Standards Subcommittee

October 30, 2024, St. Louis, MO.

Standards Subcommittee		
Chair: Daniel Sauer	**Vice-Chair: Marcos Ferreira**	**Secretary: Ajith Varghese**
Standards Coordinator: Steve Shull		
Room: Grand Ballroom E	Date: October 30, 2024	Time: 4:30 PM to 05:15 pm
Total Members: 84	Present at time of quorum check: 43	Attended per Record: 49
Guests present: 67	Membership requested: 21	Membership accepted: 12

L.1 Meeting Attendance

The Standards Subcommittee met on Wednesday; Oct 30th, 2024, at 4:31 PM (CST).

43 members were in attendance at the beginning of the meeting, which met the quorum requirement.

Based on attendance roster and after correction to membership, it was confirmed that **49 of 84** members were present. 66 guests were also present of which **21** guests requested membership of which **12** met attendance requirement and will be granted membership.

L.2 Chair's Remarks

The Chair welcomed members and guests to the F24 meeting. Chair briefly highlighted the requirement that while introducing one need to state their affiliation.

The agenda was moved by Tom Prevost and seconded by Sanjib Som. The motion was carried with unanimous consent. The Minutes for Spring 2024 was moved by Eric Davis and seconded by Francis Mills. The motion was carried with unanimous consent.

Chair presented the IEEE requirement for patent and copyrights. The Chair reminded WGs that call of the patent is required a during every WG meetings including on-line/Teleconference meeting. If there are any patent claim, it shall be noted but not discussed at the working group meetings. The chair reminded members of their membership duties to respond to surveys and ballots to maintain.

The Chair reminded the WG and TF leaders to submit their minutes from the meetings within **15 days** to the SC secretary. The SC Secretary then must submit the SC minutes within 45 days of the SC meeting.

WG on C57.12.00, C57.12.90, C57.152 and C57.133 and TF on IEEE/IEC and Reverse Power flow provided an update on status of their standards/TF.

- **WG C57.12.00:** Two business items are approved during this week to add to next revision of C57.12.00. These are related to modification to Induce Over Voltage Factor and new section for Class I PD Testing, approved by TF of low frequency test and Dielectric Test SC.

- **WG C57.12.90 Test Code**: The six Task Forces that are working on material for continuous revision of C57.12.90-2021 all met in St Louis on Monday and Tuesday. There are two business that were approved in a Task Force meeting this.

  Both C57.12.00 and C57.12.90 are tentatively planning to launch the next IEEE-SA ballot by the end of 2025 or early 2026, therefore, will consider closing off any pending work soon after the Spring 2025 meeting

Sanjib Som raised questions on functioning of WG C57.12.00 and C57.12.90 as these WG don't have meeting and there is no formal WG approval for addition/modification to standards. The chair clarified that all changes to these standards are discussed and approved in respective TF and approved by respective subcommittee. David Wallach added that transformer ADCOM is in process of revising manuals and at some point, in future this will be discussed

- **WG C57.152 Field guide**: Ballot is in progress and had to be extended to get the required 75% response. WG approved a motion to confirm the comment resolution board and volunteers were identified to be part of CRG.

- **WG C57.133 Reverse Power flow:** WG had their first meeting. Three presentations were made and initial work/outlined were discussed. WG plan to meet virtually before S25 to get an initial working definition and refine the framework

- **TF IEEE/IEC Cross Reference**: TF did not have quorum. TF started work to develop an index document to compare IEC and IEEE and have some volunteers confirmed their availability to work with chair to develop further.

- **WG C57.12.80 Terminology Guide**: Did not meet. Recirculation is completed and currently hoping to have the document published in early 2025.

- **WG C57.12.70 Terminal Markings:** Currently not active and did not meet.

- **WG C57.163 Guide for Establishing Power Transformer Capability while under Geomagnetic Disturbances:** WG is not active and did not meet.

Detailed WG/TF reports are included as part of this report (pages 4 to 35).

L.4 Old Business

Under the old Business, Dan Blaydon made a presentation explaining the basic concept of reverse flow and references to Step Up/ Step down and service conditions currently found in various transformer standards.

Follow up discussion on next step on where to go with definition of the Reverse flow and modifying the service condition, some member wanted to have WG of C57.133 to take initial lead but some suggested creating another Task force or extend the scope of PAR study group created for the defining of reverse flow to add as addendum to C57.12.80. After more discussion, a motion was passed to Table (1) PAR study group on defining Reverse flow definition and (2) further discussion/action of changes to service condition till WG C57.133 make progress and can give recommendation to SC on these items. Motion was passed with 30 in favor, 5 against and 5 abstaining.

L.5 New Business

No new item was discussed.

L.6 Attendance

Included as last two pages of this minutes.

L.7 Adjournment

The meeting was adjourned at 5:25 PM CST.

Subcommittee New business and SC attendees list are included at end of this minutes after WG/TF reports (pages 36-37).

Respectfully submitted,
Ajith M. Varghese
Standards SC Secretary
04/06/2024

L.3 Working Group and Task Force Reports

L.3.1 Standards Working Group on the Continuous Revision of C57.12.00

Standards Working Group on the Continuous Revision of C57.12.00

Standards Subcommittee
IEEE/PES Transformers Committee
WG Chair: Eric Davis
Fall 2024 St. Louis, MO; October 30, 2024

INTRODUCTION

This is a working group by committee of task forces, for continuous revision of C57.12.00. 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. The WG exists administratively in the Standards Subcommittee, and the technical work is done in other subcommittees, based on expertise and scope. This WG coordinates efforts with the companion standard C57.12.90 so that they publish together.

SUMMARY

C57.12.00-2021 was approved by IEEE SA Standards Board on November 9, 2021. and published January 2022. A Project Authorization Request (PAR) for Revision of PC57.12.00 was approved May 13, 2022. It expires December 31, 2026.

Changes approved by the appropriate subcommittees by the end of the Spring 2025 meeting will be included in the next revision of C57.12.00. This will allow sufficient time to ballot and resolve any comments prior to the expiration of the existing PAR.

FUTURE REVISIONS AND PENDING WORK

Any new material provided by the various Task Forces to this WG for inclusion in the next revision, will first be approved by the responsible technical subcommittee (Dielectric Test, PCS, Distribution, IL, etc.) and then presented to the Standards Subcommittee for the "official" vote of approval to go to ballot.

The following groups are reviewing proposed changes that may impact this standard.

- TF PCS Continuous Revisions to C57.12.00 (PCS)
  - The TF discussed the following items. Please refer to the TF and SC meeting minutes for additional details.
  - Item 116: Update KVA levels in Table 11.
  - Item 117: Withdrawn
  - Item 118: Add Heat Run Test Time in the Test Report
- TF Revision of Impulse Tests C57.12.00 & C57.12.90 (DiTest)

- Please refer to the TF and SC meeting minutes for details.

- TF Continuous Revisions of Low Frequency Tests (DiTest)
  - Partial Discharge for Class I Transformers: Approved by TF and SC.

Table 4—Dielectric insulation levels for all windings of Class II power transformers, voltages in kV

Maximum system voltage (kV rms)	Nominal system voltage[a] (kV rms)	Applied-voltage test[g] (kV rms)			Induced-voltage test[b, c] (phase to ground) (kV rms)		Winding line-end BIL[d] (kV crest)				Neutral BIL[e, g] (kV crest)	
		Delta and fully insulated wye	Grounded wye	Impedance grounded wye or grounded wye with higher BIL	Enhanced 7200 cycle	One hour	Mini-mum	Alternates			Grounded wye	Impedance grounded wye or grounded wye with higher BIL
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12	Col 13
≤ 17	≤ 15	34	34	34	16	14	**110**				110	110
26	25	50	34	40	26	23	**150**				110	125
36	34.5	70	34	50	36	32	**200**				110	150
48	46	95	34	70	48	42	200	**250**			110	200
73	69	140	34	95	72	63	250	**350**			110	250
121	115	173	34	95	120	105	350	**450**	550		110	250
145	138	207	34	95	145	125	450	**550**	650		110	250
169	161	242	34	140	170	145	550	**650**	750	825	110	350
242	230	345	34	140	240	210	650	**750**	**825**	900	110	350
362	345	518	34	140	360	315	900	1050	1175		110	350
550	500	N/A	34	140	550[f]	475[f]	1425	1550	1675		110	350
765	735	N/A	34	140	880[f]	750[f]	1950[f]	2050			110	350
800	765	N/A	34	140	885[f]	795[f]	1950[f]	2050			110	350

[a]For nominal system voltage greater than maximum system voltage, use the next higher voltage class for applied-voltage test levels.

[b]The induced-voltage tests~~ shall be conducted at~~ voltages in the table above are based on an overvoltage factor of approximately 1.58 × nominal system voltage for the one hour test and 1.80 × nominal system voltage for the enhanced 7200 cycle test.

