

Annex J Performance Characteristics Subcommittee

October 25, 2016
Vancouver, BC, Canada

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

J.1 Introduction / Attendance

The Performance Characteristics Subcommittee (PCS) met on Wednesday, October 25th, 2016 at 3pm with 171 people attending. Of these, 67 were members and 104 were guests. There were 41 first time attendees. Prior to this meeting, the total membership of PCS was 87 members; therefore, quorum was achieved with 77% of the membership in attendance.

There were 18 guests requesting membership (those guest's meeting attendance will be reviewed and if acceptable will be added to PCS before the Spring 2017 meeting).

The Vice-Chair distributed rosters for the seating arrangement in the room.

J.2 Chairman's Remarks

The Chair provided the following updates and comments.

Status of Pars

- Neutral Grounding Devices PC57.32 approved
- 2016 PAR's
 - Distributed Photo-Voltaic Grid Transformers C57.159
 - IEEE/IEC Wind Turbine Generator Transformers, P60076-16
 - Tertiary/Stabilization Windings PC57.158
 - Loss Evaluation Guide C57.120
- 2018 PAR's
 - Non-sinusoidal Load Currents C57.110
 - Shunt Reactors C57.21
- 2019 PAR's
 - 3-ph Transf. Connections C57.105
 - C57.109 - Through-Fault-Current Duration

Status of Standards

- C57.18.10 Semiconductor Rectifier Transformers (2019 PAR to be submitted)
- C57.136 Sound Abatement Guide (2018 – will let expire)
- C57.123 Loss Measurement Guide (2020)
- C57.142 Transient Guide (2020)
- C57.149 SFRA Guide (2022)
- C57.133 Guide for Short Circuit Testing (Expired)

Future Technical Presentation

- TF Report on HV & EHV Transients C57.142

Attendance and Quorum

- The chair requested attendees to record their attendance on one of the rosters being circulated – only attendees name was required if it is not on the roster

- PCS now has 87 members after a review of the Spring 2016 meeting attendance, along with the 4 previous meetings
- 10 “Corresponding Members” are counted as “Guests” in terms of attendance for a quorum
- Requests for membership will be granted if an attendee made the past 3 of the last 5 meetings
- Today meeting quorum will be reached if 44 members are in attendance

The following 7 Members missed 3 or more of the last 5 meetings and have been moved to “Guest” status:

- Raj Ahuja
- Fred Elliott
- George Frimpong
- Alexander Kraetge
- Mario Locarno
- Michael Miller
- Peter Zhao

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

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

The following 13 Guests requested membership at the Spring 2016 meeting, attended the past 2 meetings and have been added as Members for the fall meeting:

- Hamid Abdelkamel
- Christopher Baumgartner
- Marcos Ferreira
- Hugo Flores
- Anthony Franchitti
- Kristopher Neild
- Harry Pepe
- Kirk Robbins
- Rodrigo Ronchi
- Yong Tae Sohn
- Kiran Vedante
- David Walker
- Matthew Weisensee

The following 7 Guests requested membership but have not participated in the past 2 meetings

- Myron Bell
- Florian Costa
- Sidney Johnson
- Tim-Felix Mai
- Andre Shor
- Michael Spurlock
- Alwyn VanderWalt

Current breakdown of the Working Group:

- 87 Members
- 10 Corresponding Members (counted as guests)
- 87 total members; 44 are needed for a quorum

The Chair all stressed that attendees must be sure that their e-mail address is up to date in the AMS system – many undeliverable notices were received during WG communication attempts

Next the Chair made attendance roll call and requested attendees raise their hand if they see their name on the screen.

J.3 Approval of Agenda

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

J.4 Approval of Last Meeting Minutes

The chairman presented the minutes of the last meeting held in Atlanta, Georgia – April, 2016. A motion to accept as proposed was given by Dan Sauer and seconded by Hemchandra Shertudke. The acceptance of the minutes was passed by unanimous vote.

J.5 Minutes from Working Groups and Task Force

The following WG and Task Force reports were received next (the reports are below):

- | | |
|---|-----------------------|
| • WG on Tertiary/Stabilization Windings PC57.158 | E. Betancourt |
| • WG on PCS Revisions to Test Code C57.12.90 | M. Perkins |
| • WG on C57.109 - Through-Fault-Current Duration | V. Mehrotra |
| • TF on Audible Sound Revision to Clause 13 of C57.12.90 | B.Beaster in place of |
| R. Girgis | |
| • WG on Non-sinusoidal Load Currents C57.110 | R. Marek |
| • WG on PCS Revisions to C57.12.00 (by Craig S) | T. Ansari |
| • WG Shunt Reactors C57.21 | S. Som |
| • IEEE/IEC WG Wind Turbine Generator Transformers, P60076-1 | P.Hopkinson in place |
| of D. Buckmaster | |
| • WG on C57.18.10 | S. Kennedy |
| • Loss Evaluation C57.120 | Rogerio Verdolin |
| • WG 3-ph Transf. Connections C57.105 | A. Bromley |
| • WG on Distributed Photo-Voltaic Grid Transformers C57.159 | H. Shertukde |
| • TF on HV & EHV Transients C57.142 | J. McBride |
| • TF Short Circuit Criteria | S. Patel |

J.6 Unfinished (Old) Business

None

J.7 New Business

For C57.110, Rick Marek proposed a motion to take the standard to ballot. This was seconded by Sam Sharpless. The proposal was carried unanimously by voice vote.

Sheldon Kennedy stated that the C57.32 guide for neutral grounding devices received comments from 'MS Resistance' in France. Sheldon led a task force to review these comments and the TF agreed that changes to the recently published C57.32 are needed. Sheldon proposed a motion to the SC to form a WG to seek a PAR and make the revision to the guide. This was seconded by Tom Melle. The motion was accepted through unanimous voice vote.

For C57.105, the current chair Adam Bromley is stepping down. The Chair announced that the new chair will be Rogerio Verdolin.

Sanjib Som stated that he had a question during the Bushing Subcommittee meeting and it came out that bushing overloading capability is not as clear as it is for transformers. Hence transformer engineers need to look into this while selecting bushings for their transformers.

There was a question about the C57.12.00 system voltages and why some of the voltage variations are not +/- 5% (most are). Steve Snyder commented that this was investigated some years ago in C57.12.00 and it was established that the table reflects the North American practices.

Adjournment was proposed by Ramsis Girgis 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 WG on Tertiary/Stabilization Windings PC57.158 E. Betancourt

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

*Performance Characteristics Subcommittee
IEEE / PES Transformers Committee*

*October 24, 2016 9:30 AM
The Sheraton Vancouver Wall Centre Hotel, Jr. Ballroom CD
Vancouver, BC, Canada*

UNAPPROVED MINUTES

The WG C57.158 met at 9:30 AM on October 24, 2016. **18** Members out of **31** were present so we had a quorum to conduct regular business. 4 Corresponding Members and **55** Guests were also present and **seven** of them requested membership.

Javier Arteaga	ABB Inc.
Markus Schiessl	SGB
YT Sohn	HICO
Matt Weisensee	PacifiCorp
Anton Koshel	Delta Star
Kris Neild	Megger
Jeffrey Wright	Mitsubishi

The Agenda was approved with no comments or amendments. A motion for approval of the Atlanta WG meeting minutes was made by Hemchandra Shertukde, seconded by Hugo Flores and approved.

The Essential Patent Claim notification to the working group was requested with no response from those in attendance.

A. Old Business

The Vice Chair discussed the present status of Draft 6 rev. A of the Guide and change in figures due to copyright issues. The draft is out for ballot.

