

Annex J Performance Characteristics Subcommittee (PCS)

October 30th, 2019, Columbus, Ohio, USA

UNAPPROVED MINUTES

Chair: Craig Stiegemeier

Vice Chair: Sanjib Som

Secretary: Rogerio Verdolin / Kris Zibert

J.1 Introduction / Attendance

There were 70 of the 107 PCS members in attendance so quorum was achieved (65% in attendance). In addition, 80 guests were present at the meeting. The total attendance at the meeting was 150. There were 23 guests who requested membership. Their requests for membership and past attendance will be reviewed. If they meet the membership requirements, they will be granted membership before the next meeting in Charlotte, North Carolina, March 22 – 26, 2020.

J.2 Chairman's Remarks

The Chair introduced himself, the vice-chair and secretary and provided the below updates and comments. The chair announced he is stepping down from his position and the secretary of the PCS, Rogerio Verdolin will be the new chair of the PCS. The chair announced that the secretary position is open and informed that anybody interested in this role should contact the new chair.

The chair stressed the importance and make sure that participating in this activity should agree to comply with the IEEE Code of Ethics, all applicable laws, and all IEEE policies and procedures including, but not limited to the IEEE-SA Copyright Policy.

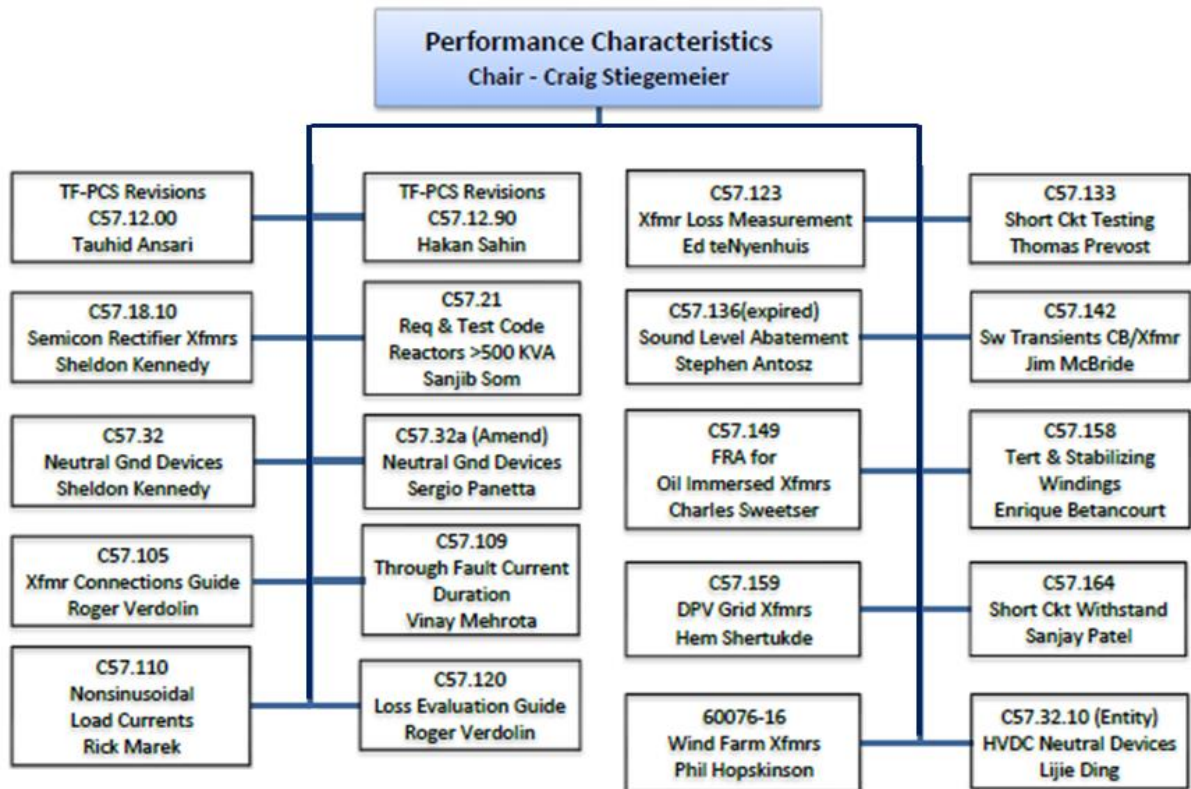
The chair stressed that all participants shall inform the IEEE (or cause the IEEE to be informed) of the identity of each holder of any potential Essential Patent Claims of which they are personally aware if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents.

PCS Responsibilities: Defined by the Transformers Committee Organization and Procedures Manual.

The Performance Characteristics Subcommittee shall be responsible for the following:

- Studying and reviewing the treatment of loss, impedance, exciting current, inrush current audible sound and vibration, and other performance characteristics and their methods of application, measurement, or test for liquid filled transformers and liquid filled and dry type reactors.
- Studying and reviewing the treatment of the performance characteristics of other special use transformers e.g. photovoltaic, wind, and rectifier transformers.
- Developing and maintaining related standards, recommended practices, and guides for such criteria
- Coordinating with other technical committees, groups, societies, and associations as required

Standards Supported by PCS:



- C57.12.00-2015 (Rev. 2010) – TF to provide PCS revisions – T. Ansari
- C57.12.90-2015 (Corr. 2017) – TF to provide PCS revisions – H. Sahin (test code) & R. Girgis (audible sound)
- C57.18.10-1998 (Amend. 2008) – Semiconductor rectifier transformers – S. Kennedy
- C57.21-2008 (Rev. 1990) – Requirements & Test Code For Shunt Reactors >500kVA – S. Som
- C57.32-2015 (Rev. IEEE Std. 32-1972) – Neutral Grounding Devices (2025) – S. Kennedy
- C57.32a (Amendment) – Neutral grounding devices – S. Panetta
- C57.32.10 - new Entity PAR - WG Neutral Grounding Reactors Guide for HVDC Converter Transformers
- C57.105-2019 – Transformer connections guide – R. Verdolin
- C57.109-2018 – Through Fault Current Duration – V. Mehrotra
- C57.110-2018 (Rev. 1998) – Xfmr Capability when Supplying Nonsinusoidal Load Currents – R. Marek

- C57.120-2017 – Guide for loss evaluation – R. Verdolin
- C57.123-2010 (Rev. 2002) – Transformer Loss Measurement – E. teNyenhuis
- C57.133-exp – Guide for Short Circuit Testing (Expired – now covered by C57.12.90) – T. Prevost
- C57.136-2000 (Reaff. 2005) – Sound Abatement Guide (will let expire, may cover in C57.12.90) – S. Antosz
- C57.142-2010 – Switching Transients Circuit breaker/Transformer – J. McBride
- C57.149-2012 – New SFRA Guide (2022) – C. Sweetser
- C57.158-2017 – Tertiary & Stabilizing Windings (2027) – E. Betancourt
- C57.159-2016 – DPV Transformers (2026) – H. Shertukde
- C57.164-new – Short Circuit Withstand (in development) – S. Patel
- 60076-16-2018 – Wind Turbine Generator Transformers – P. Hopkinson
- Moved TF to determine if a new guide for field testing OLTCs is needed is now preparing a
- PAR under the Standards SC as TF PC12.152 – M. Ferreira

