Standards Subcommittee

November 17, 2021 Virtual meeting

Standards Subcommittee		
Chair: Daniel Sauer	**Vice-Chair: Marcos Ferreira**	**Secretary: Ajith Varghese**
Standards Coordinator: Steve Shull		
Room: Virtual	Date: Nov 17th, 2021	Time: 3:45 PM to 04:32 pm
Members: 81	Present at time of quorum check: 44	Attended per WebEx Record: 49
Guests present: 79	Membership requested: 9	Membership accepted: 7

L.1 Meeting Attendance

The Standards Subcommittee met on Wednesday; Nov 17, 2021 and started at 3:45 PM (CST). **44 of 81** members were in attendance at the beginning of the meeting which met the quorum requirement.

Overall, the attendance roll showed according to WebEx pool: there were **128** attendees (49 members and **79** guests (**9** guests requested membership and **7** met attendance requirement and will be granted membership).

L.2 Chair's Remarks

The Chair welcomed members and guests to the virtual meeting. Chair briefly highlighted the requirement that while introducing one need to state their affiliation. Chair noted the meeting is recorded for the purpose of minutes and will be deleted after that.

Chair presented revised agenda that included new business on digital Standard. The Agenda was moved by Rogerio Verdolin and seconded by Vinay Mehrotra. The motion was carried with unanimous consent. The Minutes for spring 2021 was moved by Jerry Murphy and seconded by Steve Shull. 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 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. The Chair welcomed members and guests to the virtual meeting.

Chair briefly highlighted the requirement that while introducing one need to state their affiliation. Chair noted the meeting is recorded for the purpose of minutes and will be deleted after that.

Two motions were passed during the SC meeting

- Motion to initiate PAR for next revision of C57.12.00 with same title and scope as 2021 revision was moved by Steve Antosz and seconded by Steve Shull.

- Motion to initiate PAR for next revision of C57.12.90 with same title and scope as 2021 was moved by Steve Snyder and seconded by Ajith Varghese.

Both motions passed unanimously.

Steve Snyder informed SC that he will be stepping down from Chair for WG C57.12.00. Chair thanked Steve for years of service and informed SC to contact him if anyone of interested in taking over this position.

Under New business, Chair communicated that transformer committee is working to setup a digital compilation of standards relevant to transformers and would like to get feedback if there are any specific standards or guides that should be included.

Meeting adjourned at 3:42 pm.

Minutes respectfully submitted by

Ajith M. Varghese
Secretary Standards SC.

Standards SC F21 Attendance List

Role	First Name	Last Name	Company
Chair	Jerry	Murphy	Reedy Creek Energy Services
Vice-Chair	Marcos	Ferreira	Beale AFB
Secretary	Ajith	Varghese	SPX Transformer Solutions, Inc.
Member	Susan	McNelly	Xcel Energy
Member	Bruce	Forsyth	Bruce Forsyth and Associates PLLC
Member	Bill	Griesacker	Duquesne Light Co.
Member	Eduardo	Garcia Wild	Siemens Energy
Member	Steven	Snyder	Hitachi Energy
Member	Lee	Matthews	Howard Industries
Member	Ed	teNyenhuis	Hitachi Energy
Member	Gary	King	Howard Industries
Member	Stephen	Antosz	Stephen Antosz & Associates, Inc
Member	Ramsis	Girgis	Hitachi Energy
Member	Peter	Zhao	Hydro One
Member	Vinay	Mehrotra	SPX Transformer Solutions, Inc.
Member	Rogerio	Verdolin	Verdolin Solutions Inc.
Member	Gary	Hoffman	Advanced Power Technologies
Member	Hemchandra	Shertukde	University of Hartford
Member	Scott	Reed	MVA
Member	Scott	Digby	Duke Energy
Member	Stephen	Shull	BBC Electrical Services, Inc.
Member	James	Graham	Weidmann Electrical Technology
Member	Daniel	Blaydon	Baltimore Gas & Electric
Member	Daniel	Sauer	EATON Corporation
Member	Parminder	Panesar	Virginia Transformer Corp.
Member	Rob	Ghosh	General Electric
Member	Sukhdev	Walia	New Energy Power Co.
Member	Weijun	Li	Braintree Electric Light Dept.
Member	John	John	Virginia Transformer Corp.
Member	Jarrod	Prince	ERMCO
Member	Paul	Morakinyo	PSEG
Member	Amitabh	Sarkar	Virginia Transformer Corp.
Member	Kurt	Kaineder	Siemens Energy
Member	Kristopher	Neild	Megger
Member	Jason	Varnell	Doble Engineering Co.
Member	Jonathan	Reimer	FortisBC
Member	Thomas	Dauzat	General Electric
Member	Kris	Zibert	Allgeier, Martin and Associates
Member	Tim-Felix	Mai	Siemens Energy
Member	Mickel	Saad	Hitachi Energy
Member	Drew	Welton	Intellirent
Member	Joseph	Tedesco	Hitachi Energy
Member	Gilles	Bargone	FISO Technologies Inc.
Member	Bruce	Webb	Knoxville Utilities Board
Member	Sergio	Hernandez Cano	Hammond Power Solutions
Member	Samragni	Dutta Roy	Siemens Energy
Member	Jonathan	Sinclair	PPL Electric Utilities
Member	Evgenii	Ermakov	Hitachi Energy
Member	Andrew	Larison	Hitachi Energy

