

Annex J Performance Characteristics Subcommittee

April 5, 2017
New Orleans, LA

Chair: Ed teNyenhuis
Vice Chair: Craig Stiegemeier
Secretary: Sanjib Som

J.1 Introduction / Attendance

The Performance Characteristics Subcommittee (PCS) met on Wednesday, April 5th, 2017 at 3pm with 176 people attending. Of these, 69 were members and 107 were guests. Prior to this meeting, the total membership of the PCS was 90 members; therefore, quorum was achieved with 76% of the membership in attendance.

There were 21 guests requesting membership (their meeting attendance will be reviewed and those that are acceptable will be added to the PCS membership prior to the Fall 2017 meeting). The Vice-Chair distributed rosters for the seating arrangement in the room.

J.2 Chairman's Remarks

The Chair provided the following updates and comments.

Status of PAR'ss

- C57.120 – Loss Evaluation Guide - DONE
- 2018 PAR's
 - P60076-16 IEEE/IEC Wind Turbine Transformers
 - C57.158 Tertiary/Stabilization Windings
 - C57.110 Non-sinusoidal Load Currents
 - C57.21 Shunt Reactors
- 2019 PAR's
 - C57.105 3-ph Transf. Connections
 - C57.109 Through-Fault-Current Duration
- 2020 PAR's
 - C57.164 Short Circuit Withstand Guide
 - C57.18.10 Semiconductor Rectifier Transformers
- 2021 PAR's
 - C57.142 Transient Guide
 - C57.32A Neutral Grounding Devices amendment

Status of Standards

- C57.133 Guide for Short Circuit Testing (Expired)
- C57.136 Sound Abatement Guide (2018 – will let expire)
- C57.123 Loss Measurement Guide (2020)
- C57.149 SFRA Guide (2022)
- C57.32 Neutral Grounding Devices (2025)
- C57.159 DPV Transformers (2026)

Attendance and Quorum

- The chair requested attendees to record their attendance on one of the rosters being circulated – only the attendee’s name was required if it is not on the roster
- PCS now has 90 members after a review of the Spring 2016 meeting attendance and after review of previous meetings
- 10 “Corresponding Members” are counted as “Guests” in terms of attendance for a quorum
- Requests for membership will be granted if an attendee made the past 3 of the last 5 meetings
- Today’s meeting quorum will be reached if 45 members are in attendance

The following 3 Members missed 3 or more of the last 5 meetings and have been moved to “Guest” status:

- Emil Bercea
- David Buckmaster
- Kirk Robbins
- Alan Traut
- Jane Ann Verner
- Jim Zhang

The following 10 Corresponding Members are being counted as guest status to support reaching the meeting quorum. They continue to receive communications and their guidance for the working group is most welcome:

- Donald Chu
- Larry Coffeen
- Jerry Corkran
- Alan Darwin
- Richard Dudley
- John Lackey
- Tamyres Machado Junior
- Dennis Marlow
- Paulette Powell
- Loren Wagenaar

The following 11 Guests had requested membership at the Fall 2016 meeting, attended the past 2 meetings and have been added as Members for the this meeting:

- Myron Bell
- Scott Dennis

- Jose Gamboa
- Neil Kranich
- Weijun Li
- Gregorio Lobo
- Rhea Montpool
- Mike Spurlock
- Kevin Sullivan
- Susmitha Tarlapally
- Krishnamurthy Vijayan

The Chair stressed that all attendees must be sure that their e-mail address is up to date in the AMS system – many undeliverable notices were received during WG communication attempts. Next the Chair made attendance roll call and requested attendees raise their hand if they see their name on the screen.

J.3 Approval of Agenda

The Chair presented the agenda. A motion to accept as proposed was given by Dan Sauer and seconded by Marcos Ferreira. The chair requested comments or objections - there were none. The agenda had been earlier sent to the members by email several weeks prior to the meeting

J.4 Approval of Last Meeting Minutes

The chairman presented the minutes of the last meeting held in Vancouver, BC, Canada in Oct, 2016. A motion to accept as proposed was given by Hugo Flores and seconded by Dan Sauer. The acceptance of the minutes was passed by unanimous vote.

J.5 Minutes from Working Groups and Task Force

The following WG and Task Force reports were received (the reports are appended later).

- | | |
|--|---------------|
| • WG Short Circuit Design Criteria C57.164 | S. Patel |
| • WG on Tertiary/Stabilization Windings PC57.158 | E. Betancourt |
| • TF on PCS Revisions to Test Code C57.12.90 | H. Sahin |
| • WG on C57.109 - Through-Fault-Current Duration | V. Mehrotra |
| • TF on Audible Sound Revision to Clause 13 of C57.12.90 | R. Girgis |
| • WG on Non-sinusoidal Load Currents C57.110 | R. Marek |
| • TF on PCS Revisions to C57.12.00 | T. Ansari |
| • WG Shunt Reactors C57.21 | S. Som |
| • IEEE/IEC WG Wind Turbine Generator Transformers, P60076-16 | P. Hopkinson |
| • TF on Neutral Grounding Devices PC57.32 amendment | S. Kennedy |
| • WG on C57.18.10 Semiconductor Rectifier Transformers | S. Kennedy |
| • WG on Loss Evaluation Guide C57.120 | R. Marek |
| • WG 3-ph Transf. Connections C57.105 | R. Verdolin |
| • WG on HV & EHV Transients C57.142 | J. McBride |

J.6 Unfinished (Old) Business

None

J.7 New Business and Motions

Vinay Mehrotra made a motion to on draft D1.1 of PC57.109 to take to ballot, this was seconded by Kiran Vedante. The motion was approved with overwhelming majority.

A motion was made by Marcos Ferreira to set up a new Task Force to investigate the need for a guide for various field tests for LTC's. This was seconded by Rogerio Verdolin. The task force would consider the following:

- Evaluate various field tests for LTC's
- Propose method of performing the tests
- Propose interpretation of test results
- Deliverable to PCS – Recommend if a guide is needed, recommend scope of the guide

The following discussion took place. Bertrand Poulin suggested to use the existing field guide and update it. Craig Steigemier agreed with Bertrand Poulin. Tauhid Ansari asked whether it should be included in tap-changer testing - Marcos Ferreira clarified that this will not be part of factory testing. Dan Sauer opined that this should be under standards committee. Jim Graham clarified that terminology "OLTC or "LTC" has not been finalized.

The motion carried without any opposition, two abstentions and all others approving.

Peter Zhao sought help from PCS on bushing thermal overloading. Bertrand Poulin opined that similar issues exists in LTC and such matters should be completed at design stage. Some members responded to Peter and the matter would be finalized amongst them after the meeting.

