

## **Annex D Dry Type Transformers Subcommittee**

**March 28, 2018**

**Pittsburgh, PA USA**

**Chair: Charles Johnson**

**Vice-Chair: Casey Ballard**

**Secretary: David Stankes**

### **D.1 Introductions and Approval of Agenda and Minutes**

The Subcommittee met on March 28, 2018 at 1:30PM in the Monongahela room of the Omni William Penn Hotel.

The meeting was convened with 31 people in attendance. 20 of the 28 members of the Dry Type Subcommittee were present, so quorum was reached. Two guests requested membership, and request will be reviewed to determine if they meet eligibility requirements. The attendance roster will be kept in the AMS.

The Chairman reviewed the proposed Agenda. A motion to approve the agenda was made by Phil Hopkinson and seconded by Tim Felix-Mai. The agenda was approved unanimously.

The chairman noted that the unapproved minutes from the Fall 2017 SC meeting held in Louisville had been posted on the SC Transformer Committee website. A motion to approve the minutes was made by David Walker and seconded by Jim Antweiler. The minutes were approved unanimously.

### **D.2 Chairs Remarks**

Chair reminded the SC that it is not allowed to record proceedings or take pictures of any slides that are presented. Exception is the recording of meeting to support the creation of written meeting minutes, but recording must be destroyed upon completion of written minutes.

### **D.3 Working Group/Task Force Reports**

The next order of business was the presentation of the reports of the various working groups and task forces. See the following sections for the individual reports:

#### **D.3.1 Revision of IEEE PC57.12.01 - Dry Type General Requirements Chair Casey Ballard**

The working group met in the Conference Center B Room of the Omni William Penn Hotel.

The meeting was called to order at 1:45 PM by Chairman Casey Ballard.

Chairman made opening comments.

Introductions were made by all participants. WG Roster has been distributed and signed.

The meeting was convened with 42 participants, 18 of them are members. Quorum was reached (23 current members). 3 guests requested membership, 1 request granted. The attendance was reported in the AMS.

The Agenda was approved unanimously being no negative votes (moved by T.-F. Mai and seconded by V. Tendulkar).

The Minutes of Fall 2018 Louisville meeting was approved unanimously (moved by J. John and seconded by V. Tendulkar).

The chair made a call for known patent disclosure. No patent related issues were claimed.

- Draft 4 of the revision has been circulated prior to the meeting.
- Chair informed on the revisions that were incorporated into Draft 4 as results of the decisions made in Fall 2017 meeting:

- Maximum system voltage column added to former Table 5 (new Table 4).

Maximum voltages: 25 kV nominal with a 27 kV maximum, 34.5 kV nominal with a 37 kV maximum, 46 kV nominal with a 49 kV maximum.

- Designation of the cooling classes of transformers modified in Section 5.1.

Some discussion on the cooling designation:

- ✓ P. Hopkinson asked on clarification of the case when a transformer installed in the wind tower's sealed nacelle – the transformer is not sealed in this case.
- ✓ C. Johnson commented that typical GNGA case uses nitrogen; agreed to use “dry air or nitrogen” definition of this type of cooling.
- ✓ J. Antweiler asked about clarification of “slash” in the cooling designation. It was agreed to define that “slash” means the transformer with dual rating based on the cooling. Also, the additional example on ANAF (no “slash”) case will be added for a clarity.

- Partial discharge test typo ( from version 2015) corrected in Section 5.10.3.5: reference to Table 6 has been substituted for reference to Figure 2.

## **Old business**

- Discussion on the Short Circuit Thermal Limits (Table 15, new Table 14):

- David Stankes' proposal for Sections 7.8 and 7.9:

**7.8 Effects of temperature on transformer windings during short-circuit conditions** The winding temperature will increase during a short circuit, and care shall be exercised in the winding design and the application of the conductor material to avoid a significant loss of yield strength or damage to the insulation system in the period of fault duration. In most applications of dry-type transformers with normal application limits for fuses and circuit breakers, the duration of a short circuit is limited to a few cycles, and the added temperature-rise effects are minimal. Where it is determined that the fault duration is more than a few cycles and a need exists to determine by calculation the temperature rise for a specific application, the temperature rise may be calculated as described in 7.10.