Role	First Name	Last Name	Company
Guest	William	Boettger	Boettger Transformer Consulting LLC
Guest	Dinesh	Sankarakurup	Duke Energy
Guest	Wallace	Binder	WBBinder Consultant
Guest	Reto	Fausch	RF Solutions
Guest	Don	Dorris	Nashville Electric Service
Guest	David	Wallach	Duke Energy
Guest	Mike	Spurlock	Spurlock Engineering Services, LLC
Guest	George	Frimpong	Hitachi Energy
Guest	Donald	Lamontagne	Arizona Public Service Co.
Guest	Peter	Werelius	Megger
Guest	Marco	Espindola	Hitachi Energy
Guest	Hakan	Sahin	Virginia/Georgia Transformer
Guest	Mark	Tostrud	Dynamic Ratings, Inc.
Guest	Juan Carlos	Cruz Valdes	Prolec GE
Guest	Sanjib	Som	Pennsylvania Transformer
Guest	Pugal	Selvaraj	Virginia Transformer Corp.
Guest	Huan	Dinh	Hitachi Energy
Guest	Aaron	Meyers	EATON Corporation
Guest	Krishnamurthy	Vijayan	PTI Transformers
Guest	Ali	Naderian	METSCO Energy Solutions Inc.
Guest	Ryan	Musgrove	Oklahoma Gas & Electric
Guest	Diego	Robalino	Megger
Guest	Alejandro	Macias	CenterPoint Energy
Guest	Jagdish	Burde	Virginia Transformer Corp
Guest	John	Poelma	NRG Energy
Guest	Joshua	Verdell	ERMCO
Guest	Steven	Brzoznowski	Bonneville Power Administration
Guest	Mats	Bernesjo	Hitachi Energy
Guest	Marc	Taylor	JFE Shoji Power Canada Inc.
Guest	Christopher	Whitten	Hitachi Energy
Guest	Markus	Schiessl	SGB
Guest	Alwyn	Van Der Walt	Electrical Consultants, Inc.
Guest	Toby	Johnson	Hunt Electric
Guest	Jonathan	Reimer	FortisBC
Guest	Jeffrey	Wright	Duquesne Light Co.
Guest	William	Elliott	Prolec GE
Guest	Rashed	Minhaz	Transformer Consulting Services Inc.
Guest	Samuel	Sharpless	Rimkus Consulting Group
Guest	Jeremiah	Bradshaw	Bureau of Reclamation
Guest	William	Whitehead	H2scan Corporation
Guest	Anastasia	O'Malley	Consolidated Edison Co. of NY
Guest	Daniela	Ember Baciu	Hydro-Quebec IREQ
Guest	Feras	Fattal	Manitoba Hydro
Guest	Malia	Zaman	IEEE
Guest	Cihangir	Sen	Duke Energy
Guest	Stacey	Kessler	TC Energy
Guest	Janusz	Szczechowski	Maschinenfabrik Reinhausen
Guest	Deepak	Kumaria	Applied Materials
Guest	Elise	Arnold	SGB
Guest	Muhammad Ali Masood	Cheema	Northern Transformer
Guest	John	Reagan	RWE Renewables
Guest	David	Calitz	Siemens Energy
Guest	Moonhee	Lee	Hammond Power Solutions
Guest	Hugh	Waldrop	Memphis Light, Gas & Water
Guest	Sylvain	Plante	Hydro-Quebec
Guest	Dmitriy	Klempner	Southern California Edison
Guest	Shawn	Gossett	Ameren
Guest	Afshin	Rezaei-Zare	York University
Guest	Saramma	Hoffman	PPL Electric Utilities
Guest	Matthew	McFadden	Oncor Electric Delivery
Guest	Raymond	Frazier	Ameren
Guest	Alan	Washburn	Burns & McDonnell
Guest	Pragnesh	Vyas	Sunbelt-Solomon Solutions
Guest	Chris	Powell	Intermountain Electronics
Guest	Edmundo	Arevalo	Bonneville Power Administration
Guest	Jared	Bates	Oncor Electric Delivery
Guest	Brandon	Dent	Memphis Light, Gas & Water
Guest	Angela	Leigl	EATON Corporation
Guest	Tiffany	Lucas, P.E.	SPX Transformer Solutions, Inc.
Guest	Albert	Sanchez	Knoxville Utilities Board
Guest	Balakrishnan	Mani	Virginia Transformer Corp.
Guest	Nabi	Almeida	Prolec GE
Guest	Hampton	Steele	Tennessee Valley Authority
Guest	Thomas	Eagle	SPX Transformer Solutions, Inc.
Guest	Rehan	Ali	Siemens Energy
Guest	Nathan	Katz	PacifiCorp
Guest	Sudip	Chanda	Virginia Transformer Corp.
Guest	Matthew	Pinard	Weidmann Electrical Technology

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: Steven L. Snyder
November 17, 2021

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.

Standards C57.12.00 was last published in 2015. A revision ballot was initiated in March 2021 with the following key points from the ballot:

Ballot Opened	3-19-2021
Ballot Closed	4-19-2021
Recirculation #1 Open	8-10-2021
Recirculation #1 Close	8-25-2021
Recirculation #2 Open	8-27-2021
Recirculation #2 Close	9-08-2021

Number in Ballot Pool	231
Number of Affirmative Votes (final)	187
Number of Negative Votes (final)	0
Number of Abstentions (final)	4

Return Rate (final)	82%
Affirmative Rate (final)	100%

The project was approved by IEEE SA Standards Board on 11-9-2021, and the revised standard will be good for 10 years. My understanding is that it will bear the 2021 publication date.

Thanks to everyone that voted, provided constructive comments, and helped with the resolution process.

Respectfully submitted,
Steven L. Snyder, WG Chair C57.12.00
November 17, 2021

L.3.2 WG Standard Terminal Markings and Connections for Transformers C57.12.70

WG on C57.12.70 did not meet during Fall 21 TF Meeting.

L.3.3 WG Standard Transformer Terminology for Transformers C57.12.80

L.3.3.1 2021 Sep 13th Meeting

Document #:	**C57.12.80**		
Document Title:	**Standard Terminology for Distribution and Power Transformers**		
Chair:	**James Graham**	**Vice-Chair**	**Open**
Secretary	**Shankar Nambi (acting)**		
Current Draft Being Worked On:	**1.0**	**Dated:**	**NA**
Meeting Date:	**2021-09-13**	**Time:**	**9:00 AM**

Attendance:	**Members**	**11**
	Guests:	**12**
	Total	**23**

Meeting Minutes / Significant Issues / Comments:

The Chair opened the meeting at 9:00 a.m. (Central) on Monday 13 September, 2021.

1) Quorum Check
   Quorum was achieved with 11 of 14 members present. 12 non-voting participants also attended. No new members have been added, and one member was dropped since the last meeting.
2) Approval of the Agenda
   The agenda was approved as presented with no objections.
3) Approval of the Fall 2020 minutes
   A reference to one member in the minutes was corrected. The revised April 2021 meeting minutes were approved unanimously.
4) Call for Essential Patents
   A call for essential patents was made. No essential patent issues were reported.
5) Copyright policy
   The IEEE copyright policy was briefly reviewed.
6) Unfinished Business

a) Core Form and Shell form definitions

The chair of the task force assigned to develop revised definitions for core form and shell form transformers gave a status report. Task force consensus was reached on revised definitions, and recommended revised definitions were presented to the working group. A motion was made by Dan Sauer to accept the task force recommendations, seconded by Kyle Heiden. After a lengthy discussion, the question was called, and the motion failed. Points of contention included the definition did not align with 7-leg shell form construction and 5-leg construction which appears to be shell construction but is widely referred to as a core construction.

Further work is needed. Jeff Wright made a motion authorize the task force to continue their work and consider adding illustrations of various core types, seconded by Kris Zibert. The motion passed with no objections.

Jeff Wright volunteered to consult with Ramsis Girgis, a recognized subject matter expert related to core construction & performance, for additional input.

b) GSU transformer definition

This was not discussed and is a closed item.

Transformer Class Designations

A request was received to consider creating definitions of Class 1 transformers to clarify the difference between distribution transformers and Class I (small power) transformers. There was no support within working group to create transformer class definitions. This is a closed item.

c) Insulating Fluids definitions

This item was tabled due to a lack of time for discussion.

7) New Business

a) Shankar Nambi will provide definitions from C57.100 and 1276 that Rick Marek has proposed to migrate to C57.12.80. It was discussed that definitions can reside in both C57.12.80 and IEEE 1276, although it is preferred to have them in only one place.
b) Power Transformers definitions review – no update was provided
c) A proposed definition for stray gassing will be developed
d) Rick Marek offered to help with definition of thermally upgraded paper along with Tom Prevost. They will coordinate with Shankar Nambi.
e) Standards Review – Volunteers
Volunteers still needed to review standards from the Bushings, Dielectric Test, Distribution, Instrument Transformers, and Performance Characteristics Subcommittees.