Jim McBride apprised all that a modeling conference was held in Spain where two models and measurements were compared. It was identified that models should include damping. He provided the following summary of Work from CIGRE A2-C4.52 HF Modeling Group. The CIGRE group on High Frequency (HF) Transformer Modeling met in Madrid, Spain in March 2017. The meeting was hosted by Xose Lopez-Fernandez. The group has performed measurements and HF modeling on both a single phase and a three phase transformer. The comparison between the measured data and the modeled data was presented at this meeting. A few observations from the results presented at the meeting are listed below:

- 1) It is important to include damping information in the model to get good agreement between the measured and modeled results. There may need to be more work to better learn the methods to predict the damping factors.
- 2) Most manufacturers model the transformer to determine that all stress in the transformer is below the level of the insulation system. Matching the exact time domain shape produced by the model is not as critical for manufacturers as the agreement between the stress envelope predicted by the model and the measured stress. There can be significant differences between different modeling software in the time domain. This is often due to small differences in the frequency estimates that present as larger time domain shape differences as the frequency differences accumulate with time. The models are considered good if the envelope of the time domain shapes are similar between the measured and various modeled results.
- 3) Significant amount of work to verify the HF models for White Box, Grey Box, and Black Box models

Adjournment was proposed by Marcos Ferreira and seconded by Dan Sauer.

Meeting was adjourned at 4.15 pm.

J.8 Minutes of Meetings of Working Group (WG) and Task Force (TF) Reports (all unapproved)

J.8.1 WG C57.164 Short Circuit Withstand - S. Patel

Minutes

**Working Group C57.164 Short Circuit Withstand
New Orleans, LA – Apr 4, 2017**

Ed teNyenhuis, April 4, 2017, Rev 0

- The Working Group met at 4.45 PM in the Grand Ballroom C on April 4, 2017
- The Vice Chair and Secretary were not able to be present so Ed teNyenhuis acted as secretary.
- The Chairman, Sanjay Patel, led the meeting.
- The previous attendance from the Vancouver meeting was not recorded so a record of the membership was not available. Thus the actual membership was not known and quorum was not established for this meeting.
- Per the roster sheets, there were 79 persons present with 37 signed guests and 42 new members (everyone who requested membership was made a member).
- The agenda and previous meeting minutes were shown but could not be approved.
- A request for patent disclosures was done and there were no responses.
- The Chair reviewed most the recent draft of the IEC 60076-5 short circuit guide which is being presently revised. Joe Watson agreed to review the Annex A for integration into the IEEE guide.
- Ed teNyenhuis will confirm that it is allowed that the IEC draft guide can be posted on the WG website for the members to review.
- The Chair reviewed the draft guide D1 which was prepared by the secretary, Rajendra Ahuja. The below was agreed upon for the guide revisions:
 - Section 3 – Definitions – Sanjib Som agreed to work on this section.
 - Section 5 – Guidelines for Design Review – Bob Ganser agreed to work on this section.
 - Section 6 – Forces – Ramsis Girgis agreed to work on this section and also on shell form transformer discussion.
 - Section 7 – Short Circuit Design Criteria – Andy Speigel, Bob Ganser and the Chair agreed to work on this section.
 - Section 8.3 should be renamed “Design Approach”

- It was suggested that a checklist of items to guide the user on what to look for in short circuit evaluation should be added to the guide
- The Chair will check with Kema if the SC presentation given in Vancouver could be put on the website
- The meeting was adjourned at 18.01

J.8.2 PCS Working Group on Guide for Application of Tertiary and Stabilizing Windings PC57.158

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee
April 3, 2017 9:30 AM
The Aster Crowne Plaza Hotel, Grand Ballroom AB
New Orleans, LA, USA
UNAPPROVED MINUTES*

The Chair called the PC57.158 WG to order at 9:30AM on April 3, 2017. A quorum was achieved to conduct regular business with **22** out of **33** WG Members in attendance (note that RFID system had a count of 58 WG Members). **67** Guests were present also, with one attendee requesting membership to the group. As the document is at the balloting stage, no new members were been considered since the last WG meeting.

The Chair proceeded to present the WG Statement of Assignment, proposed meeting agenda, call for essential patents related to this Guide and proceeded with introductions and the distribution of rosters. A motion to approve the WG minutes from the Vancouver meeting was made by Hugo Flores and seconded by Kushal Singh. The motion was unanimously approved.

The Chair reported that the PAR has been extended until December 2018.

The following is the redline review of the Draft 7 revision, based on the ballot comments resolution, to be recirculated in about one month.

- Definition of neutral shift was added to the Guide along with reference per C57.142 and Westinghouse Blue Book
- A definition for a “primary station power transformer” to be applied in this Guide was met with much resistance as several people had issues with the terminology. It was thought it would be confused as a transformer that supplies substation power and several different suggestions were made without success. An alternative name will be determined and distributed to the WG for resolution.
- Will use “transformer bank” instead of “transformation bank”
- Will use “insulating liquid” instead of “oil”
- Will use “OLTC” instead of “LTC”
- Literature references (Blume Chapter 7 among them) will be used as the reference for unbalanced loads of up to 10% in three legged core transformers without stabilizing windings
- Figure showing flux in the tank walls to be added
- Proper reference to “IEEE default short circuit condition” added

- Removed all references to “distribution transformers” since they fall outside of this PAR
- Improved brief description of examples of utility applications of tertiary windings
- Added the definitions for the symbols used in the positive and zero sequence diagrams
- Described how the zero sequence branch handles unbalanced loads
- The T-diagram in relation to short circuit currents now includes all cases
- Corrected the short circuit analysis diagram
- Reference to publication by Ramsis Girgis/Kiran Vedante on GIC and stabilizing windings
- Term “open delta” was changed to “delta with one corner open”
- Added a caution on the loading of an autotransformer common winding during step up transformer operation with a loaded tertiary winding
- Objection to the term “booster transformer” for regulating the terminal voltage on a loaded tertiary winding of a variable flux transformer. Sanjay Patel will provide a definition for a compensating winding for this purpose.
- Corrections required to the current distribution for thermal tests of three winding transformers due to tested versus application impedance differences
- Changed “shall” to “should” to conform to the IEEE requirements for Guide documents.
- Defined “floating neutral” as “not grounded terminal”
- Additional references were added to the list

The thermal loading of stabilizing windings described in C57.12.00 has been checked and verified as correct between the documents

Figure 14 to be corrected or removed, as currently redundant to Figure 3.

A new working draft is going to be distributed to the WG Members for review.

The WG shared the October 2016 Ballot statistics

- Size of ballot group – 134
- Response rate – 87%
- Approved – 91%
- 237 comments

With no New Business, the meeting was adjourned at 10:45 AM.

Respectfully submitted,

Enrique Betancourt

WG Chair

Brian Penny, WG Vice-Chair

And acting Secretary for Marnie Roussel

J.8.3 Working Group for Revision of C57.12.90

Meeting Minutes

Task Force on PCS Revisions to C57.12.90

April 3, 2017, 11:00am-12:15pm

Grand Ballroom C, Astor Crowne Plaza, New Orleans

Hakan Sahin, Chairman; Craig Stiegemeier, Secretary

1. The TF Chair called the meeting to order at 11am.

Reiner Focher MR from Reinhausen did not agree that any other requirements for DGA with arcing compartments would be too complicated. PCS subcommittee minutes were too short. Later Reiner pulled his comment back and agreed to the approval of the fall 2016 meeting minutes.

