Bruce Forsyth, to make those changes and get the survey launched. This should be completed well before the next meeting so that at the next meeting we can close this item.

**WG Item 96, Table 18 Resistance Measurements for All Taps on Power Transformers  
– Discussion of Proposal**

A proposal to require resistance measurements on all taps for power transformers was discussed, with many comments received from the Working Group:

Give consideration to the special case of a series transformer, where all taps would yield approximately equal measurements.

There is a risk of significantly increasing the winding temperature during the test for all taps, making it impossible to reproduce reference measurements in the field.

If the purpose of the proposed test is to identify bad contacts, a “contact resistance measuring instrument” would yield better results.

If the purpose of the test is to measure winding resistance, there is no sense in measuring all taps individually.

Some members were in favor of establishing resistance measurements only on selected taps. At least some bridging and non-bridging tap positions should be involved.

It was pointed out that, for in service transformers, the test can be a good means to check for contact wear. Exercising the tap changer, and control of gases generated in LTC compartment would be helpful.

A participant from the utility side cited a case of a new transformer with a tap changer lead that came loose during transportation, and having detected the problem through the routine use of the winding resistance test, checking all taps.

As the individual leading the proposal, Joe Foldi, was unable to attend the meeting, these comments will be forwarded to him and his study group for further refinement. The refined

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proposal will then be surveyed among PCS and the WG, with the final discussion and disposition expected at the autumn Milwaukee meeting.

WG Item 97, Table 18 Operational Tests of LTC Equipment  
- Discussion of Proposal

The proposal requires detailed operational tests on the LTC equipment. Again, Joe Foldi is the individual leading the effort, and since he was not in attendance, there was practically no discussion on this topic. One question was raised concerning the purpose of the test, if it is to demonstrate the ability of a new tap changer to perform properly, then the test could be carried out before installing it on the transformer. It was clarified also that the proposed test is not addressed in the IEEE standard on LTCs. The next step on this item is to obtain a final proposal from the study group, survey PCS and the WG, and review the results at the next meeting.

New Business

WG Item 99, Clarification of Ratio Requirement in Standard C57.12.00

A clarification was requested from an earlier C57.12.90 meeting concerning the ratio requirements specified in C57.12.00 in regards to the tolerance for ratio. The issue identified pertains particularly to transformers with LTC where the tap sections are not uniform and hence the nameplate voltages at each tap may not be within the 0.50% tolerance, but if based upon the actual turns are within tolerance. Another factor bearing upon the ratio test measurement is the influence of the preventive auto when in the bridging position. There was a lot discussion about possible changes in the standard to recognize these situations, but it will require a lot more work to finalize. Raj Ahuja volunteered to lead a study group to develop a proposal, which will then be surveyed within PCS and the WG before the Milwaukee meeting.

The meeting was adjourned at 6:00 PM.

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

The Neutral Grounding Devices working group was called to order at 3:20 PM on March 13, 2012. There were 22 attendees present.

1. Quorum was established from new membership survey - 12 working group members were present with 10 guests.
2. Minutes were approved from the Fall 2011 meeting.
3. Chairman's Remarks – (Sheldon Kennedy) Chairman presented a brief history of the WG and introduced the new PAR, which will expire December 31, 2015.
4. It was noted that the new PAR does not list a purpose. A motion was introduced to remove the purpose statement from the draft document. The motion was approved.

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5. Discussion of Draft 11 ensued by way of a review of the devices included in the document. Discussion centered on the following:

- insulation temperature classes
- the comparison of definitions in the document to IEEE 100
- maximum voltage class levels to be included
- the source of the time factor multipliers from STD-32
- updating test levels to those in the current version of C57.12.00
- test levels for single phase devices

6. Consideration was given to comparing the document to IEC calculations for temperature rise, continuous duty and short time ratings. This will be investigated by Don Ayers.

7. New Business: none

8. Meeting was adjourned at 4:35pm.

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

The Chair called the WG meeting to order at 9:50 am on March 12, 2012.

There were 16 members in the meeting, out of 29 counting members, therefore we had a quorum. 56 Guests attended also, and 5 of them requested membership.