Status of Active PAR's:

- **2019 PAR's**
 - C57.105 3-ph Transf. Connections (complete)
 - C57.109 Through-Fault-Current Duration (complete)
- **2020 PAR's**
 - C57.18.10 Semiconductor Rectifier Transformers (WG in draft development)
 - C57.21 Shunt Reactors over 500kVA (filed PAR extension in May 2018, sponsor ballot open, closing today)
 - C57.164 Short Circuit Withstand Guide (WG in draft development)
- **2021 PAR's**
 - C57.142 Transient Guide (WG in draft development)
 - C57.32a Neutral Grounding Devices amendment (Sponsor Ballot complete: in Comment Resolution phase)
 - C57.123 Loss measurement guide (WG in draft development)

- **2022 PAR's**
 - C57.32.10 Entity WG Neutral Grounding Reactors Guide for HVDC Converter Transformers
 - C57.149-2012 – SFRA Guide (WG in draft development)

Status of Standards without active PARs

- WG Guide for FRA for Liquid Filled Transformers C57.149 C. Sweetser
- TF PCS Continuous Revisions to Test Code C57.12.90 H. Sahin
- TF PCS Audible Sound Revision to Clause 13 of C57.12.90 R. Girgis
- WG on Loss Measurement C57.123 E. teNyenhuis
- TF PCS Continuous Revisions to C57.12.00 T. Ansari
- WG Shunt Reactors C57.21 S. Som
- WG HVDC Converter Neutral Devices Entity PC57.32.10 H. Zhang
- WG Semiconductor Rectifier Transformers C57.18.10 S. Kennedy
- WG HV & EHV Breaker & Transformer Sw. Transients C57.142 J. McBride
- WG Short Circuit Withstand Design Criteria C57.164 S. Patel

Performance Characteristics Subcommittee WG / TF Activities & Member responsibilities

- WG/TF should focus on developing standards related to performance and function and not on design, construction or material specifications
- Association Management System (AMS) should be kept current and reflect your association at the time of the meeting
- AMS is the only place where attendance is recorded
- It is your responsibility to identify potential situations where the WG product could infringe on a patent
- Anything presented and all comments made during the meeting is copy written by the IEEE

Performance Characteristics Subcommittee WG / TF Leaders

- Issue agenda at least 30 days ahead of time
- Recording minutes of each meeting according to Clause 6.5 and IEEE guidelines and publishing them within 15 calendar days of the end of the meeting. 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

Working Group / Task Force Leaders

WG Guide for FRA for Liquid Filled Transformers C57.149	C. Sweetser
TF PCS Continuous Revisions to Test Code C57.12.90	H. Sahin
TF PCS Audible Sound Revision to Clause 13 of C57.12.90	R. Girgis
WG on Loss Measurement C57.123	E. teNyenhuis
TF PCS Continuous Revisions to C57.12.00	T. Ansari
WG Shunt Reactors C57.21	S. Som
WG HVDC Converter Neutral Devices Entity PC57.32.10	H. Zhang
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WG Short Circuit Withstand Design Criteria C57.164	S. Patel

WG / TF Leaders – Process Requirements

- AdCom discussed and agreed that the Comment Resolution Group (CRG) should vote at a simple majority when reviewing comments
- AdCom also agreed that if the comments were brought back to the WG for consideration the voting requirements would also be a simple majority.
- Virtual meetings between physical meetings help move things along, but you must announce them by circulating an Agenda to the entire PCS using the AM System at least 15 days before the meeting
- Every meeting's minutes must record both member & guest attendance using the AM System and must include: Attendance; Quorum; Motions (with names) and Voting results
- The minutes from every meeting (physical and virtual) must be provided to the PCS secretary within 15 days
- Minutes will be posted on the Transformers Committee website

Attendance / Membership / Quorum

- Please record your attendance on one of the Sign-in Sheets being circulated – we only need your name if you are not on the Sign-in Sheets being circulated
- 17 “Corresponding Members” are counted as “Guests” in terms of attendance
- 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 107 members after a review of the Spring 2019 meeting attendance, along with the 4 previous meetings
- A meeting quorum will be reached if 54 members are in attendance

Attendance / Membership – moved to Guest status

The following 9 Members missed the past 2 meetings and have been moved to “Guest” status:

- Florian Costa
- Michael Franchek
- Gregorio Lobo
- Mickel Saad
- Michael Sharp
- Daniel Weyer

Please contact Sanjib by sending him a message or see him after the meeting if you believe your membership status is not accurate.

Attendance / Membership – New Members

These 6 former Guests requested membership at the Fall 2019 meeting and have attended the past 2 or 3 of the last 5 meetings:

- Israel Barrientos
- Muhammad Ali Masood Cheema
- Jorge Cruz
- Aniruddha Narawane
- Sylvain Plante
- Amitabh Sarkar

Welcome the New Members: We look forward to your contributions to the Subcommittee

Attendance / Membership – counted as Guest status

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. Daniel Sauer made 1st motion to approve the agenda and was seconded by Marcos Ferreira.

J.4 Approval of Last Meeting Minutes

The Chair presented the minutes of meeting held in the Spring 2019 - Anaheim, California, March 24 – 28, 2019 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. Bertrand Poulin made 1st motion to approve Spring 2019 meeting, which was seconded by Tauhid Ansari.

J.5 Minutes from Working Groups and Task Force

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

- **WG Guide for FRA for Liquid Filled Transformers C57.149**
- **TF PCS Continuous Revisions to Test Code C57.12.90**
- C. Sweetser**
- H. Sahin**

- **TF PCS Audible Sound Revision to Clause 13 of C57.12.90** **R. Girgis**
- **WG on Loss Measurement C57.123** **E. teNyenhuis**
- **TF PCS Continuous Revisions to C57.12.00** **T. Ansari**
- **WG Shunt Reactors C57.21** **S. Som**
- **WG HVDC Converter Neutral Devices Entity PC57.32.10** **H. Zhang**
- **WG Semiconductor Rectifier Transformers C57.18.10** **S. Kennedy**
- **WG HV & EHV Breaker & Transformer Sw. Transients C57.142** **J. McBride**
- **WG Short Circuit Withstand Design Criteria C57.164** **S. Patel**

Below are highlights that were discussed at the PCS meeting:

1) WG Guide for FRA for Liquid Filled Transformers C57.149 C. Sweetser

After review of the document C57.149, the WG has decided on three components as the main focus for revision.