The chair went through a review of the purpose of the task force

2. Agenda – Steve Snyder motion, Vladimir second motion and the agenda was unanimous approved
3. Approval of the Fall 2016 meeting minutes. Dan Saur motion, Roger Vandolin second – unanimous approval - The Minutes of the fall 2016 Vancouver meeting were all approved unanimously. The task force moved on to old business, which is the LTC performance voltage test and current test to be included in future versions of C57.12.90.
4. Agenda comments

The Chair reviewed the Agenda and asked for corrections or additions to the New Business section to be reviewed later during the meeting and to ensure enough time was allocated for new business. Subash Tuli asked for Clause 9.5 zero sequence measurement. 9.5.3 and 9.5.2 brought out or buried tertiary transformers. He proposed that 9.5.3 should have a disclaimer that the same value is only for two winding wye-wye transformers, not autotransformers. Kuchal Sincan ComEd – no requirement for infrared scanning during temp rise. Ronnie C57.12.90 talks about the ration test. Looking for definition of ratio when a winding is split – is there something to allow for the comparison of the ratio test on a winding when it is split into two parts.

5. Membership and attendance

The current membership of the Task Force is 65 members, which is a correction from the 66 reported during the meeting. After a review of the attendance rosters, there were 43 of the 65 Task Force members present for the meeting. With 66% of the membership in attendance, a quorum was reached. In addition, 85 guests and one of the 4 Corresponding Members were in attendance. Of the 85 guests, 29 were first time attendees. Eleven (11) of those guests requested membership on the Task Force. After a review of past attendance, 6 met the criteria and will be added as Members for the Fall 2017 meeting. Also, 9 of the current Members will be removed due to a lack of ongoing participation, bringing membership of the Task Force to 62. The interest in the work of this Task Force remains high. The participant count is over 500, and many of those have not attended a meeting for quite some time. For the fall meeting roster, 310 people will be removed as those individuals have not made any of the past 5 Task Force meetings. Hakan Sahin thanked Mark Perkins, the former chair, for providing his guidance and moving the activities of this Task Force along.

6. Old Business

A proposal was to be developed and presented to the group at this meeting.

8.7 On-Load Tap Changer End to End Voltage Test

In order to verify the performance of a transformer that has a load tap changer (LTC), the LTC shall be operated through one end to end to end (from one extreme tap to the other extreme tap and back) with the transformer energized at rated voltage. The test may be performed in intervals if needed, but it is a requirement that the transformer be energized at no less than rated voltage for each tap change. The transformer shall be observed during this test and the operator shall identify that the sound during the tap changing operations was either normal or abnormal. Note that with some types of tap changers, there will be an abnormally loud sound if components are not connected properly. The transformer will have passed this test if the tap changer operates normally, with no abnormal sound and with no abnormal combustible gas generated in the insulating liquid of the transformer.

Comments from the attendees:

Bertrand – noted on load tap changer

Reiner – sound when reversing switch operations will be different than operation in other positions. May be a slight amount of sparking due to capacitance of the windgs.

Daivid Walker – MJM Transformers. Suggested that the end to end is redundant.

Tauhid – how do we define normal and abnormal sound. How do we define what is normal? He suggested that we take the sound out. Hakan noted that the TF

Hakem form CG power – should mention criteria that voltage variation will vary dependant on the tap range. Say something about adjusting the voltage when we change taps. Should be allowed to have a voltage

Scott Marshall - Power Engineers - +/- range of the OLTC. He requires a run of 2 cycles of the OLTC, not just one. He also recommended that DGA should be performed both before and after each test.

Dan Sauer – Eaton – Section under current review. The end to end wording has been addressed multiple times. We should leave it as is. In regards to sound, that sound is what occurs most of the time. The passing through neutral will only happen 2-3 times during the course of a run of the full tap range from end to end. Leave the sound as presented should make it clear enough.

Chase Miller – PPL – Reference sound during applied test.

Don Ayers – consultant – DGA before and after is oil for vacuum OLTC. But for arcing oil OLTC

Gargis SPX – when to take DGAs is not well defined in C57.12.90. No need to take oil sample from the main transformer. Taking a sample when oil flow is low may not allow adequate mixing of the oil. He wants to leave DGA out of this section.

Reiner – DGA issue. Was included in the very first proposal. Gas was generated by the reversing switch. Wants to cover all types of tap changers. If there are issues with the tap selector or reversing switch this will show up in transformer oil for in-tank OLTC's. Joe, Tauhid and Reiner made a proposal that only works for the vacuum type OLTCs.

Comment from Joe Foldi - It would be good to add that the dissolved gasses should be checked for vacuum type LTC's in the main tank and in the LTC compartment. For other types in the main tank only.

Don Ayers – OLTCs with different ratios will have different sound

Tauhid – DGA of a vacuum type reactance tap changer. Good idea to do the test. This will confirm the PA lead connection. He's not worried about transformer experts. The definition of normal and abnormal. For safety reasons, most companies do not allow someone near the transformer during testing.

Dave Geibel – normal vs abnormal. Different turns give different sound. Sound should be defined by the manufacturer and the customer. Oil testing for gas, any OLTC should be testing the transformer oil for any OILTC that has contacts in the transformer oil.

The Chair presented the following as a suggestion for the section

9.6, Load Tap Changer End to End Current Test:

In order to verify the performance of a transformer that has a load tap changer (LTC), the LTC shall be operated through one end to end (from one extreme tap to the other extreme tap) with the transformer current at the top nameplate MVA rating. The test may be performed in intervals if needed, but it is a requirement that the transformer current be no less than 80% of the top MVA nameplate current for each tap change. The transformer shall be observed during this test and the operator shall identify that the sound during the tap changing operations was either normal or abnormal. Note that with some types of tap changers, there will be an abnormally loud sound if components are not connected properly. The transformer will have passed this test if the tap changer operates normally, with no abnormal sound and with no abnormal combustible gas generated in the insulating liquid of the transformer.

Comments from the attendees:

Reiner suggested that a DGA be done on the Reiner and Tauhid

Scott Marshall - Recommended that 2 cycles be used. Allow 80% if there are equipment limitations. DGAs on the main tank can identify overheating of the oil.

Jeff Power Diagnostics – Comment that 80% may be a limit for inverter based sources. Maybe for on-site testing for inverter based systems may require a lower level of testing.

Doug – Normal and abnormal doesn't feel right, as it has something to do with feeling. Maybe some equipment should be used to measure sound so you don't have to rely on experience. A sonogram to compare with earlier experience would help.

Jon Fusha – SPX Waukesha – 80% is necessary. Abnormal is subjective and could lead to problems in definition of normal.

Mark Perkins – ABB – Asha said it right. If polarity on the PA is wrong, the sound will be extremely different.

The Chair noted that the purpose of the test was to

Ramsis Girgis – ABB – 2 parts. 1 is a mechanical issue or a problem with connections. The 2nd is bridging position versus non-bridging position. If the PA is not manufactured well, the bridging position is much louder, with different frequencies being generated at bridging positions.

Gorgiz – something transformer – If the purpose of the paragraph is to show the customer we can withstand full voltage or full current, the working needs to be changed. There may be other ways to determine that the OLTC is performing as expected. As an engineer, he would change it to be more subjective. He is for doing the test, just objects to the subjectivity of the sound level.

Chase Miller – PPL – If the goal is to have the testing crew to determine normal and abnormal. Cut the rest of the section in 9.6 after normal and abnormal.

Chair summarize discussions – We need to come up with a better wording to try to define what is abnormal. DGA should be kept into the text, but better worded. He suggested we send out a survey and gather comments.