The effect of the calculated temperature increase on a transformer in a specific application may thus be determined, and proper allowance made to ensure insulation system integrity and to decrease permanent reduction in conductor mechanical strength due to annealing, and to coordinate any temporary reduction in conductor strength with the applied forces at any time.

## **7.9 Temperature limits of transformer for short-circuit conditions**

The final temperature of the conductor in the windings of transformers not exempted by Section 1.1, under the short circuit conditions described in 7.8, shall not exceed the values given in Table 15. The insulation system should be appropriately selected to withstand these temperatures.”

Insulation System Temperature Class (°C)	Assumed initial average temperatures of winding (°C)	Final conductors temperatures (°C)
130	115	300
155	135	350
180	155	400
200	175	425
220	190	450

C. Ballard commented that there is no test method available to quantify the short term insulation temperature limits.

R. Marek noted that this IEEE WG shall make some input in the relevant IEC standard currently under revision.

C. Johnson commented that the Table with the temperature limits was first introduced in 1998 revision and, probably, was related to the harmonization with IEC. Before that, no limits were defined.

C. Ballard has reviewed the previous edition (1989) of the standard, but no better method of the evaluation or any recommended limits were found.

P. Hopkinson proposed to look at the material thermal qualification test and make an estimate on the allowable temperature based on the agreed upon loss-of-life over sc event. R. Wicks commented that there are multiple aging durations were used in the different qualification cases (standards) and the selection of the appropriate life equation for such an estimation would be challenging.

D. Stankes moved to accept his proposal for the revision of Sections 7.8 and 7.9 (see above); D. Walker seconded. With 18 supporting votes, the motion passed.

## New Business

- Impedance value ranges.

J. Medina proposed to consider defining the ranges of impedances in the Standard based on the fact that C57.12.01 references to the specific product standards for the recommendations on the impedance ranges, but none of the product standards has clear instructions on this issue. He proposed to use DOE recommendations on so-called “Normal Impedance Ranges for Dry-Type Transformers” as a base for these ranges. In the discussion, D. Walker suggested that usage of the existing OEM standards maybe acceptable. J. John was convinced that the impedance value shall come from the customer as it’s related to the system coordination not available to the transformer OEM. J. Medina has amended his proposal and agreed to consider the WG comments and send the amended proposal to the group later.

- T.-F. Mai proposed a motion to transfer the test description for the PD measurement from C57.12.01 to C57.12.91 and only keep the PD limits in C57.12.01, M. Gromlovits seconded. 17 voted in support of the motion with 1 abstained – motion passed.

Specifically, the following changes were accepted:

### 5.10.3.5 Partial discharge tests

Partial discharge tests are intended to verify that the internal insulation is free from damaging discharges. Partial discharge tests shall be performed as *in accordance with the procedures described in IEEE Std C57.12.91* required by Figure 2. ~~The transformers under this standard shall be designed to have a minimum extinction voltage of 1.3 times the rated voltage. For transformers which have only solid insulation in the region between high to low voltage, the partial discharge limiting values shall be applicable during both the induced and applied tests. The preferred arrangement for partial discharge tests is to have the transformer fully assembled before conducting the partial discharge tests; however, testing~~

of coils separately is acceptable if approved by the user. As stated in the forward of IEEE Std C57.124™, bus assemblies may be disconnected from the coils when conducting the partial discharge tests.

~~Partial discharge extinction voltage is the highest voltage at which partial discharge no longer exceeds the intensity specified, as the applied voltage is gradually decreased from the inception level. If partial discharge inception does not occur, or is less than the intensity listed, the transformer is considered partial discharge free. Both winding ends of each phase shall be tested. No test shall be made on a terminal that is intended to be grounded. The general procedure for partial discharge testing is as follows: The voltage is raised to the pre stress level of 1.8 times rated voltage, held for a minimum of 30 s, and is then reduced to the voltage level equivalent to 1.3 times rated voltage of the winding under test. After maintaining the 1.3 times rated voltage for 3 minutes, make the partial discharge measurement (see Figure 2). The ambient level of the instrumentation shall be considered when determining the final value of partial discharge. This value shall be measured in picoCoulombs (pC) using techniques described in IEEE Std C57.124. This test procedure is to be used for all dry-type transformers. The maximum acceptable level of partial discharge for solid cast windings is 10 pC. The maximum acceptable level of partial discharge for resin-encapsulated windings is 50 pC”.~~

In addition, C. Johnson proposed to move a calculation of the sc test parameters to C57.12.91.

