Annex J Performance Characteristics Subcommittee

October 17th, 2018; Jacksonville, Florida, USA

UNAPPROVED MINUTES

Chair: Craig Stiegemeier
Vice Chair: Sanjib Som
Secretary: Rogerio Verdolin
Substitute Secretary: Hamid Abdelkamel

J.1 Introduction / Attendance

There were 77 of the 108 PCS members in attendance so quorum was achieved (71% in attendance). In addition, 82 guests were present at the meeting. The total attendance at the meeting was 159. There were 23 guests who requested membership, if they had attended the last meeting in Pittsburgh they will be added as members. They will be reviewed and added before the Spring 2019 meeting in Anaheim, California USA.

J.2 Chairman's Remarks

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

- 2018 PAR's
  - C57.158 Tertiary/Stabilization Windings (complete)
  - C57.110 Non-sinusoidal Load Currents (complete)
  - C57.21 Shunt Reactors (filed PAR extension in September, D4 approved)
- 2019 PAR's
  - C57.105 3-ph Transf. Connections
  - C57.109 Through-Fault-Current Duration
- 2020 PAR's
  - C57.164 Short Circuit Withstand Guide
  - C57.18.10 Semiconductor Rectifier Transformers
- 2021 PAR's
  - C57.142 Transient Guide
  - C57.32A Neutral Grounding Devices amendment
  - C57.123 Loss measurement guide

- C57.133 Guide for Short Circuit Testing (Expired)
- C57.136 Sound Abatement Guide (Expiring at the end of 2018 – will let expire as appropriate content has been added to C57.12.90 in Clause 13)
- C57.149 SFRA Guide (2022)
- C57.159 DPV Transformers (2026)
- C57.32 Neutral Grounding Devices (2025)
- C57.120 Loss Evaluation Guide (2027)
- C57.32.10 Neutral Grounding Reactors Guide (new)

Working Group / Task Force Leaders

- An agenda must be provided when each leader reviews the preliminary agenda for the next meeting to secure a meeting room at the meeting
- Minutes are officially due in 15 days, but please get at least a draft copy of them to Rogerio (secretary) on Wednesday (the day of the PCS meeting) by 10:00 AM, in MS Word (not PDF) format
- Please keep your webpages up to date – review them regularly and send updates to Sue (a new system is coming that may give you that power)
- 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
- Please keep your membership fresh – remove anyone who has missed the last two consecutive meetings

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
- 9 "Corresponding Members" are counted as "Guests" in terms of attendance for a quorum
- Requests for membership will be granted after the meeting if you've made the past 2 or 3 of the last 5 meetings
- PCS now has 108 members after a review of the Spring 2018 meeting attendance, along with the 4 previous meetings
- A meeting quorum will be reached if 55 members are in attendance

Attendance / Membership – moved to Guest status

The following 6 Members missed the past 2 meetings and have been moved to "Guest" status:

- Mark Perkins
- Larry Coffeen
- Mike Spurlock
- Douglas McCullough
- Adam Bromley
- David Walker

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 11 former Guests requested membership at the Spring 2018 meeting and have attended the past 2 or 3 of the last 5 meetings:

- Robert Ballard
- Florian Costa
- Everton De Oliveira
- Bill Griesacker
- Stacey Kessler
- Cornelius Plath
- Mickel Saad
- Richard vonGemmingen
- Joe Watson
- Joshua Yun
- Peter Zhao

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

Attendance / Membership – Quorum determination

- Current breakdown of the Subcommittee:
  - 108 Members
  - 55 are needed for a quorum

J.3 Approval of Agenda

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

J.4 Approval of Last Meeting Minutes

The Chair presented the minutes of meeting held in the Spring 2018 - Pittsburgh, Pennsylvania, USA on March 28th, 2018 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. Wallace Binder made 1st motion to approve spring 2018 meeting, which was seconded by Dan Sauer.

J.5 Minutes from Working Groups and Task Force

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

• TF to determine need for OLTC Field Test Guide	M. Ferreira
• TF on PCS Revisions to Test Code C57.12.90	H. Sahin
• TF on Audible Sound Revision to Clause 13 of C57.12.90	R. Girgis (B. Beaster)
• WG Guide for FRA for Liquid Filled Transformers C57.149	C. Sweetser
• WG on Loss Measurement C57.123	E. teNyenhuis
• TF on PCS Revisions to C57.12.00	T.Ansari (E. Betancourt)
• WG Shunt Reactors C57.21	S. Som
• WG on C57.18.10 Semiconductor Rectifier Transformers	S. Kennedy
• WG on HV & EHV (Breaker & Transformer) Transients C57.142	J. McBride
• WG Short Circuit Design Criteria C57.164	S. Patel
• WG on Amendment to Neutral Grounding Devices PC57.32a	S. Panetta

Below are highlights that were discussed at the PCS meeting:

1) **TF to determine need for OLTC Field Test Guide:**
   The task force came up with a Title and Scope for a field test guide for on-load tap changer. The title is “On-Load Tap Changer Diagnostic Field Testing Guide” and the scope was "Guide for diagnostic field testing of On-Load Tap Changers (OLTC) during tap change operation to assess their condition. This guide includes diagnostic testing methods for various OLTC types with results, analyses and interpretations." A vote was taken and the PCS agreed with the TF that they should prepare a PAR for submission to AdCom to put together a Working Group to develop the guide for evaluating on-load tap changers during operation.
   Marcos made a motion to create a WG to develop a document for field testing of on load tap changers. Raka Levi seconded the motion. Chair opened floor for discussion. Dan Sauer commented that scope is too narrow. Raka stated that this document would be a stand-alone. A straw ballot was conducted yielding 43 in favor of creating a PAR to develop document, 8 abstentions, and 2 negatives votes. The motion passed.
2) **TF on PCS Revisions to Test Code C57.12.90:**
   A straw ballot approved working in the TF minutes for changes in sections 8.7 (On-Load Tap Changer End to End Voltage Test) and 9.6 (On-Load Tap Changer End to End Current Test) of

the standard. The TF also reviewed clarified wording being considered for the "Winding resistance test requirement on wye connected transformers with neutral bushing brought out". The TF also reviewed and agreed to pass along this recommendation: "Revise the standards to say it is recommended that the insulating liquid used for service also be used for factory testing. In the case it is agreed by the user and manufacturer to not test with the same liquid type, it should be supported by calculation or experience"
There was a discussion about the correction of liquid temperature to accommodate for differences at high altitude. After some discussion, it was determined that this really belongs to the Insulation Life Subcommittee.
The final technical topic was a discussion on the OLTC continuity tests. After some discussion, it was agreed that this is a quality control test and does not fall under our responsibility for C57.12.90.

3) **TF on Audible Sound Revision to Clause 13 of C57.12.90:**
Prior to the meeting, a survey was issued to members of the Performance Characteristics Subcommittee for comments on the TF revisions to Table 17 and Annex C in C57.12.00. Out of 43 returns, 41 were approvals w/w/o comments. All comments were discussed and the result was implemented.

4) **WG Guide for FRA for Liquid Filled Transformers C57.149:**
This was the first meeting, and volunteers stepped forward to lead the review of specific sections of the document.
1. Scope/Application – Steve Schappell (SPX Transformer Solutions)
2. FRA Test Parameters – Peter Werelius (Megger)
3. Making an FRA Measurement – Diego Robalino (Megger)
4. Test Records – Alex Kraetge (Omicron)
5. Analysis & Interpretation
   - Mario Locarno (Doble)
   - Luiz Cheim (ABB)
   - Hemchandra Shertukde (UHart)
   - Peter Werelius (Megger)
6. Appendix: FRA Theory – Mark Lachman (Doble)

Malia will work with Chuck to get the MS Word version of the current document to enable effective editing.
Data is a key for this WG, and Proovi Patel and James Cross are going to work together to develop a template to ensure consistent gathering of data.