As part of the Old Business, the Group was updated on the PAR request approval status. The application has been submitted to the NesCom through MySpace, and a positive response is anticipated by the beginning of June [Thank's to Bill Bartley and Steve Antosz for their support]. The Title, Scope and Purpose of the new document will be:

TITLE - "Guide for Application of Tertiary and Stabilizing windings in Power Transformers".

SCOPE - This Guide addresses the application of tertiary and stabilizing windings in liquid immersed power transformers, as covered by IEEE Std C57.12.00, as well as recommendations to evaluate the need or convenience of having such windings. The primary application of this guide is for transformers and autotransformers with wye-wye connected windings, with or without a delta connected tertiary or stabilizing winding. The guide does not address tertiary windings in conventional delta-wye, or delta-delta connected transformers.

PURPOSE - This Guide provides users with a conceptual framework and recommendations for the specification, application, and performance evaluation of tertiary and stabilizing windings.

NEED - There is a great deal of interest in the transformer industry to develop an application guide for tertiary and stabilizing windings. This proposed document is intended to fill a gap in currently available literature, regarding guidance for the need for a tertiary or stabilizing winding in a Y-Y connected transformer or autotransformer; and guidance on the kVA rating of said winding.

Next item on the Agenda: A literature and industry practice survey was performed by TF members in the last months, and samples of the results were presented in form of:

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1. A paper by Sanjay Patel: Title “Tertiary Delta Winding for Y-Y Connected Transformers”, which explains some advantages and disadvantages of the use of tertiary windings in Y-Y connected transformers from both technical and commercial point of view.
2. A presentation by Xose Lopez-Fernandez with the title “Transformer Tertiary Stabilizing Windings” touches on the apparent power rating of the stabilizing winding and overheating hazard on tank walls.
3. A short summary of responses from utility participants regarding practices to specify tertiary and stabilizing windings.

The list of references and a full summary of responses will be posted on the web, accessible to WG members.

Several guests attending the meeting provided recommendations to the Group regarding technical aspects to be considered:

Dan D. Perco – On the transformer without tertiary, the zero sequence current will flow in other delta nearby. Are these transformers designed to take the extra current?  
Follow up observations by Dan D Perco – specification of tertiary winding to be added to list. Insulation levels required for buried tertiary winding.

Edgar R. Trummer- Observation "3 leg core type transformers do not need a tertiary winding" in a standard or guide is dangerous and must be avoided. In this case the Zero Sequence flux is forced towards to the tank and creates additional losses and hotspots in this area, if the 3-phase system is unbalanced. In this case it would be better to have a 5 leg core since the Zero Sequence flux will mainly be collected in the auxiliary legs and not go through the tank".

At this point, [the Chair] clarified that our work is precisely to provide recommendations that eliminate risk and ambiguity, and that we will be looking at three different cases:

Transmission and Intertie Transformers and Autotransformers  
Wind farm collectors  
Primary distribution transformers and autotransformers

As a last item on the Agenda, the Table of Contents of the new document was reviewed and first inputs from the audience included.

There being no new business, meeting was adjourned at 11:05 am.

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

The TF met at 1:45 PM on Monday, March 12, 2012 with a total of 77 in attendance. There were 18 of 50 members in attendance along with 59 guests. Seven guests requested task force membership. After the introductions of attendees and circulation of attendance sheets the unofficial minutes of the fall 2011 Boston meeting minutes were presented. At the meeting, there was a request for corrections and an unofficial approval of the minutes pending a meeting quorum. Since we did not have a quorum at this meeting, they will remain tentatively approved until a quorum can be established. Prior to the meeting a



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request for inclusion of a comment from Jeewan Puri was forwarded to the Chairman for review and this comment was added to the minutes.