5.10.5.5 Induced-voltage test for Class II power transformers
With the transformer connected and excited as it will be in service, an induced-voltage test shall be performed as indicated in Figure 2, at voltage levels indicated in Columns 6 and 7 of Table 4. ~~Minimum line-to-ground induced test levels for Class II power transformers shall be a multiple of corresponding line-to-ground nominal system voltage as follows: 1.58 times for one-hour tests and 1.8 times for 7200 cycles enhancement level tests.~~

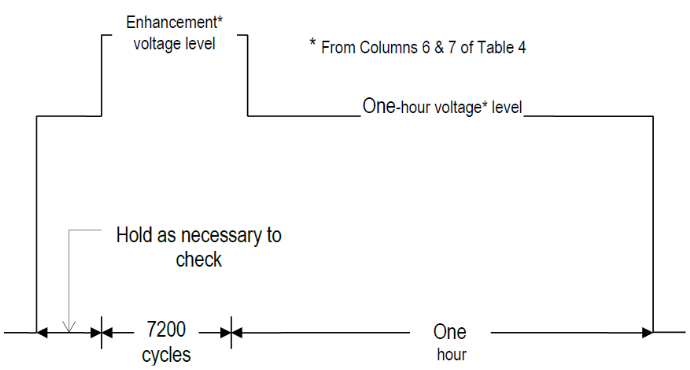

Figure 2—Induced-voltage test for Class II power transformers

- Induced Overvoltage – Nominal versus Maximum operating voltage: Approved by TF and SC

Table 3—Dielectric insulation levels for distribution and Class I power transformers, voltages in kV

Maximum system voltage (kV rms)	Nominal system voltage[a, g] (kV rms)	Applied- voltage test[f] (kV rms)			Induced-voltage test[b, f] (phase to ground) (kV rms)	Winding line-end BIL[c, f] (kV crest)			Neutral BIL[d, f, h] (kV crest)	
		Delta or fully insulated wye	Grounded wye	Impedance grounded wye or grounded wye with higher BIL		Minimum	Alternates		Grounded wye	Impedance grounded wye or grounded wye with higher BIL
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11
Part A - Distribution transformers										
1.5	1.2[e]	10	-	10	1.4	**30**			30	30
3.5	2.5[e]	15	-	15	2.9	**45**			45	45
6.9	5[e]	19	-	19	5.8	**60**			60	60
11	8.7[e]	26	-	26	10	**75**			75	75
17	15	34	-	34	17	**95**	110		75	75
26	25	40	-	40	29	**125**	**150**		75	95
36	34.5	50	-	50	40	125	**150**	**200**	75	125
48	46	95	-	70	53	200	**250**		95	150
73	69	140	-	95	80	250	**350**		95	200
Part B - Class I power transformers without partial discharge testing										
1.5	1.2	10	10	10	1.4	**30**	**45**		45	45
3.5	2.5	15	15	15	2.9	**45**	**60**		60	60
6.9	5	19	19	19	5.8	**60**	**75**		75	75
11	8.7	26	26	26	10	**75**	**95**		95	95
17	15	34	26	34	17	**95**	**110**		95	110
26	25	50	26	40	29	**150**			95	125
36	34.5	70	26	50	40	**200**			95	150
48	46	95	34	70	53	200	**250**		110	200
73	69	140	34	95	80	250	**350**		110	250

Maximum system voltage (kV rms)	Nominal system voltage[a, g] (kV rms)	Applied- voltage test[f] (kV rms)			Induced- voltage test[f,i] (phase to ground) (kV rms)		Winding line-end BIL[c, f] (kV crest)		Neutral BIL[d, f, h] (kV crest)	
		Delta or fully insulated wye	Grounded wye	Impedance grounded wye or grounded wye with higher BIL	Enhanced 7200 cycles	One hour	Minimum	Alternate	Grounded wye	Impedance grounded wye or grounded wye with higher BIL
Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 11	Col 12
Part C - Class I power transformers with partial discharge testing specifically requested by purchaser										
1.5	1.2	10	10	10	1.2	1.1	**30**	**45**	45	45
3.5	2.5	15	15	15	2.6	2.3	**45**	**60**	60	60
6.9	5	19	19	19	5.2	4.6	**60**	**75**	75	75
11	8.7	26	26	26	9	7.9	**75**	**95**	95	95
17	15	34	34	34	16	14	**95**	**110**	95	110
26	25	50	34	40	26	23	**150**		95	125
36	34.5	70	34	50	36	32	**200**		95	150
48	46	95	34	70	48	42	200	**250**	110	200
73	69	140	34	95	72	63	250	**350**	110	250

[a]For nominal system voltage greater than maximum system voltage, use the next higher voltage class for applied-voltage test levels.

[b]Induced-voltage tests shall be conducted at 2.0 × nominal system voltage for 7200 cycles.

[c]Bold typeface BILs are the most commonly used standard levels.

[d]Y-Y-connected transformers using a common solidly grounded neutral may use neutral BIL selected in accordance with the low-voltage winding rating.

[e]Single-phase distribution and power transformers and regulating transformers for voltage ratings between terminals of 8.7 kV and below are designed for both Y and Δ connection, and are insulated for the test voltages corresponding to the Y connection so that a single line of transformers serves for the Y and Δ applications. The test voltages for such transformers, when connected and operated, are therefore higher than needed for their voltage rating.

[f]For series windings in transformers, such as regulating transformers, the test values to ground shall be determined by the BIL of the series windings rather than by the rated voltage between terminals.

[g]Values listed as nominal system voltage in some cases (particularly voltages 34.5 kV and below) are applicable to other lesser voltages of approximately the same value. For example, 15 kV encompasses nominal system voltages of 14 440 V, 13 800 V, 13 200 V, 13 090 V, 12 600 V, 12 470 V, 12 000 V, and 11 950 V.

[h]Neutral BIL shall never exceed winding BIL.

[i]Induced voltage tests shall be conducted at 1.58 x nominal system voltage for one hour and 1.8 x nominal system voltage for enhanced 7200 cycle test.

Three changes have *already been approved* by the respective SC for the next revision. These approved changes are:

1. Changes to Low Frequency Tests from Ajith Varghese's RLFT TF in the Dielectric Test SC. The final survey approved by TF and SC in the Spring 2023 meeting is shown below. Text in black is existing, red is revised, blue is added.

5.10.5.5 Induced-voltage test for Class II power transformers

With the transformer connected and excited as it will be in service, an induced-voltage test shall be performed as indicated in Figure 2, at voltage levels indicated in Columns 6 and 7 and 1.05 times the line to ground voltage per column 2 of Table 4. Minimum line-to-ground induced test levels for Class II power transformers shall be a multiple of corresponding line-to-ground nominal system voltage as follows: 1.58 times for one-hour tests and 1.8 times for 7200 cycles enhancement level tests.

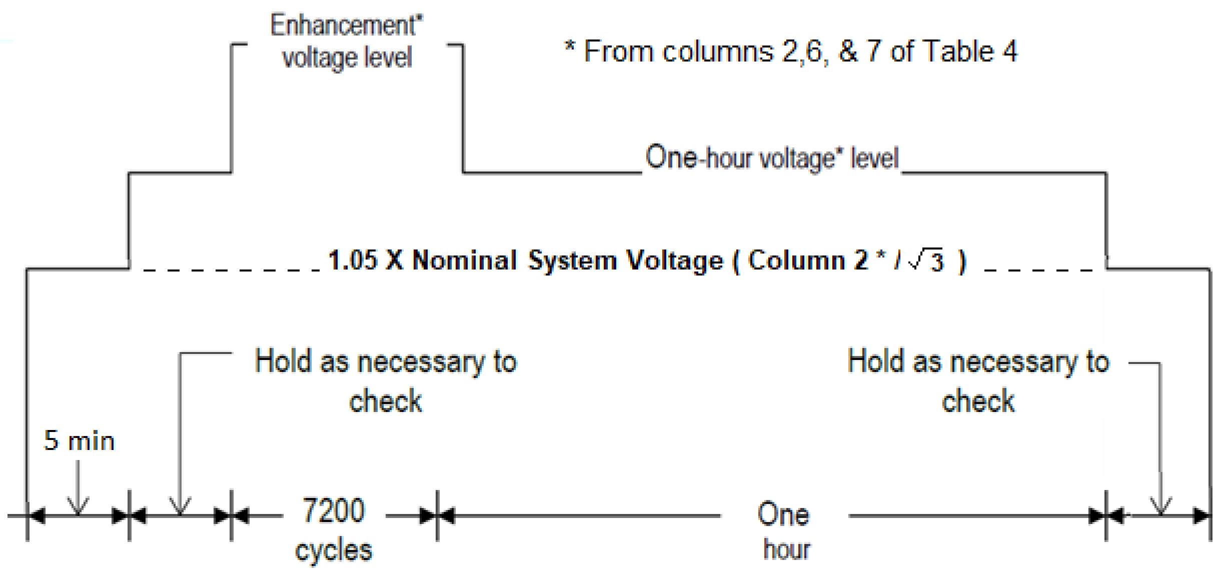

Figure 2 —Induced-voltage test for Class II power transformers

2. Changes to Measurements of Auxiliary Losses from T. Ansari's Continuous Revisions to C57.12.00 in the Performance Characteristics SC. The motion approved by the TF and SC in the Spring 2024 meeting are shown below. The actual text from C57.12.00 is shown after the motion. Text in black is existing, red is revised, blue is added.

1. WG Item 113, Measurement of Auxiliary Losses/Ajith Varghese (Prolec GE). To clarify what component's losses would be included as "control losses", to avoid different interpretation of "integral parts of the transformer", a new proposed text was presented to the Group and approved:
    - *For Class II transformers (see 5.10)****, auxiliary cooling equipment*** *losses shall be measured and recorded. All stages of cooling, and all associated cooling control equipment shall be energized,* ***provided these components are integral parts of the transformer to meet guaranteed thermal performance****.*

      Note:

      The auxiliary losses ***do not include control cabinet components*** *including but are not limited to cabinet heaters, online DGA or ancillary devices such as dehydrate breathers, nitrogen cabinet heaters, etc.*

5.9 Total losses

The total losses of a transformer shall be the sum of the no-load losses and the load losses. The losses of cooling fans, insulating liquid pumps, space heaters, and other ancillary equipment are not included in the total losses. When specified, power loss data on such ancillary equipment shall be furnished.
The standard reference temperature for the load losses of power and distribution transformers shall be defined as 20 °C plus the rated average winding rise. The standard reference temperature for the no-load losses of power and distribution transformers shall be 20 °C.
For Class II transformers (see 5.10), ~~control/auxiliary (cooling)~~ auxiliary cooling equipment losses shall be measured and recorded. All stages of cooling, ~~pumps, heaters,~~ and all associated cooling control equipment shall be energized, provided these components are integral parts of the transformer to meet guaranteed thermal performance.
Note: The auxiliary losses do not include control cabinet components including but are not limited to cabinet heaters, online DGA or ancillary devices such as dehydrate breathers, nitrogen cabinet heaters, etc.

3. Changes to Phasor Diagrams from T. Ansari's Continuous Revisions to C57.12.00 in the Performance Characteristics SC. The motion approved by the TF and SC in the Spring 2024 meeting are shown below. The actual text from C57.12.00 is shown after the motion. Text in black is existing, red is revised, blue is added.