5) **WG on Loss Measurement C57.123:**
Draft 4 of the standard was reviewed at the meeting. All chapter assignments are complete except for Chapter 7. A commitment was made by Reto Fausch to complete the review of chapter 7 and send them to the chair before Anaheim for incorporation into the next draft of the standard. Also, a statement is being developed to cover the impact of core steel coatings that are different for distribution and power transformers. It was approved for the chair to survey PCS before the next meeting, once these updates are incorporated. The guide should be ready for ballot after discussion at Anaheim.

6) **TF on PCS Revisions to C57.12.00:**
There was a discussion about the language of Table 17 in the section about the load loss testing. A motion was made and approved and later withdrawn about clearing up the language related to the rated/maximum kVA for the test. A discussion also occurred on the tolerances for the transformer ratio and Hakim Shamoun will prepare a statement before the next meeting to make this tolerance statement clearer.

7) **WG Shunt Reactors C57.21:**

This standard and the current PAR for this group will expire at the end of the year. In September a 2 year PAR extension was submitted by the Chairman. Draft 4 of the standard was circulated with a good response from the membership with more than 2/3 of the members voting. A CRG is in place to resolve all the issue, which are documented in detail in the WG's minutes.
Sanjib made a motion to take the revised draft to the subcommittee for procedural vote, which was seconded by Dan Sauer. The motion was unanimously approved.

8) **WG on C57.18.10 Semiconductor Rectifier Transformers:**
This Working Group was not able to achieve a quorum. Draft 4 revisions were reviewed with the members present.
9) **WG on HV & EHV (Breaker & Transformer) Transients C57.142:**
Extensive discussions about the transformer/breaker interaction were held. A review of both calculation as well as physical construction (such as shields) methods of dealing with the transients took place. Also, the minutes will contain a summary of locations and conference where the topic is being discussed occurred. There are still editing changes in the current draft that will be brought to the Anaheim meeting.
10) **WG Short Circuit Design Criteria C57.164:**
A presentation on short-circuit testing was given by Shankar Subramany from the KEMA Laboratories. It was agreed that 1.0 per-unit of nominal system voltage should be used versus 1.05 that was in the previous draft, unless specified otherwise.
11) **WG on Amendment to Neutral Grounding Devices PC57.32a:**
This WG did not meet in their allocated slot here in Jacksonville. The last meeting of the WG was a virtual meeting that took place on September 5th and in those minutes they announced the next meeting would be here in Jacksonville. Unfortunately they did not take advantage of face to face meetings here. They have balloted changes developed as an amendment to C57.32, and were quite challenged for the need for a supermajority. The changes for CRG requirements should allow this WG to complete their task by or at the Anaheim meeting.

J.6 Unfinished (Old) Business

None

J.7 New Business and Motions

PC57.32.10 Neutral Grounding Reactors Guide - Ulf Radbrandt

This is an entity Working Group that will be having its first meeting in Anaheim. Ulf made a motion to create TF to develop neutral grounding reactor guide. Motion was seconded by Mike Sharp. Motion was withdrawn.

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

J.8.1 PCS Task Force on OLTC Diagnostics

Performance Characteristics Subcommittee
IEEE / PES Transformers Committee

October 15th, 2018 9:30AM
Hyatt Regency hotel Jacksonville Florida, USA

UNAPPROVED MINUTES

The PCS Task Force on OLTC testing / diagnostics met on Monday, October 15th 2018. The Chair Marcos Ferreira called the Group to order at 9:30am and explained purpose and scope of the TF. There were 71 guests and 24 members present. Group has 45 members so we had the quorum; 22 guests requested membership. Task force officials were Marcos Ferreira the chair, Raka Levi the vice-chair and Roger Fenton as interim secretary.

The motion to approve the agenda was initiated by Drew Welton and seconded by Jon Heron. No discussion took place and agenda was approved unanimously with no comments or amendments.
Motion to approve the minutes of last meeting was initiated by Ed teNyenhuis and seconded by Jon Heron. No discussion took place and minutes was approved unanimously.
Agenda Items were covered as follows.
Chair reminded the group this TF determined that “a guide is needed” at the last meeting and our task today is to define the title and the scope of the proposed future work.
The group discussed the title and its wording. After further discussion the motion was proposed by Marc Foata and seconded by Peter Werelius to have the following title:
“On-Load Tap Changer Diagnostic Field Testing Guide”
The vote for this title proposal was 15 for and 7 against, with 3 abstained. The title was approved.
During this discussion, a motion was proposed by John Herron to work on two test methods only: DRM and VAM. Following a vote with 13 against and 12 for, the proposal was rejected.
John Herron mentioned that the scope is too broad and LTC testing is covered in the standard C57.152.
Many modifications were brought up for the SCOPE, and a final motion was proposed by Joe Foldi and seconded by Ed teNyenhuis:
"Guide for diagnostic field testing of On-Load Tap Changers (OLTC) during tap change operation to assess their condition. This guide includes diagnostic testing methods for various OLTC types with results, analyses and interpretations."
Following a vote with 22 for the proposal, 1 against and 1 abstained; the wording of the SCOPE was approved.
Vice-Chair requested the motion to present our decisions to the PCS subcommittee for initiating working group on a guide on OLTC diagnostics test. Motion was initiated by a Timothy Tillery and seconded by Joe Foldi. No discussion took place and decision was approved unanimously.
Meeting adjourned at 10:50AM.
Respectfully submitted by

Marcos Ferreira	Raka Levi	Roger Fenton
Chair	Vice Chair	Interim Secretary

J.8.2 Task Force on PCS Revisions to C57.12.90

Title: Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers

October 15, 2018, 11:00am-12:15pm
Hyatt Regency Jacksonville Riverfront
Meeting Room "Grand Ballroom 5"
Jacksonville, Florida USA
Chair: Hakan Sahin Secretary: Hamid Abdelkamel

The TF Chair called the meeting to order at 11:05am. Meeting attendees stood up and introduced themselves.
The chair went through a review of the purpose of the task force and the proposed agenda for the meeting.
There were 41 of the 68 TF members in attendance making this meeting "official" as a quorum of 60.3% was reached.
A total of 89 people attended the meeting of which 9 guests requested membership. Secretary will review whether or not membership requirements are met and will include in meeting minutes prior to spring 2019 meeting.

The chair asked if any changes needed to be made to the agenda or if anyone had new business. No new business was requested.

Bertrand Poulin made the 1st motion to approve the agenda, which was seconded by Dan Sauer. Fall 2018 agenda was approved.

Dan Sauer made 1st motion to approve spring 2018 meeting minutes, which was seconded by Bertrand Poulin. Spring 2018 meeting minutes were approved.