8) The meeting was adjourned at 10:35 a.m. (Central)

Next meeting –November 2021 via Webex

Submitted by: Jim Graham, Chair

Meeting Attendance List

Role	Last Name	First Name	Affiliation	2021-09-13
Chair	Graham	James	Weidmann Electrical Technology	X
Secretary	vonGemmingen	Richard	Dominion Energy	
Member	Betancourt	Enrique	Prolec GE	
Member	Heiden	Kyle	EATON Corporation	X
Member	Hoffman	Gary	Advanced Power Technologies	X
Member	Li	Weijun	Braintree Electric Light Dept.	X
Member	Mai	Tim-Felix	Siemens Energy	X
Member	Matthews	Lee	Howard Industries	X
Member	Murphy	Jerry	Reedy Creek Energy Services	
Member	Musgrove	Ryan	Oklahoma Gas & Electric	X
Member	Nambi	Shankar	Bechtel	X
Member	Sauer	Daniel	EATON Corporation	X
Member	Wright	Jeffrey	Duquesne Light Co.	X
Member	Zibert	Kris	Allgeier, Martin and Associates	X

Role	Last Name	First Name	Company	2021-09-13
Guest	Cruz Valdes	Juan Carlos	Prolec GE	X
Guest	Gonzalez	Luis	Canduct Industries Limited	X
Guest	Hogg	Ryan	Bureau of Reclamation	X
Guest	Karas	Jon	SDMyers, LLC.	X
Guest	Macias	Alejandro	CenterPoint Energy	X
Guest	Marek	Richard	Retired	X
Guest	Montpool	Rhea	Schneider Electric	X
Guest	Portillo	Homero	Advanced Power Technologies	X
Guest	Shingari	Avijit	Pepco Holdings Inc.	X
Guest	Washburn	Alan	Burns & McDonnell	X
Guest	Webb	Matthew	SPX Transformer Solutions, Inc.	X
Guest	Zaman	Malia	IEEE	X

L.3.3.1 2021 Nov 15th Meeting

Document #:	**C57.12.80**
Document Title:	**Standard Terminology for Distribution and Power Transformers**

Chair:	**James Graham**	**Vice-Chair**	**Open**
Secretary	**Richard vonGemmingen)**		

Current Draft Being Worked On:	**1.0**	**Dated:**	**NA**
Meeting Date:	**2021-11-15**	**Time:**	**9:25 AM – 11:40 AM**

Attendance:	**Members**	**14**
	Guests:	**31**
	Total	**45**

Meeting Minutes / Significant Issues / Comments:

The Chair opened the meeting at 9:25 a.m. (Central) on Monday 15 November, 2021.

9) Quorum Check
Quorum was achieved with 14 of 14 members present. 31 non-voting participants also attended. No new members have been added.

10) Approval of the Agenda
A motion proposed by Dan Sauer, seconded by Lee Matthews, to approve the agenda as presented passed unanimously.

11) Approval of the Fall 2020 minutes
A motion proposed by Lee Matthews, seconded by Jerry Murphy, to approve the 13 September 2021 meeting minutes passed unanimously.

12) Call for Essential Patents
A call for essential patents was made. No essential patent issues were reported.

13) Copyright policy
The IEEE copyright policy was briefly reviewed.

14) Unfinished Business
a) Core Form and Shell form definitions
Task force chair Dan Saur reported the task force met several times but could not reach a consensus on revised definitions of core-form and shell-form construction. Distribution transformer core construction variations proved to be difficult to quantify as core or shell type. The task force made the following recommendations:
i. Keep the existing definitions of core form transformer and shell form transformer as is.
ii. Send a suggestion to PCS Continuous Revisions to C57.12.00 to include type of core construction and number of limbs (legs) to Type C transformer nameplates.

iii. Send a suggestion to WG PC57.105 to include core construction sketches in that document

A motion made by Dan Saur, seconded by Jerry Murphy, to accept the taskforce recommendations passed unanimously.

Thermally Upgraded Paper definition

A proposed definition of thermally upgraded paper was reviewed. After a thorough discussion a motion was made by Shankar Nambi to accept the following definition of thermally upgraded paper, seconded by Ryan Musgrove. The motion passed unanimously.

thermally upgraded paper:

Cellulose based paper that has been chemically modified to reduce the rate at which the paper decomposes. Ageing effects are reduced either by partial elimination of water forming agents (as in cyanoethylation) or by inhibiting the formation of water through the use of stabilizing agents (as in amine addition with dicyandiamide).

A paper is considered to be thermally upgraded if:

1. When tested in accordance with IEEE C57.100, Annex H, "Standard Test Procedure for Qualification of Thermally Upgraded Kraft Paper," it retains a minimum of 50% of initial tensile strength for a time/temperature combination given by the equation:
   $\text{Time (h)} = e^{(15{,}000/(T+273)-28.082)}$ Where: T = test temperature in °C,
2. The unused paper has a minimum nitrogen content of 1.3 %,
3. The paper retains a minimum of 50% of initial nitrogen content after performing the IEEE C57.100, Annex H test.

Note 1 - A typical test time/temperature combination is 476 hours at 165 °C

Note 2 - The criterion to retain 50% tensile strength should be considered only as a qualification criterion to determine if a kraft paper can be considered thermally upgraded. The actual expected life of the paper in equipment is longer than given by the formula. Decades of operating equipment manufactured using the Industry Proven System (IPS) including thermally upgraded kraft paper, cellulose pressboard, Polyvinyl Formal (PVF) coated magnet wire, and mineral oil, has shown that a minimum life expectancy of at least 180 000 hours may be assumed, if the hottest-spot temperature of 110 °C, at rated load as defined in IEEE Std C57.12.00 or IEC 60076-1, is maintained.

Note 3 - Because the thermal upgrading chemicals used today contain nitrogen, which is not present in kraft pulp, the degree of chemical modification is determined by testing for the amount of nitrogen present in the treated paper in accordance with ASTM D-982.

b) Insulation Life Definitions

Several definitions of conventional and high temperature insulation from IEEE Std 1276 and C57.154 were proposed for consideration. These definitions were determined to be too vague when taken of context of the source standards. A motion made by Jerry Murphy, seconded by Jeff Wright, was made to leave these definitions out of PC57.12.80. The motion passed unanimously.

c) Insulating Fluids definitions

Proposed definitions from Insulating Fluids standards previously shared with the working group were discussed. Due to limited time remaining in the PAR, it was noted we may not have time to properly review these definitions. A motion was made by Dan Sauer, seconded by Jerry Murphy,

to table consideration of these definitions until the next revision cycle. The motion passed unanimously.

d) Stray Gassing Definition

A proposed definition of stray gassing with some background was presented. It was noted the term "Stray Gassing" traditionally applied to unexplained generation of hydrogen and hydrocarbon fault gassing but was becoming extended to CO and CO2 and other gasses. This item was tabled until the next meeting due to insufficient time to complete the review.

15) New Business

The PAR for PC57.12.80 expires in December 2021. A PAR extension was submitted and will be considered at the December NesCom meeting.