- P. Hopkinson commented on the problems with inverter transformers, where “Y” non grounded primary winding connection causes the high frequency voltage transferring to the HV side creating failures. C. Ballard explained that this type of transformers are excluded from this standard.
- C. Ballard informed that several members of WG proposed to discuss whether the Standard shall define the test voltages for the systems below 1.2 kV as in Table 5. After short discussion, C. Johnson moved a motion to eliminate system voltages less than 1.2 kV from this Standard, P. Hopkinson seconded; motion passed with 15 voted for and 3 abstained.
- Balloting plan in support of PAR expiration on 12/31/2020.

Closing remarks by C. Ballard:

- We have completed our discussion on all the topics used to justify opening the PAR, along with a few others.
- There are no major issues left open that I am aware of.
- Therefore, I plan to send out Draft 5 to the WG for review and comment this summer so we can discuss the comments in Jacksonville this Fall. That gives us a full year to address any comments and I plan to seek SC approval for SA ballot in Fall 19.

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

With no further business, the meeting was adjourned at 3 PM.

Chairman: Casey Ballard

Secretary: Sasha Levin

### **D.3.2 Revision of IEEE PC57.12.60 - Dry Type Thermal Aging      Chair Roger Wicks**

The meeting was called to order at 1:45 PM by Chairman Roger Wicks. Introductions were made and attendance sheet was circulated.

The meeting was convened with 27 people in attendance. 14 guests / 13 members present. Quorum was reached. 2 guests requested membership, one of whom can be added immediately and the second after he attends an additional meeting.

The Chairman reviewed the proposed Agenda. Motion to approve the agenda was made by Tim-Felix Mai and seconded by Chuck Johnson. The agenda was approved unanimously.

Motion to approve the minutes from Louisville Fall meeting was made by Sasha Levin and seconded by Tim-Felix Mai. The minutes from the Fall 2017 WG meeting were approved unanimously.

The chairman presented slides pertaining to essential patent claims (no issues were noted) and meeting guidelines. Chuck Johnson reminded WG that attendees were not allowed to record the meeting.

### **IEC 61857-41 - Changes - inception to current state**

Chairman described that 61857-41 has changed significantly since it was first introduced as a (15 page) New Work Item Proposal (NWIP) to current (43 page) Committee Draft (CD2). An even more recent document has been developed, but it has not been circulated to IEC and cannot be shared with IEEE at this time. There are mixed opinions within the WG regarding whether or not it will be issued as a CDV or CD3. Chair reminded the WG that several people from the C57.12.60 WG have also participated on development of the IEC document.

The changes from NWIP to CDV/CD3 include:

- Initial document assumed one winding style (layer winding), new document allows for all winding types.
- Defined screening tests for helping set up the test program – both thermally and electrically
- Inclusion of impulse testing as a requirement for all HV systems above 2.5kV
- Detailed Aging discussion to assist with selection of aging temperatures
- Number of Samples required per temperature set

### **IEC 61857-41 - Areas of “improvement” from IEEE C57.12.60**

The chairman discussed areas where this work could impact the C57.12.60 document, including:

- Improved aging table which allows more realistic aging temperature options
- Concept of screening tests (thermal and electrical) to help set up the test plan in a more logical fashion
  - Current “usability test” just ensures that coil quality is acceptable prior to testing
  - New Pre aging design identifies realistic upper limit for thermal aging
  - New dielectric breakdown screening helps set test parameters to ensure test can reach failure in a reasonable amount of time.
- Aging guidance (Annex B)
  - Thermal screening ID’s the top temperature for aging test. Annex B helps identify the other temperature points used in the test.
- Discussion on Relative Aging Tests (substitution procedures)

### **IEC 61857-41 - What now are the major differences vs. IEEE C57.12.60?**

Chairman reviewed how the C57.12.60 document compared today to IEC 61857-41 CDV/CD3

- Method of test (Impulse / Operating Voltage Test)
- Clarity added to the IEC document. For example, how to perform dielectric test and how to determine failures. Procedure could be followed by someone not well versed in this type of testing.
- Rated BIL test vs. ability to test at 75% of rated limit as identified in screening test

WG discussed the effect of positive/negative waveform and impact on test. Chuck Johnson described the possibility of pockets of air that may affect the test, especially in open/varnished winding. Casey Ballard commented that if test is conducted in similar way (consistently), results should be acceptable.

