

Annex J Performance Characteristics Subcommittee

March 28th, 2018; Pittsburgh, Pennsylvania USA

UNAPPROVED MINUTES

Chair: Craig Stiegemeier

Vice Chair: Sanjib Som

Secretary: Rogerio Verdolin

J.1 Introduction / Attendance

There were 75 of the 107 PCS members in attendance so quorum was achieved (70% in attendance). In addition, 85 guests were present at the meeting, of which 26 were first time attendees. The total attendance at the meeting was 160. There were 11 guests who attended previous meetings that requested membership - they will be reviewed and added before the Fall 2018 meeting in Jacksonville, Florida, if they meet the membership requirements.

The Secretary distributed rosters for the seating arrangement in the room.

J.2 Chairman's Remarks

The Chair introduced himself, the vice-chair and secretary and provided the below updates and comments.

- 2018 PAR's
 - P60076-16 IEEE/IEC Wind Turbine Transformers (waiting on IEC)
 - C57.158 Tertiary/Stabilization Windings (complete)
 - C57.110 Non-sinusoidal Load Currents (complete)
 - C57.21 Shunt Reactors (will file PAR extension in May)
- 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
 - C57.123 Loss measurement guide
- C57.133 Guide for Short Circuit Testing (Expired)
- C57.136 Sound Abatement Guide (2018 – will let expire)
- C57.149 SFRA Guide (2022)
- C57.159 DPV Transformers (2026)

- C57.32 Neutral Grounding Devices (2025)
- C57.120 Loss Evaluation Guide (2027)

Working Group / Task Force Leaders

- Issue agenda at least 2 weeks ahead of time
- Minutes are due in 15 days – MS Word format
- Please keep your webpages up to date – review regularly and send any content/files to Sue
- Must track attendance in AM System
- A patent call must occur at every WG meeting
- No photography or recording of any kind is allowed
- Except by officers to support accurate minutes
- It must not be shared and deleted immediately after use

Attendance / Membership / Quorum

- Please record your attendance on one of the rosters being circulated – we only need your name if you are not on the roster
- 9 “Corresponding Members” are counted as “Guests” in terms of attendance for a quorum
- Requests for membership will be granted after the meeting if you’ve made the past 2 or 3 of the last 5 meetings
- PCS now has 98 members after a review of the Fall 2017 meeting attendance, along with the 4 previous meetings
- A meeting quorum will be reached if 50 members are in attendance

The below 17 Guests requested membership at the Fall 2017 meeting and have attended the past 2 or 3 of the last 5 meetings. They have been added as Members for the Spring 2018 meeting:

- | | |
|---------------------|-------------------------|
| • Daniel Blaydon | • Tim-Felix Mai |
| • Reto Fausch | • Emilio Morales-Cruz |
| • Rob Ghosh | • Shankar Nambi |
| • John Herron | • Sanjay Patel |
| • Thang Hochanh | • Ion Radu |
| • John John | • Jason Varnell |
| • Egon Kirchenmayer | • Krishnamurthy Vijayan |
| • Alexander Kraetge | • Kris Zibert |
| • Deepak Kumaria | |

The below 5 Guests requested membership but have not participated in the past 2 or 3 of the past 5 meetings. If present today and still request membership, these Guests will become Members at the Fall 2018 meeting:

- | | |
|------------------|------------------------|
| • Florian Costa | • Gary Hoffman |
| • Ramsis Girgis | • Richard vonGemmingen |
| • Monty Goulkhah | |

These 9 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
- Richard Dudley
- Tamyres Machado Junior
- Dennis Marlow
- Bipin Patel
- Paulette Powell
- Loren Wagenaar

J.3 Approval of Agenda

The Chair presented the agenda and requested if there was any objection to unanimous approval of the agenda - hearing none the agenda was unanimously approved. The agenda had been sent to the members by email several weeks prior to the meeting

J.4 Approval of Last Meeting Minutes

The Chair presented the minutes of meeting held in the Fall 2017 meeting, Louisville, Kentucky, USA on November 1st, 2017 and requested if there was any objection to unanimous approval of the agenda - hearing none the minutes was unanimously approved. The minutes had been sent to the members by email several weeks prior to the meeting

J.5 Minutes from Working Groups and Task Force

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

- | | |
|--|------------------------|
| • WG on Tertiary/Stabilization Windings PC57.158 | E. Betancourt |
| • TF to determine need for OLTC Field Test Guide | M. Ferreira |
| • 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 (B. Beaster) |
| • 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 |
| • WG IEEE/IEC Wind Turbine Generator Transformers, P60076-16 | P. Hopkinson |
| • WG on C57.18.10 Semiconductor Rectifier Transformers | S. Kennedy |
| • WG 3-ph Transf. Connections C57.105 | R. Verdolin |
| • WG on HV & EHV (Breaker & Transformer) Transients C57.142 | J. McBride |
| • WG Short Circuit Design Criteria C57.164 | S. Patel |
| • WG on Neutral Grounding Devices PC57.32 | S. Panetta |
| • WG on Loss Measurement C57.123 | E. teNyenhuis |
| • TF to deal with the impact of different oils | E. teNyenhuis |

Below are highlights that were discussed at the PCS meeting:

- 1) **WG on Tertiary/Stabilization Windings PC57.158:** The WG C57.158 Guide for Application of Tertiary and Stabilizing Windings did not meet the quorum to conduct any further official business. Before starting the meeting, it was announced that the work of this Group had been completed, as the document was approved during the last RevCom meeting (December 2017).
- 2) **TF to determine need for OLTC Field Test Guide:** TF was created to determine a need for OLTC diagnostic Field testing guide, the Chair reminded to the group this TF is to evaluate various field diagnostic testing processes used in the industry. At the TF meeting a motion was approved unanimously with no negative vote “A field diagnostic testing guide is needed for OLTC”. At the PCS meeting a motion to create a PAR was tabled during the meeting, giving the TF time to work out details of submitting a PAR at the Jacksonville meeting. During that meeting they will develop a title, scope and purpose for the standard.