A motion to create a comment resolution group was made by Hemchandra Shertukde, seconded by Xose M Lopez-Fernandez second and approved.

Volunteers for the comments resolution group were asked to sign-up after the meeting.

B. New Business

No new business was presented before the WG.

Motion to adjourn WG meeting was made by Hemchandra Shertukde and seconded by Hugo Flores.

Meeting was adjourned at 09:55 am.
Respectfully submitted,
Enrique Betancourt, WG Chair
Brian Penny, Vice Chair
Marnie Roussell, Secretary

J.8.2 Working Group on PCS Revisions to C57.12.90 - Mark Perkins

Meeting Minutes
Task Force on PCS Revisions to C57.12.90
October 24, 2016, 11:00am-12:15pm
Grand Ballroom CD, Sheraton Vancouver
Mark Perkins, Chairman; Craig Stiegemeier, Secretary

1. PCS Chair Comments

- Ed teNyenhuis, PCS Chair, called the meeting to order. Ed informed all that the Working Group would become a Task Force in the future. Since C57.12.90 revisions are the responsibility of the Standards Subcommittee (not PCS,) this must become a Task Force. The Task Force would still be responsible for providing PCS comments to the Standards SC for future updates to C57.12.90.
- Ed informed all that this will be Mark's last meeting as Chair of the Task Force. The attendees thanked Mark for all his efforts to keep C57.12.90 current. Hakan Sahin will take over as the new Chair of the Task Force at the end of this task force meeting.

2. Introduction of members and guests

- Mark Perkins presided over the meeting as Chair. Craig Stiegemeier was secretary. Three (3) attendance rosters were circulated for those in attendance to record their presence and confirm their membership or guest status.

3. Attendance

- A review of the adjusted membership was conducted and 38 of the 57 TF members were in attendance. This resulted in attendance of 66% of the membership, making this meeting "official" as a quorum was reached. In addition, 79 guests were present at the meeting, of which 28 were first time attendees. 20 of those guests requested membership on the Task Force. A review of past attendance will be conducted, and those that meet the requirement of participating in the TF and have either attended the previous 2 meetings or 3 of the past 5 TF meetings will become TF Members. They will be on the roster for the Spring 2017 New Orleans meeting. Also, any of the current members will be removed if they have not attended 3 of the past 5 meetings. Also, anyone who has not attended any of the past 10 meetings will be removed from the rosters circulated at the Spring meeting to help control the size of the roster.

4. Agenda approval

- Dan Sauer made a motion to approve the agenda and Bertrand Poulin seconded the motion. Unanimous approval was confirmed by all in attendance.

5. Minutes of the Spring 2016 meeting

- A review of the Spring 2016 Atlanta minutes was conducted by the chair. Bertrand Poulin made a motion, and it was seconded by Dan Sauer to approve the Spring

2016 minutes as written. Minutes were approved by the membership unanimously.

6. Old Business

- A review of the discussion that occurred at the Atlanta meeting on the voltage test of the LTC.
 - Test range with current at load loss connection
 - Rainer Frotscher from Reinhausen cleared up that the full current test is to test the tap changer. He attributed the suggestion to Joe Foldi.
 - Joe Foldi stepped up and explained that the intention of the test was to run through the full range of the LTC. IEC requires that the test take place for 10 times going 2 steps up and down so the reversing switch operates for 10 operations.
 - Pierre Riffon suggested that the test follow the IEC test.
 - Bertrand Poulin noted that the end-to-end test is ideal. If it is not practical, the IEC approach is a reasonable engineering compromise. His opinion is that 5 complete cycles (10 operations of the reversing switch) should be the minimum number of operations.
 - Ajith Varghese from SPX suggested that +2 and -2 should be operated at least 3 times. There would be
 - Don Ayres suggested that going from one end through the reversing switch and returning to the end, at the highest power rating of the transformer.
 - Joe Foldi believes that it is not unreasonable to go through the complete range of the LTC.
 - Shamaun Hakim of CG Power Manitoba made a comment.
 - Jason Varnell of SPX Transformers noted that the specific type of regulation (coarse/fine, linear, buck/boost) should be considered.
 - Kushal Singh of ComEd noted that end to end testing is in their specification. They've never had a manufacturer object to the end to end at full rated current as shown on the nameplate.
 - Javier Artega from ABB noted that most times LTC's are plus/minus type with a reversing switch. He noted that linear type LTC's do not have reversing switch and the testing should apply to all types of LTC's.
 - Matt Weisensee at PacifiCorp noted that is an OEM has an obligation to test per the nameplate.
 - Steve Schroeder ABB South Boston is concerned that this test helps determine that a reactive type LTC is properly connected. The test makes sure that the leads are corrected properly. Steve's opinion was that connection issues are found only with a current test, as a voltage test would not find the problem.
 - Mark Perkins was under the opinion that a voltage test would find the problem.
 - Jeorg Olin from SMIT Netherlands – end to end testing is a challenge with very large autotransformers. He suggests that we stick with the 2 steps up and then two down, causing operation of a reversing switch (if present.)
 - Mike Spurlock from AEP noted that they require an overload test at 25% above maximum nameplate rating.
 - Leopoldo Rodriguez of EFACEC commented that testing the LTC with full current and full voltage from end-to-end is essential in finding

- problems before the transformer ships. Anything less that that would not identify all issues.
- The Chair summarized that the group seems split about evenly, with half preferring end to end and others preferring two steps up and down through the reversing switch
 - Dan Blaydon, BG&E suggested we confirm a quorum before any motions to vote. As noted above, a quorum was confirmed.
 - Ajith Varghese of SPX suggested that the TF vote, Rogerio Verdolin seconded. The motion was that we take a vote of end to end or +/- through the neutral.
 1. 21 voted that the test be performed from end to end of the tap range; with 11 voting to go 2 steps up and then down while going through the reversing switch if present.)
 2. We will include end to end in the first draft
- A discussion of the current level during the test took place during the meeting.
- Krishnamurthy Vijayan of PTI Manitoba suggested the test always be conducted at the top rating on the nameplate.
 - Dan Blaydon of BG&E suggested that the overload requirement be left up to the user to specify an overload condition as they seem to vary quite a bit from user to user.
 - Bertrand Poulin motioned, and Dan Sauer seconded that the test specified in the standard be limited to the top rating of the transformer. Dave Ostrander mentioned that the rating should be made clearer, there may be a need for a minimum test level at 80% of the top nameplate rating. Bertrand clarified that his intent was that the current on the nameplate would apply for each tap. Shamaun Hakim of CG comment that 85% was in line with the minimum heat run test levels in our standards. Rainer Frotscher from Reinhausen suggested that it wasn't necessary to adjust the current for each tap as this is a significant burden. Joe Foldi reinforced Dave Ostrander's comment that by putting an 80% minimum current would accomplish the goal of performing the test with significant current without putting an undue burden on the OEM. Javier Arteaga from ABB suggested that changing the current at each tap would be an undue burden. The amended motion is that the test be performed as close as possible to the top nameplate rating, but not less than 80% of the top rating. The motion passed with 32 member voting for the motion and no one against the motion.
- Mark called for a discussion on the pass/fail criteria for the test.
- Bertrand Poulin noted that a pass/fail would have to be applied to some measurement or observation. He noted that most people go by what they hear during the test, and observations of the current during the transition (such as unusually high during the transition.) He noted that DGA varies dramatically based on LTC, transformer design and application of the LTC
 - Rainer Frotscher suggested that one criteria would be requiring that DGA in the main tank should not change during the test. In tank

LTC's should not exceed 12ppm, as some contacts will produce low level of gasses.

