Annex L Standards Subcommittee – Unapproved Minutes

October 17, 2018
Jacksonville, FL
USA

Chair: Jerry Murphy
Vice Chair: Daniel Sauer
Secretary: Marcos Ferreira
Standards Coordinator: Jim Graham

The Chair, Jerry Murphy opened the meeting calling for a show of members to establish quorum which was met.

L.1 Meeting Attendance

The Standards Subcommittee met on Wednesday, October 17, 2018 at 4:30 PM EDT. A show of hands indicated 28 of 48 members in attendance the beginning of the meeting which met the quorum requirement. Overall the attendance roll showed there were 84 attendees, 28 members, 51 guests, including 5 that requested membership upon tabulation of the circulated rosters and will be reviewed for eligibility. Furthermore, RFID system and paper rosters were available. Jim Graham moved to approve the agenda with second by Steve Shull; motion was carried with unanimous consent. Jerry then requested a review of the Pittsburg minutes; motion was made by Jim Graham and seconded by Steve Shull; motion was carried with unanimous consent.

L.2 Chair's Remarks

L.3 Working Group and Task Force Reports

L.3.1 Continuous Revision of C57.12.00-2015 – Steve Snyder

The purpose of this WG is to compile all the work being done in various TF/WG/SC's for inclusion in the continuous revision of C57.12.00 in a consistent manner. This WG coordinates efforts with the companion Standard C57.12.90 so that they publish together.

The current standard was approved by the IEEE-SA Standards Board on December 5, 2015, with an official publication date of May 12, 2016. The standard is good for 10 years but is under continuous revision and will be next balloted when sufficient new material is available. The PAR which covers the ongoing continuous work on the document is good through December 31, 2021.

As agreed at the Fall 2016 Standards Subcommittee meeting, any new material provide to me for inclusion in the next revision, will first be presented to this subcommittee for the "official" vote of approval. At this time no new **approved** material has been submitted to me since the Spring 2018 meeting.

I am aware of new material that is nearly ready for inclusion: An update to the Minimum External Clearances of Transformer Live Parts, Table 10 (Dielectric Tests), and the inclusion of a new reference tables for sound pressure level (Performance Characteristics). Based upon this and other work in process, I anticipate the next revision ballot to begin in 2020, with all the updates collected at the close of 2019. I will reach out to all SC chairs after this meeting to request they update me with whatever material they have already approved.

L.3.2 Continuous Revision of C57.12.90-2015 & Cor. corrections – Steve Antosz

INTRODUCTION

This is a working group by committee of task forces, for continuous revision of C57.12.90. The purpose of the WG is to keep track of the work being done in various TF/WG/SC's for inclusion in the continuous revision of C57.12.90 in a consistent manner.

SUMMARY

The revised document was published in March 2016 as IEEE Std C57.12.90-2015. Shortly after the document was published, one error and one omission were discovered, so a Corrigendum was done and published on March 23, 2017.

STATUS

A new PAR was approved by NESCOM in December 2017.

FUTURE REVISIONS AND PENDING WORK

As agreed at the Fall 2016 Standards Subcommittee meeting, any new material provided by the various Task Forces to this WG Chair for inclusion in the next revision, will first be approved by the responsible technical subcommittee (Diel Test, PCS, Dist, IL, etc) and then presented to the Standards Subcommittee for the "official" vote of approval.

Since this is a continuous revision document, there continues to be ongoing work in the various Task Forces.

Changes *already approved* for the next revision:

- Changes to 9.3.1 Wattmeter-voltmeter-ammeter method from Mark Perkins' PCS TF for Revision of C57.12.90. Final survey approved in Nov 2015 in both the TF and PCS. The following text is to be added just prior to Figure 18 for three-phase transformers:

  An alternate method for either single phase or three phase transformers is to provide capacitive compensation for the transformer impedance at the terminals of the transformer so that the AC source need only supply the real power for the test. Figure 18 shows the apparatus and connections for a single-phase transformer for this alternate method and the method can also be used in a three-phase configuration. In this case, the wattmeter will measure the real power of the transformer under test plus the power of the capacitors, which will be very small compared to the power in the transformer. The load loss in the transformer is determined by subtracting the loss in the capacitors from the measured loss. For modern oil film capacitors, a loss of 0.2 watts per actual kVAR may be used unless a specific capacitor bank loss is known. This method requires a separate CT or set of CTs at the transformer for setting the current and measuring the transformer impedance. The advantage of this alternate method is that the phase angle between the voltage and current at the wattmeter is low (closer to zero degrees) due to the capacitor compensation, so any phase angle errors in the loss measurement circuit are much less significant.