- Grounding Recommendations (New Section)
- Analysis and Interpretation of Test results
- Test Connections (Improvement/Additional Diagrams)

2) TF on PCS Continuous Revisions to Test Code C57.12.90 H. Sahin (Presented by Tauhid Ansari)

Short circuit number of tests business continued to be discussed. There were many technical discussions and the decision was made to have off site group crated and continue working on this topic and present where the TF is during the spring meeting.

Motion made and approved to have an internal discussion among some of the working group that the wording of a new proposal be created for proposal to the entire working group in Charlotte meeting. Frequency tolerance for Voltage and frequency during ratio testing was discussed and the TF agreed with the proposal to add 30% tolerance and proposal was made and agreed to have a survey among the PCS on the proposal.

New Business to revise the section 7.3 “Ratio Methods” was discussed. After several pages of presentation and discussions on the necessity to revise the section.

Motion was approved to add this topic for the TF to work on to modernization of the ratio testing section of the standard.

The Chair noted that there has been a lot of activity and new businesses passed through the TF in the last 6 meetings and he will be sending out surveys to PCS for these changes to be finalized and submitted to standards.

Steve Antosz raised questions regarding procedure concerns. In the last meetings, around 2 years, none of the materials were not received from this TF. Has to work the way up to the subcommittee and coming to the Standard subcommittee, which has not happened. C57.12.90 was planned to conclude at the end of this year. The 6 items from the survey have not come to the subcommittee. Steve suggested have the survey done by Email in the next month or two. Tauhid Ansari suggested to have a motion to have the survey going out, all items that have been approved in the TF. Some items were approved in the previous meetings. Steve stated that lots of items were approved at the TF level and he believes no of them came to this subcommittee to get formal approval. The chair suggested Tauhid take back to the TF and communicate with everybody. DanielSauer asked for a motion for to

have approval of this survey at the PCS, to approve the results of the survey. The chair suggested having these 6 items listed in the survey to be presented at the next PCS meeting.

3) TF on Audible Sound Revision to Clause 13 of C57.12.90 R. Girgis

The TF is presently discussing texts to be added to C57.12.90 Clause 13 regarding the impact of temperature on core noise and load noise as well as impact of tap position on Load noise.

Also, there is now a new effort to establish a WG to produce a new Sound Abatement Guide that would be an update of the previously expired Sound Abatement Guide. Steve Antosz agreed to undertake the chairman position of that WG. In the TF meeting, the Chairman reviewed the content of the present Guide and what updates would be needed.

There was some discussion on what the scope of the new Guide should be; e.g. whether it would include oil filled shunt reactors, and whether it would include both distribution and Power transformers. It was agreed to circulate to the attendees a proposed Scope and Title for their input.

4) WG on Loss Measurement C57.123 E. teNyenhuis

The WG has concluded the document. There was a recirculation and the document is under RevCom.

5) TF on PCS Continuous Revisions to C57.12.00 T. Ansari

6) The result of survey on including core information on nameplate and modification of load loss measurement statement was presented to group. Result of survey as under: Core information in nameplate: 41 responses, 98% Affirmative, 2% Disapprove

7) Tauhid Ansari asked for a motion to include this modification in the standard C57.12.00. Craig stated that if this motion is successful then this suggestion will be passed on to the WG. Javier Arteaga has seconded the motion. Steve Antosz raised the question regarding the type 2. Craig stated that there is no class designation. Ramsis mentioned in the TF meeting about the core forms. There are 6 core forms. More clarification is required; it has to go back to the TF. Javier Arteaga stated that the word "other" can include possible combinations of core forms. Ramsis stated that type of core forms are not other. Daniel Sauer asked to move to table the current motion and send back to the TF to clarify how to do with class 2 power transformers. There were discussions on this motion. The decision was to go back to TF.

8)

9) Load loss measurement: 41 Responses, 68% Affirmative, 24% Disapprove, 7% Abstentions.

10) Chair agreed to initiate the motion in PCS Subcommittee for voting on addition to next revision of C57.12.00

11) Two more items were discussed both related to ratio. After discussions it was decided to rewrite the proposal. Chair agreed to contact few interested members to draft the proposal before next meeting.

12) There were discussions about rated current vs rated kVA. The chair suggested having all these issues to send back to the TF to be discussed. To table the motion that was on the floor, send back to the TF. A motion to end discussion. Super majority, 2/3. Call the question. With 66 members attending, we had 41. So, we can keep discussion, but we have a lot of work to discuss. The motion was to send to the WG responsible to update C57.12.00. There were 34 members in favour. 15 voted negative and the rest has abstained.

6) WG Shunt Reactors C57.21 S. Som

The WG finished the first round of ballot. Ballot results, first round yielded 67 returns out of 76; 88% return. 60 approvals out of which 7 approvals were with comments; 89% approval. It will go to the second round of ballot. Comments were resolved in the WG.

7) WG HVDC Converter Neutral Devices Entity PC57.32.10 – H. Zhang

The second WG meeting of PC57.32.10 (Guide for the Selection of Neutral-Grounding Devices for HVDC Converter Transformers) was held in Columbus, Ohio, from 11:00 a.m. to 12:15 p.m. on 29 October 2019. The quorum was confirmed as 7 of the 9 entity members attended the meeting (1 in person and 6 via web-conference). Altogether 25 specialists attended the meeting, including 7 entity representatives and 15 guests.

At the meeting, the outline and progress of the guide was presented, and the first-edition draft briefly introduced. According to the comments, WG members agreed to work on special requirements for neutral-grounding reactors for converter transformers with comparison to that for other kinds of transformers. Three guests were approved as Invited Experts. The next WG meeting is scheduled to be held in Chengdu, China in April, 2020. By then, the second-edition draft will have been completed.

The meeting was great. There were people from Turkey, England, Mexico, and the US. The WG is planning to conclude the document in a couple of months. The WG will re-circulate the draft.

The draft 4.2 of the document is now in the balloting process, closing on March 27, 2019.

There are no plans to extend the ballot closing date.

The Chair requested additional volunteers to join the BRG: Mike Sharp, Dharamvir and Ulf Radbrandt have volunteered to the BRG.

Next step is to resolve the comments and recirculate the document. Target date is end of May 2019.

8) WG on C57.18.10 Semiconductor Rectifier Transformers S. Kennedy (Presented by David Walker)

The C57.18.10 Working Group addressed all of the comments from the email ballot on Draft 6 of C57.18.10. Then the Working Group voted to submit Draft 6 for SA ballot. Finally, the Working Group voted to create a Comment Resolution Group and authorized the CRG to complete the SA ballot process (ballot, comment resolution, recirculating, etc.) without further Working Group input.

9) WG on HV & EHV Breaker & Transformer Sw. Transients C57.142 J. McBride

Great effort working with IEEE Switchgear Committee. Much progress in gaining a better understanding of the cause, magnitude and impact of transients. Also, we're understanding each other's terminology better as we exchange information.