- Detlev Gross from Power Diagnostics suggested that DC resistance performed before and after test should show no change. He also noted that a requirement be placed on the compartment containing the selector switch not produce any combustible gas during the test. Rainer Frotscher from Reinhausen noted that vacuum switching makes no difference based on the current of the test, but some small amount of combustible gas may take place during selector switch operation.
- Bertrand Poulin from ABB suggested that test should be proposed, and then voted on once the proposed text was reviewed. He suggested the Chair should put together the material, circulate the suggestion before the next meeting and the members come to the meeting ready for a discussion and acceptance.

7. New Business

- As the discussion of the details of the Load Tap Changer Performance Test Procedure took the entire meeting, there was no time for new business as the time for the meeting expired.

8. Adjournment

Bertrand Poulin motioned and Dan Sauer seconded that the TF adjourn as the meeting time expired, The motion was accepted unanimously, and the meeting was adjourned at 12:17 pm.

J.8.3 Working Group for Revision of C57.109

IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration Vancouver, BC, Canada, October, 24 2016

Minutes of the Working Group Meeting

The meeting was held on Monday October 24, at 1.45 pm and four of the nine members were present and therefore there was not a quorum. There were a total of 35 people present which consisted of 4 members and 31 guests. Eight guests requested membership.

The Working group reviewed comments that were submitted by the K16 Working Group on Revisions to C37.91 *IEEE Guide for Protecting Power Transformers*. The first comment provided by the K16 group was to make an editorial correction to consistently refer to the "times rated winding current" instead of "times rated current." There was no discussion on this topic and therefore the recommendation was upheld and the change will be made. The next comment was regarding inconsistencies between the values in Table 2 and the associated plot in Figure 1. Raj Ahuja added to the discussion by suggesting that the working group examine the history and source for the values that were originally in Table 2 before agreeing to change the values per the K16 recommendation.

The next comment by the K16 working group was regarding the term "symmetrical currents" in section 4.0. They requested that the term be changed to "symmetrical winding currents." There were no objections or additional discussion and therefore the working group will make

the change. The next topic was regarding the term “% transformer impedance” as found on Figures 2a, 3a, and 4. They requested that the term be changed to “% transformer short-circuit impedance.” There were no objections or additional discussion and therefore the working group will make the change.

The next comment from the K16 working group was an editorial comment regarding the deletion of a sentence from section 4.3. It was determined that the sentence was removed by error and will be added back to the next draft. Discussion about the changes to Table 4 were discussed in great detail. The K16 working group recommended that the old values from Table 4 remain in the guide but perhaps in a different table for historical reference. The working group decided to include the old Table 4 as an informative annex.

Some additional comments were provided by the PC37.91 working group that related to the usage of the C57.109 guide but not particularly about the content of the guide. The C57.109 working group determined that the chair would respond to their comments. The topics included fault durations in excess of 2 seconds, pre-fault conditions, and single-line to ground faults.

Next the working group reviewed the redline version of the D1 draft. Raj Ahuja had a comment regarding the statement in section 4.1 regarding low current values that may be the result of overloads up to 3.5 times rated current. Raj stated that the 3.5 times rated current for an overload condition exceeds that of C57.91 and should be removed. Kushal Singh commented that distribution transformers that are only protected by fuses may experience current close to 3.5 times. It was then noted that section 4.1 refers to category I transformers and therefore Raj retracted his comment. It was agreed to leave the section unchanged.

A motion was raised by Bill Griesacker to adjourn. Hemchandra Shertukde seconded the motion. The working group unanimously approved the adjournment. The meeting adjourned at 2:50pm.

Respectfully submitted
Vinay Mehrotra
WG Chair

J.8.4 TF on Audible Sound Revision to Clause 13 of C57.12.90 - R. Girgis

Unofficial Minutes of fall 2016 Meeting of TF “Audible Sound Revision to Test Code C57.12.90”, in Vancouver, BC Canada

The TF met at 1:45 PM, on Monday, October 24, 2016. Chairman Dr. Ramsis Girgis presided over the meeting. Secretary Barry Beaster assisted with the administrative duties.

After the Spring meeting, the membership had been adjusted to 52 members. For meeting preparation, a meeting agenda along with the unapproved Spring 2016 minutes were circulated to all members and guests of the last meeting. A copy of the prior meeting attendance for the past six years was circulated to the members for any possible oversight in recording attendance.

The meeting was attended by 26 of the 52 members and 65 guests for a total of 91 persons; the largest in the records for this TF. A quorum was established by a review of the meeting rosters after the end of the meeting. The proposed agenda was presented with one addition after the preliminary mailing. This additional agenda item: “Need for an IEEE Noise

measurement Application Guide”, was proposed by Bertrand Poulin at the spring meeting of the TF. The revised agenda was unanimously approved without change. The spring 2016 meeting minutes had no requested changes nor corrections and was unanimously approved. Since a quorum was determined after the meeting, the agenda and prior meeting minutes were officially approved.

There were nine requests for TF membership; which will be reviewed based on previous meeting attendance.

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

The first item of business was a presentation by Dr. Chris Ploetner on the status of the IEC Sound Measurement Standard and Application Guide. Both have already been published earlier in 2016. He also presented the similarities and the small differences between the IEEE and IEC Standards. Chris commented that both IEC and IEEE Standards are widely comparable and, due to some small differences between these Standards, that the maximum difference to be expected between the Sound level measured using the two Standards is within ± 1.0 dB. He also stated that the harmonization process will continue with a target to fully align sound level measurements in the two Standards. Chris recommended to the attendees to read the IEC Application Guide (IEC 60076-10-1) for educational purposes. The Chairman supported that and stated that the Application Guide has excellent tutorial information on both transformer noise and measuring transformer noise.

The next item on the Agenda was the development of “REFERENCE Load noise levels for single-phase power transformers”. The Chairman presented measured Load noise Sound Power levels received, as provided by a number of transformer manufacturers, at a wide range of rated MVA vs. calculated load noise using Reiplinger’s Equation for both 50 and 60 Hz transformers separately. The data again showed that measured values of load noise can be as much as 10 dB higher than the levels calculated using Reiplinger’s equation. Therefore, adding 10 dB to the calculated values would represent a reasonable calculated REFERENCE levels for load noise of single-phase transformers.

The next topic was an open discussion of the purpose of developing ‘REFERENCE Noise Levels’. For this discussion, the Chairman presented slides showing how measured and guaranteed no-load noise levels of a large number of transformers compare to the NEMA TR1 levels. The data demonstrated that these levels can have a spread of as much as 25 – 30 dB from the NEMA TR1 levels. The Chairman then presented two possible objectives of establishing “REFERENCE Noise Levels”. One objective is to use them as a measuring stick to determine how much lower a guaranteed noise level of a transformer is from the REFERENCE level. The second possible objective is providing ranges of sound levels for No-load and Load Noise for certain transformer classes per the CIGRE WG plan. The Chairman stated that noise levels of Power transformers should be specified based on the required sound level at the first recipient or boundary.

The attendees were encouraged to participate in the discussion on the above. Joe Foldi supported the purpose of REFERENCE noise levels as a measuring stick to determine how much lower a guaranteed noise level of a transformer is from the REFERENCE level. He also stressed the importance of specifying the noise level based on the noise level required at the first recipient or boundary. Joe commented that it does not justify spending additional money for a transformer quieter than necessary. On the other hand, Robert Ganser indicated a concern that providing REFERENCE noise levels” could result in a possible drop in quality by some manufacturers that may get relief if the “REFERENCE noise levels” are set too high, as well as possible hardship for others. It was also suggested to introduce a note that the total

noise of a transformer on site could be higher than the guaranteed level if the user does not consider load noise in the guaranteed value.