16) The meeting was adjourned at 11:45 a.m. (Central)

Next meeting –January 2022 via Webex, pending approval of a PAR extension

Submitted by: Jim Graham, Chair

Date: 11/15/2021

WG C57.12.80 Meeting Attendance List

Role	Last Name	First Name	Company	4/26/2021
Chair	Graham	James	Weidmann Electrical Technology	X
Member	Betancourt	Enrique	Prolec GE	X
Member	Heiden	Kyle	EATON Corporation	X
Member	Hoffman	Gary	Advanced Power Technologies	X
Member	Li	Weijun	Braintree Electric Light Dept.	X
Member	Mai	Tim-Felix	Siemens Energy	X
Member	Matthews	Lee	Howard Industries	X
Member	Murphy	Jerry	Reedy Creek Energy Services	X
Member	Musgrove	Ryan	Oklahoma Gas & Electric	X
Member	Nambi	Shankar	Bechtel	X
Member	Sauer	Daniel	EATON Corporation	X
Member	Wright	Jeffrey	Duquesne Light Co.	X
Member	Zibert	Kris	Allgeier, Martin and Associates	X
			Members attending	13

Role	Last Name	First Name	Company	4/26/2021
Guest	Bernesjo	Mats	Hitachi ABB Power Grids	X
Guest	Clift	Bobby	Xcel Energy	X
Guest	Cruz Valdes	Juan Carlos	Prolec GE	X
Guest	Ferreira	Marcos	Beale AFB	X
Guest	Gonzalez	Luis	Canduct Industries Limited	X
Guest	Herron	John	Raytech USA	X
Guest	Issack	Ramadan	American Electric Power	X
Guest	McNelly	Susan	Xcel Energy	X
Guest	Shingari	Avijit	Pepco Holdings Inc.	X
Guest	Shukla	Kunal	PECO Energy Company	X
Guest	Webb	Matthew	SPX Transformer Solutions, Inc.	X
Guest	Zaman	Malia	IEEE	X
			Nonvoting attendees	12

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
Fall 2021, Nov 17, 2021

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.

Currently there are five 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: Pierre Riffon
4. Dielectric Test – Cont Rev to LowFrequency Tests Clause 10, TF Chair: Bill Griesacker
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, TF Chair: Dinesh Sankarakurup

SUMMARY

PC57.12.90 was approved as a revised standard by the IEEE SA Standards Board on November 9, 2021. The new version will be C57.12.90-2021. The title is unchanged. It is expected to be published in a month or two; probably will be early in 2022.

The revisions can be found in the Introduction and are as follows:

7. Implemented corrigendum C57.12.90-2015/Cor 1-2017, to correct an editorial mistake of the constant k in the definitions for Equation (2) in 8.3, and in 10.8.2 the terminal voltage was changed from 115 kV to 69 kV to reflect the new definition (in 2015) of Class II transformers.
8. Subclause 5.4.1. Added requirement for line-to-gnd resistance measurement on wye windings.
9. Subclause 9.3.1. Added text for an alternate method for measuring load loss and impedance, and a new Figure 19. All figures after this in the document are renumbered accordingly.
10. Subclause 10.2.4. Added text regarding tap connection during switching impulse test.
11. Subclause 10.3.1 & 10.3.1.1. Added text regarding impulse waveshape & front-time of full wave.
12. Subclause 10.3.1.3. Added text regarding steepness of voltage collapse for chopped-wave test.

13. Subclause 10.3.2.1. Added text regarding connection of tertiary terminals during impulse test.
14. Subclause 10.7.7. Inserted a new procedure for a special induced test to detect improper core grounding of wound cores, for distribution transformers and Class I power transformers. This is to coincide with a new requirement in IEEE Std C57.12.00-2021, Subclause 6.7.2.1 & Table 17.
15. Subclause 10.8.1. Added text regarding tap connection during induced voltage test. Also, added Annex D with more information on this subject. The plan is to transfer the Annex and possibly parts of the subclause text into a future guide on low frequency testing, currently in development.
16. Subclause 10.8.2. Added requirement that overpressure is not allowed during induced test.
17. Subclause 10.8.5. Decreased partial discharge failure detection limits: 500 to 250; 150 to 50 pC.
18. Subclause 11.1.2.2 e). Added text to allow subsequent gradient runs of 30 min, instead of 60.
19. Subclause 11.4.3. Change (editorial) from 3280 to 3300 feet as 1000 m equivalent. This is to coordinate with altitude corrections used here and in other IEEE documents such as IEEE Std C57.12.00 and IEEE Std C57.91.

- #2 & 3 came from Performance Characteristics Subcommittee; Mark Perkins/Hakan Sahin Task Force on Resistance, LL & Impedance.
- 4,5,6,7 came from Ajith Varghese's Dielectric Test Subcommittee; Pierre Riffon Task Force on Impulse.
- 8,9,10,11 came from Ajith Varghese's Dielectric Test Subcommittee; Bertrand Poulin/Bill Griesacker Task Force on Induced test.
- #12 came from Insulation Life Subcommittee; Ajith Varghese Task Force on Temperature Test.
- 1 & 13 came from Stephen Antosz WG in the Standards Subcommittee.

Once the new document is published, we will have to immediately request a new PAR.

The work already continues, for a next revision in 5 years or so …

FUTURE REVISIONS AND PENDING WORK

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.

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, and there are no changes to the text.

      The existing 7.3.2 Comparison method should be renumbered to be 7.3.3, and there are no changes to the text or the 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.*

      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.
      Proposed 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. *Load Tap Changer performance test with rated voltage. New subclause 8.7.*

      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.*

d. *Load Tap Changer performance test with rated current. New subclause 9.6.*

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.*

e. *Number of short-circuit tests under subclause 12.3.4.*

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.

Proposed 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.*

All of these above items have been approved in Hakan's Task Force on Tues Nov 16, 2021. They have been passed up to the Performance Characteristics Subcommittee and await the subcommittee's survey and approval.

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. 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 will be:

   10.10.2 Instrumentation

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

   The accuracy of measurement should be as follows:
   - *for PF<1% , +/-2% of reading +/-0.05% absolute*
   - *for PF>1% , +/-5% of reading +/-0.05% absolute*

   I AM NOT SURE OF THE EXACT TEXT NOR THE EXACT CHANGES. NEED TO GET IT FROM DIEGO ROBALINO. STEVE Nov 2021

3. *Other ?*

PENDING WORK

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

1. *Possible revisions from Hakan Sahin's PCS TF for Revision of C57.12.90.*
2. *Possible changes to Clause 13 sound test from Ramsis' TF.*
3. *Possible changes to Subclause 10.2 or 10.3 from Pierre Riffon's TF regarding switching and lightning impulse tests.*
4. Other possible revisions to subclauses 10.5 to 10.10 from Bill Griesacker's TF for revision of low frequency tests. Ongoing work continues.
   - Revision to PD test procedure for Class II
   - Class I transformer PD test revision to the test procedure
   - Clarification of measuring voltage during low frequency tests
   - Venting bushings during PD test,
5. Possible changes to subclauses 10.10 and 10.11 from Diego Robalino's TF regarding insulation power factor and insulation resistance.
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.

- 11.1.2.2.c and 11.3.2. Defining the top oil rise as the last reading at the end of the stabilization period of the total loss run, not an average.
- Possible revision to 11.4.1 and 11.4.2, regarding K and L type insulating fluids for temperature rise test corrections.
- Request for clarification for temp test of 3-winding transformers

Respectfully submitted,
Stephen Antosz, WG Chair
Nov 17, 2021

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

November 15, 2021, 12:55PM – 2:10PM, CT
Virtual meeting
UNAPPROVED MINUTES

Welcome

The chair, Marcos Ferreira, opened the meeting at 12:55PM.