After approving the fall 2018 agenda and the minutes from the spring 2018 meeting, the task force moved on to old business, which is the LTC performance voltage test and current test to be included in future versions of C57.12.90.
The Chair gave about 5 minutes for those attending the meeting to read the below text in 8.7. Then the Cahir showed the text for section 9.6.
8.7 On-Load Tap Changer End to End Voltage Test
In order to verify the performance of a transformer that has an on-load tap changer (OLTC), the OLTC shall be operated through one end to end to end (from one extreme tap to the other extreme tap and back) with the transformer energized at rated voltage with minimum control and motor voltage of 85%. For safety, the OLTC shall be fitted with and connected as for service including protective devices and must not be operated manually. The test may be performed at intervals, if necessary, such as to adjust the test circuit, but it is a requirement that the transformer be energized at no less than rated voltage corresponding to each tap to be changed and the applied voltage can be adjusted to the rated voltage of the tap position. The transformer shall be observed during this test and the operator shall identify that the sound during the tap changing operations was either normal or abnormal. Note that with some types of tap changers, there will be abnormally loud sound if components are not assembled properly. The transformer will have passed this test if the tap changer operates normally with no abnormal sound and no abnormal observations in the test control system such as a trip of the test circuit. Oil samples shall be taken from the OLTC compartment of vacuum type tap-changers before and after the test and analyzed for dissolved gasses. Results of the analysis may show some increase of dissolved gases due to current commutation,

resistor heating and / or stray-gassing of the oil. For mineral oil filled vacuum OLTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type OLTCs and 6 ppm for compartment type OLTCs. For non-vacuum type OLTCs or OLTCs filled with a liquid other than mineral oil, the determination of abnormality is through sound only and there is not a limit for increase in gases.
Note: During the operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

9.6 On-Load Tap Changer End to End Current Test
In order to verify the performance of a transformer that has an on-load tap changer (OLTC), the OLTC shall be operated through one end to the other end (from one extreme tap to the other extreme tap) with the transformer current corresponding to the top nameplate MVA rating with minimum control and motor voltage of 85%. For safety, the OLTC shall be fitted with and connected as for service including protective devices and must not be operated manually. The test may be performed at intervals, if necessary, such as to adjust the test circuit, but it is a requirement that the transformer current shall not be less than 80% of the top MVA nameplate current for each tap change. The transformer shall be observed during this test and the operator shall identify that the sound during each tap changing operations was either normal or abnormal. Note that with some types of tap changers, there will be abnormally loud sound if components are not assembled properly. The transformer will have passed this test if the tap changer operates normally with no abnormal sound and no abnormal observations in the test control system such as a trip of the test circuit. Oil samples shall be taken from the OLTC compartment of vacuum type tap changers before and after the test and analyzed for dissolved gasses. Results of the analysis may show some increase of dissolved gases due to current commutation, resistor heating and / or stray-gassing of the oil. For mineral oil filled vacuum OLTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type OLTCs and 6 ppm for compartment type LTCs. For non-vacuum type OLTCs or OLTCs filled with a liquid other than mineral oil, the determination of abnormality is through sound only and there is not a limit for increase in gases.
Note: During the operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

The Chair then stated that he reviewed all comments he received and incorporated as much as he could to produce the aforementioned clauses (8.7 and 9.6).
The Chair conducted a straw ballot and the majority accepted 8.7 and 9.6 as shown above.
The Chair showed the text (below) final version of "Winding resistance test requirement on wye connected transformers with neutral bushing brought out" for information only.
"For the wye windings, the reported resistance measurement may be from terminal to terminal or from terminal to neutral. When there is a neutral bushing brought out, at least one terminal-to-neutral measurement must be made at rated tap position and reported. For the reported total winding resistance, the resistance of the lead from the neutral connection to the neutral bushing may be excluded. For the terminal-to-terminal measurements, the total resistance reported is the sum of the three measurements divided by two."

After that the Chair moved on to discuss new business items.
New Business #1 – Using the same oil for testing by Steve Schroeder , Ed teNyenhuis

- During the Fall 2017 meeting a new business was brought up by Steve Schroeder requesting that the Insulating Liquid used for service also to be used for factory testing
- This new business was addressed in the Task Force Meeting for Insulating Liquid for Factory Testing during the Spring 2018 with the below agenda:

- Technical Overview by Patrick McShane & Alan Sbravati of impact of using different insulating liquid for first impregnation & factory testing versus insulating liquid used for design / service
- Manufacturing impact for having an extra insulating liquid service in factory (extra cost?)
- Utility perspective
- Final discussion
- Motion / vote on path forward

- The TF decided the below:
- "Revise the standards to say it is recommended that the insulating liquid used for service also be used for factory testing. In the case it is agreed by the user and manufacturer to not test with the same liquid type, it should be supported by calculation or experience"
- At PCS it was agreed to send this to our TF to implement into C57.12.90. It is suggested for this recommendation to go in the following 2 sections as:

10.1.5.3 Assembly

Transformers, including bushings and terminal compartments when necessary to verify air clearances, shall be assembled prior to making dielectric tests. However, assembly of items that do not affect dielectric tests, such as radiators and cabinets, is not necessary. Bushings shall, unless otherwise authorized by the purchaser, be those to be supplied with the transformer.

It is recommended that the insulating liquid used for service also be used for factory dielectric testing. In case it is agreed by the user and transformer manufacturer to not test with the same liquid, it should be supported by calculation or experience.

11. Temperature-rise tests

A temperature-rise test is defined as a test to determine the temperature rise above ambient of one or more of the transformer's windings, as measured at the terminals. The result for a given terminal pair or winding is the average value of the temperature of the entire circuit; it is not the temperature at any given point in a specific winding. The term *average temperature rise* refers to the value determined by measurements on a given terminal pair of the winding. It does not refer to the arithmetic average of results determined from different terminal pairs of the transformer.

See 4.1.2 and 5.11.2 of IEEE Std C57.12.00-2015 for conditions under which temperature limits apply. All temperature-rise tests shall be made under normal (or equivalent to normal) conditions for the means of cooling, as follows:

a) Temperature-rise tests shall be conducted on transformers that are completely assembled and filled to the proper liquid level.

b) Temperature-rise tests shall be made in a room that is as free from drafts as practicable; defined as a wind speed of 0.5 m/s, or less.

c) When it is not possible or practical to test the transformer as a completed assembly, the transformer shall be tested with the components required to replicate normal means of cooling the transformer during temperature-rise tests. When the transformers are equipped with thermal indicators, bushing current transformers, or the like, such devices shall be assembled with the transformer.

It is recommended that the insulating liquid used for service also be used for the temperature rise test. In the case it is agreed by the user and transformer manufacturer to not test with the same liquid type, it should be supported by calculation or experience.

Bertrand Poulin recommended clarify meaning of same oil. He also recommended to change it to type of oil.
Steve Schroeder explained that type would mean using inhibited vs. non-inhibited oil, etc.
A question was asked for reason behind new businesses above? Answer was to make sure transformers are tested with specified oil type.
Steve Antosz asked why separate temperature rise test, short circuit, and dielectrics and why not put them in the general section.
Ajit Varghese requested that new businesses above are addresses in sections where they do not cause any conflict.
Steve Antosz recommended to verify where each clause would fall under. Steve Anotsz will figure out which clause or subcommittee aforementioned new businesses would belong to.
The Chair moved on to new business#2
New Business #2 – Number of Short Circuit tests Clause 12.3.4 by Shankar Subramany
Shankar states the following:
There is a confusion on the number of tests to be performed while applying the 1.5 method on a 3 phase transformer as well as single phase testing of a single phase transformer.
Shankar has a detail presentation which was presented by him during the spring 2018 meeting in WG PC57.164, which was agreed that it did not belong there and to be reviewed as a new business in our TF.

12.3.4 Number of tests

Each phase of the transformer shall be subjected to a total of six tests satisfying the symmetrical current requirement specified in 12.3.1 or 12.3.2, as applicable. Two of these tests on each phase shall also satisfy the asymmetrical current requirements specified in 12.3.3.

The Chair showed Shankar Subramany's summary below.

Test lab interpretation of number of tests – 3 phase tests

Test number	1	2	3	4	5	6	Total tests per phase
Phase 1	Asym	Asym	Sym	Sym	Sym	Sym	6 per phase
Phase 2	Sym	Sym	Asym	Asym	Sym	Sym	6 per phase
Phase 3	Sym	Sym	Sym	Sym	Asym	Asym	6 per phase

Asym	Required peak current (100%)
Sym	Symmetrical or reduced peak current (100%)

The 1.5 phase method results in similar mechanical stresses as full 3-phase testing at the critical instant of asymmetrical current peak.