2. WG Item 114, Modification of Sec 5.7.2/Steve Antosz (Prolec GE)
    - Proposal to add the phasor-group designation as required nomenclature for identifying the angular displacement between windings for three-phase power and distribution transformers. Std. C57.12.70 "Standard Terminal Markings and Connections" was recently revised and updated with that concept. As both standards are linked through mutual references, the proposal includes the phasor group designation be shown on the transformer's nameplate. The nomenclature is detailed in 12.70. This proposal also harmonized with IEC Stds.
    - Three motions passed:
        - Motion #1: Add the following sentence at the end of the second paragraph in Subclause 5.7.2: "The phasor group designation (vector group) shall be shown on the transformer's nameplate, near the phasor diagram."
        - Motion #2: Revise existing Figure 1 to describe the phasor group designation for the four example connections given, as: Dd0, Yd1, Yy0, Dy1
        - Motion #3: Revise Table 6, Row 11 for Nameplates A, B, and C. Change "Phasor Diagram" to "Phasor Diagram and Phasor Group Designation"

5.7.2 Angular displacement (nominal) between voltages of windings for three-phase transformers

The angular displacement of a polyphase transformer is the time angle expressed in degrees between the line-to-neutral voltage of the reference identified high-voltage terminal H_1 and the line-to-neutral voltage of the corresponding identified low-voltage terminal X_1.
Unless specified otherwise and identified on the nameplate, the angular displacement between high-voltage and low-voltage phase voltages of three-phase transformers with Δ-Δ or Y-Y connections shall be zero degrees. The phasor group designation (vector group) shall be shown on the transformer's nameplate, near the phasor diagram.
The angular displacement between high-voltage and low-voltage phase voltages of three-phase transformers with Y-Δ or Δ-Y connections shall be 30°, with the low voltage lagging the high voltage as shown in Figure 1.
Additional phasor diagrams are described in IEEE Std C57.12.70.

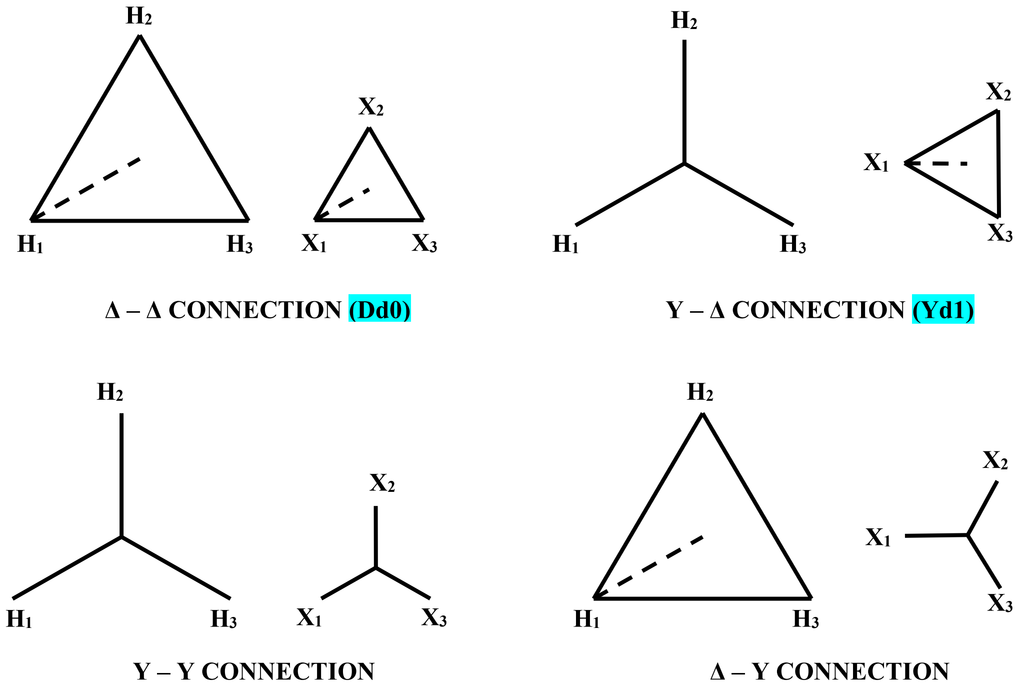

Figure 1 —Phase relation of terminal designation for three-phase transformers

Table 6—Nameplate information

Row	Nameplate A	Nameplate B	Nameplate C
1	Serial number[a]	Serial number[a]	Serial number[a]
2	Month/year of manufacture	Month/year of manufacture	Month/year of manufacture
3	Class (ONAN, ONAF, etc.)[b]	Class (ONAN, ONAF, etc.)[b]	Class (ONAN, ONAF, etc.)[b]
4	Number of phases	Number of phases	Number of phases
5	Frequency	Frequency	Frequency
6	kVA rating[a, b]	kVA rating[a, b]	kVA (or MVA) rating[a, b]
7	Voltage ratings[a, c]	Voltage ratings[a, c]	Voltage ratings[a, c]
8	Tap voltages[d]	Tap voltages[d]	Tap voltages[d]
9	Temperature rise, °C	Temperature rise, °C	Temperature rise, °C
10	Polarity (single-phase transformers)	Polarity (single-phase transformers)	Polarity (single-phase transformers)
11	Phasor diagram and phasor group designation (polyphase transformers)	Phasor diagram and phasor group designation (polyphase transformers)	Phasor diagram and phasor group designation (polyphase transformers)
12	Percent impedance[e]	Percent impedance[e]	Percent impedance[e]
13	—	Basic lightning impulse insulation levels (BIL)[f]	Basic lightning impulse insulation levels (BIL)[f]
14	Approximate total mass in kg or weight in lb[g]	Approximate total mass in kg or weight in lb[h]	Approximate total mass in kg or weight in lb[h]
15	Connection diagram[i]	Connection diagram[i]	Connection diagram[i]
16	Name and location (country) of manufacturer	Name and location (country) of manufacture	Name and location (country) of manufacture
17	Installation and operating instructions reference	Installation and operating instructions reference	Installation and operating instructions reference
18	The word *transformer* or *autotransformer*	The word *transformer* or *autotransformer*	The word *transformer* or *autotransformer*
19	Type of insulating liquid (generic name preferred)[j]	Type of insulating liquid (generic name preferred)[j]	Type of insulating liquid (generic name preferred)[j]
20	Conductor material (of each winding)	Conductor material (of each winding)	Conductor material (of each winding)
21	Liquid volume	—	Step-up operation suitability[k]
22	—	—	Maximum value of primary voltage[l]
23	—	—	Tank, pressure, and liquid data[m]
24	Department of Energy (DOE) compliant[n]	DOE compliant[n]	DOE compliant[n]
25	---	---	Core Design – Core or Shell form
26	---	---	Core Type - Number of limbs (wound), Shell Type - D type , 7 limbs, or others

Respectfully submitted,
Eric Davis, WG Chair
November 6, 2024

L.3.4 WG Standards Transformer on Continuous Revision for C57.12.90

Standards Working Group on the Continuous Revision of C57.12.90
Standards Subcommittee
IEEE/PES Transformers Committee
WG Chair: Stephen Antosz
Vice-Chair/Secretary: Jason Varnell
Fall 2024 St. Louis; October 30, 2024 (new text is highlighted)

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. The WG exists administratively in the Standards Subcommittee and has no live meetings. The technical work is done in other subcommittees based on expertise and scope. WG membership consists of the people actively working on revisions. These people are the TF Chairs, SC Chairs, and other significant contributors to the current version. WG Members are:

Hakan Sahin
Ramsis Girgis
Sylvain Plante
Ajith Varghese
Diego Robalino
Dinesh Sankarakurup
Daniel Sauer
Rogerio Verdolin
Poorvi Patel
Sam Sharpless
Bertrand Poulin guest
John Sen guest
Polo Rodriguez guest
Zan Kiparizoski guest

Currently there are six Task Forces in three different Subcommittees, as follows:

1. PCS – Cont Rev to Test Code C57.12.90 Clauses 5-9, & 12, TF Chair: Hakan Sahin
2. PCS – Audible Sound Revision Clause 13, TF Chair: Ramsis Girgis
3. Dielectric Test – Cont Rev to Impulse Tests in Clause 10, TF Chair: Sylvain Plante
4. Dielectric Test – Cont Rev to LowFrequency Tests Clause 10, TF Chair: Ajith Varghese
5. Dielectric Test –Insulation Power Factor and Resistance, 10.10 and 10.11, TF Chair: Diego Robalino
6. Insulation Life – Cont Rev to Temperature Test Clause 11 and Resistance Clause 5, TF Chair: Dinesh Sankarakurup

SUMMARY

C57.12.90-2021 was approved as a revised standard by the IEEE-SA Standards Board on Nov 9, 2021. It was published on Feb 4, 2022. The WG Chair took out a new PAR on Feb 28, 2022, which was approved by the IEEE-SA Standards Board on May 13, 2022. The PAR expires on December 31, 2026.

We are looking to launch the next ballot by the end of 2025 or early 2026. Therefore, would close off pending work at the Spring 2025 meeting, for mid 2025 completion. This might be adjusted later.

FUTURE REVISIONS AND PENDING WORK

Any new material provided by the various Task Forces to this WG 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 to go to ballot.

Changes *ALREADY APPROVED* for the next revision:

1. Hakan Sahin's PCS TF for Revision of C57.12.90.

   a. Changes to subclause 7.3, Ratio test methods to "modernize" it. Final survey approved in the Spring 2021 virtual meeting.

      Insert a new subclause 7.3.1 as follows:
      7.3.1 Electronic ratio and phase measurement meters
      An electronic meter that determines the transformer turns ratio, polarity and phase angle may be used for the measurement of these parameters.