- Add in subclause 10.3.1 and 10.3.1.1 Lightning Impulse, the following words in red; by Pierre Riffon's WG Revision to Impulse Test in Dielectric Test Subcommittee. Submitted on 11/4/2016. These subjects have been surveyed within the Dielectric Tests SC and within the TF. The 4th survey got a 100% approval rate.

  10.3.1 Impulse tests shall be made without excitation. The impulse waveshape parameters such as peak voltage, front time and tail time are determined on the test voltage curve which is obtained after having processed the recorded curve using the test voltage function method, as defined in IEEE Std. 4.

10.3.1.1 Full-wave test

The test wave rises to crest in 1.2 µs and decays to half of crest value in 50 µs from the virtual time zero. The crest value shall be in accordance with the assigned basic impulse insulation level (BIL), subject to a tolerance of ± 3%; and no flashover of the bushing or test gap shall occur. The tolerance on virtual front time should be ± 30%, and the tolerance on time to half of crest should be ± 20%. However, as a practical matter, once the manufacturer has proven that they have test equipment limitations, the following shall be considered:

a) If the standard impulse shape cannot reasonably be obtained because of low winding inductance or high capacitance to earth and the resulting impulse shape is oscillatory so that the relative overshoot magnitude exceeds 5 % then the front time may be increased to reduce the overshoot amplitude. In all cases, the front time shall not exceed 2.5 µs regardless of the overshoot amplitude.

Note 1: The overshoot can be reduced by increasing the front resistor value of the impulse generator. The use of low inductance connections between the impulse generator and the tested transformer are also recommended.

- New wording in subclause 10.3.1.3 Chopped-wave test, approved following the Louisville meeting in Fall 2017.

10.3.1.3 Chopped-wave test

A chopped wave is inherently a full lightning impulse wave, except that the crest value shall be at the required level and the voltage wave shall be chopped at or after the required time to flashover (time to chopping) but not later than 6 µs after virtual origin. The virtual front time of the chopped wave may be different than the virtual front during a full-wave test because of the presence of the chopping gap. Nevertheless, the tolerance on the virtual front time for the chopped-wave test should remain as defined for full-wave test.

The gap or other equivalent chopping device shall be located as close as possible to the terminals of the transformer without disrupting its electrical field distribution. The distance between the chopping device and the test object shall not exceed a lead length greater than the total height of the transformer (tank + bushing). The impedance between the tested terminal and the grounded end of the chopping device shall be limited to that of the necessary leads. The voltage zero following the instant of chopping should occur within 1 µs. However, for some winding and transformer designs (particularly low-voltage windings of high stray capacitance, layer windings, high capacitance windings, UHV transformers requiring large clearances, etc.), the circuit response after chopping may not be oscillatory it may be overdamped or may collapse to zero with a lower frequency (slower voltage collapse). For such cases, the time interval to the first voltage zero after the instant of chopping may be significantly greater than 1 µs and this deviation shall be accepted if the chopping gap is located as described above.

In order to have a common procedure for the determination of the steepness of voltage collapse, the steepness of the voltage collapse shall be the time interval between the instant of the voltage chopping to the instant where the applied voltage is 20% of the voltage level at instant of chopping. This time interval should be equal to or less than 0.8 µs.

Only for cases…(*this paragraph and the last paragraph remain as they are in the 2015 edition, including the three NOTES*)…"

- Add the following text in red to subclause 10.8.2 Test Procedure (for Induced Test). This work was done in Bill Griesacker's (formerly Bertrand Poulin) Task Force. The work started in 2015 and after several surveys was approved in October 2018. It stipulates a limit of overpressure applied inside a transformer tank during induced voltage test.

10.8.2 Test procedure

The voltage shall first be raised to the 1 h level and held for a minimum of 1 min or until a stable partial discharge level is obtained to verify that there are no partial discharge problems. The level of partial discharges shall be recorded just before raising the voltage to the enhancement level. The voltage shall then be raised to the enhancement level and held for 7200 cycles. The voltage shall then be reduced directly to the 1 h level and held for 1 h.

During this 1 h period, partial discharge measurements shall be made at 5 min intervals. Partial discharge acceptance criteria shall be based on each line terminal rated 69 kV and above. These measurements shall be made in accordance with 10.9.

The pressure inside the transformer tank during induced test shall not be increased by artificial means for the purpose of reducing the PD level. The liquid level and pressure inside of the transformer tank and/or conservator tank shall be configured such that oil head pressure during the induced test does not exceed the pressure under usual service conditions. Any exceptions that increase tank pressure by more than 3.5 kPa (0.5 psi) over normal operating pressure, such as the use of an elevated test facility conservator tank, requires customer approval prior to test. A note shall be added to the certified test report confirming this approval.