Test lab interpretation of # of tests – 1.5 method, **should we add 4 tests per phase, 100% Sym, making it a total of 18 tests to the above table?**

Test lab interpretation of # of tests – 1-phase test on 1-phase transformer, **How to distribute the two asymmetrical tests over Max., Nominal and Min tap positions?**

Short circuit test requirements IEEE vs IEC – 1 phase test, **Should IEEE also specify 3 x Asym tests, one in each f the extremes and the nominal tap for both three-phase and single-phase transformers?**

Group agreed that this is a valid new business and the TF to continue working to rewrite the clause.

The Chair showed New Business #3 – Altitude correction, clause 11.4.2 by Steve Schroeder

11.4.3 Correction of liquid temperature rises for differences in altitude

When tests are made at an altitude of 1000 m (3280 ft) or less, no altitude correction shall be applied to the temperature rises.

When a transformer tested at an altitude less than 1000 m (3280 ft) is to be operated at an altitude above 1000 m (3280 ft), it shall be assumed that the liquid temperature rise will increase in accordance with Equation (32):

$$\Delta\theta_A = \Delta\theta_o \left(\frac{A}{A_o} - 1 \right) F \qquad (32)$$

where

$\Delta\theta_A$ is the increase in liquid temperature rise (°C) at altitude A meters (ft)
$\Delta\theta_o$ is the observed liquid temperature rise (°C)
A is altitude meters (ft)
A_0 is 1000 m (3300 ft)
F is 0.04 for self-cooled mode or 0.06 for forced-air-cooled mode

NOTE—Winding temperature rise above liquid temperature is not affected by altitude.

11.4.3 Correction of liquid temperature rises for differences in altitude

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where

$\Delta\theta_A$ is the increase in liquid temperature rise (°C) at altitude A meters (ft)
$\Delta\theta_o$ is the observed liquid temperature rise (°C)
A is altitude meters (ft)
A_0 is 1000 m (3300 ft)
F is 0.04 for self-cooled mode or 0.06 for forced-air-cooled mode

NOTE—Winding temperature rise above liquid temperature is not affected by altitude.

After a short discussion, it was decided that this new business belongs to insulation life SC.
However, Chair agreed to fix the typo in the above sections where 1000 m shown as (3280 ft) and then in the formula as (3300 ft)
The Chair moved to New Business #4 – OLTC Continuity tests by Kushal Singh

For reactance type OLTCs where a reactor (Preventive auto transformer) is used, in order to verify that the preventive auto leads are connected correctly, Kushal requests our TF to add the continuity test, crossed PA lead test, also known as "flicker" test.
The Chair and the group decided not to pursue this new business since it is more of quality check.
The Chair also shared another new business question from Toni Franchitti about another field diagnostic LTC continuity test as following:
"Continuity test during routine diagnostic testing, in which the voltage at the output is monitored by an analog meter and the tap changer is moved from one extreme to the other".
Chair and the group agreed also that this is a quality control test and does not belong in C57.12.90.
The meeting was adjourned at 12:15pm.

J.8.3 TF Audible Sound Revision to Test Code C57.12.90

Title: Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
Jacksonville, Florida

The TF met at 1:45 PM, on Monday, October 15, 2018. Mats Bernesjo presided over the meeting in the absence of Chairman Ramsis Girgis. Secretary Barry Beaster assisted with the administrative duties.

After the Spring 2018 meeting, the membership was adjusted to 46 members. This meeting was attended by 25 of the 46 members and 55 guests for a total of 80 persons. A quorum was established, but not until after the final attendance was recorded in the AMS system. During the meeting, a call was made for any objections for a tentative unanimous approval, no objections were raised so we have a post meeting official approval of the Spring 2018 TF minutes. The unapproved agenda was presented with a change in the Sound Abatement discussion being set aside until the next meeting. There were six requests for TF membership; which will be reviewed based on previous meeting attendance.

Member Mats Bernesjo presided over the technical portion of the meeting.

Prior to the meeting, a survey was issued to members of the Performance Characteristics Subcommittee for comments on the TF revisions to Table 17 and Annex C in C57.12.00.

The first technical Agenda item presented was a summary of the returns of the aforementioned survey. There was a total of 43 returns. The breakdown is; 33 approved with no comments, 8 approvals with comments, one not approved, and one abstain. The chair of the TF replied to each of the comments via email prior to the meeting addressing all comments received. Agreed upon changes / additions to Table 17 and Appendix – C resulting from this Survey were presented in the meeting and they were all accepted by TF members. In discussing whether to use the words "Full MVA Rating", or "Top MVA Rating", or "Maximum MVA Rating" in the note below Table of Appendix C3 for load noise, it was suggested to use the words "Top MVA Rating".

An overview of the measured impact of the Tap position on Load Sound was presented. John Sen (Duke Energy) had a question on how the regulating winding was operating during load noise tests with all turns in vs. all turns out. Sanjay Patel (SMIT) clarified some of the results that he had previously provided to the TF in this area. The presenter shared with the meeting attendance the Chair's as well as his comments regarding these results and the observations made (that are in line with what was previously reported in this TF). No objections nor comments were raised regarding the proposed added sentence to C57.12.90 Clause 13.3.3.2 "***Note that load sound level experiences small changes with the tap position***"

Impact of temperature on core noise: Sanjay Patel commented that he had observed higher core noise levels vs. time for transformers operating at flux densities as low as 1.5 T, with lower quality coating materials. The presenter shared with the attendees that the proposed note to be added to C57.12.90 Clause 13.3.3.1 covers both lower quality coating materials as well as the lower flux density as "***this is more noticeable for high loss core steels at high flux densities***". No objections nor comments were raised.

On the impact of temperature on load noise, a question was raised from the audience whether the load noise measurements presented were made after the heat run was completed and the oil temperature was cooled down. The presenter shared that the measurements "after heat run" were made while the oil temperature was still high after the heat run. The presenter shared with the audience that the proposed added sentence to C57.12.90 Clause 13.3.3.2 ***"Note that load sound level experiences small increases or decreases after the heat run test (s) depending on the design of the transformer"*** considers that a small change may occur but would be within what is typically experienced. No objections nor comments were raised.

Subsequent to the meeting, the chairman of the TF decided to send a survey to the TF on the 3 added notes above related to the impact of temperature on both core & load noise and impact of tap position on load noise.

Steve Brzoznowski (BPA) asked the presenter how the sound measurements were performed, in particular the results presented on the relationship between ONAN, ONAF, and Fan sound. The presenter emphasized that the data presented are very accurate and the conclusions are accurate.

The agenda item on revising / overhauling the TR1 (C1) tables is planned for the spring 2019 TF meeting.

With no further discussion or comments, the meeting was adjourned at 2:30 PM.

Respectively submitted,

Barry Beaster, TF Secretary

J.8.4 WG Guide for FRA for Liquid Filled Transformers C57.149

Title: Guide for the Application and Interpretation of Frequency Response Analysis for Oil-Immersed Transformers

Meeting Date/Time: Oct. 15, 2018 1:45 PM
Meeting Location: Grand Ballroom 5 – Hyatt Regency Jacksonville Riverfront
Chairman: Charles Sweetser (OMICRON)
Vice-Chair: Poorvi Patel (EPRI)
Secretary: James Cross (Kinectrics)

Meeting was convened at 1:45 PM by Chairman Charles Sweetser (OMICRON) with 46 total attendees, consisting of 16 members and 30 guests.
The Chairman noted that several volunteers were going to be needed to support the WG and asked for a volunteer to be Secretary. James Cross (Kinectrics) volunteered and joined the podium.
The Chairman presented the agenda for the session, and the obligatory patent disclosure slides were discussed.
Charles Sweetser reviewed the scope and purpose of the guide and offered some thoughts on the work to be done by the WG. A key part of this working group will be to hopefully expand on the "Analysis and