      The existing 7.3.1 Voltmeter method should be renumbered to be 7.3.2, are no changes to the text.
      The existing 7.3.2 Comparison method should be renumbered to be 7.3.3, no changes to the text or figures 10 & 11.
      The existing 7.3.3 Ratio meter clause and figure 12 is to be deleted.

   b. Ratio test voltage and frequency under subclause 7.1.2. Request to change frequency bandwith. TF and SC approved in Spring 2022.

      7.0 Ratio test
      Current Version:
      7.1.2 Voltage and frequency
      The ratio test shall be made at rated or lower voltage and rated or higher frequency.
      Revised Version
      7.1.2 Voltage and frequency
      The ratio test shall be made at rated or lower voltage and be such that the ratio of test voltage to test frequency is less than or equal to the ratio of rated voltage to rated frequency.

   c. Number of short-circuit tests under subclause 12.3.4. TF and SC approved in Spring 2022.

      Current Version:
      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.

      Revised Version
      12.3.4 Number of tests

- When a three-phase transformer is tested in a three-phase test circuit or in a single-phase test circuit as given in Annex C, each phase of the transformer shall be subjected to three tests satisfying the asymmetrical current requirements specified in 12.3.3. The tests shall be performed on one of the outer phases with the tap-changer in the maximum position, on the other outer phase with the tap-changer in the minimum position and on the middle phase with the tap-changer in the principal position
- When a single-phase transformer is tested in a single-phase test circuit the transformer shall be subjected to three tests satisfying the asymmetrical current requirements specified in 12.3.3. The three tests shall be performed one each, with the tap-changer in the maximum, minimum and principal position.

d. Load Tap Changer performance test with rated voltage. New subclause 8.7. TF and SC approved in Spring 2022. It was re-discussed in Fall 2022 but no changes were made so still considered to be approved.

8.7 Load Tap Changer Voltage Test
8.7.1 General
In order to verify the performance of a transformer that has a load tap changer (LTC), the LTC shall be operated through one end-to-end-to-end sequence (from one tap extreme to the other tap extreme and back again) with the transformer energized at rated voltage.

8.7.2 Control voltage
Control voltage for the LTC motor during the test shall be as near to rated voltage as possible, with a minimum of 85%.

8.7.3 Preparation for the test
The LTC shall be fitted with all included equipment. It shall be connected as it will be in service, including protective devices.

8.7.4 Procedure
Either the high or low voltage winding of the transformer under test shall be energized at rated voltage and frequency, unless otherwise specified. The LTC shall be operated using the motor drive but not manual rotation. The LTC shall be operated through all tap positions twice, starting at one tap extreme and progressing to the other tap extreme, and then return back again to the original tap position. The test may be performed at intervals, if necessary, such as to adjust the test circuit for the applied voltage to be adjusted to the rated voltage of the tap position, but it is a requirement that the transformer be energized at no less than rated voltage corresponding to each tap to be changed.

8.7.5 Observations and Analysis
8.7.5.1 Audible Sound
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. With some types of tap changers, there will be abnormally loud sounds if components are not assembled properly. Note that during operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

8.7.5.2 Supply Test Circuit
The test control system shall be monitored for any trip of the test circuit that automatically stops the circuit from keeping the transformer energized.

8.7.5.3 Dissolved Gas-in-Oil Analysis
Oil samples shall be taken from the LTC 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.

8.7.6 Failure Detection and Acceptance Criteria
The transformer will have passed this LTC Voltage test if:

- The tap changer operates normally with no abnormal sound
- The transformer stays energized without a trip in the supply test circuit
- For mineral oil filled vacuum LTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type LTCs and 6 ppm for compartment type LTCs.
- For non-vacuum type LTCs, or LTCs filled with a liquid other than mineral oil, the determination of acceptance criteria is through sound only and there is not a limit for increase in gases.

e. Load Tap Changer performance test with rated current. New subclause 9.6. TF and SC approved in Spring 2022. It was re-discussed in Fall 2022 but no changes were made so still considered to be approved.

9.6 Load Tap Changer Current Test
9.6.1 General
In order to verify the performance of a transformer that has a load tap changer (LTC), the LTC shall be operated through one end-to-end-to-end sequence (from one tap extreme to the other tap extreme and back again) with the transformer current flowing through the windings, corresponding to the top nameplate MVA rating.

9.6.2 Control voltage
Control voltage for the LTC motor during the test shall be as near to rated voltage as possible, with a minimum of 85%.

9.6.3 Preparation for the test
The LTC shall be fitted with all included equipment. It shall be connected as it will be in service, including protective devices.

9.6.4 Procedure
The test shall be performed by applying a short circuit either the high-voltage winding or the low-voltage winding and applying sufficient voltage across the other winding to cause a specific current to flow in the windings. The LTC shall be operated using the motor drive but not manual rotation. The LTC shall be operated through all tap positions twice, starting at one tap extreme and progressing to the other tap extreme, and then return back again to the original tap position. The test may be performed at intervals, if necessary, such as to adjust the test circuit for the applied voltage to be adjusted to the required current of the tap position, but it is a requirement that the transformer be energized at no less than 80% of the top MVA nameplate current value for each tap change.

9.6.5 Observations and Analysis

9.6.5.1 Audible Sound

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. With some types of tap changers, there will be abnormally loud sounds if components are not assembled properly. Note that during operation of the change-over selector (reversing switch or coarse-tap selector) the sound can be slightly different.

9.6.5.2 Supply Test Circuit

The test control system shall be monitored for any trip of the test circuit that automatically stops the circuit from keeping the transformer energized.

9.6.5.3 Dissolved Gas-in-Oil Analysis

Oil samples shall be taken from the LTC 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.

9.6.6 Failure Detection and Acceptance Criteria

The transformer will have passed this LTC Voltage test if:

- The tap changer operates normally with no abnormal sound
- The transformer stays energized without a trip in the supply test circuit
- For mineral oil filled vacuum LTCs, the increase of the sum of H2, CH4, C2H6, C2H4 and C2H2 should not exceed 12 ppm for in-tank type LTCs and 6 ppm for compartment type LTCs.
- For non-vacuum type LTCs, or LTCs filled with a liquid other than mineral oil, the determination of acceptance criteria is through sound only and there is not a limit for increase in gases.

2. Changes to Insulation Power Factor test, from Diego Robalino's Diel Test SC TF for Winding Insulation Power Factor. Final survey approved in the Fall 2021 virtual meeting and by DielTest SC Jan 2022. Specifically with regards to Subclause 10.10.2 revising the accuracy requirements of instrumentation.

The existing text is:

> **10.10.2 Instrumentation**
>
> The insulation power factor may be measured by special bridge circuits or by the voltampere-watt method. The accuracy of measurement should be within ± 0.25% insulation power factor, and the measurement should be made at or near a frequency of 60 Hz.

The revised text to replace it will be:

10.10.2 Instrumentation

The insulation line-frequency power factor or dissipation factor may be measured by special bridge circuits or by the voltampere-watt method. The accuracy of the measurement instrumentation at or near rated frequency should be:

- for Insulation Power Factor Below 1%: +/-2% of reading +/-0.05% absolute

- for Insulation Power Factor Above 1%: +/-5% of reading +/-0.05% absolute

3. Changes to Clause 11 Temperature Test, from Dinesh Sankarakurup's TF in the Insulation Life SC.

   a. Changes to subclause 11.3.2, Liquid Temp Rise Determination. Final survey approved by TF and SC in the Spring 2023 meeting. In the first paragraph change the word "ultimate" to "stabilized", and add a sentence that the top oil rise shall not be averaged over time. Text in black is existing, red is revised, blue is deleted.

   Liquid temperature rise is the difference between liquid temperature and ambient temperature. The ~~ultimate~~ stabilized temperature rise above ambient shall be considered to be reached when the top liquid temperature rise does not vary more than 2.5% or 1 °C, whichever is greater, during a consecutive 3 h period. The stabilized liquid temperature rise determined at the end of the total loss run shall not be averaged over time.

4. Changes to Audible Sound from Ramsis Girgis' TF in the Perf Char SC. These changes were approved by the TF at Spring 2023. The Perf Char SC approved in-person at the Kansas City meeting. Text in black is existing, red is revised, blue is deleted.

   a. Changes to 13.3.3.1 No-load audible sound level.

   When a transformer is equipped with a tap changer, the transformer may, on certain tap changer positions, produce sound levels that are higher than the audible sound level at the rated tap position. For these transformers, the measurements shall ~~may, upon purchaser request, and as agreed upon,~~ be made with the transformer on the highest sound producing tap position.

   Also, other excitation conditions may occur in service leading to lower, or higher, core noise. For example, transformers designed to operate with variable flux the core audible sound level is strongly impacted by the tapping position. The same is true for SVC transformers when connected to a capacitive load; Again, for these transformers, the measurements shall ~~may, upon purchaser request, and as agreed upon,~~ be made with the transformer operating at the highest sound producing condition.

   b. Changes to 13.5.5.1 Measuring ambient sound pressure level.

   ~~The ambient sound pressure level shall be established by averaging the ambient sound pressure levels measured immediately preceding and immediately following the sound measurements with the transformer energized. The ambient sound shall be measured at a minimum of four locations, and the instruments shall be in conformance with 13.2.~~ The ambient sound pressure level shall be measured at a minimum of four locations around the transformer immediately preceding and immediately following the sound measurements with the transformer energized. The ambient sound pressure level shall be established by calculating the logarithmic average of measured values of the ambient sound pressure levels. The measuring instruments shall be in conformance with 13.2. However, additional measurements may be made if agreed to by the manufacturer and purchaser or if the ambient measurements vary by more than 3 dB around the transformer. …

   c. Changes to 13.3.3.2 Load audible sound level.

Since load audible sound becomes a contributor to the total audible sound of the transformer at higher loads, the load audible sound level shall be measured at the ONAF measuring contour. For transformers with only an ONAN rating, load noise is to be measured at the ONAN sound measuring contour.