First, the Chairman shared with the attendees a summary review of the agreed upon additions to Section 13 of C57.12.90. These are:

- Making the Wall sound reflection correction
  - Per IEC but limit correction to 4 dB and test room cases to 4
- Using the “Sound Intensity Method”
  - As an alternative method
  - Use newly developed correction for  $4 < (L_p - L_i) < 6$  dB
  - Consider method invalid for  $(L_p - L_i) > 6$
- Measuring Load Noise
  - When requested by purchaser
  - Can measure at current  $60 \% < I \text{ rated} < 130 \%$  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, the chairman reviewed and discussed new text that addressed comments / suggestions that were brought up and agreed upon by the TF in the Boston meeting. Here are the items discussed and the decisions made based on input from the attendees:

Item1: Agreement on environmental corrections

The sound pressure method had a comment regarding the environmental correction to be agreed upon between the manufacturer and the purchaser of the transformer. There were three choices to respond to whether a modification of this statement is needed. The choices were:

- Leave the statement as is.
- Remove the statement completely.
- Agreement needed only if an alternative method is proposed.

A decision was made, based on Pierre Riffon’s suggestion and agreed upon by the attendees, to remove the agreement statement and to have the reported final test report data include the measured noise levels along with the corrections used in determining the final value.

Item 2: Allowing load noise measurement at a current in the 60 – 130% range of full load

The chairman explained that test equipment limitations can dictate measuring at a lower current than rated current and when the ambient noise is not sufficiently lower than load noise of the transformer at full load, it is permissible to measure load noise of the transformer at a higher current than rated current. Data was presented in an earlier TF meeting that showed the error involved in this allowable range is a fraction of a dB. The same is also presented in an IEEE paper on Load noise published 2 years ago.

Item 3: Appropriate Environmental conditions for Sound Intensity Method

It was agreed to add the following text:

“When the environmental conditions are such that  $L_p - L_i > 6$  dB, using the Sound Intensity method, under these conditions, would be considered invalid. This condition is typically caused by:

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1. High ambient noise. In this case, the transformer manufacturer could attempt to reduce the ambient noise.
2. High sound wall reflections. In this case, the transformer manufacturer could, if feasible, move the transformer into a larger test area / room.

Alternatively, the transformer noise could be measured using the Sound Pressure method while following the recommended corrections described in sections 13.5.5.1 and 13.5.5.3 for high ambient noise and / or high sound wall reflections “

**Item 4: Near – Field Correction**

This correction was suggested in order to compensate for the measuring error caused by the near – field reactive sound power around the transformer. The chairman suggested a 1.5 dB correction for the ONAN measurements and 0.5 dB for the ONAF measurements. Pierre Riffon suggested no correction for the ONAF measurements. The chairman agreed that this was reasonable. The chairman stated that an IEC WG headed by Dr. Chris Ploetner is working in parallel with this TF to update the IEC Standard on measuring transformer noise. He suggested that he will let Chris Ploetner know about this Near – Field correction being adopted by this IEEE TF.

**Item 5: Transformer Operating Conditions**

It was suggested to replace this present title of section 13.3.3 to read “Determination of Total Noise of a transformer”

**Item 6: Determination of total Noise level of a transformer**

The chairman reviewed with the attendees the suggested write – up of this section. One item was brought up by B. Poulin on using  $L_p$  in this calculation; which referenced in the document as Sound Pressure level. However, noise levels measured using the Sound Intensity Method are referred to as  $L_i$ . However, the total noise calculation applies to both but the formula is given in terms of  $L_p$  only. This possible cause of confusion needs to be resolved.

Another item that causes a little complication in the calculation is that the ONAN measurements are made at the 1/3 m ONAN contour while the ONAF and Load noise measurements are made at the larger 2 m ONAF contour. It was suggested, again in this TF meeting, to consider making all noise measurements at a 1 m contour. The chairman supported for this idea; as it has the following advantages:

1. It would simplify calculations of the total noise level of the transformer (Load + No load noise)
2. It would remove the need to make the near – field correction or reduce it to one value of 1 dB
3. It would simplify the measurement process by using only one contour.

Also, the chairman stated that it is not necessary to be at 2 m from the fans when running if a wind screen is used. The chairman, however, expressed concern that such a change may be difficult to get agreement on from the Transformer committee at large after decades of using two different contours and using noise levels referenced to the present contours. The difficulty in getting consensus from users would be a major hurdle in using only one distance contour.