Interpretation" section of the guide to take into account the progress in the field since the initial publication of the guide.
Patrick Picher was invited to make a presentation on the work done on the CIGRE SFRA bulletin A2.53, so that the group could better understand that team's approach to the topic, and possible collaborate.
Luiz Cheim (ABB) made a suggestion to use previously obtained SFRA data in the application of algorithms and machine learning techniques ("supervised learning") to obtain diagnoses from sample SFRA data.
Poorvi Patel (EPRI) noted that it is important to access other SFRA data sources from the WG members.
Alexander Kraetge (OMICRON) asked if the WG had the intention of harmonizing the IEEE and the IEC standards in this area.
Mario Locarno (Doble) noted that the intended audience of the guide is transformer "laymen" not necessarily the experts developing the guide, so the content should reflect this reality.
Transportation effects on SFRA were discussed in the context of whether there would/should be a cross-reference to the guide dealing with transformer transportation.
The chairman asked the group for volunteers to undertake review/re-writing of the major sections or "chapters" of the guide.
The following people offered to lead the sections as noted below:

1. Scope/Application – Steve Schappell (SPX Transformer Solutions)
2. FRA Test Parameters – Peter Werelius (Megger)
3. Making an FRA Measurement – Diego Robalino (Megger)
4. Test Records – Alex Kraetge (OMICRON)
5. Analysis & Interpretation
    - Mario Locarno (Doble)
    - Luiz Cheim (ABB)
    - Hemchandra Shertukde (UHart)
    - Peter Werelius (Megger)
    - Lachman (Doble)
6. Appendix: FRA Theory – TBD

Any new case studies correlated to SFRA data should be sent to Mario Locarno (Doble).
Malia Zamanat IEEE should be able to get us the final MS Word version of the guide to use as a basis for starting the re-write/edits.
Poorvi Patel (EPRI) and James Cross (Kinectrics) will work together to develop a template spreadsheet to gather SFRA data. Charles Sweetser (OMICRON) noted that the spreadsheet should be simple with a minimal number of data fields required (eg. Vector group; Voltage; Failure Mode)
Luiz Cheim (ABB) wanted enough data fields to be able to perform supervised machine learning analysis techniques.
Next meeting will take place during the Spring/2019 meeting session in Anaheim.
Peter Werelius (Megger) moved to adjourn at 2:51 PM.

J.8.5 Working Group C57.123 Loss Measurement Guide

Title: Guide for Transformer Loss Measurement

Jacksonville, FL – Oct 15, 2018

- The Working Group met at 15:15 in the Grand Ballroom 6 at the Hyatt Regency Hotel on Oct 15, 2018. This was the third meeting since receiving the PAR for revision of the guide. This guide was first published in 2002, revised in 2010 and there is now a PAR for revision that expires in 2021.

- The Chair, Ed teNyenhuis, led the meeting and recorded the minutes. The secretary, Anthony Franchitti, was not able to be at the meeting.

- The following persons were present:
  Ricardo Lopes
  Ed teNyenhuis (member)
  Vladimir Khalin
  Adnan Rashid
  Jarrod Prince
  Colby Lovins
  Jill Holmes
  Richard Simonelli
  Timothy Tillery
  Darren Brown
  Craig Stiegemeier (member)
  Dhiru Patel
  Nigel Macdonald
  Anirudhdhsinh Jhala
  Reto Fausch (member)
  Mats Bernesjo
  Joaquin Martinez
  Radoslaw Szewczyk
  Rogelio Martinez
  Piotr Blaszczyk
  Andy Steineman (member)

  - Four of the eight members were present. Therefore, a quorum was reached.

  - The Agenda was presented and a motion to approve the agenda was made by Craig Stiegemeier and seconded by Reto Fausch. There were no comments and the agenda was approved unanimously.

  - A motion to approve the meeting minutes was made by Andy Steineman and seconded by Craig Stiegemeier. There were no comments and the minutes were approved unanimously.

  - The Chair commented that all chapter assignments were completed except for Chapter 7. This included revisions by Dr. Eddy So that were recently received.

  - All changes to date have been incorporated into the Draft 4 and were reviewed in detail in the working group meeting.

  - Reto Fausch agreed to complete his review of the Chapter 7 and send his comments to the Chair.

  - Timothy Tillery agreed to provide comments to the Chair on the impact of core steel coating being different for distribution transformers versus power transformers.

  - It was generally agreed that the draft guide is nearly complete. A motion was made by Craig Stiegemeier and seconded by Reto Fausch to send the draft guide to the PCS for a survey prior to the next meeting. There were no comments and the minutes were approved unanimously. The Chair will thus send the draft guide to PCS and collect the comments prior to the next meeting

(Spring 2019 in Anaheim CA). It is expected that the guide will be ready for ballot after the next meeting.

NEW BUSINESS

- There was no new business to discuss.
- The meeting was adjourned at 16:10 with a motion by Craig Stiegemeier and seconded by Reto Fausch. There were no comments and the agenda was approved unanimously.

J.8.6 Task Force on General Requirements C57.12.00

Title: Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

Performance Characteristics Subcommittee
IEEE / PES Transformers Committee

October 15, 2018 4:45 PM
The Hyatt Regency Jacksonville Hotel
Jacksonville, Florida USA

UNAPPROVED MINUTES

The PCS Task Force on General Requirements for C57.12.00 met on Monday, October 15, 2018. The (acting) Chair Enrique Betancourt called the Group to order at 16:47 and reminded purpose and scope of the TF. According to paper roaster, **38** Members and **52** guests were present but hands counting indicated **44** members present. The RFID results were received, but the system was not identifying correctly the attendees who were members. The quorum was decided according to the hand count based on **85** members in Task Force membership and the Chair continued regular business with the Group. The following **8** guests requested membership:

Babanna Suresh	Southwest Electric Co.
Daniel Weyer	Nebraska Public Power District
David Walker	MGM Transformer Co.
Everton De Oliveira	Siemens Ltda
Jorge Cruz Cienfuegos	Partner Technologies Inc.
Kushal Singh	ComEd
Mario Alonso	Transformer Quality Consulting
Stephen Schroeder	ABB Inc.

The Pittsburgh (Spring 2018) minutes were approved by the Group (Akash Joshi/Hemchandra Shertukde), with no one opposed. The Agenda was approved by the group with minor amendments. Agenda Items were covered as follows.

1. NEW BUSINESS
   A. WG Item 110, Table 17: Daniel Blaydon (Baltimore Gas & Electric) proposed a clear definition of the "rated current" during load loss test.

   Discussion on the subject started in this meeting and was not concluded. The Chair presented the existing item on Table 17 and opened the floor for discussion.

Javier Arteaga proposed referring to rated kVA since it is defined but Dan mentioned it does not clearly say if it is maximum or minimum kVA.
Bertrand Poulin also agreed to add a statement to clarify the rated current since there are multiple rated currents the losses can be measured.
Pierre Riffon suggested to specify the rated current based on the kVA that the losses are guaranteed.
Ray Musgrove referred to C57.12.10 that clearly defines the base kVA rating as "The kilovoltampere rating of the transformer shall be based on its capacity at ONAN cooling stage" and proposed to assume rated current as the base kVA current.

Motion to revise the language of the Table 17 section about the load loss test was approved (Daniel Blaydon/Sanjib Som).
The meeting Chairman suggested Daniel Blaydon to prepare a clear statement and send it to the WG Chair for circulating among members before the next meeting. Daniel Blaydon withdrew the motion to provide a proposed clear statement and send it to the WG Chair, Tauhid Ansari.

B. As next new business, the Chair presented the request from Bipin Patel to add a statement on the nameplate that the transformer design is in compliance with Item 4.1.6.1 of C57.12.00.

Joe Foldi mentioned that the end user should provide the maximum operating voltage of the generator and nameplate is already indicating that the transformer is according to C57.12.00 so it is not necessary to add this statement.
Ryan Musgrove referred to Note "l" of the Table 6- Nameplate Information in C57.12.00: "The maximum value of primary voltage as indicated in 4.1.6.1."
According to this information, the proposal was not accepted for future discussion.