5. Changes to Low Frequency Tests from Ajith Varghese's RLFT TF in the Diel Test SC. Final survey approved by TF and SC in the Spring 2023 meeting. Text in black is existing, red is revised, blue is deleted.

   a. Changes to Induced Test for Class II, Clause 10.8.2 PD Test Procedure

10.8.2 Test procedure

The voltage shall first be raised from zero to the 1.05 X line to ground value of the nominal system voltage (column 2, C57.12.00 Table 4) and held long enough to attain a stable partial discharge level and then record the level of partial discharge. The voltage shall then be raised to the one-hour level and held for a minimum of 5 min or until a stable partial discharge level is obtained to verify that there are no partial discharge problems. The partial discharge level shall be measured at the end of the 5 min period. If the 5 min. period at the 1 h voltage level is extended to obtain a stable partial discharge level the partial discharge shall be measured at the end of this period so that the level of partial discharges are 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 one-hour 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.

Immediately following the 1 h period, the voltage shall then be reduced to 1.05 X line to ground value of the nominal system voltage (column 2, C57.12.00 Table 4) and held until a stable partial discharge level is obtained and the partial discharge level measured.

   b. Changes to Induced Test for Class II, Clause 10.8.5 PD Failure Detection.

10.8.5 Failure detection

Failure may be indicated by the presence of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, or a sudden increase in the test current. Any such indication shall be carefully investigated by observation, by repeating the test, and by other diagnostic tests to determine whether a failure has occurred. In terms of interpretation of partial discharge measurements, the results shall be considered acceptable and no further partial discharge tests required under the following conditions:

a) The magnitude of the partial discharge level does not exceed 250 pC during the 1 h test period.
b) The increase in partial discharge levels during the 1 h period does not exceed 50 pC.
c) The partial discharge levels during the 1 h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.
d) The magnitude of partial discharge level at 1.05 X Nominal System Voltage following the 1 h test period does not exceed 100 pC.

   c. Addition of text regarding venting of bushings during PD test. In Vancouver S24, the Dielectric Tests SC approved the following text to be added to the end of Subclause 10.8.5.

If the partial discharge is measured during the Induced-voltage testing of the transformer and is suspected to be generated within an OIP (oil-impregnated-paper) bushing(s), it is permissible to "vent" the bushing(s) exhibiting partial discharge to the atmosphere using the bushing manufacturer's instructions.

Unless agreed between manufacturer & purchaser, bushings shall not be vented proactively prior to dielectric testing. The Induced-voltage test shall be entirely repeated after venting the bushing and a note shall be added to the certified test report indicating bushing(s) were vented during the induced-voltage test.

Notes:

1) Partial discharge intended to be addressed by venting the bushing, is a low energy discharge arising from partial vacuum (pressure below atmosphere) created in the expansion chamber and/or gas bubbles generated during the Temperature Rise test and the cooling down afterwards. Partial vacuum is created in the expansion chamber due to absorption of nitrogen or air into oil, and gas bubbles are formed due to saturation of nitrogen or air. Partial discharges from these cases may be resolved by venting the bushing. If continuous gas bubble generation or elevated partial discharge remains after the venting, additional investigations are required.

2) If there are concerns of gas generation from the temperature rise test causing bushing failure during impulse or applied voltage test, an induced-voltage test can be performed before impulse testing for diagnostic purposes. A complete induced-voltage test shall be performed as the last dielectric test, as specified in subclause 10.1.5.1 for dielectric test sequence.

3) Not all OIP bushings exhibit these conditions, so bushing design can be a factor.

4) The same condition of gas bubble formation or partial vacuum may occur in service during normal operation of load and overload cycles.
5) Re-establishment of the bushing gas space blanket and resealing of the bushing must also be performed in accordance with the bushing manufacturer's instructions. The internal integrity of the bushing may be compromised by venting, by allowing in oxygen and moisture or by not reestablishing proper conditions.

d. A revision to add clarification to the overvoltage factor for Induced Test in 10.8.1. In St Louis F24, the Dielectric Tests SC approved the following revisions to Subclause 10.8 Induced-voltage test for Class II power transformers. Text in black is existing, red is revised, blue is deleted.

10.8.1 General

Each Class II power transformer shall receive an induced-voltage test with the required test voltage levels from IEEE Std C57.12.00-2021 Table 4 columns 6 and 7 based on the HV voltage class corresponding to the maximum system voltage. The required test voltage levels shall be induced in the high-voltage winding. The tap connections shall be chosen, when possible, so that test levels developed in the other windings during the one-hour test are *x* times their nominal system ~~maximum operating~~ voltages, as specified in Table 4 of IEEE Std C57.12.00-2021, where *x* (also referred to as the "overvoltage factor" in the text that follows) is the ratio of the line-to-line test voltage on the high-voltage winding to the nominal system ~~maximum operating~~ voltage.

e. Class I PD test. Revision to the test procedure by Don Ayer's sub Task Force. In St Louis F24, the Dielectric Tests SC approved revisions to Subclause 10.7 to insert a new category of test for Class I power transformers when PD measurements are specifically requested by the purchaser. What follows in red text is all new.

Induced-voltage tests for Class I power transformers with partial discharge measurements specifically requested by the purchaser

General

Each Class I power transformer shall receive an induced-voltage test with the required test levels induced in the high-voltage winding. The tap connections shall be chosen, when possible, so that test levels developed in the other windings during the one-hour test are *x* times their maximum operating voltages, as specified in Table 3, Part C of IEEE Std C57.12.00-2021, where *x* (also referred to as the "overvoltage factor" in the text that follows) is the ratio of the test voltage on the high-voltage winding to the maximum operating voltage.

For a transformer built with a single magnetic core holding all windings, all windings are excited at a unique induction level, often referred to as "volts-per-turn." During an induced-voltage test, with the transformer connected and excited as in service, all windings are excited at the same overvoltage factor, regardless of what tap is selected. Each winding turn receives the same voltage. The tap connections shall be chosen, when possible, such that voltages developed across other windings meet or exceed the required overvoltage factor.

The situation is quite different when transformers are equipped with auxiliary devices with separate magnetic cores, such as preventive autotransformer (reactor), series (booster) transformer, or series regulator. Different magnetic cores can be excited at different levels during operation or testing. In certain tap positions, these auxiliary devices do not have their core excited at all and no voltage appears across their windings. For such cases, the selection of the tap-changer position shall be guided by the principles described below. One exception is when such auxiliary devices are not excited on a permanent basis but used only as transitional devices. If equalizing windings are used, the highest voltage impressed across the preventive autotransformer will occur in either the bridging or non-bridging positions. This is because the preventive autotransformer is energized in all tap positions (bridging and non-bridging).

NOTE 1—Equalizing windings are described in IEEE Std C57.131 and IEC 60214-1.

For transformers equipped with a series (booster) transformer, preventive autotransformer (reactor), or any other device, the selected tap position of the load tap-changer (LTC) shall be the one that produces the highest voltage across the windings of the series transformer, preventive autotransformer, and other auxiliary devices as applicable. There can be a conflict of choosing such a tap position when more than one such device is present. In such a case, the selected tap position of the LTC should be the best compromise so that all devices are tested with overvoltage. One common example is the case where a series transformer and preventive autotransformer are both present. In this case, the tap selected shall be the one that is closest to the position that produces the highest voltage across the windings of the series transformer and simultaneously excites the preventive autotransformer, which is typically a bridging position (not applicable when the preventive autotransformer is energized only during transition).

In order to test the series (booster) transformer, preventive autotransformer, and other devices, at the required minimum overvoltage factor, the voltage developed on the terminals of other windings may exceed the one-hour level mentioned in Table 3, Part C of IEEE Std C57.12.00-2021. In such cases, an alternative tap position may be selected by agreement between the manufacturer and the purchaser to avoid overstressing components such as bushings. Annex D shows examples that can serve as a guide to select the LTC tap position for transformers having series (booster) transformer and/or preventive autotransformers.

For certain types of devices such as series reactors used as current limiting devices, there is no voltage developed across their windings during the induced voltage test as these devices are only excited when current flows in their windings. There is no option available to apply any overvoltage for these devices during the induced test.

NOTE 2—The selection of the tap-changer position for induced test should be agreed upon between manufacturer and purchaser prior to design to avoid conflicts during final acceptance tests.

Test procedure

The voltage shall first be raised to the one-hour 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 one-hour 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 per subclause 10.7.2.5 and these measurements shall be made in accordance with 10.9.

The pressure inside the transformer tank during the 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 the 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 needs to be repeated with no added pressure as stated previously.

Connections

The transformer shall be excited exactly as it will be in service. The voltage may be induced from any winding or from special windings or taps provided for test purposes. Single-phase transformers shall be excited from single-phase sources. Three-phase transformers shall be excited from three-phase sources. The neutral terminals and other terminals that are normally grounded in service shall be solidly grounded. This will stress all of the insulation at the same per unit of overstress.

Frequency

The test frequency shall be increased, relative to operating frequency, as required to avoid core saturation. The requirements in 10.7.2 are also applicable in the case of this induced test

Failure detection

Failure may be indicated by the presence of smoke and bubbles rising in the insulating liquid, an audible sound such as a thump, or a sudden increase in the test current. Any such indication shall be carefully investigated by observation, by repeating the test, and by other diagnostic tests to determine whether a failure has occurred. In terms of interpretation of partial discharge measurements, the results shall be considered acceptable and no further partial discharge tests required under the following conditions.

a) For transformers with nominal system voltage (NSV) of 34.5KV and above, the magnitude of the partial discharge level does not exceed 250 pC during the 1 h test period. For transformers below 34.5 kV NSV, the magnitude of the partial discharge level shall be set by agreement between the purchaser and the manufacturer.

b) For transformers with nominal system voltage (NSV) of 34.5 kV and above the increase in partial discharge levels during the 1 h period does not exceed 50 pC. For transformers rated below 34.5 kV NSV, the increase of the partial discharge level shall be set by agreement between the purchaser and the manufacturer.

c) The partial discharge levels during the 1 h period do not exhibit any steadily rising trend, and no sudden sustained increase in the levels occurs during the last 20 min of the test.

Judgment should be used on the 5 min readings so that momentary excursions of the partial discharge readings caused by cranes or other ambient sources are not recorded. Also, the test may be extended or repeated until acceptable results are obtained.