### **Previously agreed to changes in our prior working group meetings**

Chairman presented previously agreed upon changes decided by the WG including:

- Cold Shock Test on all types of models – extend beyond just cast
- Full Size Working Coil Definition modified
- PD Detection during the aging cycles for use as trending only (not a requirement) – placed into an annex
- Ratioing down a result from a tested system for use in lower voltages

### **Open Item – How to conduct a change to an insulation system?**

Chair described details of how current (varnish) changes are made to an insulation system using Sealed Tube test, including procedure and how the results are interpreted. Mark Raymond from UL confirmed use and interpretation of this test.

- Chair proposed possibility of using a single point test, using midpoint temperature used in original system (1000-1500 hours) as a way to approve changes to a current system.
  - Described how to evaluate results, including discussion regarding “5 degree rule”
  - Mark Raymond described round robin testing between different test labs that helped develop basis for 5 degree rule.
  - Casey Ballard suggested it may be better to use half of the aging constant of the original system as basis for interpretation of results. The participants of the WG agreed that this may be a better basis on which to interpret results.
  - Dhiru Patel and Joe Tedesco questioned whether a test that obtained a greater than 5 degree result would be granted approval. Mark Raymond confirmed that a higher thermal rating could not be assigned if a higher result compared to the original system was obtained.
- Chair proposed possibility of increasing either the temperature or the time of test for Sealed Tube test.
  - Described how current test requires a long time to complete due to the time to collect the many minor components, and that a longer test time could be run (in same total amount of time as current test) by eliminating the need of adding the many minor components to the test.

- Casey Ballard suggested that Sealed Tube test may be bypassed if the manufacture has sufficient technical test data supporting the change.
- Mark Raymond reminded the WG that the UL 1562 transformer document references use of UL 1446 to describe how changes may be made, and that there is a choice of running a Sealed Tube Test or a Single Point Test.
- Chuck Johnson voiced his opinion that the procedure for making changes perhaps should remain undisturbed, as there were more pressing areas to address in this revision.

**Path Forward – What is needed to create final draft for WG approval to go to ballot?**

Chairman suggested that the WG was in agreement on which items (if any) of the IEC changes should be incorporated into the draft.

- Casey Ballard made a motion for the Chairman to review the IEC document and include the new aging table and thermal screening test into the next IEEE C57.12.60 draft.
  - Motion was seconded by Chuck Johnson.
  - No discussion was noted and motion was passed unanimously.
- Joe Tedesco made a motion for the Chairman to review the IEC document and include new dielectric screening test to the next IEEE C57.12.60 draft.
  - Motion was seconded by Chuck Johnson
  - No discussion was noted and motion was passed unanimously.
- Solomon Chiang made a motion for the Chairman to add simplified change information to the IEEE document.
  - Motion was seconded by Joe Tedesco
  - Discussion:
    - Chuck Johnson reiterated that this topic had been discussed previously with no clear resolution, and that perhaps this area should be tabled until the next revision
    - Casey Ballard suggested that IEEE is silent on this subject and that the document should provide some guidance regarding this subject.
    - A question regarding where this information would reside. Solomon suggested that the information would be informative only, and adjusted motion to include this information.
    - Motion was approved with all in favor except one.

As there was no more time left, the Chair thanked the WG and meeting was adjourned.

Meeting was concluded at 3:00PM.

It was confirmed that the WG would meet again at the fall 2018 Transformer Committee Meeting.

Chair: Roger Wicks

Co-Chair: Dave Stankes

**D.3.3 Revision of IEEE PC57.12.58 - Dry Type Transient Analysis**

**Chair Roger Wicks**

The WG did not meet in Pittsburg as the document is complete and now available. Chair stated that a request for awards has been entered. Malia Zaman recommended that Stephen Antosz be notified that award request has been entered.