1. **Attendance and Attendance for Quorum**

At the time of the meeting there are 47 Members, including Chair, Vice Chair and Secretary. The poll registered 91 participants, where 28 Members, 44 non-members, and 4 guests with unknown status. No answer from 15.

27 members present of 47 mean requirements for quorum was fulfilled. Further analysis of attendance information shows that 34 members were present, and that not all responded to the poll. The list of attendees is shown below:

Name	Affiliation	Status
Ferreira, Marcos	Beale AFB	Chair
Werelius, Peter	Megger	Vice chair
Milojevic, Goran	DV Power	Secretary
Binder, Wallace	WBBinder Consultant	Member
Colopy, Craig	EATON Corporation	Member
Dorris, Don	Nashville Electric Service	Member
Dutta Roy, Samragni	Siemens Energy	Member
Foata, Mark	Maschinenfabrik Reinhausen	Member
Gara, Lorne	Shermco Industries	Member
Guner, Ismail	Hydro-Quebec	Member
Gustavsson, Niklas	Hitachi Energy	Member
Harley, John	FirstPower Group LLC	Member
Hayes, Roger	General Electric	Member
Heiden, Kyle	EATON Corporation	Member
Hemchandra, Shertukde	University of Hartford	Member
Herron, John	Raytech USA	Member
Kraemer, Axel	Maschinenfabrik Reinhausen	Member
Lejay, Olivier	Huaming USA Corp.	Member
Locarno, Mario	Doble Engineering	Member

Mayer, Robert	Siemens Energy	Member
McNelly, Susan	Xcel Energy	Member
Murray, David	Tennessee Valley Authority	Member
Musgrove, Ryan	OG&E	Member
Plath, Cornelius	OMICRON Energy Solutions GmbH	Member
Pugal, Selvaraj	Virginia Transformer Corp.	Member
Reed, Scott	MVA	Member
Robalino, Diego	Megger USA	Member
Saad, Mickel	Hitachi Energy	Member
Sweetser, Charles	OMICRON electronics Corp USA	Member
Tanaka, Troy	Burns & McDonnell	Member
teNyenhuis, Ed	Hitachi Energy	Member
Verdolin, Rogerio	Verdolin Solutions Inc.	Member
Walia, Sukhdev	New Energy Power LLC	Member
Welton, Drew	Intellirent	Member
Aldenlid, Jennie	Hitachi Energy	Guest
Benzler, Olle	Megger	Guest
Boettger, William	Boettger Transformer Consulting LLC	Guest
Bolar, Sanket	Megger	Guest
Boman, Paul	Hartford Steam Boiler	Guest
Bradshaw, Jeremiah	US Bureau of Reclamation	Guest
Burde, Jagdish	Virginia Transformer Corp.	Guest
Christodoulou, Larry	Electric Power Systems	Guest
Clark, Cloin	AltaLink	Guest
Davis, Eric	Burns & McDonnell	Guest
Elliot, Will	Prolec - GE	Guest
Ellis, Wayne	Memphis Light, Gas and Water	Guest
Ermakov, Evgenii	Hitachi Energy	Guest
Forsyth, Bruce	Bruce Forsyth and Associates PLLC	Guest
Frotscher, Rainer	Maschinenfabrik Reinhausen	Guest
Garcia, Eduardo	Siemens Energy	Guest
Gardner, James	SPX Transformer Solutions	Guest
Graham, James	Weidmann Electrical Technology	Guest
Harper, Robert	Soltex	Guest
Hernandez, Ronald	Doble Engineering	Guest
Hoffman, Gary	Advanced Power Technologies	Guest
Hoffman, Saramma	PPL Electric Utilities	Guest
Hogg, Ryan	US Bureau of Reclamation	Guest
Johnson, Toby	Hunt Electric	Guest
Kadar, Laszlo	Hatch	Guest
Kennedy, Gael R.	GR Kennedy & Associates LLC	Guest
Lamontaigne, Don	Arizona Public Service	Guest
Mangubat, Darrel	Siemens Energy	Guest
McBride, Jim	JMX High Voltage	Guest
Millard, Zack	Great River Energy	Guest
Miller, Phillip	Memphis Light, Gas and Water	Guest

Moleski, Hali	SDMyers, LLC	Guest
Mudryk, Anatoliy	Camlin	Guest
Nield, Kris	Megger	Guest
Niroula, Ashmita	Ergon	Guest
Panesar, Parminder	Virginia Transformer Corp.	Guest
Patel, Rakesh	Hitachi Energy	Guest
Pattabi, Pranav Ketharam	Metsco Energy Solutions	Guest
Peterson, Tim	Nomos Systems	Guest
Pinard, Matthew	Weidmann Electrical Technology Inc.	Guest
Poelma, John	NRG	Guest
Polson, Adam	Arizona Public Service	Guest
Portillo, Alvaro		Guest
Pruente, John	SPX Transformer Solutions	Guest
Rackley, Donnie	RESA Power	Guest
Reagan, John	University of Arizona, Tucson	Guest
Reimer, Jonathan	Fortis BC	Guest
Rock, Patrick	American Transmission Company	Guest
Roizman, Oleg	IntellPower	Guest
Schrom, Wes	Carolina Dielectric Co	Guest
Sharma, Devki	Entergy	Guest
Sinclair, Jonathan	PPL Electric Utilities	Guest
Strongosky, Neil	Memphis Light, Gas and Water	Guest
Tolcachir, Eduardo	Tubos Trans Electric	Guest
Van der Walt, Alwyn	Electrical Consultants, Inc.	Guest
Vermette, Yves	Hubbell	Guest
Wagner, Dieter	Hydro One	Guest
Washburn, Alan	Burns & McDonnell	Guest
Weatherbee, Eric	Hubbell	Guest
Whitehead, Bill	H2scan Corporation	Guest
Zaman, Malia	IEEE SA	Guest
Zemanovic, Kyle	EATON Corporation	Guest
Zhang, Shibao	PCORE Electric	Guest
Zhao, Peter	Hydro One	Guest
Ziebert, Kris	Allgeier Martin	Guest

2. Approval of Agenda

After a motion by Drew Welton, and seconded by Wallace Binder, the group unanimously approved the agenda.

3. Approval of Minutes of Meeting from Spring 2021

After a motion by Shertukde Hemchandra, and seconded by Dave Murray, the group unanimously approved Meeting from Spring 2021.

4. Call for Patents

The chair presented slide 1-4, dated January 2, 2018 informing 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

"Welcome to the STD. WG C57.152 to work on revision. This is the third virtual meeting and we are going to try to provide the latest on working progress of each task force**."**

"We hope this meeting we can have some discussed among the attendees (members and guests) so we can keep progressing to complete the task of the new revision for the document."

7. Task Forces Working Progress Report

TF-1: Section 7.2 – Main Tank Volunteers
Charles Sweetser (team leader)

The work of the Task Force 1 on the revisions of the Section 7.2 has been completed prior to the Spring 2021 meeting, and the comments have been submitted to the members of WG to vote on whether they will be included. A total of 30 comments out of 130 were selected. Due to insufficient number of votes (only 15 out of 47 members voted to accept), the vote was inconclusive.

The poll will be re-submitted by the WG officers to the members for another vote, together with the comments. Members who already voted in the previous poll do not need to do so again.