- 3) **TF on PCS Revisions to Test Code C57.12.90:** The TF has agreed to keep the voltage and current functional test proposal. The TF will have meetings between now and the fall to finalize sections 8.7 and 9.6 and send out for a vote before the fall meeting. The TF reviewed the winding resistance test requirement on wye connection transformers with neutral bushing brought out that verifies the neutral connection. It was agreed to pass on a recommendation to update Section 5.4.1 to state: “In addition, in order to verify neutral connection, when there is a neutral bushing brought out, at least one terminal-to-neutral measurement must be made and reported at the neutral position”. This helps clear up confusion over whether terminal to terminal or terminal to neutral resistance reading should be reported.
- 4) **WG on C57.109 - Through-Fault-Current Duration:** The ballot resolution group reviewed 31 comments that were received on Draft D3.0. The chair reviewed the disposition comments for each comment with the WG. There were no comments from the WG on the dispositions given by the ballot resolution group. After all the ballot comments were reviewed a general discussion took place regarding the terminology used in the guide when referring to overloading. The discussion ended as the WG decided to proceed with the wording in the current draft.
- 5) **TF on Audible Sound Revision to Clause 13 of C57.12.90:** Editorial comments from the 2nd survey for revisions to Table 17 and Annex C in C57.12.00 were incorporated into the TF’s recommendations. Review the full minutes for details on 5 topics that have lingered from previous meetings. The topic of including fan noise in load noise rather than no load noise will be reviewed in the Jacksonville Fall.
- 6) **WG on Non-sinusoidal Load Currents C57.110:** No meeting was held this time since the document was just successfully balloted on October 19, followed by two successful Recirculation ballots. The ballot has met the 75% returned ballot requirement. 123 eligible people in this ballot group. 100% affirmative votes. 90% votes received. The document is ready to be submitted to RevCom and should be ready to publish well before the PAR expires at the end of this year.
- 7) **TF on PCS Revisions to C57.12.00:** The TF determined that there is not a need to change the present working relating to the definition of short circuit power on multi-winding transformers. There was discussion related to the fault contribution from all un-faulted terminals, if not otherwise specified by customers.
- 8) **WG Shunt Reactors C57.21:** A request for PAR extension will be submitted since there is not enough time to complete the process by year’s end. During the meeting, an Excel file with technically incorrect topics was presented and several topics were corrected and closed.
- 9) **WG IEEE/IEC Wind Turbine Generator Transformers, P60076-16:** The Chair reported that the intent of the meeting was to review the last ballot and then to vote to send the standard on to RevCom. This schedule was delayed because the chair received a list of “editorial changes” from Tom Breckenridge indicating that the FDIS from IEC would include these changes.
- 10) **WG on C57.18.10 Semiconductor Rectifier Transformers:** The Chair and Vice-Chair went over the changes in Draft 3. Impulse testing of rectifier transformers was discussed during the meeting.
- 11) **WG 3-ph Transf. Connections C57.105:** The new draft D6 was approved to go to sponsor ballot by the WG and PCS.
- 12) **WG on HV & EHV (Breaker & Transformer) Transients C57.142:** Much of the material from the task force paper and the neutral grounding material have been included in Draft 4.
- 13) **WG Short Circuit Design Criteria C57.164:** A brief presentation on short-circuit testing was given by Shankar Subramany from the KEMA Laboratories. It was agreed that 1.0 per-unit of nominal system voltage should be used versus 1.05 that was in the previous draft, unless specified otherwise.
- 14) **WG on Neutral Grounding Devices PC57.32:** TF submitted to PCS for ballot. Procedure for balloting was presented in the meeting.
- 15) **WG on Loss Measurement C57.123:** Results of a survey were reviewed and draft text for review in Jacksonville will be prepared before the meeting. The Chair is ensuring

communication with IEC 60076-19 on loss uncertainty to confirm C57.123 is in sync with the content in the IEC guide.

- 16) **TF to deal with the impact of different oils:** A motion in PCS was made to move the agreed upon TF motion to the C57.12.90 continuous revision for implementation. The motion was “Revise the standards to say it is recommended that the insulating liquid used for service also be used for factory testing. In the case it is agreed by the user and manufacturer to not test with the same liquid type, it should be supported by calculation or experience”.

J.6 Unfinished (Old) Business

None

J.7 New Business and Motions

A PAR will be open on C57.149-2012, the SFRA test guide, as it will expire in 2022. Chuck Sweetser volunteered to be the chair, and he’s selected Poorvi Patel as Vice Chair. Brief review of core gassing phenomena by Phil Hopkinson, as already reported in other SC’s.

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

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

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee*

The WG C57.158 Guide for Application of Tertiary and Stabilizing Windings met on March 26, at 9:30 AM. Nine Members and 13 Guests were present, out of 32 regular members; we did not meet a quorum to conduct any further official business. Before starting the meeting, it was announced that the work of this Group had been completed, as the document was approved during the last RevCom meeting (December 2017). The Chair presented to the attendance the most relevant editorial adjustments made to the latest draft of C57.158, showing that no changes were made to the technical contents of the document. Publication of our document is expected in a term of two to three months.

There were a few, minor corrections to the minutes of the previous meeting from Louisville, Kentucky, proposed by members present. As we did not meet a quorum, the Chair of the WG will promote approval of those minutes by e-mail communication. Summary of approval votes and corrected minutes will be submitted to the Chair of the PCS, as soon as the process is completed.

Respectfully submitted: Enrique Betancourt, WG Chair

J.8.2 PCS Task Force on OLTC Diagnostics / Testing

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee*

*March 27th, 2018 9:30AM
Omni William Penn Hotel Pittsburgh, Pennsylvania, USA*

The PCS Task Force on OLTC testing / diagnostics met on Monday, March 26th 2018. The Chair Marcos Ferreira called the Group to order at 9:30am and explained purpose and scope of the TF. There were 38 guest and 33 members present. Group has 48 members so we had the quorum. 9 guests requested membership.

The motion to approve the agenda was initiated by Ed teNyenhuis and seconded by Axel Kraemer. No discussion took place and agenda was approved unanimously with no comments or amendments. Motion to approve the minutes of last meeting was initiated by Kristopher Neild and seconded by Wes Schrom, No discussion took place and minutes was approved unanimously. Agenda Items were covered as follows.

Chair Marcos Ferreira reminded the group This TF is to evaluate various field diagnostic testing processes used in the industry and determine a guide is needed” and request Raka Levi to present the literature search results on different type of LTC diagnostics tests. Raka Levi presented slides on industry data, manufacturers of instruments for Dynamic resistance and vibro-acoustic method of LTC diagnostics

and reference to several papers written in past twenty years. At the conclusion of presentation, Raka suggested an IEEE guide on these tests is needed.

John Herron made the comment that we are seeing only two test method and not talking about all the previous method of testing in the field. Chair suggested that these two method does not have any guide hence we are discussing it.

Chair invited Peter Werelius to present the DRM test method. Peter presented DRM testing done on resistance type tap changers and demonstrated the different way of performing DRM is producing different result and hence with limited guidance it is confusing to many people. Several different methods such as dynamic voltage, Dynamic current and Dynamic resistance method is used. In lieu of proper guide and understanding it is very difficult to reach at right conclusion hence it is important to have a LTC diagnostics guide.

Chair invited Cornelius Plath to present the DRM test method. Cornelius highlighted the various factor affecting the test and analysis. DRM produces different signature for different type of LTC and very difficult to diagnose the old tap changers. During the presentation an example of DRM test before and after maintenance of LTC was presented. Question was asked on what type of maintenance, to that Cornelius informed that it was complete mechanical maintenance and he does not have other details of maintenance. In conclusion Cornelius insisted need of guide to give proper understanding in industry. John Harron commented that all the test data presented belongs to resistance type and no where it is mentioned about the reactor type.

Raka Levi replied that the test data of reactor type LTC is available and mentioned in several papers presented in last 10 years. Peter Werelius mentioned that there are data of different test method producing different result.

Chair invited Marc Foata to present the Vibration method of diagnostics. Marc said the interpretation is not easy and at present all the investigators are working individually without talking to each other is making the process of diagnosis harder. Every method has its limitation diagnosing the problem with different type of tap changer i.e. one method does not fit all so the guide will be helpful highlighting those limitations.

Joe Foldi asked if there is consideration of using the sound method for diagnostics, Raka insisted the Vibro acoustic method is in fact a sound test, the accelerometer is just larger frequency spectrum instrument compared to a microphone, which Marc mentioned that these are two different method. Pure sound and vibration sound are two different method and cannot be treated as one to supplement other. John Harron asked if this test is performed by transformer manufacturer, to that Marc said No. John if there is no bench mark from manufacturer how can it be used in field as diagnostics method. Marc said more work need to be done.

John Harron mentioned that the scope is too broad and LTC testing is covered in field test guide C57.152. So it will be good idea expanding the LTC test section in C57.152 than creating another guide.

Motion initiated by Stephanie Denzer and seconded by Anthony Franchitti “The group has evaluated the need of a guide for DRM and Vibration method of LTC diagnostics”.