**D.3.4 Revision of C57.12.51 – Ventilated Dry-Type Power Transformers – Chair Sanjib Som**

Casey Ballard reported the minutes of C57.12.51, as Sanjib Som could not be present. It was explained that the Working Group had approved Draft 3 of the document at the Pittsburgh meeting. Casey Ballard made a motion that the SC vote to send Draft 3 to editorial review to be followed by SA-balloting. Vote was conducted by a show of hands, with 18 approving the motion and none opposed. Casey Ballard offered to inform Sanjib Som of the vote to move forward, and ask that he contact Malia Zaman to help facilitate the next steps in the approval process.

The working group met in the Conference Centre B (CL) in Omni William Penn Hotel, Pittsburgh, Pennsylvania, USA.

The meeting was called to order at 11:00 AM by Chairman Sanjib Som.

Chairman made opening comments including that we only have this year before the PAR expires.

WG Roster was distributed for attendees to sign-in.

The meeting was convened with 23 participants, 11 of them are members. Since there are 12 members, quorum was reached and official business was possible to be performed. The document is done, no further membership is being entertained.

The Agenda were agreed upon with unanimous approval.

The Minutes of Fall 2017 Louisville meeting was approved with unanimous approval.

The chair made a call for known patent issues. No patent related issues were claimed.

**Old business**

- No old business

**New Business**

**Review of comments submitted by WG members for Draft 3:**

The Draft 3 had been circulated prior to the meeting. 11 members voted "as is" , 1 (Jagdish Burde) had a comment. His comment was in regard to "tap ranges by KV Rating". Chair said that the comment was covered in C57.12.01 and not in the current working group. He opened C57.12.01 to section 5.3 to show the member. Casey told the member that NEMA ST20, which is for LV, covered his comment and that our document C57.12.51 does not cover LV. The scope was reviewed and it is for 1.2KV and above. The member withdrew his comment.

Chuck Johnson reminded the group that our document was written and intended as a guide/reference for those writing specifications.

Chair reminded the group that the customer can specify what he wants and reviewed the definition of the word "shall", and it is used in our document.

Discussion continued for several minutes regarding the purpose of our document. No further comments worth noting or action came from the discussion.

Phil Hopkinson attempted to bring up a proposal but was reminded that it was moved to C57.12.01, no further discussion.



Chair asked for a motion to approve "Draft 3" - Jerry Murphy made the motion; it was seconded by Casey Ballard. Vote was unanimous "Yes" among all the 11 members present.

Chuck explained how the next steps in the process will work.

It was suggested that the Chair speak with Jim Graham and Malia Zaman for help moving forward.

Chair reviewed a few small editorial changes to the document including Phil Hopkinson's name being spelled incorrectly and Fig 1 being a bit fuzzy and it being replaced with a clearer representation.

Draft 3 is good to go.

After this, Malia arrived and discussed next steps with the chair. She agreed to help the Chair work through the next steps in the process.

Chuck congratulated the Chair and the group for making it through the process thus far.

Chair reminded the group that any comments from SA ballot must be reviewed by the group. Chuck said "you can expect comments".

Chair asked for volunteers to work through the comments ballot resolution process – Sanjib, Casey, Jerry, Chuck, Derek and Joe agreed to help. This will be the comment resolution group.

Meeting adjourned at 11:26 AM.

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

With no further business, the meeting was adjourned at 12:15 PM.

Respectfully submitted,

Chairman: Sanjib Som

Secretary: Mark Gromlovits Secretary

### **D.3.5 Revision of IEEE PC57.12.91 - Standard Test Code**

**Chair David Walker**

The Working Group met in the Conference Center A meeting room. The meeting was called to order at 4:45 PM by Chairman David Walker.

Chairman made opening comments.

Introductions were made by all participants. WG Roster has been distributed and signed.

There were 21 people present. 12 out of 19 members and 9 guests were present. A quorum was present. The attendance was reported in the AMS.

The agenda was approved unanimously. Motion: Roger Wicks, Second: Casey Ballard

The minutes of the October 2017 meeting in Louisville were approved unanimously. Motion: Vijay Tendulkar, Second: Derek Foster

The patent call was given. No one replied with any patent issues.