Note: Increasing the pressure for diagnostic purposes, such as to identify and possibly reduce suspected bubbles in the liquid, may be done as a remedial step to diagnose a source of high PD. To be considered valid, the test shall be repeated with no added pressure as stated above.

pending work

- Possible future addition of a new clause for a Load Tap Changer Performance Test, from Hakan Sahid PCS TF for Revision of C57.12.90.

  This TF also is considering:

  a) to add a new clause 4.5 in General Section that a transformer be tested with the same insulation liquid that it will use in service. For example, a unit to be filled with ester liquid should (or shall?) not be tested with mineral oil in the factory. Or this requirement may be put into C57.12.00 Clause 8.1 General Testing.

  b) Load Tap Changer performance 8.7 voltage test and 9.6 current test. Text seems to have been approved in Fall 2018, and moved up to the Perf Char SC.

  c) Addition in 5.4.1 new wording for winding resistance test requirement on wye connected transformers with neutral bushing brought out

  d) Number of short circuit tests under clause 12.3.4

  e) Altitude correction under clause 11.4.2

  f) OLTC continuity tests

- Other possible revisions to subclauses 10.2 to 10.4 from Pierre Riffon's TF for revision of impulse tests. Ongoing work continues.
  - Revision to 10.3.2.1 Connection of tertiary bushings during impulse test

10.3.2.1 Terminals not being tested

Neutral terminals shall be solidly grounded. Line terminals, including those of autotransformers and regulating transformers, shall be either solidly grounded or grounded through a resistor with an ohmic value not in excess of the values given in Table 3.

Tertiary winding terminals shall be considered as line terminals.

When buried stabilizing winding terminals ~~which are buried and~~ have been temporarily brought out of the tank for testing purposes only, they shall be ~~kept~~ connected ~~in~~ the same way ~~condition~~ as they will be in service during impulse tests (grounded or in open circuit) ~~as foreseen for service~~.

When a stabilizing winding terminal is brought out of the tank for ~~the purpose~~ ~~of~~ grounding purposes ~~the winding~~, this terminal shall be grounded during ~~the entire~~ impulse tests ~~sequence~~.

When stabilizing winding terminals are brought out of the tank for the purpose of grounding the winding and ~~for~~ closing the delta, these terminals shall be ~~grounded and~~ connected as ~~required~~ intended for ~~use in~~ service ~~for~~ during ~~the~~ impulse tests ~~sequence~~.

The rest of the clause remains as is.

- 10.2.4 Tap positions during Switching Impulse Test

10.2.4 Tap connection
The choice of the tap connection shall follow the following rules:

- **The tap position shall be selected in order to induce, as close as possible (preferably within ±3%), the rated switching impulse withstand voltage value on the LV winding terminal;**

- **If the LV winding has no rated switching impulse level, the tap position shall be selected in order to induce, as close as possible (preferably within ±3%), 83% of the LV winding rated BIL value on LV winding terminal.**

It should be noted that for some cases, the LV winding may receive a voltage which is less than its rated switching impulse level or 83% of its rated BIL and this shall be accepted.
It should be also noted that for some other cases, the LV winding may receive a voltage which is higher than its rated switching impulse level or 83%of its rated BIL, this shall be accepted and the transformer shall be designed for it.
For transformers having a preventive autotransformer, the tap changer shall be in a bridging positing if this operational mode is permitted for continuous operation."

This text was approved by the Task Force in Fall 2018 and moved to the Diel Test SC.

- Other possible revisions to subclauses 10.5 to 10.10 from Bill Griesacker's TF (formerly Bertrand Poulin) for revision of low frequency tests. Ongoing work continues.
  - A TF has been formed to look at reducing the limit for PD level Failure Detection in 10.8.5, along with the PD test procedure.
  - Text for venting bushings during PD test. Dave Geibel Study Group

    "If partial discharge is observed during the induced testing of the transformer and appears to be generated within an OIP bushing(s), it is permissible to "vent" the bushing(s) to atmosphere using the bushing manufacturer's instructions to allow for the dissipation of gas

bubbles in the oil. Gas bubbles sometimes form following a temperature rise test during cool down or may be present for other reasons. Reestablishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer's instructions following completion of the induced test."