7. New Business

Subash Tuli asked for Clause 9.5 zero sequence measurement. 9.5.3 and 9.5.2 brought out or buried tertiary transformers. He proposed that 9.5.3 should have a disclaimer that the same value is only for two winding wye-wye transformers, not autotransformers.

Bertrand Poulin – the test is non-linear. You only need 3 of 4 tests to work out the equivalent circuit. ABD and ABC would result in the same result. Working out the circuit gives redundant results. If B and D are not done at the same percentage would give a different result. This should be further analyzed, as he got identical results for autos as long as test is at the same level

Subhash says he is correct, more investigation should take place as his knowledge is based on hundreds of transformers. He suggests that a minor change should be made in relation to autotransformers. Manufacturers and labs should go back and investigate results.

Ajit from SPX – Z1, Z2 and Z3 is what the power systems needs. More discussions are needed. Bertrand – since these tests are done at very reduced current, the value measured is only an approximation since these are non-linear. Test #2 and test #4 the differences are different. If it's fully linear, these tests are redundant.

Chair requested that this may need to be developed as a new business. Only 4 thought that this should be looked at as a new issue. Bertrand suggested that manufacturers offer data to prove the issue 9.5.3.

Kushal Singh ComEd – no requirement for infrared scanning during temp rise. This needs to go to insulation life.

Ronnie C57.12.90 talks about the ration test. Looking for definition of ratio when a winding is split – is there something to allow for the comparison of the ratio test on a winding when it is split into two parts.

Bertrand said that the real issue is whether both halves of a center connected winding is identical. There is no way to test the halves separately once the manufacturer connects the windings together. This can't be part of a final test.

Baitan Yang – PA Transformer – they do the test before assembly. You will not see the difference. Core loss will be higher when there is a problem. Other tests will highlight the problem. Bertrand noted that a winding with 1000 turns will have very little difference if only a turn off.

Sakar - GA Transformer – every manufacturer verifies turns.

The Chair requested that the group decide that something needs to be added to standards for determination and the group agreed that this is more quality control and don't need to be in the standards.

8. Meeting adjournment

Dan Sauer – Marchel seconded to adjourn at 12:13pm.

J.8.4 Working Group for Revision of C57.109 - IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration

New Orleans, LA, April, 3 2017

Minutes of the Working Group Meeting

The meeting was held on Monday April 3, at 1.45 pm and five of the eight members were present and therefore there was a quorum. There were a total of 43 people present which consisted of 5 members and 38 guests. Six guests requested membership.

The meeting began with a patent call and there were none brought forward. After quorum was determined the Working Group unanimously approved the agenda for the current meeting as well as the meeting minutes from the Spring-Atlanta 2016 and Fall-Vancouver 2016 working group meetings.

The working group chair then displayed the current draft (draft D1.1) to the working group and highlighted the key areas that have changed from the original document. There was no discussion on the changes. Weijun Lei made a motion to take draft D1.1 to ballot and thereby requesting approval from the

subcommittee. Kiran Vedante seconded the motion and the WG unanimously approved the motion. It was agreed that the next step would be for the chair to request that the subcommittee go to ballot with draft D1.1.

A motion was raised by Weijun Lei to adjourn. Kiran Vedante seconded the motion. The working group unanimously approved the adjournment. The meeting adjourned at 2:20pm.

Respectfully submitted
Vinay Mehrotra
WG Chair

J.8.5 Unofficial Minutes of Spring 2017 Meeting of TF “Audible Sound Revision to Test Code C57.12.90”, in New Orleans, Louisiana

The TF met at 1:45 PM, on Monday, April 3, 2017. Chairman Dr. Ramsis Girgis presided over the meeting. Secretary Barry Beaster assisted with the administrative duties.

After the Fall 2016 meeting, the membership had been adjusted to 49 members. For meeting preparation, a meeting agenda along with the unapproved Fall 2016 minutes were circulated to all members and guests of the last meeting. Additionally, proposed wording of text to be added to Table 17 of C57.12.00 explaining the purpose of the reference noise levels included in Annex – C was circulated to the membership asking for review of the proposed wording.

The meeting was attended by 31 of the 49 members and 63 guests for a total of 94 persons. A quorum was established at the start of the meeting by a hand count. This was later confirmed by the RFID tag in system. The unapproved agenda was presented and unanimously approved without change. The Fall 2016 meeting minutes had no requested changes or corrections and were also unanimously approved. There were seven requests for TF membership; which will be reviewed based on previous meeting attendance.

After the introductions, Chairman Dr. Ramsis Girgis presided over the technical portion of the meeting.

The first technical Agenda item presented was the previously agreed upon incorporation of the no load noise levels NEMA TR1 Tables 1 & 2 into Annex C of C57.12.00. Accordingly, reference to Annex – C will be introduced to the statement in Table 17 referring to these tables. The statement will read:

Transformers shall meet standard audible No Load sound level as listed in NEMA TR1-2013, Table 1 for power transformers and Table 2 for distribution transformers given in Annex C, or as specified by the purchaser.

In discussing this item, the chairman presented previously collected measured noise level data demonstrating that NEMA Sound pressure levels still represent no load sound levels of transformers where no design or external means of no load noise reduction are used. For example designs with cores made of regular grain oriented steel, high core flux density, high speed fans, and no external means of noise reduction.

Next item discussed was replacing the formulas presently included in Annex – C, for calculating reference load noise Sound Power levels, with tables of corresponding Sound Pressure levels. This is since the NEMA levels of no load noise are Sound pressure levels. Also, IEEE Standards deal with Sound Pressure levels not Sound Power Levels. Accordingly, the reference to Annex – C in the statement in Table 17 referring to these load noise tables will be slightly modified to read as follows:

Upon Purchaser's request, the transformer may be tested for its audible load sound level in order to determine the total sound level of the transformer under pre-specified load (s). For reference load sound pressure levels, refer to Annex C.

In response to a question on whether the proposed load noise levels apply to single phase transformers as well, the chairman answered that the difference between Load Sound levels of single phase and three phase transformers is small and is much smaller than differences in noise levels of transformers of the same MVA rating.

In response to a question on total noise level of banks of three single phase transformers, the chairman answered that noise levels given in Annex – C apply to individual transformers and relate to testing individual transformers in the factory.

Enrique Betancourt asked about small transformers as to whether there is need to use a different set of Reference load noise levels. The chairman responded that the Reiplinger's curve still runs in about the middle of the measured load noise level data for low MVA transformers. Also, load noise is not much a factor for small power transformers.

The next item of business was the review of the proposed wording of note to be added to Table 17 in C57.12.00 referencing noise levels incorporated in Annex – C. This wording was circulated prior to the meeting and several members responded with comments. This wording was reviewed and modified by the Chairman for the Task Force meeting. The proposal was reviewed and discussion was held. No disagreements were raised. Below is the modified text of that note:

Sound levels given in Annex – C for No Load and Load Sound Pressure levels correspond to Sound levels of transformers where no special design, or external, means of noise reduction, are used. The objective of these levels is to be used as a measuring stick for how much lower a guaranteed sound level of a transformer is from these levels. Specifying the sound level of a transformer should be based on the required sound level at the boundary.