TF2: Section 7.3 – Bushings Volunteers
Mario Locarno (team leader)

Mario briefly described the work on the section. The previously proposed material on DFR test was included in this section instead of a separate annex. The section is close to completion, and after remaining minor edits, Mario will submit his work to the WG officers, who will send it to the rest of the WG members for review and vote.

TF3: Section 7.4 – Tap Changers Volunteers
Marcos Ferreira (team leader)

Marcos briefly described the work on the section. Previously proposed additions about the LTC reactors and series transformer devices will not be included in the current revision due to lack of volunteers and limited time remaining. This section is also close to completion, and after remaining minor edits, Marcos will send it to the rest of the WG members for review and vote.

TF4: New Annexes: Dynamic Resistance and Vibroacoustic Measurements
Goran Milojevic

Goran briefly described the work on the two Annexes. Some minor work and revision remain, and the proposed text of the annexes will be sent to the WG members for review and vote by the end of December.

8. Old Business Related to the Work that Has Been Done So Far

Due to need to finalize the work of the WG and the limited time remaining, the chair Marcos Ferreira proposed that new annexes that were proposed at the previous meeting will not be added within the current revision, and that the efforts should be made to finalize the work already started during next year.

Wallace Binder repeated his earlier proposal of addition of column with recommended tests after transportation of power transformers to Table 1 in Section 5.1. A discussion was held on this point, in which Marcos Ferreira, Mario Locarno, Don Dorris and Susan McNelly took part. It was proposed that dew point test should be added to the list. The conclusion of the discussion was that Wallace Binder will take responsibility to run a Task Force (TF-5) among help from Marcos Ferreira and Mario Locarno to review the proposal made by Wallace and determine if the changes can be made within the limited time remaining and finalize by the Spring 2022 Meetings

Goran Milojevic mentioned proposed additions to Section 8 by Sanket Bolar, who responded to a call for volunteers made at the previous meeting and asked for Sanket's permission to send the comments to the rest of the WG for comments. Sanket granted the permission.

9. Meeting Adjournment

A motion to adjourn the meeting was raised by Wallace Binder and seconded by Diego Robalino. The meeting adjourned at 2:05PM

Respectfully submitted,

Marcos Ferreira – Chair Peter Werelius – Vice Chair Goran Milojevic – Secretary

L.3.6 WG PC57.163 IEEE Guide for Establishing Power Transformer Capability while under Geomagnetic Disturbances

PC57.163 - WG for the Revision of IEEE Guide for Establishing Power Transformer Capability while under Geomagnetic Disturbances

2:20 PM to 3:35 PM Central, November 16, 2021 (Virtual Session)

Unapproved Meeting Minutes

The WG Chair Dan Blaydon presided over this virtual WG meeting with both the Vice-Chair, Ramsis Girgis, and Secretary, Scott Digby, in attendance. This was the third meeting of this Working Group, all of which have been in virtual format. Meeting attendance numbers as derived from the electronic meeting records are as follows:

Total Attendance	80
Members in Attendance	40 (out of 65 members, **quorum achieved**)
Guests in Attendance	40
Guests Requesting Membership	1

Guests Requesting Membership (attendance at 2 out of 3 meetings required to qualify for membership):

	Membership Granted? (effective after this meeting)
Bill Griesacker	Yes

Participants were advised that membership requests could be made via email requests from attendees to the WG Chair.
The requisite patent and IEEE-SA copyright policy slides were reviewed, with no items noted. The agenda was reviewed by the Chair, with no changes requested by attendees. The agenda was approved by unanimous consent. The minutes from the Spring-2021 meeting had been circulated prior to the meeting. There were no changes to the Spring-2021 meeting minutes requested. The minutes were approved by unanimous consent. The project milestones were reviewed, with key dates being the PAR expiration date of December-2024 and the published document's expiration date of December-2025.
The Chair reviewed the project milestones, noting that the objective was to have the document ready for balloting by the end of 2023, with the PAR expiring December-2024. The current document expires December-2025.
Activity since last meeting and status was reviewed. Since last meeting in the Spring, the proposed revisions and restructuring discussed during the Spring WG meeting had been incorporated into a Draft (D1) of the document, which had been circulated to the WG for review and comment. Comments received thus far have been compiled into a spreadsheet for tracking and communication purposes, including proposed disposition/resolution of each. It was reported that the WG officers had worked prior to this WG meeting to propose disposition of most of the comments. This tracking spreadsheet was shared with the WG prior to the meeting and members were asked to review and advise if there was any disagreement with the proposed dispositions. Some comments were identified as needing discussion at the WG meeting, so the remaining time was spent discussing those comments.
There had been a comment asking if the document should include guidance for shunt and series reactors. As these devices are not covered in the current scope of the document doing so would require a PAR revision. After some discussion, which noted that the effect of GIC on such devices is so different from power transformers, the effect is an order of magnitude less, and that if necessary at all the information might be better suited in other documents, such as C57.21, the consensus was to not pursue this within this WG.
Five comments that had been received concerned Section 10, which covers GIC monitoring. It was noted that C57.143 (the Monitoring Guide) is currently in a revision cycle. There were several members of that activity present who advised that that document was nearing completion and that it only had a brief, high-level section on GIC monitoring, which essentially just directed readers to C57.163. So, it was agreed that the content is best kept in this GMD Guide, C57.163. Gary Hoffman volunteered to review comments concerning this section and recommend changes, with Joe Watson agreeing to work with him on this. The Chair requested that individuals contact the Chair or Gary Hoffman if they are interested in working on this Clause.
There were a couple of comments concerning the need to include definitions of I_H and I_N to ensure proper interpretation. It had been initially thought that the terms were already defined in other industry documents. WG member Afshin Rezaei-Zare and WG Vice-Chair Ramsis Girgis agreed the review and further discuss disposition outside the meeting to make a recommendation to the WG.

Another review comment is requesting text be added concerning Figure 8 to clarify that the magnitude of the magnetizing current in Amps, which is the y-axis of the Figure, is independent of the transformer MVA was discussed. During discussion it was noted that the Figure was just an example to illustrate the basic concept and that every transformer will have its own curve. WG Member Afshin Rezaei-Zare agreed to submit some proposed text to provide the desired clarification for consideration by the WG.

The last review comment discussed was about whether there should be text added to cite and refer to a specific modeling technique that is the subject of a published paper on a method of calculating temperature rises due to GIC. Several participants, which included manufacturers that perform such analysis, noted that there are other models and techniques being used, that in general each manufacturer tended to have their own models, and that they can be very different from each other. It was indicated that manufacturers don't typically publish the methods they use. The conclusion of the discussion was that the document should not refer to or endorse a specific modelling technique, but that the published paper that was indicated, as well as other published papers in the area, will be added to the document's bibliography.

As next steps, the changes indicated in the tracking spreadsheet are in the process of being incorporated into a new Draft, which, after receiving the additional inputs discussed during the WG meeting, would be prepared and posted for review and comment by the WG.

There were no Old Business items to address and there were no New Business items raised.

The next planned meeting of the WG will be during the Spring-2021 Transformers Committee meetings, scheduled to be held in Denver, CO.

The meeting adjourned at 3:29 pm central time, a few minutes ahead of its scheduled ending time of 3:35 pm central time.