C. Hakim Shamoun proposed to add a new business for item 9.1 in C57.12.00, tolerances for ratio. He said %0.5 cannot be met when there are few turns in the regulating winding of a transformer with on-load tap changer. He would like to discuss revising it according to IEC tolerances that require %1 or less than $1/10^{th}$ of the transformer impedance.

Don Dorris commented that the impedance criteria could easily cause confusion for a test engineer during the evaluation of the results.

With no further comments from the meeting attendance, the Chair requested Hakim to prepare the proposed statement to and submit it to the WG Chair before the next meeting.

There was no other new business brought up from the attendance. With motion from Sanjib Som /Hemchandra Shertukde, the meeting was adjourned at 5:30 pm.

Respectfully submitted,

Enrique Betancourt
(acting) WG Chair

Cihangir John Sen
(acting) Secretary

J.8.7 WG Shunt Reactors C57.21

Title: Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA

Jacksonville, FL
Hyatt Regency Jacksonville Riverfront Hotel

Tuesday October 16, 2018

The working group met in the Grand Ballroom 2 & 3 (2) of the Hyatt Regency Jacksonville Riverfront Hotel on Tuesday October 16, 2018, at 9:30 AM.

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

There were a total of 52 participants: 12 Members and 40 Guests out of which 7 Guests requested membership.

- The meeting was opened with the Chairman remarks and the circulation of attendance rosters.
- 12 of the current 16 WG Members were present and quorum to carry out business was met.

Meeting notes:

- **Meeting Agenda**
  - Meeting agenda, which was circulated among members and guests on October 2, 2018 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 S18 meeting in Pittsburgh, which were circulated on October 2, 2018 by email, were presented to the audience.
  - There were no objections or comments and the S18 meeting minutes were approved.

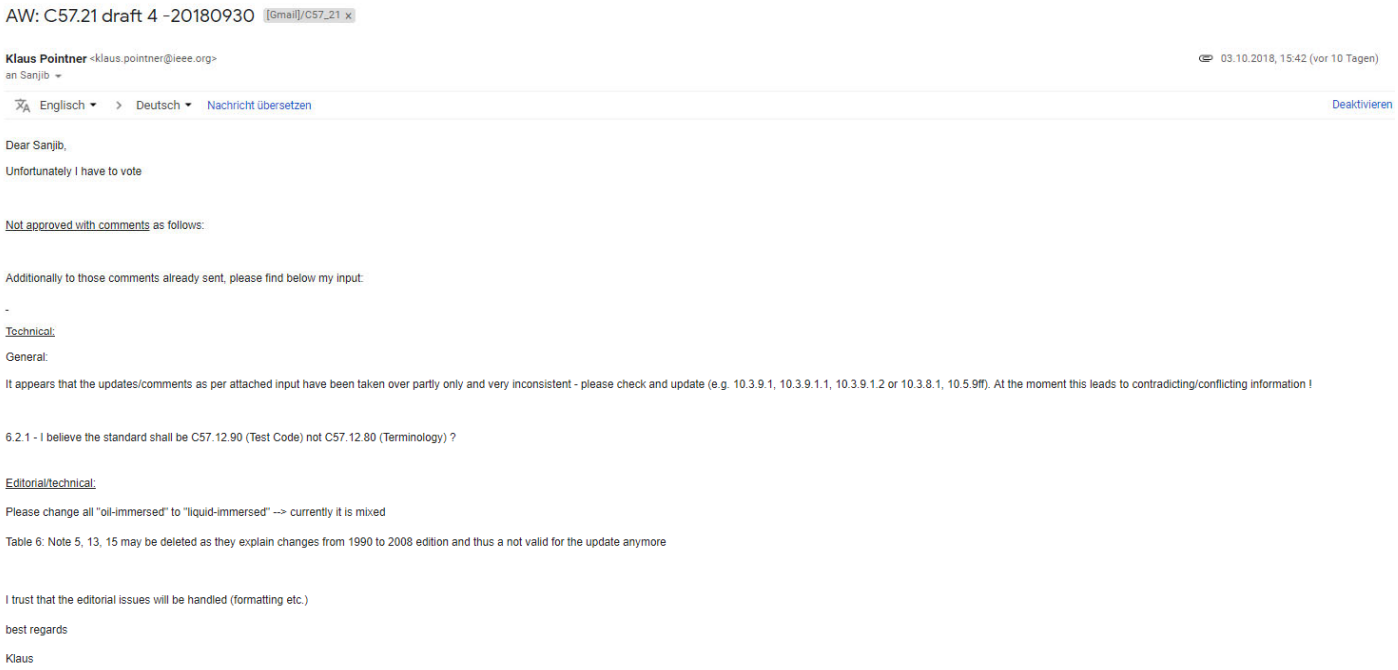
- **Unfinished Business:**

Document status:

- Par and standard expire on December 31 2018 and the standard will become inactive. A PAR extension for 2 years was submitted by the Chairman in September 2018.

- Draft 4 of the standard was circulated among the members for approval and comments.
- 13 responses to Draft 4 were received from the 15 current voting members. 9 responses received with approval with no comments there by achieving over 2/3 among members voting. The Chairman will take the Draft 4 to the PC Subcommittee. Returned comments relate to pending technical, editorial and document formatting changes. With the approved Draft 4 by the membership, next step requires approval by PCS.

- Yes with comments: Comments from Klaus Pointner:



AW: C57.21 draft 4 -20180930 [Gmail]/C57_21

Klaus Pointner <klaus.pointner@ieee.org> 03.10.2018, 15:42 (vor 10 Tagen)
an Sanjib

Englisch > Deutsch Nachricht übersetzen Deaktivieren

Dear Sanjib,

Unfortunately I have to vote

Not approved with comments as follows:

Additionally to those comments already sent, please find below my input:

-

Technical:

General:

It appears that the updates/comments as per attached input have been taken over partly only and very inconsistent - please check and update (e.g. 10.3.9.1, 10.3.9.1.1, 10.3.9.1.2 or 10.3.8.1, 10.5.9ff). At the moment this leads to contradicting/conflicting information !

6.2.1 - I believe the standard shall be C57.12.90 (Test Code) not C57.12.80 (Terminology) ?

Editorial/technical:

Please change all "oil-immersed" to "liquid-immersed" --> currently it is mixed

Table 6: Note 5, 13, 15 may be deleted as they explain changes from 1990 to 2008 edition and thus a not valid for the update anymore

I trust that the editorial issues will be handled (formatting etc.)

best regards

Klaus

- No with comments: Comments from Luc Dorpmanns:

I have checked with our test bay and we have a few remarks to the draft. I copied the guys in and also Christoph as he wrote the chapter about the noise measurements:

- Itemm9.2.4. note: tail time of switching impulse: change 1000 to 500 microseconds as in IEC (this is technically already a challenge)
- Item 10.3.4.: LI sequence: change to 1x RFW, 1x FW, 2x CFW, 2x FW (as in C57.12.90 and IEC).
- Item 10.6.3: insufficient test power: the remark in line 20-21 is contradicting the part before. And also the behaviour is highly non-linear so extrapolation is for some designs not feasible.
- Item 10.6.5: Sound pressure measurement: As mentioned before we have a preference for sound intensity method and this could be included in the standard. If a test transformer is used inside the same test bay this method should be used to rule out the noise of the test transformer.
- Item 10.6.6.: lines 30-34: Maybe it is clearer to include the PI-index here and give a guidance on that too?
- Item 10.6.6.: lines 41-43: this only works if the noise of the test transformer is about the same as of the reactor (or lower): in case the noise of the test transformer is much more than the reactor this correction will not make sense. Some remark our limit should be added.