Chair invited team for discussion, John said the scope is focusing on two methods, it needs to be general.

Craig Stiegemeier said the scope need to be general so that more diagnostics test can be added to it.

Don Platts said he is leaning towards adding to C57.152. and there is no need for a separate guide. Chuck Sweetser mentions that the evaluation is not enough on these two method at this time, hence it will be complicated. With no further discussion Chair asked for vote. The motion failed due to unanimously negative vote. The motion was modified and initiated by David Geibel “A field testing guide is needed on LTC diagnostics” seconded by Marc Foata. With no further discussion, motion passed unanimously with no negative vote.

Chair informed the group that he will request PCS subcommittee for initiating working group on A guide on LTC diagnostics test.

Meeting adjourned at 10:45AM.

Respectfully submitted by

Marcos Ferreira
Chair

Raka Levi
Vice Chair

Tauhid Ansari
Secretary

J.8.3 Task Force on PCS Revisions to C57.12.90

March 26, 2018, 11:00am-12:15pm
Omni William Penn Hotel
Meeting Room “Urban (17)”
Pittsburgh, Pennsylvania USA
Chair: Hakan Sahin Secretary: Hamid Abdelkamel

The TF Chair called the meeting to order at 11:00am

The chair went through a review of the purpose of the task force and the proposed agenda for the meeting.

Spring 2018 Agenda

1. Administrative
 - A. Statement of Purpose
 - B. Introductions and attendance sheets
 - C. Approval of agenda
 - D. Approval of the minutes of the meeting – Fall -2017
2. Old Business
 - A. Changes to C57.12.90 on the Load Tap Changer performance voltage test and current test
3. New Business
 - A. Winding resistance test requirement on wye connected transformers with neutral bushing brought out
4. New Business
5. Adjourn

The chair commented that we would come back and approve the agenda if we have the quorum. In order to leave time at the end of the meeting, chair asked if anyone would have any new business. No new business was requested.

There were 39 of the 68 TF members in attendance making this meeting “official” as a quorum of 57.3% was reached.

The following 13 members were moved to guest status due to lack of attendance (missing 3 or more of the last 5 meetings): James Antweiler, Allan Bartek, Alain Bolliger, Elizabeth Bray, John John, Vladimir Khalin, Joseph Melanson, Amitav Mukerji, David Ostrander, Kirk Robbins, Rodrigo Ronchi, Mike Spurlock, and Sukhdev Walia.

Also 20 Guests requested membership last fall 2017 meeting, and they have attended the past 2 meetings or 3 of the last 5 meetings. They are our newest Members: Hamid Abdelkamel, Raj Ahuja, Sanket Bolar, Eun Cho, Hugo Flores, John Foschia, Bill Griesacker, John Herron, Mohammad Iman, Peter Kleine, Fernando Leal, Ion Radu, Amitabh Sarker, Markus Schiessl, Cihangir John Sen, William Solano, Liz Sullivan, Janusz Szczechowski, David Walker, and Matthew Weisensee.

There are 3 Corresponding Members counted as guests.

After approving the agenda and the minutes from the Fall 2017 meeting, 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.

The Chair gave about 5 minutes for those attending the meeting to read the below text in 8.7 to enable a discussion. Then he showed the text for section 9.6.

8.7 On-Load Tap Changer End to End Voltage Test

In order to verify the performance of a transformer that has an on-load tap changer (OLTC), the OLTC 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 with minimum control voltage of 85%. 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, and the applied voltage can be adjusted to the rated voltage of the tap position. 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 no abnormal observations in the test control system which may cause the test circuit to trip. Oil samples taken from the OLTC compartment of vacuum type tap-changers, before and after the test, may show some increase of dissolved gases, which is due to current commutation, resistor heating and / or stray-gassing of the oil. For mineral oil, the increase of the sum of H₂, CH₄, C₂H₆, C₂H₄ and C₂H₂ should not exceed 12 ppm for in-tank type LTCs and 6 ppm for compartment type LTCs. For non vacuum type tap changers the determination is with abnormal sound only.

Note: During the operation of the change-over selector (reversing switch or coarse-tap selector), the sound can be slightly different.

9.6 On-Load Tap Changer End to End Current Test

In order to verify the performance of a transformer that has an on-load tap changer (OLTC), the OLTC 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 with minimum control voltage of 85%. 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 no abnormal observations in the test control system may cause the test circuit to trip. Oil samples taken from the OLTC of vacuum type tap-changers, before and after the test, may show some increase of dissolved gases, which is due to current commutation, resistor heating and / or stray-gassing of the oil. For mineral oil, the increase of the sum of H₂, CH₄, C₂H₆, C₂H₄ and C₂H₂ should not exceed 12 ppm for in-tank type LTCs and 6 ppm for compartment type LTCs. For non vacuum type tap changers the determination is with abnormal sound only.

Note: During the operation of the change-over selector (reversing switch or coarse-tap selector), the sound can be slightly different.

The Chair then opened the meeting to the floor for discussion.

Joe Foldi asked about the meaning of performing the test in intervals if needed. Joe Foldi suggested that the test be performed continuously and remove the “the test may be performed in intervals if needed”.

Due to the fact that there were similar comments for the last several years, The Chair asked by a showing of hands who agrees to keep the on load tap changer voltage and current functional test proposal in C57.12.90. The majority agreed to keep the voltage and current functional test proposal.

The Chair commented that he will email members and guests and ask for volunteers to work off site and have meetings via skype or other means, and finalize section 8.7 and 9.6 and send out for voting prior to next meeting (fall 2018).

The Chair then moved on to discuss new business from fall 2017 meeting, pertinent to winding resistance test requirement on wye connected transformers with neutral bushing brought out Sections 5.4 and 5.4.1 below are taken from C57.12.90 – 2015.

5.4 Resistance measurement connections and reporting

The individual phase- or terminal-to-terminal resistance readings shall be reported along with the sum total winding resistance.

5.4.1 Wye windings

For wye windings, the reported resistance measurement may be from terminal to terminal or from terminal to neutral. For the reported total winding resistance, the resistance of the lead from the neutral connection to the neutral bushing may be excluded. For terminal-to-terminal measurements, the total resistance reported is the sum of the three measurements divided by two.

The Chair asked the following question: If the DC winding resistance test is performed terminal-to-terminal only, can we catch an issue with the neutral connection if the test is not performed terminal to neutral?

There was a discussion on why there is a need for an additional terminal to neutral resistance if terminal-to-terminal resistance is being performed, which is required for load loss calculation. Kushal Singh shared that they had instances where a transformer supplier connected the on load tap changer to the wrong neutral location. Since then they started requesting resistance measurement on all 3 phases: terminal to terminal and terminal to neutral.

Dan Sauer explained that by performing terminal to terminal resistance measurement, the connection will be proved terminal to terminal including windings. However, an additional test, terminal to neutral would be required to verify the connection from neutral point to the bushing.

Kris Neild made a motion to approve the proposed wording for 5.4.1 shown below. Dan Sauer seconded the motion.

Ajith Varghese requested a friendly amendment to add ‘at rated tap’ to the proposed wording.

Kris Neild accepted the friendly amendment.

5.4.1 Wye windings

For the wye windings, the reported resistance measurement may be from terminal to terminal or from terminal to neutral. When there is a neutral bushing brought out, at least one terminal-to-neutral measurement must be made and reported. For the reported total winding resistance, the resistance of the lead from the neutral connection to the neutral bushing may be excluded. For the terminal-to-terminal measurements, the total resistance reported is the sum of the three measurements divided by two.