Draft 7 is about 80% complete, and will be posted in the next few weeks. The Working Group continues to provide review support and great supporting information is being put together for inclusion into an Annex. Damping factors were discussed in the meeting, and mitigation methods are being gathered. The presentations made during the meeting will be posted on the WG area on the PCS website.

10) WG Short Circuit Withstand Design Criteria C57.164 S. Patel

The WG discussed the project schedule. The PAR expires at the end of 2020 so the WG has just one more meeting to complete the work and approve the document to go to ballot. The WG still have the Appendix remaining, the References and some final edits to be done.

The Appendix, will contain a brief discussion of short circuit forces and equations that will help the user review manufacturers' calculated forces which should be more precise and accurate, but within a reasonable range for comparisons and discussions.

A motion was passed to include a discussion of stresses in the Appendix, but to not include any numerical margins or limits, and to leave those criteria to the manufacturer and user. The Appendix should be completed before the end of this year and the WG plans to issue a straw ballot to the members and guests of the WG with hopes of completing the Document and sending it to the SC for balloting approval at the Spring meeting.

If the WG fails to complete the Guide by the spring meeting, the WG will need to request a PAR extension

J.6 Unfinished (Old) Business

J.7 New Business and Motions

Possible inclusion of Steel Performance requirements – large effort, will be discussed at next meeting.

C57.12.90 changes

Possible entity PAR: "Guide for the Operating Vibration Test of the HVDC Converter Transformers". PCS decided that this is not a PAR that we think PCS should be sponsoring.

Proposal for PD Test for Gassing in Wound Cores – Bill Griesacker presented the background and PCS voted to endorse the proposal that is covered in detail in the minutes.

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

J.8.1 WG Guide for FRA for Liquid Filled Transformers C57.149

Working Group “Guide for FRA for Liquid-Filled Transformers” C57.149

(Performance Characteristics Sub-Committee)

Meeting Date/Time: October 28, 2019 0930 H

Meeting Location: Knox – Hyatt Regency

Chairman: Charles Sweetser [CS] (Omicron)

Vice-Chair: Poorvi Patel (EPRI)

Secretary: James Cross (Kinectrics)

Meeting was convened at 0935 H by Chairman Charles Sweetser with 44 total attendees, consisting of 11 members and 33 guests.

AGENDA

1. Introduction of Attendees
2. Review patent information.
3. Review agenda.
4. Approval of minutes
5. Review of Suggestions
 - a. Scope/application
 - b. Update/presentation - Grounding Influence and Technique (CS)
 - c. Update/presentation – Analysis/interpretation section (Peter W.)
6. Review case study process
7. Old Business
8. New Business
9. Adjourn

CS reviewed the standard patent disclosure info. (No response from attendees to request for patent info.)

Mario made a motion to approve minutes and agenda. Roger seconded. Carried unanimously.

Review of Suggestions:

1. Ground influence.
 - a. Chuck reviewed six different grounding cases that could be included in the grounding section.
2. Making an FRA Measurement (Test Connectins) - Diego Robalino (Megger)
3. Analysis & Interpretation - Peter Werelius (Megger)

Mario identified that bushing turrets, being painted, can present grounding issues. He says that pictures of the grounding/cabbling issues should be included in the Guide. Chuck would like this information to be on one page in the Guide.

Peter Werelius suggested that we use only one phase in the grounding section. CS said that this could cause issues in the case studies section...we would identify them phase by phase. CS believes that he has five good case studies covering these grounding situations.

Kumar made a motion to incorporate CS's grounding material in the Guide. Seconded by Peter W. Carried unanimously.

Peter noted that testing a transformer in a post-fault condition should identify that the transformer be tested in the "as-found" tap position. Diego suggested this was important information to be included. CS suggested that a disclaimer be included that the End user's procedures be followed in this respect. Diego proposed a motion that a statement be included in the Guide to this effect. Kumar seconded. Carried unanimously.

Mario suggested that we should check the IEC standard and the IEEE C57.152 Guide for consistency. Diego will lead effort to propose this wording. Mario suggested that the wording be sent to CS well in advance of the next meeting so that it can be distributed to the members.

Discussion of "Method 1" and "Method 2" grounding practices. Poorvi suggested that a statement might be included to account for lead runs. Mario says "factors influencing the grounding" (description, not charts). Poorvi volunteered to put this information together.

Analysis/Interpretation section: Peter Werelius (Megger) made a brief presentation on the analysis section. Peter asked if we should write some verbiage around "low", "medium", and "high" frequency range interpretation rather than calling out frequencies. Peter will work with Mario and Diego on a proposal.

Diego had some concerns about the connection diagrams, as did Mario. Diego showed some slides with a table with a connection matrix based on single-phase (polarity) and three-phase (vector groups).

CS asked if we should use the C57.12.70 document as the reference for these connections. Mario discussed the "understandability" of the connection matrix by technicians in the field, who are the audience for this Guide. Comment: We should be following the nameplate diagram. Discussion ensued about this connection matrix table. CS noted that the matrix still does not address the three-winding transformers, or zig-zag transformers. Peter noted that the connections are the same as for TTR tests. Mario noted that the table does not include short-circuit measurements.

Need CS' agenda

Need Diego's table for reference.

Motion to adjourn at 1045 H... Kumar moved, Roger seconded.

Request for membership

Fernando Leal – Prolec GE -

Rogério Verdolin – Verdolin Solutions, Inc. – roger.verdolin@shaw.ca

Scott Reed – MVA Diagnostics sreed@mvadiagnostics.com

James Cross

Secretary

C57.149 WG

J.8.2 TF PCS Continuous Revisions to Test Code C57.12.90

Meeting started at 11:00 am

Needed 43 members for a quorum out of 88 members after the Spring 2019 meeting.

Total number of attendees for 108

By hands count 47 members present so a quorum has been met

Agenda and last meeting minutes approved by members.

Called to order by Hakan

Presented Agenda on screen

Stated that this is the last meeting using a paper roster

Stated this is the last meeting for individual introductions to better utilize time.

Asked if any new business to allot time for. No response from floor requesting time for new business.

Showed on screen and read Purpose Statement

Introductions made by each member in the room

New guests name stated 2 total

New members status stated

Total membership statistics:

85 total members at present

3 corresponding members

Need 43 for a quorum

By hands count 47 members present so a quorum has been met

Agenda posted on screen. Agenda approved by members.