The next item presented was data on effect of the position of the Tap Changer on the load noise level. Measured data on seven transformers of different designs, varying from 70 to 180 MVA was shown. In each case, the tap with all turns in consistently resulted in the highest sound level. Some variability exists when comparing all turns out with the neutral position. Sanjay Patel offered to collect corresponding data on his company's transformers and present it in the next TF meeting.

Another area of interest presented is the change of core and load noise with temperature. Core noise levels measured during an over- excitation test over a period of eight hours show. There was little change seen with this data. The chairman indicated that this is basically true for all good quality core steels with coating that applies sufficient surface tension on the steel. He also indicated that he has had experience with core steel with poor quality coating where core losses increased up to 15 % and core noise by several dB (s) after about a 4 – hour period of over-excitation.

A similar data set was shown for Load noise versus temperature of 7 different medium and large power transformers of different designs. This data showed that in 5 of the 7 transformers, the load noise level at the end of the heat run decreased by a fraction of a dB to about 1.5 dB compared to the levels measured at cold conditions before the start of the temperature test. In 2 cases, load noise levels increased about 2 dB. The chairman commented that, in these two cases, winding noise was not the main contributor to the total load noise of the transformer. A representative of a manufacturer commented that, in one case, load sound level increased by 3 dB after 3 hours into the heat run test but then stabilized around 1 dB increase after completion of the test.

Another area presented was the contribution of measuring the sound level above the transformer cover. Data was presented for examples of regular and low sound designs for core and load noise. The conclusion from this data is that measuring sound levels over the tank cover and including these

measurements in determining the average sound level of the transformer makes a difference of a fraction of a dB compared to determining the sound level of the transformer using measurements around the transformer only (per present IEEE Standards). Also, the IEEE formula for determining the sound power level of a transformer results in an average of 1 dB higher than calculated by adding the Sound power measured around the transformer and that measured above the cover.

Finally, the chairman showed a plot depicting how the cost of transformers is impacted by the choice of a core sound level. The impact is a bounded area that indicates the impact at several percent in cost can occur; especially for lower sound level transformers. The selection of guaranteed levels should be a result of study and not arbitrary as this may not be necessary. For load noise, the cost impact is low for a sound level reduction of up to about 3 dB but can be much higher when selecting a much lower load sound level.

The Chairman made another request for all manufacturers to continue to present no load and load sound data. This is important as work will continue.

As time, has expired, the meeting was concluded.

The meeting was concluded at 3:00 PM.

Respectively submitted,

Barry Beaster, TF Secretary

J.8.6 - WG for Revision of C57.110

**Unapproved Meeting Minutes
IEEE/PES Transformers Committee
WG for Revision of C57.110
Astor Crown Plaza Hotel, New Orleans, La, USA**

Chair: Rick Marek

Secretary: Sam Sharpless

No meeting was held this time. The document has been approved by the WG and PCSC for ballot. Editing of substantial annex additions has delayed completion. The draft is expected to go to ballot before the next meeting.

J.8.7 PCS Task Force on General Requirements C57.12.00

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee*

*April 3, 2017 4:45 PM
Astor Crown Plaza Hotel
New Orleans, Louisiana USA*

UNAPPROVED MINUTES

The PCS Task Force on General Requirements for C57.12.00 met on Monday, April 3, 2016. The Chair Tauhid Ansari called the Group to order at 16:45 and explained purpose and scope of the TF. **53** Members and **82** guests were present, and as Working Group membership stands at **81** members, we did have a quorum and were able to conduct official business. The following **15** guests requested membership:

Alwyn VanderWalt	Public Service Co. of New Mexico
Don Dorris	Nashville Electric Service
Fernando Leal	Prolec GE
Gregorio Lobo	Mitsubishi Electric Power Products
Hamid Abdelkamel	Ameren
Igor Simonov	Toronto Hydro
Joshi Akash	Black & Veatch
Kris Zibert	Allgeier, Martin and Associates
Liz Sullivan	ABB Inc.
Marcos Ferreira	Advisian-Worley Parsons
Rhea Montpool	Schneider Electric
Shamaun Hakim	CG Power Systems USA
Stephen Schroeder	ABB Inc.
Will Elliot	General Electric
William Boetger	Boetger Transformer Consulting LLC

The Agenda and the minutes from the Vancouver meeting were approved (Sangib Som/John Herron), with no comments or amendments.

Agenda Items were covered as follows.

1. OLD BUSINESS

A. WG Item TF Item 106, 7.1.5.3 System characteristics, Table 14 Fault level of 46KV class is too high – Proposed by Shamun Hakim

The chairman explained that this request was not a question anymore, by explicit confirmation from Shamaun. There were no further comments from meeting attendees.

B. Inclusion of Sound Level values on transformer's nameplate

This item was brought up by Ramsis Girgis as a request received from transformers users during past activity of the Noise Level Task Force.

Ramsis explained how customers need to know transformer's sound levels to make decisions about suitable replacements for sensitive locations. Having that information only in test reports might not be useful enough a few years after installation. The chair opened the floor for discussion among members and guests.

Following arguments were brought up:

- The sound level stated on nameplate has to be the measured one in that unit, to fit customer's purpose (R.Girgis).
- Not all customers require measurement of transformer's sound level.
- Only first unit of a design should be tested.
- It could be better to state the guaranteed value, instead of the measured one.
- Utility OG&E requires by specification sound level measurement, and addition to nameplate for its transformers (R.Musgroove).

- It was proposed (Kushal S.) to define two levels of sound: “Low Sound” and “Standard”. No need of levels for Standard. For Low Sound, it has to be stated with level at nameplate.
- Another utility specifies sound level measurement and on nameplate, in case they have to move them (M. Weisensee).
- Total sound should not be specified to be on nameplate, as it would not have duplicates (S. Patel).
- Regarding extension of measured sound level to duplicates, Ramsis explained that there is a high variability on core noise levels (up to 8 dB, for same design), while by load noise it is significantly less. It’s not useful to put total noise, as not fully loaded. Today customer ask for sound level to be recorded. What does the C57.12.00 should state?
- Other participants objected that if it is in the standard, then every unit has to be tested.
- Specification of sound level should be in Std. C57.12.10 (Ajit Varghesse).
- Ramsis explained that PCS chairman referred the question to TF C57.12.00.
- What to do with old transformer that does not have sound level mentioned on nameplate (Dave Mark)?
- The TF Chair, Tauhid mentioned that already three more items will be added to nameplates in future revision of the standard.
- Another option proposed was to add a paragraph stating that the customer should request that the sound level be stated on the name plate, and action to take for sister units.
- Which nameplate, A, B or C does the noise level belong to? Would it be med in bridging position? How to know?
- Guaranteed sound level is not necessary maximum in operation (Shamaun H.).
- Noise level is a design test, not routine. We would have to change Table XVII (J.Arteaga).

A Motion was stated by Ramsis Girgis, supported by Subash Tuli:

- To add a paragraph to C57.12.00, that upon customer’s request, the measured sound level on individual units will be added to the nameplate. In the case of a multiple-units design, measured sound level of individual units could be added too.