One of the meeting attendees recommended to change ‘For the wye windings, the reported resistance measurements may be from terminal to terminal. . .’ to ‘For the wye windings, the reported resistance measurements shall be from terminal to terminal. . .’

Jason Varnell suggested to add ‘in addition to’ to the existing statement in the current section and moving the statement to the end of the paragraph 5.4.1 when adding ‘In addition, in order to verify neutral connection, when there is a neutral bushing brought out, at least one terminal-to-neutral measurement must be made and reported at the neutral position.

The group voted and agreed the changes as motion and friendly amendment agreed to.

The Chair then asked if there is any new business to be discussed during fall 2018 meeting. No new business was mentioned.

The meeting was adjourned at 12:10pm.

J.8.4 Working Group for Revision of C57.109

**IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration
Omni William Penn Hotel
Pittsburgh, Pennsylvania, USA
Monday, March 26, 2018
1:45 pm – 3:00 pm**

The Working Group (WG) met on Monday, March 26th at 1:45pm. The chair welcomed everyone to our WG meeting. The secretary passed out rosters. The chair requested any relevant patents to be brought to the attention of the WG. There were none. Quorum was established with 7 of 9 members present. There were 45 participants present. Three requested membership but only one (Shankar Subramany) met the attendance criteria for membership. The agenda for the current WG meeting was approved unanimously as were the last WG meeting minutes from Louisville.

The chair then updated the WG on the status of ballot progress. He stated that the ballot resolution group met on two occasions (Jan 26, Feb 16) via conference call between the last WG meeting in Louisville and the current WG meeting in Pittsburgh. The ballot resolution group reviewed 31 comments that were received on Draft D3.0. The chair reviewed the disposition comments for each comment with the WG. There were no comments from the WG on the dispositions given by the ballot resolution group. After all the ballot comments were reviewed a general discussion took place regarding the terminology used in the guide when referring to overloading. This comment was raised by Juan Castellanos. He was stating that it would be highly unusual for an overload to be 5x rated current and suggested that either the value of 5x be reconsidered or changing the wording such that it doesn't state that the 5x rated current is caused by overloads. There was discussion supporting observed instances where the short duration overload may be greater than 3.5x rated current in applications such as traction transformers or category I or II transformers. The discussion ended as the WG decided to proceed with the wording in the current draft and suggested the commenter review the draft during recirculation and propose the comment if desired. A motion was raised by Weijun Li to proceed to recirculation ballot with draft 4.0. This motion was seconded by Juan Castellanos. The motion passed unanimously. A motion was raised by Weijun Li to adjourn the WG meeting. This motion was seconded by Akash Joshi. The motion passed unanimously.

The meeting adjourned at 2:51pm.

Respectfully submitted

Vinay Mehrotra

WG Chair

J.8.5 TF Audible Sound Revision to Test Code C57.12.90

Pittsburgh, Pennsylvania

The TF met at 1:45 PM, on Monday, March 26, 2017. Chairman Dr. Ramsis Girgis presided over the meeting. Secretary Barry Beaster assisted with the administrative duties.

After the fall 2017 meeting, the membership had been adjusted to 43 members. This meeting was attended by 26 of the 43 members and 54 guests for a total of 80 persons. A quorum was established after the meeting via a paper sign-in count and confirmed by the RFID tag in system. The unapproved agenda was presented without change at the meeting. The fall 2017 meeting

minutes had no requested changes, corrections, or objections to being unanimously approved. There were ten requests for TF membership; which will be reviewed based on previous meeting attendance.

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

Prior to the meeting, a second survey was issued to members and recent attendees of the TF for comments on the second revision to Table 17 and Annex C in C57.12.00. In another mailing, the unapproved fall 2017 minutes were circulated to all members and guests of the last meeting.

The first technical Agenda item presented was a summary of the returns of the second task force survey. There was a total of 81 sent, with 32 returns. The breakdown is; 23 approved with no comments, 7 approvals with comments, one not approved, and one abstain. The comments were all of editorial nature but, nevertheless will improve the presentation of data in Annex C. The “Not approved” vote was related to the suggestion to guarantee the total noise level of a transformer which is not the subject of this survey.

At the meeting, a slide was presented that had the following previously agreed upon enhancements to Annex C of C57.12.00:

- Incorporate NEMA TR1 Tables 1 & 2 for No load sound levels into Annex – C.1 and C.2; respectively
- Replacing the formulas presently included in Annex – C.3, for calculating reference load Sound Power levels, with tables of corresponding Sound Pressure levels
- Modify reference to the revised Annex – C in Table 17

Per the returns of the survey, the following changes have been incorporated in Table C.1:

- In the title of the Annex, the word “oil” is replaced by the word “liquid”.
- The heading of the left column is changed to read “Sound Pressure Level, dB (A)”.
- The word “kVA” is added to the top column heading so it now reads “Equivalent Two-Winding kVA rating”
- Note 1 now includes ODWF and ONWF for column 1 and OFAF in Column 2.

For Table C.2, the heading of the first column now reads, “Equivalent Two-Winding kVA rating” and the second column now reads, “Sound Pressure Level, dB (A)”.

For Table C.3, a sound level is introduced for 30 MVA transformers. Also, MVA ratings that have the same Load noise levels are not presented as a group in one row.

The title of Table C.3 now reads, ‘Reference Audible sound pressure levels of load noise’. Asterisks have been added to clarify that the MVA values in the Table refer to the Full MVA Nameplate rating. In addition; the following note was added “*For intermediate MVA ratings, interpolate using the sound levels in the range of the closest MVA ratings*”.

Finally, the following sentence has been added to the paragraph in Table 17 that references Annex C: “*These sound pressure levels apply to both single- and three-phase transformers*”. Two comments were raised as to whether this interpolation should be done with the sound pressure readings or converted to power and then interpolated and converted. The chairman noted that a simple interpolation of the dB values would be adequate.

The next topic was a presentation of several items raised in previous TF meetings.

Item 1: Relationship between Load noise and MVAR of the transformer

- The chairman presented measured Load noise data for a number of transformers of different sizes, MVA & kV ratings, and impedances vs. MVARs. The data showed no correlation

Item 2: Addition of Sound Levels of No Load and Load Noise

- The chairman presented data for 4 different combinations of No load and load noise levels. The data showed that one would get the same value of the total sound level whether by adding the final values of these two components of the total noise or by adding their individual frequency components and then summing up the resulting frequency components of the total noise.

Item 3: Impact of Temperature on core noise

- Core Noise data, presented by two manufacturers, of a number of transformers measured at different core temperatures showed very small impact of core temperature on core losses.
- The chairman, however, stated that some core materials can experience high increases of core losses and core noise levels caused by internal mechanical stresses due to lamination elongation. This has been experienced with core laminations that has insulation coating that applies a low level of surface tension. This impact is typically experienced in higher iron loss materials when operating at high flux densities. Also, it was mentioned that core losses go back to their original value once the core temperature decreases to its original value. It was suggested that such a statement could be included in C57.12.00 for awareness purposes. A similar statement for the effect on core losses is being considered to be added to the new revision of the Loss measurement Guide, C57.123. The chairman suggested that this subject is discussed further in the next meeting of the TF.

Item 4: Impact of Temperature on Load noise

- Load Noise data of a number of transformers, measured before and after the heat-run test, were presented by three manufacturers. The data showed a small increase in some designs and a small decrease in other designs. Out of the 10 transformers tested, one design showed a 4.5 dB increase in load noise after the heat-run. It was not clear why this transformer tested higher than all other transformers.