A couple of utility representatives supported this change. A representative of a transformer manufacturer stated that he measured a 1.5 dB difference between measurements at 1m and 2 m contours. The chairman thought that this magnitude of difference is slightly higher than typical. This representative will send this data to the chairman to examine. A show of hand supporting, or opposing, this proposal did not indicate one way or the other as most

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attendees refrained from expressing their stand on this issue. This proposal will be revisited again in the fall 2012 meeting of the TF in Milwaukee. More data will be shown then. After the meeting, a representative from a manufacturer of fans used with power transformers asked whether this change will mean a change in the 2 m contour they use for measuring fan noise. The answer is that what is important for the noise rating of a fan is its sound power level. So, as long as the noise levels of the fans are provided in sound power or in sound pressure levels but with known measuring contour, there will be no need to change the measuring procedure for fan noise.

Finally, in the discussion on the calculation of the total noise level of a transformer, the subject of NEMA TR1 levels was raised. The chairman explained that the NEMA values were provided as a reference of the sound levels of a standard transformer with a non – step lap core made of regular grain oriented steel operating at a core flux of 1.75 Tesla. These typical values would be expected for designs without any special consideration for means to reduce the core noise. So, for the time being, the NEMA TR1 levels should not be used as a reference for total noise levels. Instead, there is a need to develop corresponding Tables for Load noise of transformers of different sizes. Such data is planned to be presented and reviewed at the fall 2012 meeting of the TF.

Steve Antosz suggested that, when all the proposed changes are implemented, the draft of section 13 is circulated for survey at both the TF and PCS levels. This survey should be introduced by a summary of the changes made and why.

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

The Working Group on Wind Power Transformers was called to order at 9:30 AM. Membership on the WG are those attending this first meeting and requested membership, and those that responded to a call confirming membership earlier this year.

**1. Introductions**

Chairman: Dave Buckmaster introduced the other officers of the WG  
Vice-chairman: Phil Hopkinson  
Secretary: John A. Gauthier, acting

The chairman requested that attendees indicate on a roster circulated at the meeting whether or not they are members or guests to the WG. In a review of the WG roster, a number of attendees expressed the desire to be members. The chairman declared a quorum present.

**2. Approval of the agenda**

**3. Approval of the minutes** - The minutes for meeting held 1 November 2011 were approved.

**4. Old Business**

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

4.2 It was reported that the following task assignments have been completed and posted on the IEEE site:

4.2.1 Normative reference research and cross reference – Phil Hopkinson

4.2.2 Transient Switching C57.142 Verbiage to address – Jeewan Puri

4.2.3 NFPA 70E Compliance for Arc Flash – Dave Buckmaster

4.2.4 Stress enhancement points/gas analysis – Ray Bartnikas (Status Unknown and not published)

It was noted that some members do not have the password/ID for access to the IEEE website to review the document. The chairman provided the information to those present.

It was noted that the task assignments were intended to address particular concerns within the wind power system: addressing the generation of AC power and inversions and the current trend toward all AC systems. A brief discussion ensued on the task and risks of testing oil samples on wind turbines and the need to address the requirement to turn off an entire circuit.

Mr Hopkinson noted that several issues need to be address: Gusts of wind and their effect on the turbine and its fins, when a generator can become a motor and the influence on other devices in the system. Are there conditions where some wind turbines could become motors? It could occur and become a problem. The BIL for transformer and accessories raise a concern when there are no surge arresters on the wind device. Why flashover when turbine meet BIL? There is always a weak spot: load bearing, bushing. Members engaged in additional technical discussion of bushing and switches and their mutual vulnerability in the wind farm environment . If there is a flashover, switching transients and over-voltages need to be reviewed for adequate protection. Technical discussion ensued on field experiences. It was noted that proper BIL and coordination of insulation are necessary for consideration.

The chairman urged members to review the documents on the IEEE website and provide any comments to him.

It was noted that there seems to be a limited discussion of frequency variation and continuous over-voltage. It was further noted that these are not typically seen though over-currents are experienced.