It was proposed that perhaps the term “REFERENCE” is not the appropriate wording. It was suggested that perhaps a wording like “Maximum Noise Level Limit” would be more appropriate. The Chairman then presented a preliminary wording for a note to be added to Table 17 of C57.12.00 explaining the objective of the “REFERENCE Noise levels”. This wording will be circulated to members of the TF, as well as to the guest participants, to review and propose any editing needed. The Note will read as follows:

Noise Levels given in NEMA TR1 Tables for No Load noise and in Appendix – C for Load Noise correspond to noise levels of designs where no special mean (s) of noise reduction is / are used / needed. The objective of these levels is to be used as a measuring stick to how much lower a guaranteed noise level of a transformer is from these maximum levels. Specifying the noise level of a transformer should be based on the required sound level at the first recipient / boundary.

At this point, Steve Antosz reminded the TF that there was a decision made in a previous meeting of the TF to add a new IEEE table to replace the NEMA TR1 Table. This table would be incorporated in Annex C and referred to in Table 17 of the C57.12.00 Standard.

The following new items were brought up by attendees:

- Measuring noise level above the transformer cover as one customer has a need for this data
- Effect of temperature on core noise and load noise. The Chairman commented that available test data shows an impact of temperature on core noise in the case of some core steels; while the effect of temperature on Load noise is small and could be either higher or lower since a large number of other factors influence the magnitude of this impact. A consequence is what temperature should transformer core and load noise be measured
- What Tap position should transformer load noise be measured at?
- There is a need to understand the cost impact of requiring low no load and load noise transformers
- Introducing noise level on the transformer Name plate as transformers can be moved from one are to another

The Chairman suggested addressing these at the Spring TF meeting. In the meantime, the TF will attempt to collect the data needed for these items.

Time expired and the meeting concluded at 3:00 PM.

Respectively submitted,

Ramsis Girgis (Chairman) and Barry Beaster (Secretary)

J.8.5 WG on Non-sinusoidal Load Currents C57.110 - R. Marek

WG for Revision of C57.110

Sheraton Vancouver Wall Centre Hotel; Vancouver BC, Canada

Monday, October 24, 2016

3:15 PM – 4:30 PM

Chair: Rick Marek

Secretary: Sam Sharpless

Administrative

Call to Order and Introductions at 3:18 PM

Patent call: None reported

Attendance sheets passed out and introductions were made.

Quorum was achieved with 16 members and 38 guests

Approval of agenda with no comments

- Motion: Sasha Levin and seconded by Casey Ballard with unanimous approval.

Approval of amended Spring minutes

- Motion: Sheldon Kennedy and seconded by Casey Ballard with unanimous approval.

Draft 4 Summary of changes

Chair sent out draft four with only a few changes:

- Revised Clause 6.2
- Added Annex F - Derivation of the ratio of highest winding eddy loss to average
- Added Annex G - Sample transformer loss data
- Received one comment regarding units by Sasha Levin – Chair will investigate Style Manual to determine proper formatting

Noted extra “for” in title that will be removed

Reviewed section 6.2:

- As discussed in the Spring meeting, a note was added in a box to emphasize that the loss values provided in the new table are conservative estimates.
- Ramsis Girgis noted that there is a large variation in eddy and stray losses for power transformers and the table shows > 3MVA.
- The Chair stated that this document would not generally be used above 50 MVA, which was the upper limit in the scope of the original document. Also, the losses in the new annex are all for distribution transformers. Ramsis Girgis recommended a note not to use the table of loss estimates above 20 MVA.
- Motion: Ramsis Girgis to change the table from > 3000 to 3000-20 000 with a note not to use the table above 20 MVA since these estimates do not apply and it is suggested that the reader consult the manufacturer for specific loss information.

- Eduardo Tolcachir suggested also adding the same caution to specialty transformers.
- Motion: Don Ayers and seconded by Ramsis Girgis with unanimous approval.

Appendix F reviewed:

- This annex addresses the basis for the statement in Clause 6.2.e:
“The maximum eddy-current loss density is assumed to be in the region of the winding hottest spot and is assumed to be 400% of the average eddy-current loss density for that winding.”
- This statement has raised a number of questions over the years. The Annex is based on theoretical calculations for small transformers taken from a derivation by Max Cambre.
- The Chair requested all to read the annex and comment.

Appendix G reviewed:

- This annex is a collection of winding eddy and stray loss data provided by the members in various formats.
- The results are quite varied for different kVA's and voltages, demonstrating the significant differences due to winding style.

The Chair asked for volunteers to check the four examples to make sure no errors were made in transcribing to the new document format. The results were requested by Thanksgiving.

- David Walker: 6.1.1
- Dhiru Patel: 6.3
- Eduardo Tolcachir: 6.1.2
- Javier Arteaga: 6.4

The Chair noted that he has received very few comments and the document is ready to go to ballot. The Chair asked for a motion to request PCSC approval to go to ballot

- Motion: Ramsis Girgis and seconded by Phil Hopkinson with unanimous approval.

The Chair will send the updated document to the membership with a request for comments before submission to ballot. He also noted that the WG PAR expires Dec 31, 2018 but that we should finish well ahead of that time.

No new business.

Adjourn

Motion: Phil Hopkinson and seconded by David Walker with unanimous approval

Adjourn at 4:00 PM.

J.8.6 WG on PCS Revisions to C57.12.00 - T. Ansari

*October 24, 2016 4:45 PM
Sheraton Wall Hotel
Vancouver, BC, Canada*

UNAPPROVED MINUTES

The PCS Working Group on General Requirements for C57.12.00 met on Monday, October 24, 2016. The Chair Tauhid Ansari called the Group to order at 16:45 and explained purpose and scope of the Task Force. Enrique Betancourt, the TF secretary, was not able to attend and Craig Stiegemeier recorded the minutes during the meeting.

WG. **53** Members and 86 guests were present, and as Working Group membership stands at 76 members, we did have a quorum and were able to conduct official business.

The Agenda and the minutes from the Atlanta meeting were approved (Terry, Shem), with Mark Perkins noting that the agenda should reflect Task Force rather than working group. The agenda was corrected and there was unanimous acceptance of the corrected agenda. The minutes from the Atlanta meeting were (Sanjab Sohm, Terry) reviewed. In a vote of those attending, there was unanimous acceptance of the spring 2016 Atlanta minutes. Agenda Items were covered as follows.

1. OLD BUSINESS**A. WG Item 105, Sec.4.1, Sec.7.0 Clarification on Short circuit condition. Survey result, Survey Comments, & Discussion on topic**

In Spring 2016, A motion was brought up (Ajit Varghesse/Vinay Mehrotra) as to include a statement in C57.12.00 specifying that for short circuit calculations 1.0 PU is the pre-fault voltage and that anything different has to be specified by user. The motion was amended by Mark Perkins to start first with a survey among the WG's Membership about this proposal if this is to be discussed in TF C57.12.00.

A review of the comments from those responding to the survey was conducted.

The chair sent a survey to 273, and 88 responded to the survey.

The Result as follows:

Approve	58	66%
Approve with Comment	9	10%
Disapprove	5	6%
Disapprove with comment	9	10%
No comment	7	8%
Total 32% response	88	

The approval comments were reviewed for those attending the meeting.