Item 5: Load noise vs. Tap position

- Load Noise data of a number of transformers measured at different tap positions, were presented by three manufacturers. The data generally showed an increase of a maximum of 3 dB with all turns in vs the neutral position. With all turns out, the measured load noise level was slightly higher for some transformers and slightly lower for other transformers.
- With all turns out, one Autotransformer measured about 11 dB lower. For this transformer, a much lower level of current, corresponding to this tap position was applied.

Upon completion of the discussions of Items 3, 4, and 5 above, the Chairman plans to discuss with the TF meeting attendees if there is text to be added to table 17 of C57.12.00 and / or Clause 13 of C57.12.90.

Mr. Sanjay Patel brought up the issue of whether fan noise should be included with Load noise rather no load noise as presently is the case in the Standards. This issue was briefly discussed at the end of the meeting. This subject will be covered in more detail in future meetings of the TF.

In the PCS meeting, Jin Sim asked about the need for the Sound Abatement Guide and whether this TF was going to address this. Ed teNyenhuis responded that the TF has previously recommended to let this Guide expire. In response to this request, the Chairman plans to look into the Guide and see if there are a couple of useful pieces of information that may need to be moved to C57.12.90. He intends to discuss this matter in the next meeting of the TF.

The meeting was adjourned at 3:00 PM.

Respectively submitted,

Barry Beaster, TF Secretary

J.8.6 WG for Revision of C57.110

**Spring 2018 Meeting, March 25 –29
Omni William Penn Hotel; Pittsburgh, Pennsylvania USA**

Chair: Rick Marek

Secretary: Sam Sharpless

PC57.110D6: Recommended Practice for Establishing Liquid-Immersed and Dry-Type Power and Distribution Transformer Capability When Supplying Nonsinusoidal Load Currents

No meeting was held this time since the document was just successfully balloted on October 19, followed by two successful Recirculation ballots.

The ballot has met the 75% returned ballot requirement.

123 eligible people in this ballot group.

100% affirmative votes

90% votes received

The document is ready to be submitted to RevCom and should be ready to publish well before the PAR expires at the end of this year.

J.8.7 Task Force on General Requirements C57.12.00

Performance Characteristics Subcommittee

IEEE / PES Transformers Committee

March 26, 2018 4:45 PM

The Omni William Penn Hotel

Pittsburgh, Pennsylvania USA

The PCS Task Force on General Requirements for C57.12.00 met on Monday, March 26, 2018. The Chair Tauhid Ansari called the Group to order at 16:50 and explained purpose and scope of the TF. According to paper roaster, 37 Members and 50 guests were present but hands counting and RFID indicated 42 members present. The meeting was adjourned before the roaster circulated in room so we

decided to take the hand counting and RFID data as acceptable counting. As the Task Force membership stands at 81 members, we did have a quorum to conduct official business. The following 8 guests requested membership:

Alexander Winter	Highvolt
David Walker	MGM Transformer Co.
Don Dorris	Nashville Electric Service
Gregorio Lobo	MEPPI
John Hall	TVA
Jorge Cruz Cienfuegos	PTI
Kushal Singh	ComEd
Peter Zhao	Hydro One

As a first count yielded 42 individuals standing as WG members, it was originally assumed we had a quorum, and the Chair continued regular business with the Group.

The Louisville minutes were approved by the Group (Roger Verdolin/Eduardo García), with no one opposed. The Agenda was approved by the group.

Agenda Items were covered as follows.

1. OLD BUSINESS

WG Item 109. New text proposed by Sanjay Patel complementary to the definition of short circuit power in multi-winding transformers. Discussion on the subject started in the previous meeting and was not concluded.

The Chair opened the floor for discussion. As there were no comments from the attendance, the item was considered finished, with no change recommended to present wording in the standard.

WG Item 110. Subject brought up by Liz Sullivan, pointing out differences in Applied Test Voltage values for 34.5 kV network transformers. Comparing standards C57.12.40 and C57.12.00, excessive voltage should be applied to the HV bushings, according to the second standard.

No members of the Distribution Transformers SC were present. Bertrand Poulin recommended to refer the subject to the Dielectric Test SC. Jorge Cruz pointed out that the subject does not belong to C57.12.00 WG. The topic was dropped from the WG's agenda.

2. NEW BUSINESS

There was no new business brought up from the attendance.

Phil Hoppkinson requested to consider the subject of core gassing in distribution transformers, already discussed in the PCS in 2015. No further comments from the attendance.

With motion from Akash Joshi /Kristopher Nield, the meeting was adjourned at 5:30 pm.

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
Pittsburgh, PA
Omni William Penn Hotel**

Tuesday March 27, 2018

The working group met in the Allegheny room of the Omni William Penn Hotel on Tuesday March 27, 2018, at 9:30 AM.

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

There were a total of 65 participants: 12 Members and 53 Guests.

- The meeting was opened with the Chairman remarks and the circulation of attendance rosters.
- 12 of the current 16 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 18 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 F17 meeting in Louisville, which were circulated on March 18, 2018 by email, were presented to the audience.
 - There were no objections or comments and the F17 meeting minutes were approved.
- Unfinished Business:

Document status:

- Par and standard expire December 2018 and although draft 2 has been circulated among the members for comments, it is not ready for approvals by the WG.
- Draft 2 has been circulated and after mostly editorial changes and some technical updates, draft 3 will be circulated within few days.
- Once the draft 3 is approved by the member, next step requires approval by PCS however still needs work and it won't be ready for the subcommittee meeting on March 28, 2018.
- The CRG is now set in place by the Chairman.
- A request for PAR extension will be submitted since there is not enough time to complete the process by year's end. Main issue has been the delayed response by the members; all are encouraged to expedite their comments to the Chair.
- During the meeting, an Excel file with technically incorrect topics was presented and several topics were corrected and closed, mainly:
 - Enrique Betancourt: Table 6, BIL levels for 800 kV class, values do not match those values in note 13.
 - Ulf Radbrandt: system frequency, 50 Hz vs 60 Hz equations. This topic will be addressed during the next revision of the document as it is a time consuming task.
 - Mike Sharp: section 10.6; remove the first paragraph regarding a reference to ratings as lower voltages and power.

- Arturo Del Rio: reference to a standard in the scope was corrected.
- Chris Ploetner and Luc Dorpmanns also submitted comments and updates via email as they were not present in the meeting.
- The WG agreed in principle that there are no major unresolved issues that could delay the completion of the document; however, the PAR extension will be requested after members approve draft 3 to allow due process for the editorial and balloting processes.
- Malia Zaman was present in the meeting and clarified to the participants topics related to expiry dates for the PAR and the document and the effects of a standard becoming inactive.
- The PAR extension request will be done once the document is ready for balloting, and before October 15th, 2018.

No new businesses were presented and the meeting was adjourned at 10:15 am.

Next meeting: Fall 2018, Jacksonville, FL, October 14-18, 2018.

Respectfully submitted,

Chairman: Sanjib Som (ssom@patransformer.com)

Secretary: Arturo Del Rio (a.delrio@ieee.org)

J.8.9 IEEE/IEC WG Wind Turbine Generator Transformers, P60076-16

Chairman: Phil Hopkinson; Secretary: Donald Ayers

The Working Group on Wind Turbine Generator Transformers was called to order at 8:00 a.m. EST on Tuesday, March 27, 2018 at the OMNI William Penn Hotel, Pittsburgh PA. There were 91 attendees with 27 members present of a voting membership of 59. Note: 10 attendees including 4 members did not register through the RFID system.

No quorum was present so no actions were initiated and no votes were taken.