Minutes of Spring meeting – members approved minutes

Short circuit number of tests business:

Member presented slides on the number of short circuit test. Review present standard. Noted:

- 3 phase vs 1.5 phase test
- During 1.5 phase test for 3 phase unit 2/3 of tests at 50% of current for each phase
- Interpretation question as to 1.5 test requires a total of 18 tests or 6 tests
- Reviewed single phase test
- He believes that symmetrical tests do not stress windings enough to be a valid test

Dan Sauer stated that his experience with single phase voltage regulators that impedance changes were significant due to symmetrical tests even after 2 asymmetrical tests. Also, his experience the symmetrical shot made a difference on impedance change as to the timing of the closing whether on the upswing or the downswing of the sine wave.

Presenter noted that IEC proposal is the look for impedance change stabilization which requires more than 2 tests.

Joe Foldi – (my notes not clear on his thought) - about requiring 2 asymmetrical and 4 symmetrical when performing 1.5 phase test.

Dan Sauer noted his experience changes of ¼ to ½% and sometimes 1 to 2% for some tests (single phase regulators).

The proposal by the presenter to clarify number of tests required between 3-phase and 1-phase. Also, he proposes to change to require 3 asymmetrical tests for a total of 9 tests.

There was discussion of proper procedure for dealing with proposal.

Motion made and approved to have an internal discussion among some of the working group that the wording of a new proposal be created for proposal to the entire working group in Charlotte meeting.

Motion was approved.

Slide presented on Sylvain Plant's proposal on frequency tolerance for testing.
Proposal was made and agreed to have a survey among the working group on the proposal.

New Business:

John Herron slide presentation of 3 methods for ratio testing. He believes that some of the methods used are no longer used in the industry and therefore should be eliminated from that section of the standard and moved to an Annex.

It was asked of the audience whether some of the methods are still used. (Name = Polo??) Believed one of the methods has been used recently but infrequently used.

Another in audience stated one model of a Doble instrument used capacitor ratio method for TTR.

Hakan noted that the standard is not to dictate the inner working of how a TTR "box" operates.

Hakan proposal – investigate modernizing the ratio test section as a new business item. Asked if anyone disagreed.

Motion by Dan Sauer to add the item to modernization of the ratio testing section of the standard. Motion was seconded. A raised hand vote was taken, and motion passed.

Hakan also notes that there has been a lot of activity and new businesses passed thru the TF in the last 6 meetings and he will be sending out surveys to PCS for these changes to be finalized and submitted to standards.

Meeting was adjourned at 12:00 pm

J.8.3 TF PCS Audible Sound Revision to Clause 13 of C57.12.90

Unapproved Minutes of Fall 2019 Meeting of TF "Audible Sound Revision to Test Code C57.12.90", in Columbus, OH

The TF met at 1:45 PM, on Monday, October 28, 2019. Chairman Dr. Ramsis Girgis presided over the technical part of the meeting and Secretary Barry Beaster handled the administrative duties of the meeting.

After the Spring 2019 meeting, the membership was adjusted to 47 members. The Cloud-In-Hand system recorded an attendance of 32 of 46 members with 82 in attendance. A quorum was established with 69.6% of the membership. A final verification will be recorded in the AMS system after any alignment with the circulated paper rosters for late arrivals. A call was made for any objections for a unanimous approval of the Spring 2019 TF minutes; no objections were raised so minutes are approved as written. The proposed agenda was presented without objections for approval. The circulated attendance sheets had seven requests for TF membership; which will be reviewed based on previous meetings attendance.

Prior to the TF meeting in Pittsburgh, a survey was issued on proposed text on "Impact of temperature on core noise" that says that core temperature has a small impact on core noise; except in the case of some core steels with lower quality coating that can experience a significant increase in core sound level at higher core temperatures. So, one important question raised was whether this effect is the same when the whole transformer core temperature is elevated during regular operation. So, in the TF meeting in Anaheim, the Chairman requested manufacturers of power transformers to perform 110 % core excitation tests for 4 hours before and after the heat run test and measure core noise. The Chairman received some data that he presented in this meeting. The data showed a small impact of temperature on core loss and core noise both before and after the Heat run test. This confirmed that for good quality steels the impact is small. The chairman requested manufacturers to perform the core excitation tests on cores made of other qualities of steel.

Joe Foldi commented that he has seen cases that core noise seemed to increase beyond 4 hours may not be long enough for the oil rise and suggested six hours may be better. The Chairman stated that all

measurements that he has seen showed the increase to stabilize within the first 4 hrs and suggested they discuss the case together after the meeting.

Another part of that survey was on proposed text on “Impact of temperature and Tap position on load noise” that says that both of these impacts are small. However, while quantifying the impact of temperature to be in the ± 1 -2 dB range, it was brought up by a member of the TF that the impact of the Tap position can be a little higher for some transformer winding designs. The Chairman offered to look into this effect again and report back on it in the next TF meeting.

Steve Antosz commented that in today’s test code there is text on Load noise measurement and tap position. The Chairman agreed to look into what is already there and revise the proposed wording accordingly; but there is nothing about the impact of temperature.

The Chairman presented an overview of the content of the already expired Sound Abatement Guide and recommended updates / additions to be made in the new proposed Guide. After a good discussion a proposal was made by Zan Kiparizoski and seconded by Robert Ganser to initiate a new guide. Steve Antosz agreed to undertake the chairman position of the WG that will work on the new proposed Guide.

There was some discussion on what the scope of the new Guide should be; e.g. whether it would include oil filled shunt reactors, and whether it would include both distribution and Power transformers. The Chairman suggested to look into the content of the Shunt Reactor Standard and Distribution Transformers Standard. As time was expiring, it was agreed a proposed Scope and Title be circulated to the attendees. The Chairman agreed to take this proposal to the Performance Subcommittee for their acceptance and forward to the Standards Subcommittee.

Finally, a new item brought up by Bob Ganser was what the Standard say about core noise for variable flux designs. The Chairman suggested that he will look into this and will come back with a recommendation on this.

Respectively submitted,

Ramsis Girgis, TF Chairman

Barry Beaster, TF Secretary

J.8.4 WG on Loss Measurement C57.123

Report Working Group C57.123 Loss Measurement Guide Columbus OH – Oct 30, 2019

- The Working Group did not meet in Columbus
- At the last meeting, the draft guide was approved for ballot
- The Draft 10 of the guide was submitted for Ballot in July 2019 with the below statistics:

- **RESPONSE RATE**

This ballot has met the 75% returned ballot requirement.

99 eligible people in this ballot group.

87 affirmative votes

1 total negative votes with comments

1 negative votes with new comments

0 negative votes without comments

2 abstention votes: (Lack of expertise: 1, Other: 1)

90 votes received = 90% returned

2% abstention

- **APPROVAL RATE**

The 75% affirmation requirement is being met.

87 affirmative votes

1 negative votes with comments

88 votes = 98% affirmative

- There were 60 comments. Most were editorial or questioning the year of the referenced IEEE standards. There were a few technical comments which were resolved. The negative ballot was resolved by removing Section 8.3 on Safety and changing “warning” or “caution” to “precaution”.
- The recirculation passed with 0 negative ballots
- The Draft 11 was sent to RevCom and is on the Nov 2019 agenda. The Working Group has completed its task 2 years ahead of the PAR expiry.