<p>If we are considering real-life operating conditions for short-circuit conditions in the standards then the interconnected system should also be considered. The WG on C57.158 Guide for the Application of Tertiary and Stabilizing Windings in Power Transformers failed to consider the worst case condition for tertiary currents. This is for parallel auto-transformers when a single line-to-ground fault occurs with possible X/R ratios can produce more current in the tertiary than the infinite bus condition. The condition I am describing was the subject of a white paper written some years ago by L.S. McCormick (sic) of Westinghouse Electric which raised this concern.</p> <ul style="list-style-type: none"> - Wallace Binder
<p>I think the discussion is good but vote for 1.0pu volts</p> <ul style="list-style-type: none"> - Philip Hopkinson
<p>Often times, pre-fault level becomes an issue at the stage of design review meeting. It would be better to state the condition somewhere in the current IEEE standard.</p> <ul style="list-style-type: none"> - Jinho Kang
<p>A motion was brought up (Ajit Varghesse/Vinay Mehrotra) as to include a statement in C57.12.00 specifying that for short circuit calculations 1.0 PU is the pre-fault voltage and that anything different has to be specified by user</p> <ul style="list-style-type: none"> - Neil Kranich
<p>Our transmission planning department is advising that portions of Ameren's system may see 110% as a maximum operating voltage. We believe that other utilities may be in a similar situation with the advent of renewable generation and the retirement of synchronous generators on their systems.</p> <ul style="list-style-type: none"> - David Ostrander
<p>The discussion may shed more light on the issue hopefully by other users and suppliers to benefit the process. My personal opinion is that this should be made a requirement for Class II power transformers. 105% operating voltage is more typical for large GSU and auto transformers and would be a good level to use as a pre-fault voltage. The subject is covering the requirement in a major change wise and if not much response received here my suggestion is to go up to the WG or Sub-com level to get a wider response spectrum to help the process. This may not be allowed by the IEEE process but not being sure would like to add here for in-case type scenario.</p> <ul style="list-style-type: none"> - Bipin Patel
<p>the requirement should be for 1.05 PU as this is defined as part of the transformer's continuous operation capability per Section 4.1.6.1 of C57.12.00-2015</p> <ul style="list-style-type: none"> - Brian Penny
<p>1.0p.u to be used unless specified by customer</p> <ul style="list-style-type: none"> - Krishnamurthy Vijayan
<p>I believe this topic of pre-fault voltage for short circuit calcs should be discussed. I don't believe we should require the level of margin discussed for ALL transformers which adds cost to applications that does not require it. I think it should be worded such that it is calculated at 100% but add some words that the user may want to increase to 105% or 110% pre-fault for additional margin at the time of tender by the customer.</p> <ul style="list-style-type: none"> - David Wallach

A review of those who disapproved was conducted.

TF would not be the place where the technical discussions should initially take place. Because short circuit tests become destructive tests if the device under test fails, a proposal to increase the applied energy level may have a substantial (and in many cases unnecessary) negative economic impact on both manufacturers and end users. I think that such a significant proposal should begin discussions in the Performance Characteristics Subcommittee itself. PCS can choose to deliberate the technical issue directly, or to assign it to your TF as a work item, or create a separate TF, or whatever. But to me it's too big a question for the TF to handle without a mandate from the SC.

Jeffery Britton

If there are some special considerations to be taken into account for the short circuit condition, those should be declared in the contract documentation (specifications, questionnaires, etc.), but not as a change to the standard.

Juan Castellanos

This does not qualify for discussion. There is already a statement addressing this in 7.1.5.5(d)

Bruce Forsyth

This 110 % condition needs to be clarified and understood first. System voltages are generally limited to 105 %. Even the 500 kV system voltage that has a limit of 550 kV is truly ~ 5 % of the 525 kV reference transformer Voltage. GSUs also can not have more than 105 % of its rated Voltage, I do not think. Som there is a need for clarifications from Customers who buy GSUs and System transformers. It should not be an agree disagree vote until this whole thing about 110 % V is understood operationally. Only then one can decide what the right thing is.

Ramsis Girgis

The voltage should remain 1.0 PU. The higher voltage is already specified in the standard as an application conditions requiring special considerations. That can be specified by the end user for this special condition without increasing cost of ALL transformers.

Marion Jaroszewski

The 100% voltage condition has been used for many years and also is used in other world standards. If some particular utility wishes to add a special clause for prefault overvoltage, it can be addressed in their particular specification.(and many do already) Thus there is no need to add this topic to agenda

Dennis Marlow

This should be discussed outside C57.12.00

Stephen Oakes

Unless a pre-fault condition is specified, it is imperative that 1.0PU is used for short circuit force calculation. C57.12.00 adequately covers other conditions

Dinesh Sankarakurup

100% voltage should be considered a base level, however the user may specify a higher pre-fault voltage, i.e. 110%. Rationale: I am not aware of a significant number of the short circuit failures in USA due to a weak design under current specification (i.e. 100% voltage).

Waldemar Ziomek

Shedan CG Power – he has disapproved and still has the same opinion

Vadim Rooter SPX – pre-fault condition needs to be clarified

Joe Foldi clarified that the Canadian utilities have a strong opinion that the pre-fault condition needs to be 1.1 for the purposes of calculation of short circuit currents.

Ed teNyenhuis – he noted that we can have this discussion as a part of PCS duties

Joe Foldi suggested that we're not prepared to have this discussion and maybe we should postpone to the next meeting.

Bob Thompson – RST consulting noted that some transformers are overexcited.

Ramsis Girgis noted that the voltage at the primary and secondary are limited to 5%. The excitation of the curve may be higher for certain types of transformers. Ramsis does not understand where the 110% comes from. He believes that a more basic question is to determine the basis of the 110%, as it's an excitation issue and not a voltage issue. The 105% makes sense, as that is an actual operating voltage condition.

Bob Ganzer – We have many customers that can run 110% for 24-36 hours to look at the quality. His belief was that this was a maximum value to avoid saturation and the resulting other problems, like heating. Bob noted that one could get into legal issues if the real operating voltage is not used.

Mat Weise – PacifiCop asks for 105%

Chris – Commonwealth Edison – they have seen conditions that during the summer when all capacitors are on and the load is decreasing when the voltage on 138kV goes up to 153kV. They then will turn on the cap banks.

David Murry – TVA – the operating voltages are defined in defined in ASNI 48.1

Raj – C57.12.00 is the defining standard, and other guides also define the voltage. It should be left to the customer to call out differences. Abnormal conditions should be specified by the user.

Jason Hornel – SPX – he agrees with Ramsis and Raj. Jason wants to change the working in Section 4.1.6.

Guy from SMIT – Need to be careful what is changed – operating condition or service condition. This will cause an issue in low impedance high-voltage transformers.

Neil Kranish – Jordan Transformer – short circuit calculations at 110% result in a stronger, bigger transformer. Not all customers want that.

Sanjab Som – Siemens – this is a matter of margin

Should a statement be added to the standard that the customer

Chris Slatterly – FirstEnergy – they call out 110%, and they're dealing with that 110% at a real operating condition.

Black and Veatch – Need to specify the value

Tauhid summarized that we should keep it at the current limit, but offer more clarification.

Bob Ganser – suggested the differences between a standard and guide is that a standard must be a “shall”, where a guide offers a suggestion using “will” and “should” do something. The standard is a default for protection of the transformer. Any value other than 105% at full load or 110% at no load must be defined by the individual users.

Robert Thompson – asked if it makes sense that the user would be able to energize to 105% voltage, and not require that short circuit forces be calculated at that voltage.

Mark Perkins noted that the TF agreed to consider the motion that 1.1pu is the pre-fault voltage.

Matt Weisen – PacifiCorp is using 105%. They run their system at 105%.

Shell Sain – ComEd – they don

Jill Holmes – Bureau of Reclamation – they operate at 105% and 110% of voltage. She suggested that we put

Scott Digby – Duke – they do not set the operating tap to correspond to the voltage. They set it for other reasons – such as the making sure the LTC goes through neutral

David Ostrander – Ameren – They operate parts of the system at 110% as a real operating condition. He's wondering if other utilities are seeing these higher voltage levels.