The meeting agenda and the minutes of the previous meetings will be approved by mailed ballot to members. The minutes from the Spring, 2017 meeting were reviewed.

Philip Hopkinson, Chair, reviewed the history of the working group. He reported that the intent of the meeting was to review the last ballot and then to vote to send the standard on to RevCom. This schedule was delayed because the chair received a list of “editorial changes” from Tom Breckenridge indicating that the FDIS from IEC would include these changes.

The results of the last ballot was reviewed and declared successful

RESPONSE RATE

This ballot has met the 75% returned ballot requirement. 151 eligible people in this ballot group.

122 affirmative votes

5 total negative votes with 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)

135 votes received = 89% returned

5% abstention

APPROVAL RATE

The 75% affirmation requirement is being met. 122 affirmative votes

5 negative votes with comments 127 votes = 96% affirmative

Erin Spiewak, IEEE, indicated that she would (1) have the IEEE Editorial Staff review the changes and (2) request the FDIS from the IEC be expedited. The IEEE Editorial Staff will work with the IEC to determine if the changes are truly editorial or if some technical changes are included. If the changes are just editorial, then with the submittal of the IEC FDIS, the standard will be submitted to RevCom for approval. If some changes are technical then the standard will require submittal for one last ballot prior to submittal to RevCom with a successful ballot..

With no quorum the meeting was adjourned at 8:30 a.m.

Respectfully submitted,

Donald E. Ayers Secretary

J.8.10 Working Group on Semiconductor Power Transformers – C57.18.10

Unapproved Meeting Minutes

Omni William Penn Hotel, Pittsburgh, PA

March 27, 2018

The Working Group met in the Allegheny meeting room

Sheldon called the meeting to order at 11:00am

There were 18 members and 20 guests present. A quorum was present (18 of 29 members).

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

Don Ayers moved for approval of the minutes as written, Subash Sarkar seconded. The minutes of the November 2018 meeting in Louisville were unanimously approved as written.

Discussion of Draft 3 Revisions-

Sheldon and Bill went over the changes in Draft 3. Don Ayers mentioned that normative standards need to be referenced in normative text. Sheldon suggested the reference to 1653.1 in sections 9.1 and 9.2 be modified to state that IEEE 1653.1 takes precedence over C57.18.10 only if it is cited by the customer. Subash Sarkar made motion to accept this language, Dinesh Sankarakurup seconded the motion. Motion passed unanimously. A brief discussion about the need for the tolerances in 1653.1 followed. John John said that the calculation of eddy losses in bud bars is very difficult to calculate and he had sent comments to that effect. Sheldon said that there wasn't time to include that in the draft yet. Joe Foldi said that

calculating Eddy losses in windings was easy while bus is hard is and is more like stray loss rather than eddy loss. Needs 3D FEA analysis and even that is difficult or impossible in most situations.

Paul Buddingh sent in information on high resistance grounding of rectifier transformers and the problems with resistance grounded drive transformers but there was not time to include in the draft yet. Craig Stiegimeier moved that this information be put into an annex, Vijay Tendulkay seconded the motion. Motion passed unanimously.

Old Business:

Sheldon referenced Dinesh Sankarakurup's question from the last meeting about impulse testing of rectifier transformers- Standard refers to 12.90 and 12.91 for LV impulse testing. Should we mention LV impulse testing because rectifier transformers with multiple LV sections are often tested in non-standard ways? Should we cover how you test this type of LV winding? What about testing in cases where secondary impedance was too low to get a good impulse waveform? Sheldon talked about impracticality of doing impulse on large rectifier transformers. However medium voltage drive transformers are more amenable to impulse testing. Sheldon mentioned that multipulse drive transformers often have high common voltage that require special testing. David Walker mentioned that almost all drive transformers specify a modified applied voltage test to account for common voltages.

New Business:

No new business

With no further business, the meeting was adjourned at 11:48am.

The Working Group will meet again at the Fall 2018 meeting in Jacksonville, FL

Chairman: Sheldon Kennedy

Vice Chairman: Bill Whitehead

Secretary: David Walker

**J.8.11 PC57.105 – IEEE Guide for Application of Transformer Connections
in Three-Phase Electrical Systems
Tuesday, March 27th, 2018 - (1:45 PM – 3:00 PM)**

Chair: Rogerio Verdolin

Vice-Chair: Benjamin Garcia

1. Attendance:

- a. Members (out of 10): 8
- b. Guests: 20
- c. Guests requested membership 0
- d. Total: 28
- e. Quorum (6 required): 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, March 27th, 2018.
4. **Fall 2017 Minutes Approval:** A motion was made by Phil Hopkinson, and seconded by David Walker, to approve the meeting minutes from the fall 2017 meeting in Louisville, KY. By unanimous vote, the minutes were approved.
5. **Spring 2018 Agenda Approval:** A motion was made by David Walker, and seconded by Phil Hopkinson, to approve the meeting agenda for spring 2018 in Pittsburgh, PA. By unanimous vote, the minutes were approved.
6. **PAR Status:** PAR expires December 31st, 2019, which represents 2 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. At the last meeting (Fall 2017 – Louisville, KY), all members in attendance voted and approved sending the draft standard to ballot; this vote exceeded the minimum 2/3 requirement by IEEE.
8. Since the last meeting, each member:
 - a. Reviewed the entire document for technical content and editorial changes
 - b. Took a small section ~5 pages to do a deep dive review
 - c. Reviewed the draft standard format; ensured it followed the IEEE style manual
 - d. All comments were submitted, addressed and incorporated into the draft revision completed before today's meeting
9. Based on volunteers from the membership, the ballot resolution group will be:
 - Roger Verdolin
 - David Walker
 - Dan Mulkey
 - Ben Garcia
10. Based on the updated document, Phil Hopkinson motioned that the new draft standard go to ballot. This motion was seconded by Alexandro Macias.

No Old Business:

- None

Next Steps:

- None

11. Meeting Adjourned at 2:00pm
 - a. Motion: Sam Sharpless
 - b. 2nd: Alexandro Macias

Respectively submitted,
Rogerio Verdolin, Chair

Benjamin Garcia, Vice-Chair

J.8.12 Working Group for the revision of C57.142

**Pittsburgh, Pennsylvania
Tuesday, March 27, 2018
3:15 PM – 4:30 PM
Urban (17)**

Chairman – Jim McBride
Vice Chair – Xose Lopez-Fernandez
Secretary – Tom Melle

- 1) Meeting called to order at 3:15 PM
- 2) Welcome and Chair's Remarks
- 3) No essential patent claims made
- 4) Circulation of Attendance Sheets
73 Attendees were present (45 Guests)
28 of 54 Members present (quorum was achieved)
- 5) No opposition to approval (motion by Phil Hopkinson and 2nd by Rogerio Verdolin) of Agenda and Minutes from Last WG Meeting.
- 6) Approval of Agenda (motion by Pierre Riffon and 2nd by Rogerio Verdolin)
- 7) Review of C57.142 Draft 4 – March 2018, Chair noted that some editorial changes have been included. However, there may be additional editing / cleanup needed. Much of the material from the task force paper and the neutral grounding material have been included in Draft 4. The chair requested that the membership please review and comment on the existing draft in the next two weeks if possible. We will be presenting this draft at the upcoming meeting with the Switchgear Committee in Florida.

Pierre Riffon made a comment about (capacitor bank) switching control / disconnect switch transients as a mitigation method. This mitigation method is included in the present draft Annex 5 Example 5.

There was a suggestion to possibly bullet point mitigation methods after each example.