- Yes with a question: Comment from Hemchandr Shertukde, to be addressed during balloting process:
  Shertukde, Hemchandr shertukde@hartford.edu via hartford0.onmicrosoft.com

to Dharam, Klaus, Sanjib, a.delrio@ieee.org, ebetanco@ieee.org, arup.chakraborty@deltastar.com, l.dorpm

Yes, I had provided some query which does not seem to satisfy me.
Best
Hem

- Comment by Enrique Betancourt (voted yes) but noted that some sections of text in the standard is repeated information and changes will be required to address the issue. The Chair indicated that those changes will be done during the next revision of the standard.

- No with comments from Christoph Ploetner (see below)

*******Comments from Luc on Draft 4 (blue) and comments on same by Christoph*******

I have checked with our test bay and we have a few remarks to the draft. I copied the guys in and also Christoph as he wrote the chapter about the noise measurements:

- Itemm9.2.4. note: tail time of switching impulse: change 1000 to 500 microseconds as in IEC (this is technically already a challenge)

- Item 10.3.4.: LI sequence: change to 1x RFW, 1x FW, 2x CFW, 2x FW (as in C57.12.90 and IEC).

- Item 10.6.3: insufficient test power: the remark in line 20-21 is contradicting the part before. And also the behaviour is highly non-linear so extrapolation is for some designs not feasible.

I agree, the sentence

"Tests at lower voltage levels are not qualified for extrapolation."

can be misunderstood and I suggest to delete the sentence it without replacement as it is not really needed.

Hereafter a re-phrased wording for lines 18-25 that puts a little more emphasize on manufacturer's obligation in case of reduced testing...

When the available test power is insufficient for testing at 1.05 pu nominal system / rated voltage, then the manufacturer shall notify the user of reduced voltage testing during the proposal stage and the reduced voltage test level agreed upon at the time of contract. It is the manufacturer's obligation to demonstrate to the user's satisfaction that reduced-voltage testing produces sufficiently accurate results when extrapolated to the required test voltage. The minimum permissible test voltage is set to 0.9 pu nominal system / rated voltage. ~~If a sufficient accurate extrapolation cannot be demonstrated to the user, a field test may be performed, subject of agreement between manufacturer and user at the time of contract.~~

I stroked out the last sentence as I do not really see it as an option for a reliable measurement (It came from the old version). Up to the group to decide in Jacksonville on it! Please consider to exchange theses new wording with lines 18-25 in Draft4.

We all know that reduced testing is not desirable and I have no problem to entirely remove this possibility. Historically it was justified to have this possibility because test power was widely an issue. Nowadays this has definitely changed worldwide and removing this possibility would affect probably only a few cases. And even such cases are not necessary to have because

there is sufficient competition available for all reactor ratings such that there is no commercial issue by having for instance too few venders capable doing full testing. However, it would be a huge step and I think it must be well agreed amongst the WG members at first and secondly also confirmed by the subcommittee. Maybe we do this better during next revision.

In terms of non-linearity, I do not suggest to start a discussion on technical limits for the extrapolation at this stage of revision. Let us consider and discuss during next revision – it will take too much time.

- Item 10.6.5: Sound pressure measurement: As mentioned before we have a preference for sound intensity method and this could be included in the standard. If a test transformer is used inside the same test bay this method should be used to rule out the noise of the test transformer.

C57.12.90:2015 defines two quantities for sound level reporting: Sound pressure and Sound power. It fully independently further defines two methods for sound measurements – the sound pressure method and the sound intensity method. The returned results from both methods are applicable for sound pressure and sound power reporting. The selection of the measurement method is on manufacturer's side, if not specified by the user. Therefore: The proposed wording entirely follows C57.12.90:2015 and no changes shall be made to the proposed wording. FYI: I intend to modify IEC 60076-10 likewise during next revision. IEEE C57.12.90:2015 approach is physically better.

- Item 10.6.6.: lines 30-34: Maybe it is clearer to include the PI-index here and give a guidance on that too?

Same as before. No need to modify as limits for the intensity method using the PI-index are well described in C57.12.90:2015

- Item 10.6.6.: lines 41-43: this only works if the noise of the test transformer is about the same as of the reactor (or lower): in case the noise of the test transformer is much more than the reactor this correction will not make sense. Some remark our limit should be added.

Yes this is correct. There are limits for the application of this method and the limits are given in the provided reference clause of C57.12.90:2015. Such are more stringent than suggested here. If we would allow the same sound level for the background noise and for the reactor noise, than we would overrule C57.20.90. If the WG wants to do this for this specific case in order to enable a wider applicability – technically it is justified – then we should add following sentences after line 44 of clause 10.6.6:

The application of this method is technically justified for a sound level difference between average background sound pressure level and total sound pressure level of 3 dB or more, although in clause 13.5.5.2 of IEEE Std. C57.12.90:2015 a minimum difference of 5 dB is stated. For the extended range of application it yields: For a 3 dB sound level difference, the correction to be added to the total sound pressure level is -3 dB and for a 4 dB difference it is -2.2 dB.

**********LUC's comments and comments on same by Christoph*******

- The CRG is now set in place by the Chairman.
- Changes to the WG Officers were introduced:

- Vice Chair: Arturo Del Rio (a.delrio@ieee.org)
- Secretary: Kris Zibert (kris.zibert@amce.com)

No new businesses were presented at the meeting.

A motion to adjourn the meeting was proposed by Mat Weisensee, seconded by Enrique Betancourt. Meeting was adjourned at 10:05 am.

Next meeting: Spring 2019, Anaheim, CA, March 24-28, 2019.

Respectfully submitted,

Chairman: Sanjib Som (ssom@patransformer.com)
Vice Chair: Arturo Del Rio (a.delrio@ieee.org)
Secretary: Kris Zibert

J.8.8 Working Group on Semiconductor Power Transformers – C57.18.10

Title: Standard Practices and Requirements for Semiconductor Power Rectifier Transformers
Unapproved Meeting Minutes
Hyatt Regency Jacksonville Riverfront, Jacksonville, FL
Grand Ballroom 2 &3
11:00 am, October 16, 2018

The Working Group met in the Grand Ballroom 2 & 3 meeting room

Sheldon Kennedy called the meeting to order at 11:01am

There were 14 members and 22 guests present. A quorum was not present (14 of 30 members).

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

Discussion of Draft 4 Revisions:

Sheldon went over the changes in Draft 4. Nothing on interphase transformers is in the Draft. Sheldon volunteered to write something. John John also volunteered to submit some information about interphase transformers. Added high resistance grounding, non-classical harmonics to previous draft. High frequency switching was brought up in previous meeting by Phil Hopkinson but he did not submit anything. Sheldon will ask Phil to write something on this topic. Made changes to scope of standard and added some references. Discussed adding comments on the short circuit performance of rectifier transformers which are different than standard transformers because there can be multiple secondaries. Added more information on electrostatic shields. Sheldon asked audience to submit any comments on the draft to one of the officers. Nothing added yet about impulse testing of rectifier transformers. Traction overload specification has incorrectly been listed as 200% for heavy traction rather than the correct 300%. This will be corrected. Sanjib Som mentioned that there might be excess CO and CO2 generated if the temperature exceeds 120C during traction overload testing and that it should be mentioned in the standard. Sanjib will write something about it. Casey Ballard volunteered to send in information about C57.154 on high temperature insulation systems in liquid filled transformers and how it might be related to gassing mentioned by Sanjib. Sheldon asked the audience if there were any new

topics to be addressed in the revision. Nobody replied. Sheldon will incorporate the changes into the Draft and send it out for a Working Group ballot.

New Business:

- No new business

With no further business, the meeting was adjourned at 11:42am.