Before taking a vote, there was still discussion on:

- The word “upon request” is not for a Std. Proposes something more standardized.
- Ramsis countered saying, it is used in many standards.
- Just leave to customer to specify.
- Sound level could be on nameplate drawing, only for special transformers.
- Customers can always ask for what they need on nameplate.
- Important to make customers aware that they should not accept duplicate unit results. This is an acceptance issue, not a test issue.
- Nameplate is for Operations people. Decision to move the transformer is for asset management people, with access to nameplate drawings and test report.
- Is it possible to include note on Table, instead.
- Toronto-Hydro- Request sound level test. Doesn’t want it in standards. It is the frequency (of sound) that can create problems.

By taking a vote, the Motion was rejected with 9 Members in favor, and the rest opposed.

2. NEW BUSINESS

Shamoun Hakim: Impulse level for LV side of class I transformers can unnecessarily overstress transformers. Impulse level should be according to winding rated voltage.

The Chair Tauhid referred the subject to the Dielectric Tests SC.

Sanjay Patel about Clause 7.1.1 on short circuit: Multi-winding transformers should have fault contribution from all un-faulted terminals, if not otherwise specified by customers.

Being at end of official meeting time, the subject was phased for the next TF meeting.

The meeting was adjourned at 6:00 PM (Sangib Som/Craig Stiegemeir).

Respectfully submitted,

Tauhid Ansari
WG Chair

Enrique Betancourt
Secretary

J.8.8 IEEE Standard Requirements, Terminology, and Test Code for

Shunt Reactors Rated Over 500 kVA C57.21
New Orleans, LA
Astor Crowne Plaza Hotel
Tuesday April 4, 2017

The working group met in the Grand Ballroom D of the Astor Crowne Plaza Hotel on Tuesday April 4, 2017, at 9:30 AM.

The meeting was called to order at 9:30 AM by Chairman Sanjib Som.

There were a total of 89 participants: 12 Members and 77 Guests out of which 8 Guests requested membership.

- The meeting was opened with the circulation of attendance rosters and call for potentially essential patents. No patent issues were raised.
- 12 of the current 22 WG Members were present and quorum to carry out business was met.

Meeting notes:

■ **Meeting Agenda**

- Meeting agenda, which was circulated among members and guests on March 7, 2017 by email, was presented to the audience.
- There were no objections or comments and the agenda was approved unanimously.

■ **Minutes from previous meeting**

- The minutes from the F16 meeting in Vancouver, which were circulated on March 7, 2017 by email, were presented to the audience.
- There were no objections or comments and the F16 meeting minutes were approved.

■ **Old Business:**

WG was advised that the PAR will expire in 2018. Work on the comments and draft for the standard revision will have to advance for prompt circulation among the WG members. Goal is to get documentation ready by January 2018 for SA ballot.

1. Comments on Section 12 by Mike Sharp:

- 1.1.** On section 12.2, the use of the word ‘safety’ was questioned as its use is not clear within the context of a standard from the editorial standpoint. Steve Antosz suggested going back to IEEE SA editors for guidance on rules and legal implications. Jim McBride and Erin Spiewak clarified that the standard cannot use the word ‘safety’ if to imply that by following the standard,

equipment and people would be safe. It was suggested that the section could be renamed 'Installation' or 'Precaution'.

- 1.2. Inclusion of a section on nameplate information requirements, missing from existing revision, is needed.
 - 1.3. The marked up section 12 will be circulated among the members for review.
2. Comments on Section 10 by Bertrand Poulin:
 - 2.1. Section 10 has been reviewed with the collaboration of Luc Dorpmanns on variable shunt reactors, Klaus Pointner on air core Dry Type shunt reactor, and the impulse section revised by Pierre Riffon. Marked up draft with the revisions was circulated for comments.
 - 2.2. Pending are annexes B and C related to testing that need to be reviewed. Annex C is in good shape, annex B which deals with switching transients may need work or wait for next revision. Annex B is close to the work being done on the TF PC57.142 on switching transients by J. McBride. Bertrand stated that he will review Annex B.
 - 2.3. The revisions have been circulated for comments.
 3. Comments on Section 10.6 Audible Sound test by Chris Ploetner:
 - 3.1. Several comments were presented in a summary table. Main topics listed below.
 - 3.2. A motion by Bertrand Poulin to specify the sound test at maximum 1.05 of nominal voltage was raised. Seconded by Shamaun Hakim. Accepted.
 - 3.3. A motion was raised by Chris Ploetner seconded by Mike Sharp to set a minimum of 90% of nominal voltage for sound test as acceptable if 105% cannot be achieved. Levels lower than 90% cannot be used as basis for extrapolation to 105%. Accepted.
 - 3.4. Other topics still under discussion for cold-warm sound test and sound pressure vs. sound intensity.
 - 3.5. It was clarified that references on sound levels from a CIGRE publication cannot be used in the standard unless permission granted due to copyright issues. Coordination with IEEE-SA needed.
 - 3.6. Compilation of comments has been circulated among the membership for further comments.
 4. Presentation by Hem Shertukde on gapped-core shunt reactors.
 - 4.1. Presentation of material for consideration to make it part of the standard or as an annex. Presentation has been circulated among the members.
 5. Question from Joe Melanson of test requirements (for Bertrand Poulin):
 - 5.1. Should front of wave test be included? Should test voltages in C57.12.00 annex on front of wave test levels.
 - 5.2. Bertrand to investigate and provide recommendation.
 - 5.3. Luc Dorpmanns pointed out that the annex in C57.12.00 is informative. Users may be referred to standard C57.12.90 test code for liquid immersed transformers to specify front of wave test for liquid immersed shunt reactors.
 6. Art Del Rio to coordinate with Jim McBride (support from Bertrand) on the review of the Annex B on dielectric stresses on shunt reactors during switching.

No new businesses were presented.

Meeting was adjourned at 10:45 am.

Next meeting: Fall 2017, Louisville, KY, October 29-November 2, 2017.

Respectfully submitted,
Chairman: Sanjib Som (sanjib.som@siemens.com)
Secretary: Arturo Del Rio (a.delrio@ieee.org)

J.8.9 - WG P60076-16 Standard Requirements for Wind Turbine Generator Transformers

Chairman: Phil Hopkinson; Secretary: Donald Ayers

The Working Group on Wind Turbine Generator Transformers was called to order at 9:30 a.m. EST on Tuesday, April 4, 2017 at the Astor Crowne Plaza Hotel in New Orleans, Louisiana. There were 118 attendees, 34 members were present of a membership of 55 and 84.

The minutes from the Fall 2016 meeting were approved.

Don Ayers presented the results of the Rev 3 ballot as follows:

- 151 eligible people in this ballot group.
- 119 affirmative votes
- 6 total negative votes without comments
- 0 negative votes with new comments
- 0 negative votes without comments
- 8 abstention votes: (Lack of expertise: 3, Lack of time: 1, Other: 4)
- 133 votes received = 88% returned
 - 6% abstention

This ballot has met the 75% returned ballot requirement.

- Approval Rate - The 75% affirmation requirement is being met.
- 115 affirmative votes (4 comments submitted)
- 4 affirmative votes with comments
- 6 negative votes without comments
- 125 votes = 95% affirmative

As far as the IEEE is concerned, the standard can be submitted to RevCom.