J.8.5 TF PCS Continuous Revisions to C57.12.00

PCS Task Force on General Requirements C57.12.00

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee*

*October 28, 2019 4:45 PM
The Hyatt Regency Columbus Hotel
Columbus, Ohio USA*

UNAPPROVED MINUTES

The PCS Task Force on General Requirements for C57.12.00 met on Monday, October 28, 2019. The Chair Tauhid Ansari called the Group to order at 4:50 PM and reminded purpose and scope of the TF. The copyright statement from IEEE was presented to the Group, as well as the essential patents claim; none of the present was aware of issues related to this TF’s activities. According to the automated RFID system, **47** Members and **50** guests were present. Paper rosters were distributed as a backup. The quorum to conduct regular business was established as **82** members are registered in the Task Force. The following **12** guests requested membership:

Alexander Winter	HIGHVOLT Pruftechnik Dresden
Arup Chakraborty	Delta Star Inc.
Christopher Slattery	FirstEnergy Corp.
Deepak Kumaria	ABB Inc.
Everton De Oliveira	Siemens LTDA
Fernando Leal	Prolec GE
Jeffrey Schneider	Eaton Corporation
Jeffrey Wright	Duquesne Light Co.
Kris Zibert	Allgeier, Martin and Associates
Mark Lachman	Doble Engineering Co.
Mark Lowther	Mitsubishi Electric Power Products

The Chair introduced Zan Kiparizoski as new Member of the Group. The Anaheim (Spring 2019) minutes were approved as submitted (R. Verdolin, A. Yoshi) by the Group; the WG's Agenda was also approved (S. Som, R. Verdolin).

Agenda Items were covered as follows.

1. OLD BUSINESS

A. Survey report on Core information in Nameplate and load loss measurement

A.1. Core information

The proposal for modification of Table 6 with "addition of core type information on transformer's nameplate C" was surveyed among PCS Subcommittee with following results: 41 responses, 98% Affirmative, 2% Disapprove.

According to this proposal, two new rows would be added to Table 6 of C57.12.00, column C:

Core design - Shell or Core Type
Number of legs - 2, 3, 5, 7, other

The Chair presented to the Group the comments received through the survey and opened the floor for discussion.

R. Girgis clarified that "core legs" is a definition applicable to core type transformers and to some shell types, and for single phase shell type cores "D type" would be more appropriate. J. Wright mentioned that in WG C57.12.80 discussion is currently going on about modern definition of "core type" and "shell type" transformers.

The Chair considered surveyed text strong enough to bring it up to PCS consideration. He also clarified that further modification of surveyed text would imply new survey process within the TF and PCS.

A2. Load Loss Measurement

This proposal stated addition of sentence "*At least one test shall be performed at the minimum kVA rating and one test at the maximum kVA rating.*" to current requirements for Load Loss Testing on Table 17 of C57.12.00.

Survey results were:

41 Responses, 68% Affirmative, 24% Disapprove, 7% Abstentions

The Chair presented comments received and opened the floor for discussion.

D. Blaydon clarified that the text on Table 17 would essentially remain the same and would only be added requirement to report load loss at minimum and maximum ratings. As in current practice, measurements would be at rated tap, if not otherwise specified by purchaser.

With no further questions or comments, the Chair will take the new text for discussion within the PCS meeting.

B. Next Agenda item: WG Item 111, change ratio tolerance to 1% or less than 1/10th of the transformer impedance. – Submitted by S. Hakim.

IEEE C57.12.00 Sect. 9.1 currently states that “*when the volts per turn of the winding exceeds 0.5% of the nameplate voltage, the turns ratio of the winding on all tap connections shall be to the nearest turn.*”

S. Hakim submitted proposal to modify text according to: “*when volts per turn exceeds 0.5% of the phase to ground voltage of the name plate voltage, the ratio on winding on all tap connection can be higher than +/-0.5% but not exceeding either 1/10th of percentage impedance at the base MVA or the %step of the tap whichever is lower.*”

The Chair opened the floor for discussion.

Hakim offered further clarification for his proposal, based on his experience with actual transformer designs. Other attendees referred not having had similar experience but pointed out that such differences could be captured at stage of design review. J. Foldi referred practice to put actual voltages on nameplate, in case the fell outside the 0.5% tolerance. R. Ahuja pointed out that current text in standard has provided appropriate reference for practical application for years now.

Don Dorris asked about issues with variable flux designs and suggested a note on the document referring to test reports. S. Som stated that special conditions could detected in design review, if specified.

The Chair closed discussion on the subject, by proposing development of a new text to survey, in collaboration with Hakim and other members of TF.

C. Next Agenda Item- WG Item 112, Clarification on ±0.5% tolerance of ratio of three phase transformer-Submitted by Ryan Musgrove

R. Mussgrove requested addition of a tolerance for the difference in turns ratio of the phases of three-phase transformers: “as the standard is written now, there could be a 1% difference between one phase and another”.

The Chair opened the floor for discussion.

It was mentioned that a magnetized core could produce such a behavior in a three-phase transformer. H. Shamu supported Ryan’s request, J. Foldi considered satisfactory current +/-0.5% tolerance. K. Vijayan pointed out that differences in turns ratio between phases should be limited according to system tolerances, which could be higher than 1%.

Ryan Musgrove made a motion: “to investigate acceptable tolerance in turns ratio between phases of a three-phase transformer”. Akash Yoshi seconded the motion.

Ed TeNyenhuis pointed out to Std. C62.1-1995 stating a tolerance of 0.5% between phases as acceptable.

The Chair requested voting on motion, and it passed with none opposed, no abstentions.

The Chair offered to start the process by assembling a small group to discuss the subject, to then survey the subject within a larger group.

2. NEW BUSINESS

A. The Chair asked if there were new business to bring up to the Group.

Sanjib Som clarified that, according to recent explanation about our TF operating process, new business to this Group should be brought up through the Chair of WG C57.12.00, Steve Snyder.

The meeting was adjourned at 5:50 PM (S.Som, R.Verdolin)

Respectfully submitted,

Tauhid Ansari
WG Chair

Enrique Betancourt
Secretary

J.8.6 WG Shunt Reactors C57.21

IEEE Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA C57.21

**Columbus, OH
Hyatt Regency Columbus Hotel
Tuesday October 29, 2019**

The working group met in the Union CDE room (2) of the Hyatt Regency Columbus Hotel on Tuesday October 29, 2019, at 9:30 AM.

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

There were a total of 51 participants: 15 Members and 36 Guests out of which three Guests requested membership. No new memberships granted.