The Working Group will meet again at the Spring 2019 meeting in Anaheim, CA

Chairman: Sheldon Kennedy

Vice Chairman: Bill Whitehead

Secretary: David Walker

J.8.9 Working Group for the revision of C57.142

Title: Guide to Describe the Occurrence and Mitigation of Switching Transients Induced by Transformers, Switching Device, and System Interaction

Jacksonville, Florida
Tuesday, October 16, 2018
3:15 PM – 4:30 PM
Grand Ballroom 5

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

1) Meeting called to order at 3:15 PM

2) Welcome and Chair's Remarks

3) No essential patent claims made

4) Circulation of Attendance Sheets
82 Attendees were present (51 Guests)
31 of 56 Members present (quorum was achieved at 4pm)

5) Approval of Agenda without objection.
6) Approval of meeting minutes from Spring 2018 without objection.

7) Mitigation Methods Task Force Update – Phil Hopkinson

Phil Hopkinson spoke about past transformer failures in the field that were not able to be reproduced in the laboratory.

The presentation included a discussion of series resonance in the field. Leakage reactance and magnetizing reactance (series capacitance and series reactance) may not be excited by laboratory impulse tests.

In the past, EHV reactors that were failing in the field were passing factory test levels. Mitigation methods with some success have included: higher BIL, open terminal special impulse test, and fast-front switching surge with a long tail time.

Switching devices are the likely "culprit" as the switch operations have become faster over time. The energy following a strike/restrike tends to move back-and-forth between the internal inductance and capacitance. One of the primary defenses against this phenomenon are 'snubber circuits' which can help to dampen the oscillations.

Phil reminded the WG that many old transformers had electrostatic shields. Line shields increase series capacitance and greatly reduce capacitance to ground. In the past (for 34.5 kV and below) static shields added to the winding seemed to increase probability of surviving re-strikes

Shielding solves many issues with series resonance and is relatively easy to apply. The conclusion is that increasing the series capacitance and reducing the capacitance to ground should improve the design. Phil urged the group to focus on improving transformer designs and developing new test methodologies. Advanced modeling may also be necessary in order to mitigate these issues.

The Chair added that more communication is required between the end-user of the transformer and the manufacturer with regard to the potential for exposure to high-energy transients in the field. Multiple mitigation methods are being discussed and will be addressed in the Guide.

Discussion of Transient Analysis programs by Akashi Joshi.

8) The IEEE Switchgear Committee Meeting was held April 22nd – 26th, 2018 in Lake Buena Vista, FL. The C57.142 WG provide an update at the meeting on Tuesday, April 24th, 2018 from 2:00pm – 6:00pm. The meeting was held with 49 people present, 11 present requested attendance to the WG. Dave Caverly of Trench Limited has agreed to be the liaison between Switchgear and Transformers committees

9) CIGRE meetings were held in Rio de Janeiro, Brazil – April 9-12, 2018. On April 9th -11th - JWG A2/C4.52 HF Transformer Modeling met.
On April 12th - CEPEL held a workshop on High Frequency Transient Measurement

CIGRE Biennial was held in Paris, France – August 26-31, 2018. Topics included group Discussion for Transformers and Reactors including Transformer Modeling and Transformer Impulse Testing

10) Status of Current Draft and Comments:
Phil Hopkinson commented that transformer failures can occur as a result of breaker openings or closings. The Chair added that reignition can cause severe issues as well and that limiting/preventing re-strike/re-ignition by different methods during reactor switching is being studied by several other groups.

Review of C57.142 Draft 4 – The Chair noted that some editorial changes have been included, however, there may be additional editing / cleanup needed. Much of the material from the task force paper and the neutral grounding material have been included in Draft 4. The chair requested that the membership please review and comment on the existing draft in the next few weeks if possible.

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

11) New Business: none

12) Next Meeting: (Anaheim, California)

13) Adjournment at 4:30 PM without objection

J.8.10 WG PC57.164 Short Circuit Withstand Guide

Title: 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 at 4:45 PM on October 16, 2018 with 54 attendees, including 21 of 54 WG members, so a quorum was not reached. A quorum was not reached at the previous meeting as well.
The meeting attendance was reviewed after the meeting and the status of 23 Members who did not attend the Pittsburgh or Jacksonville meetings were changed to Guest status. With the new Members added and previous Members changed to Guests, the WG now has 42 Members. An email ballot will be issued to the revised Members to approve the minutes of this meeting and the previous meeting.
No essential patents were revealed by any of the attendees when the question was raised.
The document is in the final stages of development. There were a few items discussed to add to the next Draft.

- Zig-zag transformer models will be developed and added to the circuit models in Section 4. Joe Watson volunteered to develop these models.
- After much discussion, it was agreed that an Appendix will be added for a discussion on calculating mechanical forces from the calculated fault currents and physical dimensions. The transformer supplier will be solely responsible for calculating the mechanical forces with their design programs and detailed design information, but the guidance in the Appendix will include information on the general theory and will provide users with methods on estimating the forces with general design information. Dr. Muhammad Ali Masood Cheema volunteered to provide material and help develop this Appendix.

The next Draft is expected to be ready by the end of the year and will be sent out to the WG for a straw ballot with the results to be discussed at the next meeting with the document sent to IEEE for balloting after resolution of the straw ballot comments.
The WG plans to meet in Anaheim next spring with a similar number of attendees.

J.8.11 WG on Neutral Grounding Devices PC57.32a

Title: Standard for Requirements, Terminology, and Test Procedures for Neutral Grounding Devices Amendment: Neutral Grounding Resistor Section

IEEE C57.32a Amendment

Sept 2018 WebEx Meeting

Thursday, Sept 6, 2018

9:00 AM – 11:17 AM

Chair – Sergio Panetta

Vice Chair – Yann Elassad

Secretary – Thomas Yingling

Call to Order

Patent Announcement

Quorum: Attendance by roll call

The committee has 16 voting members, 15 were present:

1.	Sheldon Kennedy: Niagra Transformer	Present
2.	Sergio Panetta: I-Guard/Telema	Present
3.	Yann Elassad: MS Resistances	Present
4.	Bernard Audouard: MS Resistances	Present
5.	Tom Yingling: Powerohm Resistors/Hubbell	Present
6.	Ed teNyenhuis': ABB	
7.	Sinan Balban: Ozdirenc	Present
8.	Federico Turner: MegaResistors	Present
9.	Richard Field: Post Glover/Telema	Present
10.	Stuart Gibbon: Post Glover/Telema	Present
11.	Edmundo Perich: I-Guard/Telema	Present
12.	Bob Berger: Post Glover/Telema	Present
13.	Pablo Sanchez: Controle Servicios	Present
14.	Todd Locker: Mosebach/Telema	Present
15.	Lodovico Mascardiv: Telema	Present
16.	Sedat Corapsiz: Hilkar Elektrik	Present

Andrew Keith has resigned from the committee.

Onesimo Sanchez was a guest.

Malia Zaman IEEE Staff attended.

Approval of March 26, 2018 Minutes, motion by Thomas Yingling, seconded by Yann Elassad, No Changes.

Review of ballot comments on C57.32a

Motion by Federico to reject ballot comments asking for the reinstatement of deleted Lines 274-279. With the response that discussions about Coefficient of Resistance should be in the Application Guide, not this NGR Standard. The vote was 7 approve, 6 disapprove, 2 abstain. Chairman stated the motion failed because it did not achieve the required 2/3rds approval.

Subsequent discussion and clarification by IEEE staff confirmed that a majority was required, not 2/3rds. The 2/3rds approval required at the Pittsburgh meeting was necessary because it was a ballot change motion. Frederico's motion above is approved.

Motion by Yann to adjourn, seconded by Frederico. Motion passes.

Next meeting is the IEEE/PES 2018 Fall meeting in Jacksonville, FL October 16, 2018

Adjournment

Respectfully Submitted,
Tom Yingling - Secretary