A failure to meet the partial discharge acceptance criterion shall not warrant immediate rejection, but it shall lead to consultation between purchaser and manufacturer about further investigations.

6. Changes to Impulse Tests from Sylvain Plante's TF in the Diel Test SC. Final survey approved by TF and SC in the Spring 2023 meeting.

   a. Changes to 10.3.2.2, 10.3.2.3, 10.4.4, 10.4.5 impulse tests on transformers with series-multiple and delta-wye connections. The following final wording was approved by the Dielectric Test SC during the S23 Milwaukee SC meeting

10.3.2.2 Windings for series, parallel or multiple connections. The windings shall be tested for all series, parallel and multiple connections. The test voltage for these conditions shall correspond to the BIL of the winding for that connection.

10.3.2.3 Windings for delta or wye connections. The three-phase transformer shall be tested on both delta and wye connections. The test voltage for each connection shall correspond to the BIL of the winding for that connection.

10.4.4 Windings for series, parallel or multiple connections. For high-voltage windings with series, parallel or multiple connections above 15 kV, the routine impulse test shall be conducted on each connection at its assigned BIL. For nominal system voltages of 15 kV and below, only the series connections shall be tested, unless tests on all connections are specified.

10.4.5 Windings for delta or wye connections. For high-voltage windings of three-phase transformers with delta or wye connection above 15 kV, the routine impulse test shall be conducted on each connection at its assigned BIL. For nominal system voltages of 15 kV and below, only the wye connection shall be tested, unless tests on all connections are specified.

b. Establishing guidelines about use of +/-3% tolerance on voltage peak for SI and LI. The following final wording was approved by the Dielectric Test SC during the F23 Kansas City SC meeting

   Add as second paragraph to Subclause 10.2.2.2 The basic rule for application of the tolerance on voltage crest value is that testing laboratories shall aim for the test value specified. For any of the impulses of a test series, if the actual measured voltage is lower than the required voltage crest value but within the allowable tolerance of ±3%, the impulse crest shall be accepted as valid. For any required subsequent impulse on the same terminal, adjustments shall be made to aim for the specified test value

   Add as second paragraph to Subclause 10.3.1.1 The basic rule for application of the tolerance on voltage crest value is that testing laboratories shall aim for the test value specified. For any of the impulses of a test series, if the actual measured voltage is lower than the required voltage crest value but within the allowable tolerance of ±3%, the impulse crest shall be accepted as valid. For any required subsequent impulse on the same terminal, adjustments shall be made to aim for the specified test value.

c. Tap position for switching impulse. The S24 Vancouver Dielectric Tests SC approved a motion to add the following at the end of Subclause 10.2.4:

   While selecting the tap connection complying to above requirements, the phase-to-phase voltage withstand capability of the transformer active part including LTC, bushings and all accessories shall be reviewed.

Testing on a non-compliant tap connection shall be discussed and agreed between manufacturer and purchaser."

PENDING WORK

Since this is a continuous revision document, there is ongoing work in Task Forces.

1. Possible revisions from Hakan Sahin's PCS TF for Revision of C57.12.90. In Fall 2024 there was discussion related to Clause 5 and determining the temperature used for measuring cold resistance. This item is ongoing, but at this time there are no decisions made and nothing to change in 12.90. Will survey TF on text proposed by Jason Varnell for temperature sensors in liquid for class II transformers while determining winding cold resistance temperature.

2. Possible changes to Clause 13 sound test from Ramsis' TF. Measuring sound level of Preventive Autotransformers (PA) in air as a Quality Control check was again presented and discussed. Possibly a Task Force Paper will be written. In Fall 2024 there was continued discussion. This item is ongoing, but at this time there are no decisions made and nothing to change in 12.90.

3. Possible changes to Subclause 10.2 or 10.3 from Sylvain Plante's TF regarding switching and lightning impulse tests. No SC motions. Will survey TF for voltage and current waveform overlay requirements.

4. Other possible revisions to subclauses 10.5 to 10.10 from Ajith Varghese's TF for revision of low frequency tests.

5. Possible changes to subclause 10.11 from Diego Robalino's TF regarding insulation resistance. This work is ongoing, the TF met in St. Louis, there was no quorum. Nothing to do yet. Possible future changes to insulation resistance measurement procedures are being considered, as compared to conflicting procedures in other documents such as C57.152. Also, possible future addition of core megger and clamp megger procedures since none currently exist in 12.90.

6. Changes to Clause 11 Temperature Test from Dinesh Sankarakurup's TF
    - 11.4.3 Add text that reverse correction for altitude is also allowed; i.e., when factory is located above 1000 m and transformer rating is based on <1000m. This work is almost complete. A final survey will be sent after the St. Louis meeting.
    - Request for clarification for temp test of 3-winding transformers, injecting maximum losses, and correcting for maximum common winding current in

autos. Prior to Kansas City a small sub group developed some wording, it was briefly discussed in Kansas City. It was not discussed in St. Louis F24.

- Proposal by Bertrand Poulin OFAF Cooling and Top Duct Oil temperature and diagram in C57.119. The draft was circulated to the Task Force for comments. This was further discussed at TF meeting in St Louis F24, and more work will be done. . Another survey will be sent after the St. Louis meeting
- Clarification to Hottest spot Rise calculation using Fiber Optics. Egon and Ewald Schweiger of Siemens advanced their proposal to add as an alternate method an option to measure hot spot temperature using direct measurement with fiber optic probes. A small sub task force will be formed to develop wording. This was further discussed at TF meeting in Vancouver S24, and more work will be done. It was not discussed in St. Louis F24.
- Standardize Method for Hot resistance extrapolation not covered in Kansas City, but Bertrand Poulin submitted some info that should be circulated to the TF. It was not discussed in St. Louis F24.

Respectfully submitted,
Stephen Antosz, WG Chair
Jason Varnell, WG Vice-Chair
November 7, 2024

L.3.5 WG Standards Transformer on Revision for C57.152, Guide of Field Tests

Standards Subcommittee,
WG – C57.152 Revision
IEEE / PES Transformers Committee

October 29, 2024, 4:45PM – 6:00PM
UNAPPROVED MINUTES

Welcome

The chair of the working group, Marcos Ferreira, and the secretary, Goran Milojevic, opened the meeting at 04:45PM.

1. **Attendance and Attendance for Quorum**

At the time of the meeting there were 38 Members, including Chair and Secretary. A total of 20 members were counted as present at the meeting. 75 members and guests signed into the circulating paper roster.

20 members present of 38 mean requirements for quorum were fulfilled. The list of attendees who signed into the paper roster is shown below:

Name	Affiliation	Status
Ferreira, Marcos	Quanta Technology	Chair
Milojevic, Goran	DV Power	Secretary
Binder, Wallace	WBBinder Consultant	Member
Bradshaw, Jeremiah	US Bureau of Reclamation	Member
Colopy, Craig	Consultant	Member
Ermakov, Evgenii	Hitachi Energy	Member
Gara, Lorne	Shermco	Member
Guner, Ismail	Hydro Quebec	Member
Gustavsson, Niklas	Hitachi Energy	Member
Hayes, Roger	GE Vernova	Member
Heiden, Kyle	EATON Corporation	Member
Hernandez, Ronald	Doble Engineering Company	Member
Locarno, Mario	Doble Engineering Company	Member
Murray, David	TVA	Member
Poorvi, Patel	EPRI	Member
Robalino, Diego	Megger	Member
Saad, Mickel	Hitachi ABB Power Grids	Member
Sweetser, Charles	OMICRON Electronics Corp USA	Member
Tanaka, Troy	Burns & McDonnell	Member
Verdolin, Rogerio	Verdolin Solutions	Member

Welton, Drew	Intellirent	Member
Ansari, Tauhid	Hitachi Energy	Guest
Balakrishnan, Mani	Delta Star	Guest
Castellanos, Juan	Prolec GE	Guest
Cheksi, Bhaumik	Hitachi Energy	Guest
Da Silva, Roberto	Maschinenfabrik Reinhausen	Guest
Delgado, Gabriel	Invenergy	Guest
Doak, Eric	D4 Energy Solutions	Guest
Dongki, Lim	ILJIN Electric	Guest
Duffy, Jesse	Nashville Electric Service	Guest
Eun Young Cho	HICO America	Guest
Faur, Florin	Prolec GE	Guest
Garner, Joshua	Independent Dielectics	Guest
Gyore, Attila	MIDEL	Guest
Hall, Jesse	Virginia Transformer	Guest
Herron, William	Reinhausen USA	Guest
Hrkac, Miljenko	Hitachi Energy	Guest
Huzmezan, Mihai	Megger	Guest
Iqbal, Fawaz	Omicron Energy	Guest
Jarosz, Patrycja	IEEE SA	Guest
Johnson, Christopher	Oncor	Guest
Jonak, Ryan	Portland General Electric	Guest
Jones, Brexton	SD Myers	Guest
Knapp, Evan	Eaton	Guest
Kosedagi, Nihat	Hitachi Energy	Guest
Kumir, Arvind	Delta Star	Guest
Lagos, Fernando	GE Vernova	Guest
Lamontagne, Don	Arizona Public Service	Guest
Leal, Fernando	Prolec GE	Guest
Loiselk, Luc	Tetratech	Guest
Malde, Jinesh	MIDEL	Guest
Mamede, Gabriel	Siemens Energy	Guest
Maratha, Swapnil	Megger	Guest
Menter, Tim	Lincoln Electric System	Guest
Newbill, Mark	Hitachi Energy	Guest
Ogajanov, Rudolf	Hitachi Energy	Guest
Raymond, Tim	Inductive Reasoning	Guest
Salvatto, Paul	Intellirent	Guest
Sami, Debass	EPRI	Guest
Sar Kinen, Garret	Xcel Energy	Guest
Seungmo, Kim	Hyosung HICO	Guest
Sinclair, John	Black & Veatch	Guest
Solano, William	Voltyx	Guest
Stacey, Brad	Leeward Renewable Energy	Guest
Steele, H. Allen	TVA	Guest
Sze, Matthew	Omicron Energy	Guest

Tan, Jonathan	Northern Transformer	Guest
Thiede, Andreas	HIGHVOLT Prueftechnik Dresden	Guest
Vanderwalt, Alwyn	ECI	Guest
Varghese, Ajith	Prolec GE	Guest
Yonghui, Kim	ILJIN Electric	Guest
White, Elliot	SD Myers	Guest
Whitten, Christopher	Hitachi Energy	Guest
Wright, Jeffrey	Duquesne Light	Guest
Zhang, Hongshi	Hitachi Energy	Guest

2. Approval of the Agenda

The motion to approve the agenda was made by Rogerio Verdolin, and seconded by Drew Welton. The motion was approved unanimously.