Erin Spiewak, IEEE reported that IEC's CDV on Rev 3 is due to close on April 21, 2017 and a copy of the comments on the FDIS have been requested. The possibility of needing another recirculation may be required based on the comments from IEC.

With no new business, the meeting was adjourned at 10:25 a.m.

The working group was not disbanded waiting for the results of the IEC ballot.

Subhas Tulle motioned and Aniruddha Narawane seconded the adjournment of the meeting. The meeting was adjourned at 9:45 a.m.

Respectfully submitted,

Donald E. Ayers
Secretary

J8.8.10 - Working Group on Revision of C57.32

Name	Company	Designation	E-Mail	Phone	Present
Sergio Panetta	I-Gard Corp.	Chair	spanetta@ieee.org		✓
Yann Ellassad	MS Resistances	Vice-Chair	yann.ellassad@msresistances.com		✓
Tom Yingling	Hubbell Inc.	Secretary	tyingling@hubbell.com	859-292-4341	✓
Sinan Balban	Oz Direnc Ltd.		sinan@ozdirenc.com		✓
Bernard Audouard	MS Resistances		bernard.audouard@msresistances.com		✓
Ed teNyenhuis	ABB		edt@ieee.org		✓
Sheldon Kennedy	Niagara Transformer		skennedy@niagaratransformer.com		✓
Les Recksiedler	Manitoba Hydro		lrecksiedler@hvdc.ca		✓

IEEE/PES Transformer Committee
Spring 2017 Meeting
April 2-6, 2017
New Orleans, LA
Meeting Room: Bourbon Room
Date: April 4, 2017
Time: 9:30-12:40

1. Call to Order
2. Welcome (Sergio Panetta)
3. Self-introduction of those present (all)
4. Record of attendance. This is our first meeting. Future quorums will be based on membership per P&P requirements. All participants that requested membership status became members since this was the first meeting.
5. Issue 1: Coefficient of Resistivity language. Language will be submitted by members and circulated to all members for comment and review.
6. Issue 2: 1.1.1.1 Ten Second, One Minute and 1.1.1.2 Ten Minute Ratings paragraphs are accepted as currently written.
7. Sergio will look into broadening the scope of this task force to add nameplate requirements to the standard. Possibly by adding an Annex.
8. 1.9.2 Change Rated current to rated voltage and considered additional language to require initial current during temperature rise test to equal or exceed the rated current. Rated current is equal to rated thermal current Per Standard 100 Definitions.
9. Consider language requiring testing environment to be reflective of the installation.
10. Add 316 stainless steel to Table 5. Change SR-18 and 1JR in table 5 to ASM type III and IV.
11. Issue 3: Paragraph 7.6, Table 24 Move Lightning Impulse Test mark in "Routine" column to "Other" column.
12. Motion to adjourn by Tom Yingling, seconded by Bernard.
13. Next Meeting - 2017 Fall meeting in Louisville, KY.

J.8.11 Working Group on Semiconductor Power Transformers – C57.18.10

Unapproved Meeting Minutes

**Astor Crowne Plaza Hotel, New Orleans, LA
Grand Ballroom D
11:00 am, April 4, 2017**

The Working Group met in the Grand Ballroom D meeting room

There were 41 people present. 11 members and 30 guests present. A quorum was present.

The patent call was given. Nobody replied with any patent issues.

The agenda was approved unanimously.

The minutes of the October, 2016 meeting in Vancouver were unanimously approved as written.

Old Business

- Bill Whitehead updated the draft standard with new scope from PAR. Need to double check that PAR and Standard scopes are in exact agreement,
- Sheldon quickly reviewed the items discussed at the previous meeting.
- Sheldon reviewed the changes to the Draft Standard and urged the audience to review the changes and comment on the changes. Sheldon will send out the login and password for the Transformers Committee web site along with the minutes since most people couldn't read the Draft.
- Sheldon asked for a volunteer to add wording on interphase applications. Nobody volunteered and it was not clear who originally proposed this issue. Tabled for now.
- Interaction between transformers and breakers- The discussion was if the Standard should just note the issue or if it should add more information? No discussion on issue. Casey Ballard volunteered to write some wording about the issue for the draft.
- Non-classical harmonics and VSDs. David Walker volunteered to write something about non-traditional harmonics for inclusion in the Standard.
- Eddy Currents and Stray Losses- The current Standard uses fixed percentages in various windings. IEC does not have fixed percentages. Most manufacturers present in the meeting said that they used FEA for harmonic loss analysis. Subhas Sarkar– some customers don't understand the percentages and can misinterpret them so they should be removed. Sheldon Kennedy- Historically fixed percentages were conservative and tended to result in conservative (expensive) designs. Rick Marek- C57.110 has reduced some percentages and added some actual test data for reference. C57.110 is primarily for users who don't have design or FEA information and not for designers. Sheldon- C57.18.10 is for designers and FEA is recommended. Vijay Tendulkar- Recommended that we retain the existing information in the standard. Not everyone has FEA and it also gives customers a means of calculation. Chuck Johnson- There is free FEA software available. Numbers from 30 years ago aren't relevant. FEA is the only accurate method. C57.18.10 is not a user document and ought to give guidance to designers to make a cost-effective transformer. Harmonic loading and calculations should be a discussion between the designer and customer. Subhas Sarkar- moved that we delete percentage information from the standard. Motion seconded by Chuck Johnson. Dhuru Patel– proposed an amendment to the motion-move percentages to an annex. Vijay Tendulkar seconded

motion. 11 in favor. Motion passed. Will need to change examples or move existing examples to the annex. Subhas to supply text for annex.

- Short Circuits on multipulse windings- No comments.
- High Resistance Grounding- Sheldon to ask Paul Buddingh to write something about it since it was his initial concern.

New Business:

- Call for new business- no responses.

With no further business, the meeting was adjourned at 11:51.

The Working Group will meet again at the Fall 2017 meeting in Louisville, KY

Chairman: Sheldon Kennedy

Vice Chairman: Bill Whitehead

Secretary: David Walker

J.8.12 PC57.105 – IEEE Guide for Application of Transformer Connections in Three-Phase Electrical Systems

Tuesday, April 4th, 2016 - (1:45 PM – 3:00 PM)

Chair: Rogerio Verdolin

Vice-Chair: Benjamin Garcia

1. Attendance:

a. Members:	7
b. Guests:	13
c. Guests requested membership	2
d. Total:	20
e. Quorum:	Yes

2. **Patents:** Call for patents were made by the Chair. No patents were claimed by guests/members.
3. **Meeting Called to Order:** 1:45 pm on Tuesday, April 4th, 2016.
4. **Spring 2017 Agenda Approval:** A motion was made by John John, and seconded by Samuel Sharpless, to approve the Spring 2017 meeting agenda. The agenda was approved unanimously.
5. **Fall 2016 Minutes Approval:** A motion was made by John John, and seconded by Samuel Sharpless, to approve the meeting minutes from the Fall 2016 meeting in Vancouver, BC Canada. By unanimous vote, the minutes were approved.