WG were reminded to do no recording or taking pictures

**Old Business**

- Chair remained that the will PAR expires 12/31/2020 and there were only three meetings left for changes. The goal is to complete discussion and changes by Fall 2018 meeting. Use 2019 to complete Draft and submit for ballot.
- The chair had updated the draft and includes already made decisions (smaller revisions). It was distributed before the meeting to the WG.
- Technical Analysis of Equation 23 in Section 11.7.1 were presented by the chair
- In the last meeting a question was raised about validity of Equation 23 that corrects temperature results for ambient temperature differences. The chair explained that, fundamental Assumption of Eqns 23 and 24 is that ratio of temperatures is equal to ratio of power dissipated raised to an empirical power n.
- The chair made a proposal to make changes to 11.8.3. A discussion about  $T_e$  started, does it have to be measured? Is it really necessary? It resulted in the proposal:  $T_e$  may be determined from test data from similar units with similar ratings; winding configuration and construction; and core dimensions, material, and excitation level. Motion: Casey Ballard, Second: Chuck Johnson without objection
- Because in C57.12.01 it was decided to move the PD to C57.12.91 the Chair made a proposal to move the PD measurement section from IEEE C57.12.01 to this document with leaving the limits in C57.12.01. Motion: Jim Antweiler, Second Chuck Johnson. The motion passed
- Discussion about the word safety. It was decided that the word “safety” have to be removed from the standard
- Chair presented differences in the sound level tests in the latest IEEE C57.12.90 and IEC60076-10 documents compared to IEEE C57.12.91 prepared by Joseph Tedesco and Tim-Felix Mai.  
Chair proposed to adopt language from C57.12.90.
  - Delete mention of tanks, radiators, etc.
  - Change measurement to 12.90 required ANSI Type 1 (+/-1dB) from 12.91 required Type 2 (+/-2.4 dB)
  - Include IEC language for microphone placement for measurements on bare core/coil

He will prepare a proposal for next meeting.

**New Business:**

- Chair proposes to approve changes from previous meetings and incorporate changes into Draft.
  - Simplifies draft by reducing number of changes in any one version.
  - Increases Readability of Drafts.
  - Reduce workload at end of process.
  - Can always reproduce changes by document comparison.
- Chair proposes to copy normative Annex B from C57.12.90 as Annex A of C57.12.91 for correction of results from 60Hz to 50Hz and vice versa.
  - Include corrections for no load loss, load loss, temperature rise, and short circuit test.
  - None of these corrections are dependent on oil vs. dry
  - Include B.5 for sound level.

- Change language of ONAN-ONAF to Dry terminology.
- Delete section B.5.1.2 on ONAF- requires both 50 and 60Hz supplies

He will prepare a proposal for next meeting.

Janusz Szczechowski will send additional information about problems on converting measurements from 50Hz to 60Hz to the vice chair. Because this information is in German, the vice chair will translate it into English.

- Discussion about measuring resistance and temperature rise at leads or terminals, Jim will prepare wording or what have to be changed for next meeting
- The vice chair remained the group that if C57.12.01 will change the letter for cooling classes they have to be changed in our document, too
- Joe Tedesco mentioned that if the sound test method is changed the Sound test report have to be adjusted, too

With no further business, the meeting was adjourned, without objection, at 5:50 PM.

The Working Group will meet again at the fall 2018 meeting in Jacksonville, Florida, October 14-18.

Chairman: David Walker

Vice Chairman: Tim-Felix Mai (acting as Secretary)

### **D.3.6 IEEE PC57.16 – Dry Type Reactors**

**Chair Art Del Rio**

The working group for the revision of C57.16 met in the Conf. Center A room of the Omni William Penn Hotel on Monday March 26, 2018, at 4:45 PM.

#### **1. Introductions and Call for Patents**

- The meeting was called to order at 4:45 PM by the WG Chair Art Del Rio.
- The meeting was opened with the introduction of participants.
- The WG Chair Art Del Rio did a call for potentially essential patents. None was reported.

#### **1. 2. Circulation of Rosters**

- The attendance rosters were circulated.

#### **3. Verification of Quorum**

- There were a total of 22 participants: 9 Members and 13 Guests out of which 4 guest requested membership; 3 were granted based on attendance.
- 9 of the current 12 WG Members were present and quorum to carry out business was met.
- The meeting agenda, which was circulated by email among members and guests on February 27, 2018, was presented to the participants.