It was noted that tap-changers are not addressed but there is a willingness to include a reference in the IEEE/IEC document.

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It was recommended that acoustic partial discharge detection be included in the list of concerns. It was agreed. To a question about addressing RIV and partial discharge in testing, it was noted that some test both and further noted that setting limits should be considered.

**5 New Business:**

Call for Task Force (5 – 6 Persons) to attend and interface with the IEC meeting during the week of September 21 in Manchester UK in order to work out a compromised scope statement.

The chairman noted that there was a need to identify a US IEEE member to participate in the TF and to attend the September meeting. Dr H. Shertukde agreed to serve in that capacity.

It was noted that the joint IEEE/IEC develop a common scope for an IEEE/IEC document. That will be an early task of the TF meetings. The chairman noted that in discussion with IEC TC14 representatives, there is a need to alternate meetings in the US and in Europe.

Mr Hopkinson briefly reviewed the contents IEC 60076-16 FDIS which has been published as an IEC standard.

It was noted that a number of issues needed to be considered:

1. Develop formats and scope (See TF verbiage above) as the first priority.
2. Issues that need to be include in the document.
  - a. Factory Tests including Partial Discharge during Induce Tests
  - b. Importance of Gas In Oil Tests and Interpretation
  - c. Loading Expectations and impact on Nameplate Rating
  - d. Harmonics, their sources and impact on specifications
  - e. Loss Evaluation techniques to reflect proper importance for relationship between load loss and no load losses
  - f. Proper BIL for both the transformer and the accessories.
  - g. Overvoltage due to switching and lightning and proper protection
  - h. Arc-Flash Prevention by switching sequences or other

There was no other new business.

**B. Adjournment**

Next in person meeting will be at the Fall IEEE Transformer Committee meetings in Milwaukee, Wisconsin. The meeting adjourned at 10:37 AM.

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

WG PC57.149 met for the development of the Frequency Response Analysis (FRA) Guide in Nashville, TN on March 12, 2012 at 1:45 PM. There were 48 people in attendance. Only 10 of our 32 members were in attendance, and a quorum was NOT established.

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The minutes from the Boston meetings were not approved.

This meeting focused on completing the final tasks for ballot recirculation. The deadline for the PAR is October 15, 2012.

All but 5 of 266 comments have been resolved. The breakdown is as follows:

Category	Must be Satisfi ed	# C o m m e n t s
Editorial	YES	38
General	YES	5
Technical	YES	50

TOTAL 93

Category	Must be Satisfi ed	# Com ment s
Editorial	NO	115
General	NO	32
Technical	NO	21/26

TOTAL 173

Peter Werelius and Mario Locarno provided an update on the status of the 5 unresolved comments that remain. The unresolved comments are Technical. The 5 issues are not disagreement, but failure to respond to the resolution group. The expected completion date is March 23.

All graphical Figures that were submitted as screen shots in color except for A3 and A6 have been updated.

Upon receipt of the remaining unresolved comment, the recirculation will begin.

The meeting was adjourned at 2:25 PM.

**10.4.10 - TF on “Distributed Photo Voltaic (DPV) Grid Transformers”, Chairman Hemchandra Shertukde; Vice Chairman: Mathieu Sauzay; Secretary: Sasha Levin**

The Task Force met in the Ryman room of the Renaissance Nashville Hotel. The meeting was called to order at 8:00 am by Chairman Hemchandra Shertukde. The meeting was convened with 12 (out of current 21 TF members - quorum) and 29 guests present, for a total 41.

Old Business - Boston’s meeting minutes were approved.

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New business

1. PAR and WG proposal. - The TF Chair informed on the current status: Task Force issued the Position Paper and, following the poll of the group, submitted proposal for PAR and WG on “IEEE Guide for Transformers for Application in Distribution Photo Voltaic (DPV) Power Generation Systems”.

The Performance Characteristics Subcommittee Chairman Ed teNyenhuis approved the proposal and it's been submitted to the Admin Subcommittee for NESCOM consideration (June meeting).