6. **PAR Status:** PAR expires December 31st, 2019, which represents 3 meetings before we have to conclude the guide. The PAR was approved March 2015. The draft has to go to ballot at the end of 2018. We have to conclude our draft by fall of 2018.
7. **Old Business (Section 4 and 5):** John John and Samuel Sharpless reviewed Sections 4 and 5 and provided their comments at the Fall 2016 Vancouver meeting. Their edits are included in C57.105_D5. No further action was taken at today's meeting on these Sections with the exception to Section 4.6.1.
8. **Old Business (References and Bibliography for the whole Draft):** The Chair said that more references and bibliography, in addition the ones already submitted, are needed. The Chair asked for a volunteer to review the current reference list and to add to it if possible.
- ACTION ITEM: Phil Hopkinson volunteered to review the current reference list and bibliography. He also stated that any document listed in this section has to be a public document and not an internal, proprietary OEM document.

Samuel Sharpless reviewed C57.12.10 to see if we should copy over any of the connection diagrams to C57.105 with respect to terminal designation. Samuel recommended that we don't include these figures for 2 reasons:

- a. Maintaining figures in 2 documents doesn't make sense.
- b. C57.105 is a "guide" not a "standard" and therefore won't be referenced when determining terminal designation.

Rogerio Verdolin will send Samuel the latest published revision of C57.12.70 so that he can complete his review of 4.6.1.

The Chair asked for another volunteer to review 4.6.1 for content and accuracy:

- ACTION ITEM: David Walker volunteered to review Section 4.6 and provide comments.

9. **Old Business (Section 6: Harmonic Currents and Voltages):** Mike Thibault reviewed Section 6 and reported back to the Working Group that he had no comments or changes. The Chair asked for a second volunteer to review Section 6 for content and accuracy.
- a. ACTION ITEM: Phil Hopkinson volunteered to review Section 6 and provide comments.
10. **Old Business (Sections 7, 8, and 10):** Dan Mulkey and Ben Garcia reviewed Sections 7, 8 and 10 and reported back to the Working Group with changes detailed in C57.105_D4. The Chair asked for a third volunteer to review the changes for content and accuracy.
- a. ACTION ITEM: John John volunteered to re-review Sections 7, 8 and 10 and provide comments.
11. **Old Business (Section 4.4 T-T Connections):** Giuseppe Termini submitted a PowerPoint presentation to the Working Group showing T-T connection diagrams that he wants to have added to C57.105_D5:
- a. Giuseppe would like to include the first 2 diagrams of his PowerPoint into the standard; PICO Energy is not the only utility to use this connection.
 - b. Phil Hopkinson thinks that this information belongs in the text of the standard; John John said he thinks that the supporting documentation from the presentation should be included in the Annex.

- c. Giuseppe will draft verbiage that fits into the standard and send it to the team for review.
12. New Business: None.
13. ACTION ITEM: Rogerio/Ben will send out an updated C57.105_D5 including all work done to-date, in a Word format for all working members to review and comment (with Track Changes on). All updates are due to the Working Group Chair by **May 4th, 2017**.
14. Meeting Adjourned at 2:45pm
- a. Motion: Phil Hopkinson
 - b. 2nd: John John.

Respectively submitted,
Rogerio Verdolin, Chair
Benjamin Garcia, Vice-Chair

J.8.13 Working Group for the revision of C57.142

**New Orleans, Louisiana Tuesday,
April 4th, 2017 3:15 PM – 4:30 PM
Grand Ballroom C
Chairman – Jim McBride
Vice Chair – Xose Lopez-Fernandez
Secretary – Tom Melle**

- 1) Welcome and Chair's Remarks
- 2) Circulation of Attendance Sheets - 134 Members and Guests Attended, 32 of 41 Members present (quorum achieved). Membership of prior TF will extended to new WG Membership requested by 27 guests, Current Membership 68 Members
- 3) Approval of Agenda and Minutes from Last TF Meeting
Agenda Approved - First: Rogerio Verdolin / Second: Phil Hopkinson
Minutes Approved - First: Bertrand Poulin / Second: Phil Hopkinson
- 4) Status of TF Paper Submission
IEEE Transactions Paper must be resubmitted to IEEE with additional author information to be added for significant contributors (authors).
- 5) Status of C57.142 PAR Application
PAR approved. Expires December 31, 2021.

This work will be jointly sponsored by the Switchgear Committee

Administrative work and main meetings will take place at Transformers committee meetings, but the Transformers committee WG will receive contributions from Switchgear Committee.

- 6) Presentation was made on the Impact of the Transformer’s Neutral Grounding Method on its Transient Performance under Lightning Impulse by Waldemar Ziomek
Presentation demonstrated significant differences in internal stress between the TV and LV windings based on solid grounded, resistive grounded, and reactively grounded neutral. These interactions were modeled and the models confirmed using a recurrent surge generator (RSG)
Motion was made to include neutral-grounding clauses presented in the revision of C57.142.
Motion by Waldemar Ziomek. Second: Bertrand Poulin
25 voted for motion. 1 vote against. Motion carried.
Jim McBride will request posting of Waldemar’s presentation on the WG website.
- 7) Presentation on Measured 500kV Shunt Reactor Switching Transients – Jim McBride
Transients interactions were presented from energization and de-energization of 500kV reactors using breakers and SF6 interrupters. The de-energization transients with the circuit switcher demonstrated re-ignition transients at the terminals of the reactor.
Phil Hopkinson asked if there were any problems found with transformers or switchgear in study?
Answer: No equipment quality problems were detected. However, problems occurred due to the system interactions between the devices.
Phil mentioned that many times involved parties are not willing to share data from failure events. He asked if this data would be available for the guide? Answer: The Chairman hopes that TF members who have already presented in the task force will allow the data/material to be used in the revision of the standard.
Rogerio Verdolin commented that the opening transient applied to the reactor at different opening points can create very different results. Answer: It was agreed that the opening point can make significant differences in the transients. This is demonstrated in the waveforms presented. These transients can be 1000 times faster than most instrument transformers are capable of measuring.
- 8) Discussion on Team for Mitigation Methods, Factory Testing, and Field Service Conditions.
Examples include: use of coupling capacitor in parallel to ground, increase of BIL, or special factory tests. A separate TF is being formed to study options. Current membership of this group is:
Phil Hopkinson
Mike Spurlock
Hamid Sharifnic
Akash Joshi
Shekhar Vora
Jim McBride
Waldemar Ziomek
Pugal Selvaraj
Dave Caverly
John Hall
Amitabh Sarkar
Cihangir Sen
- 9) New Business - Chair suggested having all WG membership associate with writing or reviewing revisions to the guide in one of the following seven areas. The Chair will seek lead persons in the

writing of the additions in each of these areas.

1. System Faults and Cable Switching that produces traveling waves with reflections that excite lightly loaded transformers to resonance
 2. Generator step-up transformers operating in back feed mode are excited to resonance by system transients
 3. High frequency switching operations close to the transformer terminals excite internal resonance due to multiple re-ignitions and restrikes
 4. Incorporate more mitigation techniques into the document
 5. Include information on stress in the transformer due to the method of neutral grounding.
 6. Include information on reactor switching interactions
 7. Include information on upstream and downstream interactions in low power factor and highly inductive circuits. dividing.
- 10) Next Meeting (Louisville, Kentucky)
Pierre Riffon to give presentation on special termination LI
- 11) Adjournment at 4:30 PM