3. Approval of Minutes of Spring 2024 Meeting

The motion to approve the Minutes of Spring 2024 Meeting was made by Evgenii Ermakov, and seconded by Jeremiah Bradshaw. The motion was approved unanimously.

4. Call for Patents

The chair presented slide 1-4, dated January 2, 2018 informing of the IEEE patent policy and participants duty to inform. There were no issues related to patent assurance brought up by attendees in the meeting.

5. IEEE Copyright Policy

The chair presented IEEE-SA Copyright Policy slides 1-2 informing the audience of the policy.

6. Chair's Remarks

The chair, Marcos Ferreira, gave the following remarks.

"Since Spring 2023, the full text of the draft of the proposed revision of the Guide was submitted to the members by email.

"The Ballot has closed without meeting the 75% response rate requirement as of 04 Oct 2024. The response rate received was 58%."

Goran and I need your support to vote as soon we're able to get an extension so we can reach the minimum required response of 75%. We count on you members of this working group.."

7. New Business

The secretary, Goran Milojevic, informed the meeting about the updated ballot response for the initial ballot, which was at 72% response rate. The gathered participants who had not already voted were invited to cast their ballot until the extended deadline of November 21st, 2024. At the time of the meeting, five votes were still needed to meet the 75% response rate. Since the ballot is in the extension period, it will automatically close once the required response rate has been achieved.

The secretary, Goran Milojevic, brought up another item of new business regarding the comment resolution board. Patrycja Jaros, IEEE program coordinator, suggested that the previously accepted comment resolution board should be re-confirmed and its authority clarified. A slide was brought up with the comment resolution board members who accepted their role during the Fall 2023 meeting, and the additional working group members who volunteered to join the comment resolution board.

During the discussion, Charles Sweetser asked that the comment resolution board is divided into subgroups that will each work with a different group of comments, based on the part of the text that was commented, and according to each member's field of expertise. Mario Locarno and Poorvi Patel requested that the plan for addressing the comments is prepared in more detail. During the discussion, it was agreed that the comment resolution board will meet online once per week once all comments are received and sorted. The meetings will include the working group officers, the people who were members of the task force which worked on the commented part of the text, and any other interested comment resolution board members. Once all comments have been addressed, a full list of proposed responses to the comments will be circulated to the comment resolution board members. Once consensus within the comment resolution board has been achieved, it will make the editorial changes and propose the responses to any technical comments to the rest of the working group, which will vote on them during the Spring 2025 meeting of the group.

The following working group members have volunteered to participate in the comment resolution board activities:

- Evgenii Ermakov
- Niklas Gustavsson
- Attila Gyore
- Marcos Ferreira
- Marc Foata
- Ronald Hernandez
- Goran Milojevic
- Diego Robalino
- Charles Sweetser

The motion to confirm the comment resolution board and authorize it to make editorial changes and to make recommendations for technical changes between meetings was made by Diego Robalino, and seconded by Evgenii Ermakov. The motion was approved unanimously.

8. Meeting Adjournment

The motion to adjourn the meeting was made by Evgenii Ermakov, and seconded by Diego Robalino. The meeting was adjourned at 05:20PM.

Respectfully submitted,

Marcos Ferreira – Chair　　　　　Goran Milojevic – Secretary

L.3.6 WG C57.133 Reverse Power Flow

First PAR Approved Meeting: WG PC57.133
"Guide for Evaluating Transformer Performance under Reverse Power Flow"

3:15-4:30 PM CDT | October 29, 2024
Grand Ballroom AB (Floor 4) | Hyatt Regency St. Louis at the Arch | St. Louis, MO

Chair:	Ryan Hogg	Bureau of Reclamation	rhogg@ieee.org
Vice Chair:	Bruce Webb	Knoxville Utilities Board	bruce.webb@kub.org
Secretary:	Drew Welton	Intellirent	dwelton@intellirentco.com

Attendees:

Working Group_membership was established at the meeting. Those who requested membership were granted membership. Guests are welcome to join after attending the next two out of three meetings.

Attendees: 121
Members: 89
Guests: 33
Non-Attendee Requesting Membership: 1

First Name	Last Name	Affiliation	Membership
Kayland	Adams	Prolec-GE Waukesha	Member
Gilles	Bargone	FISO	Member
Mats	Bernesjo	Hitachi Energy	Member
Daniel	Blaydon	Baltimore Gas and Electric	Member
William	Boettger	Boettger Transformer Consulting LLC	Member
Garrett	Bradshaw	Howard Industries	Member
Jeffrey	Brooks	Asplundh Engineering Services	Member
Alfredo	Carrizales	PROLEC	Member
Thomas	Dauzat	AEP-SWEPCO	Member
Nikolaus	Dillon	Dominion Energy	Member
Fernando	Duarte	EPRI	Member
Roger	Dugan	RC Dugan	Member
Eric	Elson	San Diego Gas & Electric	Member
Miguel	Garcia	Hitachi Energy	Member
Eduardo	Garcia	Siemens Energy	Member
David	Garcia-Paredes	Virginia Transformers Corp	Member
James	Gardner	Prolec-GE Waukesha	Member
Jose Antonio	Gonzalez Ceballos	Virginia/Georgia Transformers	Member
William	Griesacker	WGA	Member
Jesse	Hall	Virginia Transformer Corp.	Member
Corey	Hanson	Flex-Core	Member
U	Hernandez Decanini	Virginia Transformers Corp	Member
Saramma	Hoffman	PPL	Member
Ryan	Hogg	Bureau of Reclamation	Member
Derek	Hollrah	Burns & McDonnell	Member
Saif	Hossain	Trench Group	Member
Miljenko	Hrkac	Hitachi Energy	Member
Jose	Izquierdo	Siemens energy	Member
Nick	Jensen	Delta Star	Member
John	John	Virginia Transformer Corp	Member
Christopher	Johnson	Oncor	Member
Akash	Joshi	Kimley-Horn	Member
Thrinadha	Katapalli	Virginia Transformer Corp	Member
Anton	Koshel	Delta Star, Inc.	Member
Mark	Lachman	Doble	Member
Jihun	Lee	HD HYUNDAI ELECTRIC	Member
Junho	Lee	HD Hyundai Electric	Member
Kushal	Mahajan	Sungrow	Member
Swapnil	Marathe	Megger	Member
Daniel	Martinez	Jfe guest	Member
Katherine	Marulanda	Magnetron	Member
Brian	McCarrick	Virginia Transformer Corp	Member
Omar	Mendez	Prolec	Member
Emilio	Morales-Cruz	QUALITROL	Member
Tyler	Morgan	Duke Energy	Member
Dan	Mulkey	Mulkey Engineering Inc	Member
Ali	Naderian	EnerPars	Member
Shankar	Nambi	Bechtel Energy, Inc.	Member
Eduardo	Orozco	GE Grid Solutions	Member
Sanjay	Patel	SGB-Smit USA	Member
Vinay	Patel	Con Edison	Member
Gustavo	Prado	Siemens Energy	Member
Tim	Raymond	Inductive Reasoning	Member
Yuri	Rossini	Siemens Energy	Member
Marnie	Roussell	Entergy	Member
Paul	Salvato	Intellirent	Member
Amitabh	Sarkar	Virginia Transformer Corporation	Member
Markus	Schiessl	SGB	Member
Eric	Schleismann	Southern Company	Member
Leena	Shimpi	Mgm transformer	Member
Stephen	Shull	BBC Electrical Services Inv	Member
Igor	Simonov	Toronto Hydro	Member
James	Spaulding	City of Fort Collins Utilities	Member
Andy	Speegle	Entergy	Member
Brad	Staley	Leeward Renewable Energy	Member
Sunny	Swarna	Virginia Transformer Corp	Member
Marc	Taylor	JFE Shoji Canada	Member
Joseph	Tedesco	Hitachi Energy	Member