- Position paper transformed into IEEE format and will be submitted for publication.

2. Task Force reviewed the Title, Scope and Purpose of the submitted document.

- The words “Smart Grid” has been eliminated from the scope following Admin SC request.

- R. Szevczyk’s proposal to add word “design” to the Scope (“design and application”) has been supported and will be considered for the future revision

- TF discussed the terms “residential, commercial, industrial and utility scale”:

- To define the rated kVA and voltage class of these transformers are more important than above terminology (D. Ayers). H Shertukde commented that there is an indication that 69 kV (and even 115 kV systems) are either under construction or under consideration.

- Residential PV systems might not have any transformers in the system (J. Yu)

- Are there step-down PV transformers? H. Shertukde commented that there might be such cases.

- E. Betancourt mentioned that there are different situations that should be considered, e.g. when regular distribution transformer becomes a part of PV system. Typical system applications should be identified.

- Discussion on the clarification of the scope of the Guide will be continued in a course of the potential Guide development.

3. Discussion on the Contents of the potential IEEE Guide.

Acting on the assumption that PAR will be approved and WG on “IEEE Guide for Transformers for Application in Distribution Photo Voltaic (DPV) Power Generation Systems” will be created, TF started discussion on the Contents of the potential Guide.

- Six Chapters were proposed as an initial skeleton of the Guide:

- 1) Transformer General Requirements.
- 2) Specifics of DPV generation systems in relation to the transformers.
- 3) Transformer construction.
- 4) Transformer Test.
- 5) Transformer diagnostics and maintenance.
- 6) Transformer specification.

B. Bartley noticed that the potential WG shall follow the scope and should not encroach on the system aspects or any other issues under other PES Committees’ jurisdiction.

The following six TFs were formed to work on the Contents of the proposed Chapters of the Guide:

Chapter 1)

- R. Martinez – leader
- R. Wicks
- E. Betancourt

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- J. Gamboa
- V. Tendulkar

Chapter 2)

- J. Yu – leader
- J. Roach
- H. Shertukde
- V. Tendulkar

Chapter 3)

- S. Kennedy – leader
- A. Mukerji
- S. Sarkar
- K. Vedante
- J. Gamboa
- D. Ayers

Chapter 4)

- D. Ayers - leader
- S. Kennedy
- A. Mukerji
- S. Sarkar
- K. Vedante
- K. Stretch

Chapter 5)

- J. Roach - leader
- N. Field
- K. Stretch

Chapter 6)

- M. Sauzay - leader
- J. Nazarko
- J. Yu
- A. Levin

TFs will start an active work after PAR approval.

TF discussed the means of recruiting experts in power electronics and PV generation systems, as well as end users. B. Bartley informed that he is coordinating the standard association activities in IEEE PES and can help in reaching “across the isle” in IEEE PES.

J. Nazarko noticed that there are challenges in obtaining the appropriate information because of the proprietary character.

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

#### **10.4.11 Special Report**



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The C57.142 Switching Transients Induced by Transformer Breaker Interaction was recently published. The Chair thanked Rob Degeneff for his work in bringing this guide to completion.

**10.4.12 Old (unfinished) Business – Proposal for new TF to extend C57.142 to higher voltage classes**

Phil Hopkinson presented a motion to establishment a task force to investigate the interaction between transformers and breakers at higher voltage classes than is covered in the current version of C57.142. The major study in C57.142 has been on Vacuum Breakers and predominantly medium voltage transformers. The work has been excellent and provides a good general guide. As voltage classes increase, the switching device shifts from vacuum to SF6 and the power system uses open lines instead of shielded cables. Often times, bushings for higher voltage class transformers become vulnerable and transformer considerations are shifted to conditions where abrupt line swings are at play. Phil requested to see the scope of investigation to cover HV and EHV applications. The SC discussed this proposal and it was agreed that this was worthwhile to investigate and that a TF should be established. The Chair will request a time slot for the next meeting and prepare objectives for the TF.

**10.4.13 New Business**

There was no new business.

The meeting was adjourned at 4.18pm.