- There were no objections or comments and the agenda was approved unanimously.

#### **4. Approval of the minutes of the October 30, 2017, meeting in Louisville,**

##### **Kentucky.**

- The minutes from the F17 meeting in Louisville, which were circulated on February 27, 2018 by email, were presented to the participants.
- There were no objections or comments and the minutes were approved unanimously.

#### **5. Continue to discuss and review of the scope, purpose and rest of the draft.**

- The track changes function and the line numbering function have been activated in the draft.

##### **5.a Scope and purpose**

- The scope has been updated.
- Arc-suppression coils is handled by IEEE C57.32. That reference should be added.
- A reference to an Annex with explanation of the different types of converter reactors for different topologies of voltage source converters will be added together with the explanation that it is only AC-side converter reactors without direct current that will be covered by this standard.

##### **5.b Proposal on 2-level, 3-level, multi-level converter reactors. Ulf Radbrandt**

- Ulf Radbrandt presented his proposal to explanation of the differences between 2-level, 3-level and multi-level converters. It was considered to be good and it will be included in the next draft of this standard. Most of the text will go to an informative Annex and a reference to that Annex (for more information) will be done from the scope of this standard. The actual section about requirements for converter reactors should be in a normative Annex in this standard.

##### **5.c Dry-type air-core shunt capacitor reactors. Update on IEEE-PES Technical Report 16 and reference to IEEE C37.12, TLI, Dave Caverly**

- Dave Caverly did a presentation of Specific Requirements for Dry Type Air Core Shunt Capacitor Reactors.
- Requirements for inductance for inrush limiting and outrush limiting capacitor reactors have always been defined by the breaker standards to limit peak currents and frequency to values that the breakers can handle but these limits were developed based on oil breakers which have different constraints than SF6 or Vacuum breakers.
- Some changes have been made in C37.06 - 2009 which typically lead to lower inductance levels for outrush reactors. For inrush currents C37.06 - 2009 includes updated and alternate values however the basis is still Ixf. The latest version of the Application Guide for Capacitance Current Switching (C37.012 – 2014) indicates that in this revision “the subject of inrush and outrush current has not been revised, however this matter is currently under review”.
- It is a confusing situation for Users. The TLI (Transient Limiting Inductors) report (PES-TR-16) helps a lot to explain the issue.
- This standard (C57.16) does not give much guidance in this regard. It should refer to related switchgear standards and to TR-16 where applicable.

- The naming of this type of reactor were discussed, alternatives were:
  - Shunt Capacitor Reactors (in the standard today)
  - Transient Limiting Inductors (in TR-16)
  - Transient Limiting Reactors
  - Damping Reactors (commonly used but not physically correct, a reactor limits the current but a resistor damps the current).It was decided to keep the present naming (Shunt Capacitor Reactors) but with the addition “also called Transient Limiting Inductors” with reference to TR-16.
- We should cooperate with the switchgear committee in order to avoid the trouble we had during the last revision of this document. Then we added a lot of information related to TRV issues on breakers when adding current limiting reactors and later we had to remove most of it after negative votes from switchgear committee members. Dave Caverly is also participating in the switchgear committee and will try to establish cooperation.

#### **5.d Filter reactors. Sound section update, Klaus Pointner**

- Klaus Pointner received inputs too late before this meeting and did not have time to provide any proposed updates. That will be done to the next meeting.

#### **5.e Discharge CLR for series capacitor banks. Updates, Mike Sharp**

- Mike Sharp provided comments for updates, no new items identified since last meeting.

#### **5.f System considerations, TRV update based on meeting minutes. SWG committee follow up. Monty Goulkhah**

- Monty Goulkhah was not present during this meeting, Art Del Rio will ask him to provide proposed updates to the next meeting.

### **6. New Business**

- The Chair is looking for a volunteer for the revision of annex D, reactors supplied in enclosures.
- A question was raised regarding if this standard should give advice to end users, e.g. how to select the inductance levels. The conclusion was that it is the end users or the system providers that performs the necessary system studies and those studies should not be covered by this standard.