Respectfully Submitted,

Scott Digby, WG Secretary

Role	First Name	Last Name	Affiliation
Chair	Daniel	Blaydon	Baltimore Gas & Electric
Vice-Chair	Ramsis	Girgis	Hitachi ABB Power Grids
Secretary	Scott	Digby	Duke Energy
Member	Suresh	Babanna	SPX Transformer Solutions, Inc.
Member	Mats	Bernesjo	Hitachi Energy
Member	William	Boettger	Boettger Transformer Consulting LLC
Member	Muhammad Ali Masood	Cheema	Northern Transformer
Member	Hakim	Dulac	Qualitrol Company LLC
Member	Norman	Field	Stantec
Member	Bruce	Forsyth	Bruce Forsyth and Associates PLLC
Member	Anthony	Franchitti	PECO Energy Company
Member	Gary	Hoffman	Advanced Power Technologies
Member	Saramma	Hoffman	PPL Electric Utilities
Member	Kurt	Kaineder	Siemens Energy
Member	Stacey	Kessler	TC Energy
Member	Zan	Kiparizoski	Howard Industries
Member	Dmitriy	Klempner	Southern California Edison
Member	Balakrishnan	Mani	Virginia Transformer Corp.
Member	Martin	Munoz Molina	Orto de Mexico
Member	Ali	Naderian	METSCO Energy Solutions Inc.
Member	Anastasia	O'Malley	Consolidated Edison Co. of NY
Member	Patrick	Picher	Hydro-Quebec IREQ
Member	Ion	Radu	Hitachi Energy
Member	Afshin	Rezaei-Zare	York University
Member	Hakan	Sahin	Virginia/Georgia Transformer
Member	Steven	Schappell	SPX Transformer Solutions, Inc.
Member	Markus	Schiessl	SGB
Member	Eric	Schleismann	Southern Company Services
Member	Hemchandra	Shertukde	University of Hartford
Member	Marc	Taylor	JFE Shoji Power Canada Inc.
Member	Mark	Tostrud	Dynamic Ratings, Inc.
Member	Jason	Varnell	Doble Engineering Co.
Member	Kiran	Vedante	Ritz Instrument Transformers
Member	Rogerio	Verdolin	Verdolin Solutions Inc.
Member	David	Wallach	Duke Energy
Member	Joe	Watson	JD Watson and Associates Inc.
Member	Daniel	Weyer	Nebraska Public Power District

Member	William	Whitehead	H2scan Corporation
Member	Trenton	Williams	Advanced Power Technologies
Member	Waldemar	Ziomek	PTI Transformers
Guest	Kayland	Adams	SPX Transformer Solutions, Inc.
Guest	Edmundo	Arevalo	Bonneville Power Administration
Guest	Gilles	Bargone	FISO Technologies Inc.
Guest	Thomas	Blackburn	Gene Blackburn Engineering
Guest	Steven	Brzoznowski	Bonneville Power Administration
Guest	Colin	Clark	AltaLink
Guest	John	Crouse	Roswell Alliance
Guest	Roger	Fenton	Fenton Solutions
Guest	Eduardo	Garcia Wild	Siemens Energy
Guest	Shawn	Gossett	Ameren
Guest	Bill	Griesacker	Duquesne Light Co.
Guest	Thomas	Hartmann	Pepco Holdings Inc.
Guest	Paul	Jarman	University of Manchester
Guest	Nicholas	Jensen	Delta Star Inc.
Guest	Toby	Johnson	Hunt Electric
Guest	Nathan	Katz	PacifiCorp
Guest	Gael	Kennedy	GR Kennedy & Associates LLC
Guest	Anton	Koshel	Delta Star Inc.
Guest	Axel	Kraemer	Maschinenfabrik Reinhausen
Guest	John	Lackey	PowerNex Associates Inc.
Guest	Donald	Lamontagne	Arizona Public Service Co.
Guest	Lee	Matthews	Howard Industries
Guest	Susan	McNelly	Xcel Energy
Guest	Rashed	Minhaz	Transformer Consulting Services Inc.
Guest	Brady	Nesvold	Xcel Energy
Guest	Sanjay	Patel	Smit Transformer
Guest	Pranav	Pattabi	METSCO Energy Solutions Inc.
Guest	Matthew	Pinard	Weidmann Electrical Technology
Guest	John	Poelma	NRG Energy
Guest	Tim	Rocque	SPX Transformer Solutions, Inc.
Guest	Sanjib	Som	Pennsylvania Transformer
Guest	Brad	Staley	Salt River Project
Guest	Kerwin	Stretch	Siemens Energy
Guest	Troy	Tanaka	Burns & McDonnell
Guest	Reza	Torabi Goodarzi	SMIT Transformatoren B.V.
Guest	Loren	Wagenaar	WagenTrans Consulting
Guest	Michael	Warntjes	American Transmission Co.
Guest	Alan	Washburn	Burns & McDonnell
Guest	Bruce	Webb	Knoxville Utilities Board
Guest	Jeffrey	Wright	Duquesne Light Co.

L.3.7 IEEE / IEC Continuous Cross Reference

TF did not meet during Fall 2021 Transformer Committee.

L.4 Old Business

There was no old business to discuss.

L.5 New Business

Under New business, Chair communicated that transformer committee is working to setup a digital format of relevant standard and would like to get feedback if there are any specific standards or guides that should be included.

L.6 Adjournment

The meeting was adjourned by a motion made by Sanjib Som at 4:45 PM CST. The second was by Rogerio Verdolin, and was carried unanimously.