- Clarification of measuring voltage during low frequency tests – Bertrand Poulin
- Class I transformer PD test revision to the test procedure – Don Ayers

- Other possible revisions to subclause 13 on Audible Sound Tests by Ramsis Girgis' Task Force.
- Possible additions from Phil Hopkinson to detect improper core grounding in 10.7.7 for Special Induced-Voltage partial discharge Test for distribution and class I power transformers with a wound core, L-H winding construction and HV >15 kV. PD is to be measured as apparent charge in pico-coulombs (pC). One reading shall be made at the end of each interval. Minimum test duration and application of voltage:

1. Voltage shall be raised to 100% of rated volts for 30 seconds and PD shall be measured and recorded.
2. Voltage shall be raised to 110% of rated volts for 30 seconds and PD shall be measured and recorded.
3. Voltage shall be raised to 150% of rated volts, held for 1 minute and PD shall be measured and recorded.
4. Voltage shall be lowered to 140% of rated volts, held for 1 minute and PD shall be measured and recorded.
5. Voltage shall be lowered to 130% of rated volts, held for 1 minute and PD shall be measured and recorded.
6. Voltage shall be lowered to 120% of rated volts, held for 1 minute and PD shall be measured and recorded.
7. Voltage shall be lowered to 110% of rated volts, held for 10 minutes and PD shall be measured and recorded.

L.3.3 WG Standard Terminal Markings and Connections for Transformers C57.12.70

Motion for continuous revision task force made by Steve Antosz and second by Sheldon Kennedy, and passed it unanimous

L.3.4 WG Standard Transformer Terminology for Transformers C57.12.80

Meeting Minutes / Significant Issues / Comments:

1) Chair's Remarks:

The Chair opened the meeting at 9:30 a.m. on Monday 15 October 2018.
The chair noted the continued low attendance of this working group's meeting to date,

2) Attendance Sign In sheet/ Quorum Check:

Quorum was achieved with five of six members present. 15 non-voting participants also attended.

3) Approval of the Agenda

A motion to approve the agenda was passed unanimously.

4) Call for Essential Patents

A call for essential patents was made. No essential patent issues were reported.

5) Approval of the minutes

A motion to approve the Spring 2018 minutes was made and passed unanimously.

6) Unfinished Business

a) A definition for wind turbine GSU transformers has not been submitted

Action Item: Fredric Friend will contact Phil Hopkinson, to get a suggested wind farm GSU definition for working group consideration.

b) It was suggested to make the current draft of the PC57.12.80 available to the working group for review to stimulate more comments.

Action Item: Secretary Jim Graham will arrange to post PC57.12.80 draft 1.0 on the website in the protected area.

c) Create a task force to review existing standards for definitions to be added to the standard or be modified.

A request for volunteers to review existing standards documents was sent to all technical subcommittees. One subcommittee and one individual responded. Three individuals volunteered to help with the document reviews during the meeting.

7) New Business

a) Lee Matthews reported on the definitions included in C57.15, the step-voltage regulator standard.

b) Criteria for including definitions from other standards documents were discussed. It was noted the scope states common transformer terms should be included. In cases where the same definition will be included in this standard and another document the definitions should match.

c) A task force to conduct a review of existing standards for new definitions was discussed.

A request for volunteers to review existing standards documents was sent to all technical subcommittees. One subcommittee and one individual responded. Three individuals volunteered to help with the document reviews during the meeting.

d) It was suggested liaisons who can monitor developments of standards documents in the technical subcommittees be established to keep this working group informed of new or modified definitions. It was also suggested PC57.12.80 become a continuous revision subgroup.

e) There was a recommendation definition in a new standards document, C57.158, be reviewed.

f) Revised definitions for core form and shell form transformers as written in C57.105 were discussed.

8) The meeting was adjourned at 10:38 a.m.

Next meeting - March 2018 at Anaheim, CA

Submitted by: Jim Graham, Vice-chair

Date: 10/16/2018

L.3.5 IEEE / IEC Continuous Cross Reference

Minutes of the Task Force Meeting Reported by Vinay Mehrotra, TF Chair

The task force meeting was held at 4.45pm on October 15, 2018. 1 of 5 members was present, so a quorum was not achieved, 13 guests also attended, for a total attendance of 14.

This was followed by a presentation on comparison of IEEE standards C57.12.90 & C57.12.00 and IEC standards 60076-5 for short circuit tests by Shankar Subramany of KEMA Laboratories.

The task force meeting was adjourned at 5.46 pm.

Encl: Short-circuit test comparison

L.4 Old Business

There was no old business discussed.

L.5 New Business

L.5.1 Jerry Murphy, Chair, re-open C57.152 under a task force and Marcos Ferreira will be the Chair

L.6 Adjournment

The meeting and was adjourned at 5:25 PM EDT.

Respectfully submitted by Marcos Ferreira, Standards SC Secretary