- The meeting was opened with the Chairman remarks and the circulation of attendance rosters.
- 15 of the current 20 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 October 17, 2019 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 S19 meeting in Anaheim, which were circulated on October 17, 2019 by email, were presented to the audience.
- Motion for approval by Matt Weisensee seconded by Hemchandr S. There were no objections or comments and the S19 meeting minutes were approved.

■ Document status:

- Ballot results, first round yielded 67 returns out of 76; 88% return. 60 approvals out of which 7 approvals were with comments; 89% approval.

- The new draft 4.3, incorporating changes for approval was distributed to the WG membership in June 2019 via email. This was passed by email ballot. It was not posted to the website yet.
- Copyrights issue: It was discovered that figure 7 in the current draft was taken directly from IEC 60076-10:2016 by the submitter. A letter addressed to IEC has been sent through Malia Zaman, requesting permission for usage as is in C57.21; the response is being awaited.
- From the list comments several with technical comments were reviewed.
- Figure 8, in color, needs to be revised to 2 lines, one black, one dotted or dashed black for clarity. This will be done by Kris Zibert.
- For the equation 9 On page 53 the formatting will addressed by Kris Ziebert.
- Section 12.2. page 81. Lines 28-32. The minimum 8'6" clearance from NEC C2-2017. Section 124.1 specifies the minimum vertical clearances to ground. Kris Zibert will rewrite statement and provide final disposition including removing the mention of clause number and revision year.
- Comment i140 was rejected by working group.
- Section 10.6.6 - The working group revised it and the revised version was approved by all members.
- Section 10.6.3, comment i-137 was rejected by working group.
- Section 10.6.3 - The working group revised it and the revised version was approved by all members.
- Next step is to wait for approval of the approval to use figure 7.
- After that Excel sheet of comment resolution was will be updated appropriately, example Malia advised to use 'revised' instead of 'accept'.

No new businesses were presented.

The meeting was adjourned at 10:45 am.

Next meeting: Spring 2020, Charlotte, NC, March 22-26, 2020.

Respectfully submitted,

Chairman: Sanjib Som (ssom@patransformer.com)

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

Secretary: Kris Zibert (kris.zibert@amce.com)

J.8.7 WG HVDC Converter Neutral Devices Entity PC57.32.10

IEEE PC57.32.10

[Guide for the Selection of Neutral-Grounding Devices for High Voltage Direct Current (HVDC)
Converter Transformers]

Sponsored by IEEE Power and Energy Society/Transformers Committee/Performance
Characteristics Subcommittee (PE/TR/PCS)

29 October 2019
Columbus, Ohio

Minutes

Chair: Zhang Hua

Secretary: Xu Yin

1. Call to Order

- The meeting was called to order at 11:00 am.
- Participants introduced themselves and declared their affiliations.
- Participants at the face-to-face meeting signed their names on the attendance sheet.

2. Roll call of entities

- The quorum was confirmed as 8 of the 9 entity members attended the meeting (1 in person and 6 via web-conference)
- Altogether 25 specialists attended the meeting, including 7 entity representatives and 15 guests.

3. Approval of agenda

- Chair Zhang presented the agenda.
- *Motion #1*

Approve the agenda for [29 Oct 2019] meeting

Moved: Xu Yin, Beijing Jiaotong University

Seconded: Li Ying, TBEA Hengyang Transformer Co., Ltd

(Procedural, required $\geq 50\%$)

Motion passed by voice vote without opposition.

4. Approval of minutes of the last meeting

- Mr. Zhou presented the minutes.
- *Motion #1*

Approve the minutes for [29 Oct 2019] meeting

Moved: Han Yang, University of Electronic Science and Technology of China

Seconded: Yang Yan Southwest Jiaotong University

(Procedural, required $\geq 50\%$)

Motion passed by voice vote without opposition.

5. IEEE Patent Policy

- Patent Slides were presented to the participants.
- Chair Zhang made a call for potentially essential patents at 11:15 a.m. No potentially essential patent claims were declared, and no holders of potentially essential patents were identified.

6. IEEE-SA Copyright Policy

- IEEE-SA copyright policy was presented to the participants.

7. Technical Discussion

- It is suggested that related IEEE standards be referred to in Clause 2 (Normative references).
- Comments were received that WG should take the specific characteristics of converter transformers into consideration, and include special requirements of neutral-grounding reactors for converter transformers in the guide, if there are any.
- BJTU suggested that the sources of equations in Clause 4 be given in the appendix.

8. Plan

- WG membership decided to work on the special requirements of converter transformers neutral-grounding reactors compared with other kinds of transformers for the next several months.
- The 2nd edition draft is scheduled to be finished before next meeting.

9. Date and Place of the Next Meeting

WG members agreed to have the third WG meeting in Chengdu, China in April, 2020.

10. New Business

Motion #3

Approve three specialists as Invited Expert

Moved: Xu Yin, Beijing Jiaotong University

Seconded: Li Ying, TBEA Hengyang Transformer Co., Ltd

(Procedural, required $\geq 50\%$)

Motion passed by voice vote without opposition.

The WG adjourned at 12:15 p.m.

Respectively submitted by
WG PC57.32.10 Chair Zhang Hua

J.8.8 WG Semiconductor Rectifier Transformers C57.18.10

Working Group on Semiconductor Power Transformers – C57.18.10

Unapproved Meeting Minutes

Hyatt Regency Columbus, Columbus, OH

Union CDE Room

11:00 am, October 29, 2019

The Working Group met in the Union CDE meeting room

Sheldon Kennedy called the meeting to order at 11:07 am and the group did introductions.

A patent call was given. No patent issue were reported by attendees. The new copyright policy was presented.

There were 16 members and 18 guests/other present. A quorum was present (16 of 30 members).

P. Hopkinson moved for approval of the agenda. D. Patel seconded. Agenda approved.

Sheldon asked for motion to approve Anaheim minutes. V. Tendulkar so moved. S. Som seconded. Minutes approved with one abstention.

Discussion of Draft 6 Revisions-Draft 6 which had a 53% (16 votes) response rate on an email vote. There were no disapproval responses but some comments were returned.

Comment1: For multiple, axially stacked, secondary windings the temperature test winding rise should be the average of the winding rises of the stacked windings. Respondent indicated that this is the procedure in IEC standards. Sheldon presented a letter from Ugo Piovani who was convenor of IEC 61378-1 who disagreed with the commenter. The IEC standard requires reporting the temperatures of all windings. Discussion in the room also disagreed with the commenter. C. Johnson moved to reject the comment. S. Som seconded. 12 in favor, 4 abstain. Comment rejected.

Comment 2: Consider DC current in the design when the winding carries DC current. Commenter claimed that the DC fluxes cancelled in the coils and was not a problem when the currents are balanced but could be a problem when currents are not balanced. C. Johnson pointed out that in reality DC currents won't really cancel due to differences between coils. D. Ayers pointed out that the manufacturer doesn't control the load. Manish Saraf (Dhira Patel) recommended that there should be a note in the Standard that the customer needs to tell manufacturer about any unbalanced DC loads. D. Corsi moved and Shankar Subramany seconded a suggestion that the note should say that the "design should address any DC current imbalance in the transformer" 11 votes in favor, 5 abstentions. Comment retained.