Respectfully submitted,
Ajith M. Varghese
Standards SC Secretary

Standards SC S21 Attendances List

Role	First Name	Last Name	Company
Chair	Daniel	Sauer	EATON Corporation
Vice-Chair	Marcos	Ferreira	Beale AFB
Secretary	Ajith	Varghese	SPX Transformer Solutions, Inc.
Member	Jerry	Murphy	Reedy Creek Energy Services
Member	Susan	McNelly	Xcel Energy
Member	Bruce	Forsyth	Bruce Forsyth and Associates LLC
Member	Bill	Griesacker	Duquesne Light Co.
Member	Eduardo	Garcia Wild	Siemens Energy
Member	Steven	Snyder	Hitachi ABB Power Grids
Member	Ed	teNyenhuis	Hitachi ABB Power Grids
Member	Ramsis	Girgis	Hitachi ABB Power Grids
Member	Peter	Zhao	Hydro One
Member	Vinay	Mehrotra	SPX Transformer Solutions, Inc.
Member	Rogerio	Verdolin	Verdolin Solutions Inc.
Member	Hemchandra	Shertukde	University of Hartford
Member	Scott	Digby	Duke Energy
Member	Stephen	Shull	BBC Electrical Services, Inc.
Member	James	Graham	Weidmann Electrical Technology
Member	Dharam	Vir	SPX Transformer Solutions, Inc.
Member	Tauhid Haque	Ansari	Hitachi ABB Power Grids
Member	Daniel	Blaydon	Baltimore Gas & Electric
Member	Robert	Ballard	DuPont
Member	Baitun	Yang	R.E. Uptegraff
Member	Shankar	Nambi	Bechtel
Member	Rob	Ghosh	General Electric
Member	Sukhdev	Walia	New Energy Power Co.
Member	Weijun	Li	Braintree Electric Light Dept.
Member	John	John	Virginia Transformer Corp.
Member	Jarrod	Prince	ERMCO
Member	Kristopher	Neild	Megger
Member	Jason	Varnell	Doble Engineering Co.
Member	Thomas	Dauzat	General Electric
Member	Kris	Zibert	Allgeier, Martin and Associates
Member	Tim-Felix	Mai	Siemens Energy
Member	Joshua	Yun	Virginia Transformer Corporation
Member	Mickel	Saad	Hitachi ABB Power Grids
Member	Joseph	Tedesco	Hitachi ABB Power Grids
Member	Gilles	Bargone	FISO Technologies Inc.
Member	Ramadan	Issack	American Electric Power
Guest	William	Boettger	Boettger Transformer Consulting LLC
Guest	Javier	Arteaga	Hitachi ABB Power Grids
Guest	Lee	Matthews	Howard Industries
Guest	Dinesh	Sankarakurup	Duke Energy
Guest	Gary	King	Howard Industries
Guest	Loren	Wagenaar	WagenTrans Consulting
Guest	Christopher	Baumgartner	We Energies
Guest	Devki	Sharma	Entergy
Guest	Charles	Sweetser	OMICRON electronics Corp USA
Guest	Scott	Reed	MVA
Guest	Dwight	Parkinson	EATON Corporation
Guest	Jean-Noel	Berube	Rugged Monitoring Inc.
Guest	David	Wallach	Duke Energy
Guest	Neil	Strongosky	Memphis Light, Gas & Water
Guest	George	Frimpong	Hitachi ABB Power Grids
Guest	Donald	Lamontagne	Arizona Public Service Co.
Guest	Markus	Stank	Maschinenfabrik Reinhausen
Guest	Peter	Werelius	Megger
Guest	Michael	Botti	Hyosung HICO
Guest	Hakan	Sahin	Virginia and Georgia Transformers
Guest	Vijay	Tendulkar	Power Distribution, Inc. (PDI)
Guest	Brian	Penny	Retired
Guest	Poorvi	Patel	Electric Power Research Institute (EPRI)
Guest	Juan Carlos	Cruz Valdes	Prolec GE
Guest	Sanjib	Som	Pennsylvania Transformer
Guest	Huan	Dinh	Hitachi ABB Power Grids
Guest	Krishnamurthy	Vijayan	PTI Transformers
Guest	Ali	Naderian	Metsco
Guest	Ryan	Musgrove	Oklahoma Gas & Electric
Guest	Alejandro	Macias	CenterPoint Energy
Guest	Parminder	Panesar	Virginia Transformer Corp.
Guest	Joshua	Verdell	ERMCO
Guest	Steven	Brzoznowski	Bonneville Power Administration
Guest	Mats	Bernesjo	Hitachi ABB Power Grids
Guest	Marc	Taylor	Cogent Power Inc.

Role	First Name	Last Name	Company
Guest	Kendrick	Hamilton	Power Partners, Inc.
Guest	Paul	Morakinyo	PSEG
Guest	Amitabh	Sarkar	Virginia Transformer Corp.
Guest	Kurt	Kaineder	Siemens Energy
Guest	Erich	Buchgeher	Siemens Energy
Guest	Markus	Schiessl	SGB
Guest	Orlando	Giraldo	H-J Family of Companies
Guest	Rhett	Chrysler	ERMCO
Guest	Toby	Johnson	Pacificorp
Guest	Jonathan	Reimer	FortisBC
Guest	Ismail	Guner	Hydro-Quebec
Guest	Jeffrey	Wright	Duquesne Light Co.
Guest	William	Elliott	Prolec GE
Guest	Jeffrey	Gragert	Xcel Energy
Guest	Samuel	Sharpless	Rimkus Consulting Group
Guest	Jeremiah	Bradshaw	Bureau of Reclamation
Guest	William	Whitehead	Siemens Energy
Guest	Daniela	Ember Baciu	Hydro-Quebec - Laboratoire Haute
Guest	Feras	Fattal	Manitoba Hydro
Guest	Akash	Joshi	Black & Veatch
Guest	Igor	Simonov	Toronto Hydro
Guest	Malia	Zaman	IEEE
Guest	John	Foschia	SPX Transformer Solutions, Inc.
Guest	Cihangir	Sen	Duke Energy
Guest	Stacey	Kessler	Basin Electric Power Cooperative
Guest	Janusz	Szczechowski	Maschinenfabrik Reinhausen
Guest	Nikolaus	Dillon	Dominion Energy
Guest	Ken	Klein	Grand Power Systems
Guest	Nitesh	Patel	Hyundai Power Transformers USA
Guest	Elise	Arnold	SGB
Guest	Drew	Welton	Intellirent
Guest	Brad	Staley	Salt River Project
Guest	Jaber	Shalabi	VanTran Industries, Inc.
Guest	Bruce	Webb	Knoxville Utilities Board
Guest	David	Calitz	Siemens Energy
Guest	Sergio	Hernandez Cano	Hammond Power Solutions
Guest	Moonhee	Lee	Hammond Power Solutions
Guest	Hugh	Waldrop	Memphis Light, Gas & Water
Guest	Samragni	Dutta Roy	Siemens Energy
Guest	Shawn	Gossett	Ameren
Guest	Eric	Doak	D4EnergySolutions LLC
Guest	Jonathan	Sinclair	PPL Electric Utilities
Guest	Saramma	Hoffman	PPL Electric Utilities
Guest	Matthew	McFadden	Oncor Electric Delivery
Guest	Hugo	Avila	Hitachi ABB Power Grids
Guest	Megan	Eckroth	EATON Corporation
Guest	Ashmita	Niroula	Ergon, Inc.
Guest	Stefan	Schindler	Maschinenfabrik Reinhausen
Guest	William	Knapek	OMICRON electronics Corp USA
Guest	Raymond	Frazier	Ameren
Guest	Onome	Avanoma	MJ Consulting
Guest	Alan	Washburn	Burns & McDonnell
Guest	Avijit	Shingari	Pepco Holdings Inc.
Guest	Pragnesh	Vyas	Sunbelt-Solomon Solutions
Guest	Chris	Powell	Intermountain Electronics
Guest	Tejasvi	Prakash	Schweitzer Engineering Labs
Guest	Parag	Upadhyay	ABB Inc.
Guest	Duy	Vo	Central Maine Power (AVANGRID)
Guest	Evgenii	Ermakov	Hitachi ABB Power Grids
Guest	Brandon	Dent	Memphis Light, Gas & Water
Guest	Andrew	Larison	Hitachi ABB Power Grids
Guest	Jaroslaw	Chorzepa	ABB Inc.
Guest	Didier	Hamoir	Transformer Protector Corp
Guest	Michael	Warntjes	American Transmission Co.
Guest	Hossein	Nabi-Bidhendi	ABB Inc.
Guest	Tiffany	Lucas	SPX Transformer Solutions, Inc.
Guest	Albert	Sanchez	Knoxville Utilities Board
Guest	Balakrishnan	Mani	Virginia Transformer Corp.
Guest	Suresh	Babanna	SPX Transformer Solutions, Inc.
Guest	David	Holland	ExxonMobil
Guest	Christopher	Lianides	Southern California Edison
Guest	Thomas	Eagle	SPX Transformer Solutions
Guest	ANDY	DOWNEY	SPX TRANSFORMER SOLUTIONS
Guest	Stephenie	Denzer	Alliant Energy