Upon majority in survey approved to keep the motion initiated by Ajit and Vinay, that 1.0pu be used as the pre-fault voltage and that any other value should be specified by the user. A vote was taken and 28 approval, 6 disapproval, 2 abstain.

The next step is to survey the Subcommittee PCS before sending to ballot.

Shamaun Hakim brought up a topic and it was decided to move this to discussion for the next meeting.

2. NEW BUSINESS

The allocated time for the meeting was expended before any new business could be considered.

3. ADJOURNMENT

The meeting was adjourned at 5:30 PM.

Respectfully submitted,

Tauhid Ansari
Betancourt
WG Chair

Craig L Stiegemeier for Enrique
Secretary

J.8.7 Shunt Reactors C57.21 - S. Som

IEEE Standard Requirements, Terminology, and Test Code for

Shunt Reactors Rated Over 500 kVA C57.21

**Vancouver, BC Canada
Sheraton Wall Centre Hotel**

Tuesday October 25, 2016

The working group met in the Grand Ballroom AB of the Sheraton Vancouver Hotel on Tuesday October 25, 2016, at 9:30 AM.

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

There were a total of 72 participants: 13 Members and 59 Guests out of which 14 Guests requested membership.

- The meeting was opened with the introduction of participants and the circulation of attendance rosters and call for potentially essential patents.
- 13 of the current 22 WG Members were present and quorum to carry out business was met.

Meeting notes:

- **Meeting Agenda**
 - Meeting agenda, which was circulated among members and guests on October 12, 2016 by email, was presented to the audience.
 - Motion to approve the agenda was made by Dharam Vir and seconded by Raj Ahuja.
 - There were no objections or comments and the agenda was approved unanimously.
- **Minutes from previous meeting**

- The minutes from the S16 meeting in Atlanta, which were circulated on October 12, 2016 by email, were presented to the audience.
- Motion to approve the agenda was made by Luc Dorpmanns and seconded by Arup Chakravarty.
- There were no objections or comments and the S16 meeting minutes were approved.

■ **Old Business:**

WG was advised that the PAR will expire in 2018. Work on the comments and draft for the standard revision will have to advance for prompt circulation among the WG members. This is the last WG meeting for general discussions.

1. Field Measurement for vibration: Joe Meisner to provide some examples and technical background regarding field measurements, vibration test and vibration tracking over time being easier to perform and also help troubleshoot installation problems with the foundation: Joe Meisner was not present in the meeting and the chair will contact him by email.
 2. Measurements be performed at rated MVA instead of rated voltage (Bertrand Poulin) referred to working subgroup: work is on-going but not completed yet. Expected to be completed by November 15, 2016; by which date Bertrand will send to the Chair.
 3. Insulation class 150 or 155 for dry type – referred to working subgroup:
 - 3.1. Table 3: The insulation temperature class in table 3 for dry-type shunt reactors was discussed. Is it 150 or 155? Solomon Chiang pointed out that the proper denomination is 155 as there is no 150 insulation class.
 - 3.2. The table 3 needs a minor editorial change to center the DRY TYPE legend its column for clarification. Other columns specify temperature rise limits.
 - 3.3. No further clarifications required. Solomon Chiang will be asked to provide a write up on insulation temperature classes.
 4. Vibration level proposal by L. Dorpmanns: Presentation was done in previous meetings. Inputs on the draft required.
 5. Section 4 – Inputs from Gael Kennedy: inputs provided in the previous meeting.
 6. Inputs from Dieter Dohnal: tap changer as applied to variable shunt reactors. Inputs from Dieter were distributed to the WG on October 13, 2016, by email. Tap changer selection, applications, bibliography are included. Input and comments required from the WG.
- Subgroups as set by the Chair to work on different sections of the standard. The following members volunteered to work on:

Sections 1 through 4: Sanjib Som, A. Del Rio.

Sections 5 through 9: Joe Meisner, Subash Tully, Rogerio Verdorin, Raj Ahuja. Adding Mike Spurlock and Mat Weisensee.

Section 10: Bertrand Poulin, Shamum Hakim, Subash Tully, Klaus Pointner, Kris Ploetner

Sections 11: Dharam Vir.

Section 12: Mike Sharp

Pictures, figures and drawings: Rogerio Verdolin. Adding: Sanjib Som, Art Del Rio, Kris Zibert.

If anyone wishes to participate in the above groups or if anyone's name is not included inadvertently in the list, please contact the WG Chair. Target for first draft completion and circulation by email is before the next meeting which will be Spring 2017.

No new businesses were presented.

Meeting was adjourned at 10:10 am.

Next meeting: Spring 2017, New Orleans, LA, April 2-6, 2017.

Respectfully submitted,

Chairman: Sanjib Som (ssom@patransformer.com)

Secretary: Arturo Del Rio (Arturo.delrio@trench-group.com)

**J.8.8 IEEE/IEC WG Wind Turbine Generator Transformers, P60076-16 - D. Buckmaster
WG P60076-16 Standard Requirements for Wind Turbine Generator Transformers**

Chairman: Phil Hopkinson; Secretary: Donald Ayers

The Working Group on Wind Turbine Generator Transformers was called to order at 9:30 a.m. EST on Tuesday, October 25, 2016 at the Sheraton Hotel Wall Center in Vancouver, British Columbia. There were 89 attendees, 31 members present of a membership of 54 and 58 guests. A quorum was present.

It was announced by the new Chairman that David Buckmaster, prior Chairman, has resigned from office due to health problems. A large thank you to David for his effort in propelling this standard forward. Our prayers and well wishes go out to David.

The following guests requested Membership on the Working Group. After two consecutive meeting attendance they will become members.

Javier Artega, ABB, Raleigh, NC

Mark Gromlovits, EMC OEM Products Division, Bristol, VA

Amitav Mukerji, Consultant, Cary, NC

Rahul Palakandy, Black & Veatch, Overland Park, KS

Alan Sbravati, Cargill, Campinas, Brazil

William Solano, Siemens Energy, Pearl, MS

Stephan Voss, Siemens, AG, Nuremberg, Germany

David Walker, MGM Transformers, Commerce, CA

Joshua Yun, CG Power Systems, Wildwood, MO

Hemchandra Shertukda made a motion to accept the agenda for the meeting and was seconded by Rogerio Verdolin. The motion passed unanimously.

Hemchandra Shertukda made a motion to accept the minutes from the Spring 2016 meeting and was seconded by Rogerio Verdolin. The motion passed unanimously.

A call for patents was made and none were reported.

The Secretary reviewed the comments from the second ballot recirculation with resolution status. New comments were not addressed under re-balloting rules. Of the 41 comments, two were rejected, five were identified as new comments and the remaining 34 comments were addressed as editorial and accepted. The standard document was then reviewed which showed the editorial changes in red.

A motion was made by Rick Marek to accept the recommendations made on the comment resolution matrix. The motion was seconded by Rogerio Verdolin. The motion passed unanimously.

A motion was made by John John to accept the modified standard made with the comments in red. The motion was seconded by Sukhdev Walia.

Under discussion, Paul Jarman commented that the IEC editors were against the use of dual references in the document, but was working to getting the issue resolved. The last version of the standard has not been recirculated as a CDV (Committee Draft to Vote). He is investigating whether present document can be circulated as both a CDV and Final Draft.

It was reported by the Chairman that a question about the arc-flash information was raised at the IEC TC-14 meeting recently, but did not consider it an impediment to the standard. Joe Mango explained how his company analysed for arc-flash conditions and how they handle the transformer.

The vote was unanimous to accept the modified document.