Comment 3: Clause 8.6.2 I and J: Manish Saraf- delete the units "pu" from the equations as it is unnecessary since the equations will produce the same results regardless of whether pu or absolute currents are used. C. Johnson pointed out that the harmonic current as currently defined doesn't require pu. S. Som moved and C. Johnson seconded a motion to remove the "pu from the equations. 16 votes approve and 2 abstentions. Comment retained.

Comment4: P. Hopkinson noted that winding common mode voltages are not discussed in the standard. And can cause failures. No motion to include in the draft. Comment tabled.

Comment 5: C. Johnson pointed out that there are Eddy currents due to radial and axial magnetic fields. Suggested adding in a future revision. No action taken.

Editorial Comments: No need to vote on them. Will address in the editorial process.

Copyrighted information from IEEE Standard 1653.2- was incorporated in the past. According to M. Zaman use of material from other IEEE Standards prior to the new copyright requirements may be used without additional paperwork.

Sheldon proposed moving Draft 6 on to SA ballot- S. Som moved, and P. Hopkinson seconded, a motion to move Draft 6 to ballot. 16 approved, 0 disapprove, 0 abstain.

C. Ballard moved that we form a CRG and authorize the CRG to complete the SA ballot process without further Working Group approval. P. Hopkinson seconded. 15 approved, 1 disapproved.

CRG Volunteers- D. Walker, J. John, S. Kennedy.

New Business:

- P. Hopkinson suggested that there is not a test for differential voltages between bifilar windings. Chair commented that the test does exist. P. Hopkinson withdrew comment.

With no further business, the meeting was adjourned at 12:05am.

The Working Group will meet again at the Spring 2020 meeting in Charlotte, NC

Chairman: Sheldon Kennedy

Vice Chairman: Bill Whitehead

Secretary: David Walker

J.8.9 WG HV & EHV Breaker & Transformer Sw. Transients C57.142

MEETING MINUTES
IEEE / PES Transformers Committee Performance
Characteristics Subcommittee

WG to Investigate the Interaction between Substation Transients and Transformers in HV and EHV Applications and Revision of C57.142

Columbus, OH
Tuesday, October 29, 2019
3:15 PM – 4:30 PM
Union CDE (2)

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

- 1) Meeting called to order at 3:15 PM.
Welcome and Chair's Remarks
- 2) Circulation of Attendance Sheets
109 Attendees were present (64 Guests)
45 of 62 Members present (quorum was achieved)
- 3) IEEE Patent Policy Slides (no essential patent claims made)
- 4) Approval of meeting Agenda and Meeting Minutes of last meeting without objection.

- 5) Switchgear Liason Task Force Update – Dave Caverly, Jim McBride
The WG has received excellent comments from Switchgear experts via the Switchgear Liason TF(SGLT). These comments are highly regarded and will be included in the upcoming D7 of the C57.142 Guide. The presentation by Dave Caverly and the minutes from past TF meetings will be posted on the WG website.
- 6) Status of present draft and comments – Jim McBride
Editorial changes continue and D7 is approximately 80% complete with regard to the comments provided by the Switchgear committee and will be posted in the coming weeks. Ongoing review by the WG is appreciated. Any new supporting information is planned for inclusion in the Annex.

The chair reviewed a presentation / comments by Dr. Edgar Dullni (Switchgear Committee). Examples of an internal transformer resonance near 50 kHz were presented. The comment was made that many of examples had large damping factors > 20. Phil Hopkinson commented that a damping factor of 10 is more typical, but 20 is not unreasonable, depending on the design of the transformer (MV vs. HV, the magnetic steel, dielectric system, resistance of the windings, etc.). It was noted the figures are photo format and it may not be possible to reproduce them easily with more damping. The resonance and other new comments will be reviewed by Phil Hopkinson, Rogerio Verdolin, and Pierre Riffon and added to Sections 5-6 of the Guide.

Discussion ensued regarding inclusion of an additional mitigation method involving the application of MOV's into susceptible transformer windings for mitigation. It was noted this could create non-linearity's during standard impulse testing. Juliano Montanha with Siemens will provide verbiage for inclusion into the mitigation methods section Pierre Riffon also volunteered to reword Section 7.2 Mitigation Methods based on the submitted comments.

The WG will continue to review Dr. Dullni's comments, as well as ATC and Siemens comments.

- 7) Presentation: STLI in Shell Form Transformers – Ricardo Castro Lopes
Small signal voltage transfer via RSG was presented. It was noted that although Shell form transformers have high 'k' ratio and the windings are less complex, all transformer winding turns are subject to a resonant frequency that surge arrestors cannot guarantee protection. The presentation will be posted on the WG website.
- 8) Presentation: STLI in Core Form Transformers – Dharam Vir
The presentation will be posted on the WG website.
Additional presentations on TRV / STLI are pending
- 9) Meeting Minutes from Anaheim, CA were approved.
- 10) Next Meeting: (March 22-26, 2020 Charlotte, North Carolina)
- 11) Adjournment at 4:35 PM without objection

Respectfully,
Thomas R. Melle
Secretary

J.8.10 WG Short Circuit Withstand Design Criteria C57.164

Meeting Minutes Summary

PC57.164 WG
Guide for Establishing Short Circuit Withstand Capabilities
of Liquid Immersed Power Transformers, Regulators, and Reactors
Sanjay Patel – Chair, Raj Ahuja, – Vice Chair, Joe Watson - Secretary

The WG met on Tuesday, at 4:45-6:00 PM with 37 of the 42 members for a quorum. There were also 41 guests in attendance and 4 guests were accepted as new members after the meeting. The attendance and status changes have been entered in AMS.

We discussed the project schedule. The PAR expires at the end of 2020 so we have just one more meeting to complete the work and approve the document to go to ballot. We still have to prepare the Appendix. The References and the overall document also need to be reviewed.

The Appendix will contain a brief discussion of short circuit forces and equations that will help the user review manufacturers' calculated forces which should be more precise and accurate, but within a reasonable range for comparisons and discussions.

A motion was passed to include a discussion of stresses in the Appendix, but to not include any numerical margins or limits, and to leave those criteria to the manufacturer and user. The Appendix should be completed before the end of this year and we plan to issue a straw ballot to the members and guests of the WG with hopes of completing the Document and sending it to the SC for balloting approval at the Spring meeting.

If we fail to complete the Guide by the spring meeting, we will need to request a PAR extension.

The WG will meet again in the spring 2020 meeting and will need a room for at least 80 people.

We adjourned at 6:00 PM.

Joe Watson
Secretary PC57.164