Question: Joshua Yun asked if the SGC is working to further mitigate the transients created by switch devices.

Answer: There is no knowledge of active work by SGC, but several OEM's are working on limiting/preventing re-strike/re-ignition by different methods during reactor switching. We are planning to meet with the SGC at their upcoming meeting.

Phil Hopkinson asked about mitigation on the LV side of a power transformer. The Chair stated that adding capacitance to the LV side was used in the auto-transformer example. However, other methods may be more commonly used today. Phil stated that at least one manufacturer has placed arrestors at 25/50/75% points in the winding. He stated that at 34.5 kV and below static shields added to the winding seems to increase probability of surviving re-strikes.

- 8) Upcoming Co-Sponsor Switchgear Committee Meeting –
April 22nd – 26th, 2018 in Lake Buena Vista, FL
C57.142 WG Update Meeting Tuesday, April 24th, 2018 2:00–6:00pm
- 9) Upcoming CIGRE Meetings in Rio de Janeiro, Brazil – April 9-12, 2018
April 9th -11th - JWG A2/C4.52 HF Transformer Modeling. April 12th CEPEL Workshop on High
Frequency Transient Measurement
- 10) Mitigation Methods, Factory Testing, and Field Service Conditions TF
Phil Hopkinson – TF Chair
Pierre Riffon – TF Vice-Chair
Akash Joshi – TF Secretary
Jim McBride
Mike Spurlock
Hamid Sharifnic
Shekhar Vora
Waldemar Ziomek
Pugal Selvaraj
Dave Caverly
John Hall
Amitabh Sarkar
Changir Sen
Monty Goulkhah
Rogerio Verdolin

Phil Hopkinson reminded the WG that many old transformers had electrostatic shields, but they were not required to pass 100-200 BIL testing for 34.5 kV. Transformers that are failing in the field are passing test levels. Mitigation methods with some success have included: higher BIL, open terminal special impulse test, and fast-front switching surge with a long tail time. Phil urged the group to focus on both design and test. The conclusion is that increasing the series capacitance and reducing the capacitance to ground should improve the design.

Question: Dr. Bob Degeneff – how many transformers have these or are these problems affecting? He noted that factory testing is not necessarily realistic (e.g. impulse is not superimposed on 60 hz waveform)

Bill Lazerlere – Bill cautioned about putting capacitors in series with voltage taps as the capacitor may not be a “capacitor” at the higher frequencies. This mitigation method is under discussion and not necessarily the best or only mitigation tool.

Failures (Jagdish Burde) many transformers that seemed initially to fail due to switching transients.

Nigel McQuinn mentioned that in the past snubber circuits were used as mitigation methods to counteract steep front waves affecting motors and the same technology could be used for protection of transformers. The use of snubbers, however, is not as practical with HV/EHV systems. The chair noted that snubber mitigation methods were used in some of the examples in C57.142.

Joel Kern has witnessed several failures due to switching transients in a variety of transformers including factory transformers and wind farm units.

- 11) New Business: none

- 12) Next Meeting: Jacksonville, FL
- 13) Adjournment at 4:30 PM (motion by Pierre Riffon and 2nd by Rogerio Verdolin)

J.8.13 WG PC57.164 (PCS)

Short Circuit Withstand for Transformers Pittsburgh, PA – March 27, 2018

- The Working Group met at 4.45 PM in the Urban room on the 17th floor on March 27, 2018
- The Chairman, Sanjay Patel, led the meeting and the Secretary, Joe Watson was present. The Vice-Chair, Raj Ahuja, was unable to attend.
- There were 66 attendees in total with 25 of the 57 WG members present. A quorum was not present, but no items were voted on other than acceptance of the previous minutes which will need to be re-voted by email to the members. The complete attendance will be entered into the AMS database.
- There were no essential patents noted by any of the attendees when the question was raised.
- A brief presentation on short-circuit testing was given by Shankar Subramany from the KEMA Laboratories. The presentation included several questions on interpreting the IEEE standards for short circuit testing and these were referred to the working group for C57.12.90.
- Sanjay Patel reminded the group of their obligations to help write and review the document. There are still a few sections that need to be developed.
- Joe Watson briefly discussed the sections on short circuit fault current calculations and the models and equations in that section. Muhammad Ali Masood Cheema volunteered to review that section and create some additional material.
 - We discussed the standard pre-fault voltage to be used in the fault current calculations which was listed as 1.05 per-unit in the draft. It was agreed that a 1.0 per-unit pre-fault voltage should be used instead and this should be 1.0 per-unit nominal system voltage class (230 kV, 138kV, etc.) for all calculations unless specified otherwise and not the tap voltage
- Joe Watson also briefly presented the new material in the Design Review section and advised the group to download the latest draft of the document and review the new sections and be prepared to discuss any recommendations at the next meeting.
- Joe Foldi recommended that it should be the manufacturers' responsibility to calculate the mechanical forces, since they typically have more precise programs and models. We discussed including some general mechanical force calculations in the Guide, which Muhammad Ali Masood Cheema offered to draft and there was not clear consensus either way on this. This may be included in the next draft for a better evaluation.

- Joe Foldi also made some general recommendations for additions to the Design Review section to include more specific forces for different types of windings (no need for axial force evaluation on radial spacers for core-form layer windings, for example). This may be done with a table or text. To be determined.
- The meeting adjourned at 6:05 PM.

J.8.14 WG on Neutral Grounding Devices PC57.32

Pittsburgh, PA
Monday, March 26, 2018
4:45 PM – 6:00 PM
Chair – Sergio Panetta
Vice Chair – Yann Ellassad

Call to Order

Self-introduction of all present

Patent Announcement

Quorum

The committee has 14 voting members:

1. Sheldon Kennedy Present
2. Sergio Panetta Present
3. Yann Ellassad Present
4. Bernard Audouard
5. Tom Yingling Present
6. Ed teNyenhuis Present
7. Les Recksiedler
8. Sinan Balban Present
9. Federico Turner Present
10. Richard Field Present
11. Stuart Gibbon Present
12. Andrew Keith Present
13. Edmundo Perich Present
14. Bob Berger Present

Attendance: 48 total.

Approval of Minutes motion by Yann Ellassad, seconded by Stuart Gibbon. No Changes.

Comments on C57.32a draft v7, Lines 289-290 are marked as deleted in error. The lines were deleted in error and will be reinstated.

Erin Spiewak described the procedure for balloting. Editorial review, sign ups period, Comments period, Comments reviewed by committee, amendments and corrections, Final approval.

Motion by Sinan Balban to change language of Applied Voltage Test from current C57.32 standard back to language in IEEE 32-1972 that the applied voltage test is between the element and bank frame and not from the element to the enclosure, seconded by Richard Field. Point of Order that the amendment has been sent for balloting and it must be rescinded before this change can be made.

Motion to rescind current ballot by Sinan Balban, seconded by Richard Field. Yes votes: Andrew, Richard, Stuart, Edmundo, Bob, Sinan. No votes: Federico, Yann, Tom, Ed, Sheldon. Motion fails.

The chairman asked for a straw vote on rescinding the ballot. Result 5 yes, 6 no.

Erin confirmed it is acceptable to change the Applied Voltage Test during the commenting stage of ballot approval. Balloting requires 75% of the ballot voting members to vote and an approval of 75% of those who vote.

New Business

Question by Richard Field on how to change the C57.32 standard after this amendment committee has completed its task. Procedure is to petition the C57.32 committee for another amendment.