A motion was made by Hemchandra Shertukda to send the modified standard out for a recirculation ballot. The motion was seconded by Rogerio Verdolin.

Under discussion Masoud Sarifi commented on the complexity of creating a standard where there are many different parties involved. It was emphasized that the standard does not take away from special customer requirements. Sukhdev Walia gave a brief history of how the standard work began and the need.

The question was raised as to what would happen if IEEE passed the ballot but the IEC has objections or comments. This question will be referred to IEEE for explanation.

The motion for recirculation passed unanimously.

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

Respectfully submitted,

Donald E. Ayers
Secretary

J.8.9 WG on Semi-Conductor Rectifier Transformers -C57.18.10 - S. Kennedy
Working Group on Semiconductor Power Transformers – C57.18.10

Unapproved Meeting Minutes

Sheraton Wall Center Hotel, Vancouver, BC
Grand Ballroom AB
11:00 am, October 25, 2016

The Working Group met in the Grand Ballroom AB meeting room

There were 27 people present. 7 old members plus 5 new members and 15 guests present.

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

The minutes of the April, 2016 meeting in Atlanta were approved as written.

Old Business

- Sheldon presented the approved PAR. Bill Whitehead to update draft standard with new scope from PAR.
- Want to harmonize with IEC standards as much as possible.

New Business

- Topics for discussion in new standard, Phase Shifted Windings, Electrostatic Shields, Interphase applications, Circuit Break Interactions and Snubbers, non-classical harmonics associated with new inverters and drives.
 - Some phase shifted transformers are covered by patents. Standard will only cover general phase shifted windings rather than specific examples.
 - Will mention circuit breaker interactions due to use of these transformer. However, this will be covered in detail elsewhere.
- Eddy Currents and Stray Losses. Paul Buddingh- Would like guidance on Eddy currents to remain in standard because it is an issue in the field. Eduardo Tolcachir - Need to keep division between eddy and stray losses to be able to calculate currents for testing. Rick Marek thinks simple percentages are dangerous to use for complicated rectifier transformers. John John- When harmonic information is available then we use information from customer. Not always available. Vijay Tendulkar- dual secondary's with uneven loads can cause effect on heating. % values are ok for two winding but are not good for more complicated windings. Stephan Voss - For multiple winding transformers simple values are not good enough.
- Paul Buddingh - Suggested mentioning high resistance grounding can cause common mode noise problems in drive transformers.
- - IEEE has "rectifiers" while IEC uses "converter". Why not change? Sheldon said that title of standard has rectifier listed but scope covers the more general case. Also, need to mention rectifiers could be in source as well as in the load.

With no further business, the meeting was adjourned at 11:55.

The Working Group will meet again at the Spring 2017 meeting in New Orleans, LA

Chairman: Sheldon Kennedy

Vice Chairman: Bill Whitehead

Secretary: David Walker

J.8.10 WG Loss Evaluation C57.120 - R. Verdolin

Meeting Minutes

**Fall 2016 IEEE Transformers Committee Meeting — Vancouver, BC, CANADA
PC57.120 LOSS EVALUATION GUIDE FOR DISTRIBUTION AND POWER
TRANSFORMERS AND REACTORS
Tuesday, October 25, 2016 — (11:00 AM – 12:30 PM)**

Chair: Rogerio Verdolin

Vice-Chair: Rod Sauls (Rod was not able to attend the meeting)

Secretary: Marcos Ferreira / Hamid Sharifnia

1. Attendance
 - a. Members: 14
 - b. Guests: 77
 - c. Guests granted membership: 4
 - d. Guests requested membership 7
 - e. Total (Members + Guests): 91
2. The meeting was called to order at 11:00 am on Tuesday, October 25, 2016.
3. Circulating the Rosters.
4. Call for Patents – No claims
5. Introduction was made.
6. Attendance was checked to see if a quorum was established. There were 24 active members on the roster and at least 12 were needed for a quorum. There were 14 members present.
7. Agenda of meeting was approved.
8. A motion was made to approve the minutes of meeting from the Working Group Spring 2016 meeting in Atlanta, GA. The meeting minutes was approved.
9. Rogerio reported the results of the IEEE-SA sponsor ballot draft 15, Rev02 and draft 16.
10. The PC57.120 Draft 15, Rev02, went to ballot and had an excellent approval rate of 93%. The minimum approval rate requirement to have the draft approved is 75%.
11. A Ballot Resolution Committee was created in order to review the comments: Rogerio Verdolin, Rod Sauls, and Wallace Binder.
12. Conference calls were performed with the Ballot Resolution Committee to review the comments from the ballot group: September 9th, 15th, and 19th 2016.
13. Before the chair recirculated the comments reviewed by the Ballot Resolution Committee, the chair requested on September 19th, 2016 the endorsement from the members to accept the changes to the document. More than 2/3 approval rate was obtained from members.
14. Result of the recirculation of the comments: 100% approval rate.

15. The approved draft 16.1 will be sent to IEEE Standard Association RevCom for submission.
16. No New Business
17. The meeting was adjourned at 12:30 PM

Respectively submitted,
Rogerio Verdolin, Chair
Marcos Ferreira / Hamid Sharifnia, Secretary

J.8.11 WG 3-ph Transf. Connections C57.105 - A. Bromley

**Fall 2016 - IEEE Transformers Committee Meeting — Vancouver, British Columbia,
Canada
IEEE / PES Transformers Committee
Performance Characteristics SC
C57.105 – IEEE Guide for Application of Transformer Connections in Three-Phase
Electrical Systems
Tuesday, October 25th, 2016 - (1:45 PM – 3:00 PM)**

Chair: Adam Bromley
Vice-Chair: Rogerio Verdolin

1. Attendance
 - a. Members: 13
 - b. Guests: 24
 - c. Guests requested membership 0
 - d. Total: 37
2. The meeting was called to order at 1:45 pm on Tuesday, October 25th, 2016.
3. A motion to approve agenda for the meeting was made. The agenda was approved unanimously.
4. Call for patents were made by the Chair. Patents were not claim by members and guests.
5. A motion was made by Samuel Sharpless and seconded by Said Hachichi to approve the meeting minutes from the Working Group Spring 2016 meeting in Atlanta, GA. By unanimous vote, the minutes were approved.
6. Par status: Par expires December 31st, 2019, which represents 4 meetings before we have to conclude the guide. The PAR was approved March 2015. The draft has to go to ballot the end of 2018. So we have to conclude our draft by fall of 2018.
7. The chair went through the comments provided my members and David Jacobson, from Manitoba Hydro.
8. Chair has informed that he has to step out from the chair position due changes on his position in his company and the chair will not be able to attend the meetings anymore. Roger Verdolin and Benjamin Garcia will become the chair and vice-chair of the WG C57.105 respectively.
9. Figures and Tables were updated.
10. Changes were made from symbols to texts, such as Δ (Delta) Y (wye). Additional changes need to be done. Members stated that it is really difficult to read with symbols.

11. John John and Samuel Sharpless reviewed Sections 4 and 5, Electrical Connections and Magnetic Circuits.
12. Group to review specific sections. Samuel Sharpless send his updated on Sections 4 and 5. The chair went through some specific sections. There are a lot of symbols to be checked. Tables and Figures were relocated in different subsections in the draft. Section 4.5 - Connection Application Characteristics was added in the draft. The chair asked for volunteer to review Section 4.6.1 - Terminal Designation. Charles Morgan volunteered to review Section 4.6.1. Including the review the reference standards (maybe add new standards, such pad mount transformers.
13. Maybe adding a diagram to clarify the connections. Samuel Sharpless volunteered to review this topic. C57.12.10 will be used as a reference.
14. Section 4.4 T-T Connections was discussed. Charles Morgan supplied some further information to help with developing possible figures regarding these connection types. Giuseppe Termini also volunteered to provide some information to help add to this section.
15. Section 5 – Magnetic Circuits was discussed. Some Figures were relocated in different subsections.
16. A motion was made by Dan Mulkey and seconded by Thomas Callsen to approve the revision on Section 5.3.1- Inrush Current Transient provided by David Jacobson. The motion was approved by majority of the members.
17. The chair went through some additional comments and recommended all members to review the changes provided by some of the members.
18. Charles Morgan offered to review Section 4.6.1 Terminal Designation.