### **7. Adjournment**

- The meeting was adjourned at 5:44 PM.

Respectfully submitted,

Chairman: Art Del Rio (a.delrio@ieee.org)

Secretary: Ulf Radbrandt (ulf.radbrandt@ieee.org)

### **D.3.7 IEEE PC57.124 – Dry Type Partial Discharge Guide Chair**

As Tom Prevost was not present, Rick Marek presented the minutes. Rick highlighted the need for additional volunteers to assist in the TF activities highlighted in the meeting minutes.

- i) WG C.57.124  
Meeting started in Conference Center at 8:00 am. There were 44 attendees with 15 WG members present of a total of 24 and the rest were guests. 9 guests requested membership to the WG. Chair Tom Prevost could not attend due to other engagements
- ii) We had quorum to conduct the meeting.
- iii) Essential Patent claims were mentioned. There was no response of an essential patent related to the work of our WG.
- iv) Agenda for the meeting was approved.
- v) Minutes of the Louisville, KY meeting from Fall 2017 were approved. Task Force (TF) work assignments for detailed work on the User's Guide for the following topics were mentioned by the Acting Chair Richard Marek. Following TFs were set up with respective membership:
  - 1) Normative and References, Definitions etc. – Casey Ballard, Chair with Mark Gromlovits
  - 2) PD detection Systems and Test Procedure – Detlev Gross, Chair with William Larzelere, Mai Tim-Felix, Alexander Kraetge, Janusz Szczechowski
  - 3) Annexes – Chair, Ali Naderian with David Walker
  - 4) Bibliography – Jagdish Burde Chair, Joe TedescoMr. Ali to provide PC C .57.113 template to the WG leadership to be shared among all assigned TFs to maintain consistency.  
Alex Kraetge suggested that the pre-test procedure for winding testing for single phase winding to be included for early detection of PD.
- vi) New Business.  
Raja Kuppaswamy enquired if this effort would be for factory or field applications. Acting Chair responded it was for both after consultation with the TF members.
- vii) Meeting was adjourned at 8:40 am

Respectfully Submitted  
Hemchandra Shertukde  
Secretary, C.57.124

## **D.4 Old Business**

### **D.4.1 Status of Dry Type Transformers Standards**

- Chairman presented list of active standards and with noted board submission deadlines. Highlighted that IEEE C57.12.51 was the standard that was closest to deadline, and that for the most part the dry type standards were in good shape in terms of meeting revision deadlines.
- The Chair asked members to solicit new members to the Dry Type Subcommittee and Working Groups. Reminded the group that many of the standard that are being worked on are relatively young and have room to grow and improve with their help.

**D.5 New Business**

**D.5.1 Revision of IEEE 259**

Dave Stankes reviewed history of IEEE 259 and the planned work for the revision of this document..

The last revision was in 1999 by Bill Simpson

When asked for a show of hands of whom had used this document, none of the 31 attendees raised their hand.

259 was not referenced in UL 1446, 1561, 506, 5085-1, 5085-2, 5085-3.

It is referenced in C57.12.60 - but could be easily changed to another reference since the document has an active PAR.

Dave made a motion: To [administratively] withdraw IEEE 259. It was seconded by Jim Antweiler and had 16 members vote affirmative, 0 negative, 0 abstentions. 4 members had left the meeting before we made it to this business item.

The “administratively” was added based on a conversation with Jim Graham and Malia Zaman in which they said we do want to let it 'expire' instead of withdraw. The withdrawal process is only used if the document is not technically correct and requires a PAR and ballot pool in SA. The document wouldn't be available for purchase then. The administrative withdrawal (expiration) is a gentler resolution as the standard is still available for purchase and could be brought 'back to life' if we chose to in the future with a PAR.

**D.5.1 Recognition**

Before adjournment of the meeting, Casey Ballard noted to those who may have not attended the banquet on Sunday that the SA Standards Medallion had been awarded to our Chairman Chuck Johnson. This prestigious award was given to Chuck for his years of service to the IEEE Transformer Committee, and all present gave Chuck a round of well deserved applause!

**D.6 Adjournment**

With no further business, the meeting was adjourned at 2:40 PM.

Chairman: Charles Johnson

Vice Chairman: Casey Ballard

Secretary: David Stankes