Ed	teNyenhuis	Hitachi Energy	Member
Mark	Tostrud	Dynamic Ratings	Member
Kannan	Veeran	Virginia/Georgia Transformer Corp	Member
Juan	Velasquez	Magnetrón SAS	Member
Karsten	Viereck	Reinhausen Germany	Member
Krishnamurthy	Vijayan	Pennsylvania transformers	Member
Dharam	Vir	Prolec GE	Member
Pragnesh	Vyas	Sunbelt Solomon	Member
Savid	Walker	MGM Transformers	Member
Joe	Watson	JD Watson and Associates	Member
Bruce	Webb	Knoxville Utilities Board	Member
Drew	Welton	Intellirent	Member
Joe	White	POWER Engineers	Member
Jeffrey	Wright	Duquesne Light	Member
Fei	Yang	Hitachi Energy	Member
Tim	Young	Hitachi Energy	Member
Guang	Yuan	Hitachi Energy	Member
Michael	Zarnowski	Carte International	Member
Hongzhi	Zhang	Hitachi Energy	Member
Shibao	Zhang	PCORE Electric	Member
Waldemar	Ziomek	PTI Transformers LP	Member
Edwin	Betancourt	Siemens Energy	Guest
Naveen	Bhardwaj	Trench Group	Guest
Kevin	Biggie	Weidmann	Guest
Bhaumik	Choksi	Engineer	Guest
Rhett	Chrysler	ERMCO	Guest
Adriana	Cisco Sullberg	Salt River Project	Guest
Luiz	de Oliveira	Hitachi Energy	Guest
Paul	Dolloff	EKPC and University of Kentucky	Guest
Janko	Dzodan	Koncar D&ST	Guest
Sanford	Fong	Georgia Power	Guest
Raymond	Frazier	Ameren	Guest
Jose	Gamboa	The H-J Family of Companies	Guest
Dragana	Gasic	Koncar D&ST	Guest
Kevin	Hampton	Siemens Energy	Guest
Jean Carlos	Hernandez-Mejia	Georgia Tech NEETRAC	Guest
Kenneth	Klein	Johnson	Guest
Nihat	Kosedagi	Hitachi Energy	Guest
Angela	Leigl	Eaton	Guest
Xose	Lopez-Fernandez	Universidade de Vigo	Guest
Charles	Morgan	Eversource Energy	Guest
Fredy	Murcia	Siemens Energy	Guest
Higo	Murillo	Guest	Guest
Adnan	Rashid	Measurement Canada	Guest
Robert	Reepe	Georgia Power Co	Guest
Masoud	Sharifi	Siemens Gamesa Renewable Energy	Guest
Hemchandra	Shertukde	University of Hartford	Guest
Andrew	Steineman	Delta Star, Inc.	Guest
Michael	Thompson	SEL Engineering Services	Guest
Timothy	Tillery	Howard Industries	Guest
Reinaldo	Valentin	Duke Energy	Guest
Terry	Wong	Trench Limited	Guest
Koray	Yavuz	Noark Electric US	Guest
Jason	Snyder	First Energy Corp	Interested

Minutes:

1. Behavior, Copyright, and Patent Slides Displayed
2. PAR, Working Group's goal, and draft schedule (PAR expires 12/31/2028) - Reviewed by Ryan Hogg
3. Established Working Group membership, Established via QR Code System, Paper Roster
4. Agenda approval
    a. Motion to approve the agenda by Joe White
    b. Seconded by Dan Mulkey
    c. Approved unanimously
5. R. Hogg – "Reverse Power and Base C57 Standards"
6. Presentations:
    a. E. teNyenhuis – "Effect of Reverse Power Flow on Transformers"
    b. D. Mulkey – "Fundamental differences between power and distribution transformers"
    c. Slides from the presentations available on the IEEE Transformers Committee web page
    d. Discussion regarding Ed's presentation that contained illustrations of four power quadrants that may help to define reverse power
7. Definition of "Reverse Power Flow"
    a. Status of "…addendum to C57.12.80 for defining Reverse Power Flow"
    b. Our WG to hold interim meetings before Denver meeting on this topic
8. Working outline
    a. Discuss rough draft outline – Too many items? Missing items?
    b. Plan = at a future meeting, delegate drafting to task forces
9. Discussions:
    a. Ramsis Girgis - Discussed the impacts of day vs. night time on power flow, and the differences between step up and step-down transformers, and the effects on OLTC's, and the impacts of voltage regulation should be addressed. Advised he is presenting a paper on reverse power flow at next year's Doble Client Conference.
    b. Ali Gorzin - Raised the question regarding 3-winding transformers, suggested a review of outside publications, such as published papers, and seek utility guidance.
    c. Steve Shull recommended referencing a paper published in 1983 as an electric metering source – "Power Flow Direction Definitions for Metering of Bidirectional Power" by Raymond Stevens, IEEE PSIM, for presentation at the IEEE/PES 1983 Winter Meeting in New York, New York.
    d. Eric Elsum and others were in favor of the quadrant approach would be most beneficial for defining reverse power.
    e. David Walker stated that unexpected losses can occur during reverse power conditions
10. Old Business – none
11. New Business – none
12. Next meetings – Chair will send out a Doodle Poll to meet regarding:
    a. Virtual:
        i. Define "reverse power flow"
        ii. Outline development
    b. In person: Denver, CO in Spring 2025
13. Adjourn

L.3.7 TF - IEEE / IEC Continuous Cross Reference

F24 Unapproved Meeting Minutes

Standards
Subcommittee Task
Force IEEE / IEC
Cross Reference

Monday, October 28, 2024, 9:30am

to 10:45am Chair: Alan

Washburn

1. Welcome
    a. Meeting came to order at 9:35am
2. Introduction of participants
    a. 16 attendees:
    Jaroslaw Chorzepa, Juan Carlos Cruz Valdes, Kyle Heiden, Anton Koshel, Boris Nissle, Nirav Patel, Peng Fu, Marnie Roussell, Masoud Sharifi, Vedrana Starcevic Prebeg, H. Allen Steele, Can Takan, Ryan Thompson, Ajith Varghese, Dharam Vir, Alan Washburn
3. IEEE SA patent policy and call for patents
4. IEEE SA copyright policy
5. Membership review
    a. 6 of 14 members, quorum not achieved
6. Review agenda
7. Review S24 meeting minutes
8. Old business
    a. Scope of TF
        i. Continued discussion on index scope, format
        ii. Look for opportunities to make recommendations to IEEE or IEC organizations
    b. Creation of index document
        i. Involvement of other stakeholders/subcommittees, may help to collect information more quickly
    1. Start with TC-14 and TC-10
    ii. List of documents has been created
        iii. Continuing to use Collabratec for a shared file area and working document tool
9. New business
    a. Work assignments
        i. Several people volunteered to start index work:

        Ajith Varghese, Allen Steele, Alan Washburn
    b. Intermediate meetings

    i. Virtual meeting to be scheduled midway between F24 and S25 meetings, primarily to review progress on index work

10. Adjourn

Standards SC S24 Attendance List

Role	First Name	Last Name	2024 OCT
Secretary	Ajith	Varghese	X
Member	Akash	Joshi	X
Member	Alan	Washburn	X
Guest	Alireza	Gorzin	X
Member	Alwyn	Van Der Walt	X
Member	Amitabh	Sarkar	X
Guest	Ashwini	Labh	X
Member	Brad	Staley	X
Member	Carlos	Gaytan	X
Guest	Charles	Sweetser	X
Guest	Christopher	Whitten	X
Guest	Craig	Colopy	X
Member	Daniel	Blaydon	X
Chair	Daniel	Sauer	X
Member	David	Wallach	X
Guest	Deen	Park	X
Guest	Derek	Hollrah	X
Member	Dharam	Vir	X
Guest	Didier	Hamoir	X
Member	Drew	Welton	X
Member	Dwight	Parkinson	X
Member	Ed	teNyenhuis	X
Member	Eduardo	Garcia Wild	X
Guest	Edwin	Betancourt	X
Guest	Egui	Espitia	X
Member	Emilio	Morales-Cruz	X
Member	Eric	Davis	X
Guest	Eric	Elson	X
Member	Evan	Knapp	X
Guest	Eunyoung	Cho	X
Member	Evgenii	Ermakov	X
Guest	Fawaz	Iqbal	X
Guest	Fei	Yang	X
Guest	Eduardo	Orozco	X
Guest	Fernando	Tirado	X
Member	Florin	Faur	X
Member	Francis	Mills	X
Guest	Gabriel	Delgado	X
Guest	Garrett	Bradshaw	X
Member	Grace	Guang Yuan	X
Guest	Hongzhi	Zhang	X
Guest	Hugo	Bayona	X
Guest	Ismael	Naja	X
Guest	Janet	Crockett	X
Member	Jeffrey	Wright	X
Guest	Jeremiah	Bradshaw	X
Member	Jerry	Murphy	X
Guest	Jerzy	Kazmierczak	X
Guest	Jesse	Duffy	X
Guest	Jihun	Lee	X
Guest	Jie	Zhang	X
Member	Joe	White	X
Member	John	John	X
Guest	John	Wagner	X
Guest	Jonathan	Tan	X
Guest	Jose	Izquierdo	X
Member	Joseph	Tedesco	X
Guest	Joshua	Watson	X
Member	Joshua	Yun	X

Role	First Name	Last Name	2024 OCT
Guest	Junho	Lee	X
Member	Kayland	Adams	X
Guest	Koray	Yavuz	X
Guest	Krish	Vijayan	X
Guest	Kyle	Stechschulte	X
Guest	Luc	Loiselle	X
Vice-Chair	Marcos	Ferreira	X
Guest	Mark	Newbill	X
Guest	Mark	Tostrud	X
Guest	Michael	Richardson	X
Guest	Mickel	Saad	X
Member	Miguel	Garcia	X
Member	Miguel	Plascencia	X
Guest	Nabi	Almeida	X
Guest	Nick	Jensen	X
Guest	Nihat	Kosedegi	X
Member	Onome	Avanoma	X
Guest	Paul	Dolloff	X
Guest	Paul	Weyandt	X
Guest	Paulo	Avelino	X
Guest	Pedro	Truhlio	X
Guest	Peng	Fu	X
Member	Poorvi	Patel	X
Guest	Qasim	Khan	X
Member	Ramadin	Issack	X
Member	Ramsis	Girgis	X
Member	Raymond	Frazier	X
Guest	Rehan	Ali	X
Member	Robert	Ballard	X
Guest	Roberto Ignacio	Da Silva	X
Guest	Ryan	Musgrove	X
Member	Ryan	Hogg	X
Guest	Samuel	Tekle	X
Guest	Sanjay	Patel	X
Member	Sanjib	Som	X
Member	Saramma	Hoffman	X
Member	Scott	Digby	X
Member	Sergio	Hernandez Cano	X
Guest	Seugmo	Kim	X
Member	Stephen	Shull	X
Member	Steven	Snyder	X
Guest	Sylvain	Plante	X
Member	Tauhid Haque	Ansari	X
Member	Thomas	Dauzat	X
Member	Thomas	Prevost	X
Guest	Tim	Raymond	X
Guest	Troy	Tanaka	X
Guest	Traci	Hopkinson	X
Guest	Vivian	Chan	X
Guest	William	Boettger	X
Guest	Will	Elliott	X
Guest	William	Solano	X
Member	William	Whitehead	X
Guest	Wilerson	Calil	X
Guest	Yeounsoo	Kim	X
Guest	Zhing-Zang	Zhuo	X