Next meeting is the 2018 Fall meeting in Jacksonville, FL October 14-19, 2018

Adjournment

Respectfully Submitted,
Tom Yingling - Secretary
3/31/20187

J.8.15 Working Group C57.123 Loss Measurement Guide

Pittsburgh, PA – Mar 26, 2018

The Working Group met at 15:15 in the Allegheny Room on March 26, 2018. This was the second meeting since receiving the PAR for revision of the guide. This guide was first published in 2002, revised in 2010 and there is now a PAR for revision that expires in 2021.

- The Chair, Ed teNyenhuis, led the meeting. The secretary, Anthony Franchitti, took the minutes.
- The following persons were present:

Jason Attard - Guest
William Dietrich - Guest
Reto Fausch - Guest
Anthony Franchitti – Member (Secretary)
David Garcia - Guest
Ramsis Girgis - Member
Ted Johnstone - Guest
Ricardo Lopes - Guest
Dhiru Patel - Guest
Jarrod Prince - Guest
Adnan Rashid - Guest
Eduardo Robles - Guest
Adam Rosenstein - Guest
Mahesh Sampat - Guest
H. Jin Sim - Guest
Erin Spiewak - Guest
Andrew Steineman - Member
Tanya Steinhauser - Guest
Craig Stiegemeier - Member
Craig Swinderman - Guest

Dragan Tabakovic - Guest
Marc Taylor - Guest
Ed teNyenhuis – Member (Chair)
Lin Tong - Guest
Kiran Vedante - Guest
Juntao Zhong - Guest

- Four of the six members were present. Therefore, a quorum was reached.
- A motion to approve the meeting minutes was made by Ramsis Girgis and seconded by Andy Steineman. There were no comments and the minutes were approved unanimously.
- The Agenda was presented and a motion to approve the agenda was made by Ramsis Girgis and seconded by Andy Steineman. There were no comments and the agenda was approved unanimously.
- Discussion regarding the Scope of C57.123 ensued as to whether this guide should include Shunt Reactors. It was agreed that another guide (C57.41) covers Shunt Reactors and should not be part of C57.123 Scope.

OLD BUSINESS

- Agenda Items were covered as follows.
- Results of the PCS Survey on Phase Angle Correction (Sect. 4.4.1) and Bridge Method (Sect. 4.5.4) was presented by the Chair. It was determined from the comments and discussion that both methods should be retained in the guide but that section 4.4.1 should be revised to clarify when phase angle correction may be applied. Ramsis Girgis agreed to re-write this section.
- Comments from Mark Perkins on 3.5.3, 4.4.4.2 & 4.5.4 were presented and discussed. The Chair will incorporate Mark's comments into the draft guide and check with the C57.12.90 WG regarding adding discussion on the use of capacitors to correct phase angle and smooth voltage waveform during no-load loss measurements with a high impedance source. The Chair suggested that the use of capacitors during NLL measurements should be added as a cautionary note in section 3.5.3.
- Updates on Assigned tasks from the Fall 2017 were presented by the Chair:
 - Sections 3.1 to 3.5.2 were reviewed by Ramsis Girgis and draft updates were presented and discussed. A new paragraph to section 3.2.10 describing temperature effects to no-load loss measurements of lower quality core steels was added by Ramsis. General agreement was obtained from the WG to keep the paragraph as drafted.
 - Section 3.5.3 was reviewed by Bertrand Poulin. Mark Perkins also provided comments for this section which were reviewed at the meeting as mentioned above. The Chair will incorporate Mark's comments into the draft of C57.123.
 - Section 4.5.3 - Test of Three-Phase Transformer with a Single-Phase Voltage: Due to the practicality difficulties in this method, it was discussed whether this section should be deleted in its entirety. The Chair will discuss the possibility of eliminating this section with Bertrand Poulin.

- Sections 4.5.4 & 5 were to be reviewed by Eddy So. Due to time constraints, he could not able to complete his review. The Chair will ask for Eddy's review to be completed.
 - Section 6 was to be reviewed by Ramsis Girgis. Ramsis will review this section.
 - Section 7 was assigned to Reto Fauseh for review.
 - Section 8 was reviewed by Andy Steineman. Andy had no comments for this section.
 - The bibliography will be reviewed by Eddy So and Bertrand Poulin.
- It was agreed by the WG to have the above sections reviewed and comments provided within two months of this meeting. The Chair will then draft the revision to C57.123 and send out for comments before the next meeting.

NEW BUSINESS

- There was no new business to discuss.

The meeting was adjourned at 16:10 with a motion by Ramsis Girgis and seconded by Andy Steineman.

J.8.16 Task Force Meeting - Insulating Liquid for Factory Testing

Pittsburgh PA – Mar 27, 2018

- The Task Force met at 11.00 AM in the Sky Room on March 27, 2018
- The Chair, Ed teNyenhuis, led the meeting.
- There were 96 persons present. This was the first meeting so there was no membership list. The attendees were told that anyone could be a member for voting purposes since this was the first meeting.
- The original request was in the Task Force on PCS Revisions to C57.12.90 at the Fall 2017 Louisville meeting. Steve Schroeder requested: *“We should address the fact that a transformer must be tested with in the same Liquid that it will be filled with in service. This is due to the fact that natural ester and mineral oil have very different properties. This is most critical for temp run and dielectric tests”*. The scope of the task force was to recommend back to the SC if any changes to the standards should be made.
- The main point of the discussion is for transformers designed for natural ester oil but the transformer is filled with mineral oil in the factory.
- A Technical Overview was given by Alan Sbravati from Cargill of the impact of using a different insulating liquid for the first impregnation & factory testing versus a different insulating liquid for design / service. The presentation will be available for the attendees. The main conclusions were:
 1. There is sufficient design margin to account for residual mineral oil slightly affecting the dielectric and thermal properties of the natural ester oil
 2. Above 230kV it is more critical that the same oil be used for factory testing as used in service

- A transformer manufacturer commented that they strongly recommend that the same insulating liquid type should be used for factory test and in service since:
 - Cooling performance of natural esters is much different compared to mineral oil
 - Dielectric properties (strength and stress distribution) of natural ester is different compared to mineral oil
 - Material compatibility is not same for both liquids
 - Once impregnated with mineral oil, cellulose insulation cannot be re-impregnated with natural ester. This has effect on cooling, dielectric and aging performances.
- Stray gassing after the unit is in service could be an issue (with mixed mineral and ester oil)
- Several utilities indicated that they specify that the oil the transformer is designed for must be used in the factory.
- Several reasons were given why a transformer manufacturer would not want to fill the transformer with natural ester oil in the factory:
 1. Natural ester oil has a longer impregnation time (up to 3 times longer than mineral oil)
 2. The oxidation stability of natural esters would require that the transformer could not be filled with dry air during shipment (if shipped without oil). It must be filled with Nitrogen for shipping which has more complications.
 3. A separate oil farm system, hoses etc is required for natural ester oil which could be a burden for just occasional natural ester oil usage.
- A motion was given to recommend to “Revise the standards to say that the insulating liquid used for service must also be used for factory testing”. This was motioned by Paul Morakinyo and seconded by Don Platts. This was voted on and the motion did not pass (19 votes for and 24 votes against).
- A second motion was given to recommend to “Revise the standards to say it is recommended that the insulating liquid used for service also be used for factory testing. In the case it is agreed by the user and manufacturer to not test with the same liquid type, it should be supported by calculation or experience”. This was motioned by Patrick McShane and seconded by Jeff Valmus. This was voted on and the motion did pass (19 votes for and 16 votes against).
- The chair will present the TF recommendation to the subcommittee.
- Meeting was adjourned at 12.17 PM