Respectively submitted,
Adam Bromley, Chair
Rogerio Verdolin, Vice-Chair

J.8.12 WG on Distributed Photo-Voltaic Grid Transformers C57.159 - H. Shertukde

Unapproved Meeting Minutes
Vancouver, BC, Canada
Tuesday, October 25, 2016

AGENDA

1. Roster and Quorum Verification
2. Meeting Agenda Approval
3. Call for patents.
4. Approval of the S2016 Atlanta Meeting Minutes
5. Update on the editorial review and publishing of the Guide
6. New Business
7. Dissolving of WG IEEE C57.159

The Working Group met in the Grand Ballroom CD of Sheraton Vancouver Wall Center Hotel. This was ninth meeting of the WG. The meeting was called to order at 1:45 pm by Chairman H. Shertukde.

The meeting was convened with 35 participants present, 15 of them are members (this constitutes a quorum out of 28 current members in the roster).

Meeting Agenda was approved.

Spring 2016 Atlanta Meeting Minutes were approved.

Call for patents was made. No patent claims were presented.

1. Chair H. Shertukde updated WG that RevCom approved IEEE C57.159 Guide for publishing. We have finalized the process of the editorial review with minor editorial changes and the Guide is going to be published on November 3, 2016. The chair expressed thanks to the officers and members of the WG for their work and valuable contribution that allowed to complete the WG assignment on time.

2. There were no new business items proposed to the WG.

3. Chair has asked for a motion to dissolve WG C57.159, A. Narawane made a motion, M. Sauzay seconded the motion. WG approved the motion unanimously.

With no more old or new business the Meeting adjourned at 2:15 PM.

Chairman: H. Shertukde

Vice-Chairman: M. Sauzay

Secretary: S. Levin

J.8.13 TF on HV & EHV Transients C57.142 - J. McBride

**Meeting Minutes
IEEE / PES Transformers Committee
Performance Characteristics Subcommittee
TF to Investigate the Interaction between Substation Transients
and Transformers in HV and EHV Applications
Vancouver BC, Canada
Tuesday, October 25, 2016
3:15 PM – 4:30 PM
Grand Ballroom CD**

**Chairman – Jim McBride
Secretary – Tom Melle**

- 1) Welcome and Chair's Remarks. TF objective presented: to prepare a report addressing the need to revise the C57.142 guide to extend to HV and EHV applications.
- 2) Circulation of Attendance Sheets
- 3) Initially Quorum was not achieved. It was noted that those members who had not attended two of the prior three meetings were moved to Guest status.
- 4) Status of TF Paper Submission
 - TF paper is ready for immediate submission after completion of formatting and small editorial changes.

- 5) Discussion of Additional Topics for the C57.142 Revision – Topics were:
 - A) Incorporation of more mitigation techniques
 - B) Include information on stress in the transformer due to the method of neutral grounding - Waldemar Ziomek.
 - C) Include information on reactor switching (C37.015 and C57.21) - Pierre Riffon
 - D) Include information on upstream and downstream interactions in low power factor and highly inductive circuits - Phil Hopkinson
- 6) Attendance was retaken: Total attendance was 87, with 25 Members and 62 Guests present. Quorum (25 of 44 members) was achieved. Eleven guests requested membership and 8 were granted based on attendance of 2 of the last 3 meetings.
- 7) Approval of Agenda and Spring 2015 Minutes
- 8) PAR Discussion continued and a motion was made by Phil Hopkinson to remove the statement indicating that Reactor Switching does not apply and include some information regarding effects of reactor switching. The motion was Seconded by Sanjib Som. Motion carried.
- 9) Xose Lopez-Fernandez reviewed CIGRE work on white box, black box, grey box modeling methods that are described in detail in the CIGRE brochure on interactions. One of the goals for the working group is to provide standardization of the format used to identify transformer requirements. Another goal is to create a way to link the system model to the transformer model in order to study and predict possible interactions.
- 10) Phil Hopkinson presentation - Discussion of Mitigation Methods, Factory Testing, and Field Service Conditions related to regarding the effect of High frequency transient from breaker operation on transformer (will be available on TF web page).
 - A) Discussion followed as to whether certain PD techniques or SFRA analysis being studied by CIGRE A2 may be used to help judge the immunity of impulsed windings.
 - B) Mark Perkins commented that some circa 1960's core-form transformers with RC snubbers attached failed in circuits where shell-form transformers did not. The design differences should be considered.
 - C) Phil Hopkinson suggested mitigation possibilities should include part-winding arrestors
 - D) Bertrand Poulin provided information of a transient estimation study by IREQ for GSU's in backfeed mode that resulted in predictive voltage distribution.
 - E) Further discussion centered around utilizing special termination impulse, special design simulations, and adapting winding designs for "worst case" scenarios.
 - F) Phil Hopkinson stated that in his experience, standard switching impulse testing is not necessarily helpful in preventing these types of failures. Recommendations include "Front of Wave" (aka Steep Front, Fast Front, or FFSI, VFF).
- 11) The Chair commented that field measurements of the transients generated very near the

transformer terminal many times have a much faster front than 1 micro-second.

- 12) Phil Hopkinson commented that a system load will dampen the oscillations and therefore shorting the non-impulsed windings is not necessarily an adequately strenuous test. Pierre Riffon added that special terminated lightning impulse can produce much higher stress in the affected winding and suggested stronger designs and improved testing.
- 13) Phil Hopkinson asked if a longer impulse tail time would be beneficial. Pierre Riffon suggested that it would not be as stressful as the other suggested methods.
- 14) Sanjib Som suggested including an analysis of the electrical circuit prior to design of the affected transformer(s).
- 15) Considering the importance of the discussion, the Chair suggested forming a survey group to collect additional information. The following members volunteered: Phil Hopkinson, Mike Spurlock, Hamid Sharifnic, Akash Joshi, Shekhar Vora
- 16) Motion to adjourn the meeting made by Sanjib Som and the meeting was adjourned at 4:30 PM.

Respectfully Submitted,
Tom Melle, TF Secretary
10/25/2016

J.8.14 TF on short Circuit Criteria - S. Patel

MINUTES WG PC57.164,

Guide for Establishing Short Circuit Withstand Capabilities of

Liquid Immersed Power Transformers, Regulators, and Reactors

- WG met on Tuesday October 25th, from 4:45 PM in Jr. Ball Room CD
- Invitation was sent to all TF members and guests to attend the meeting
- 86 attended the first meeting, out of which 36 requested WG membership, which was accepted (Membership status will be reviewed after 3 meetings)
- Since this was first Meeting, No prior REVIEW & APPROVAL OF MINUTES was required
- Patent Disclosure statement was made
- Scope and status on approval of PAR was communicated
- Presentation was made by Shankar from KEMA lab on SC Testing of transformers in last 10 years
- Outline of the Sections of Draft Guide was reviewed – There was detailed discussions by few members on the content of few sections, and these topics will be included in the draft
- 12 members volunteered for working on the Draft
- Meeting adjourned at 6:02 PM