Dielectric Tests Subcommittee

October 30^{th,} 2019 Columbus, Ohio

Dielectric Tests Subcommittee							
Chair: Ajith M. Varghese	Vice-Chair: Thang Hochanh	Secretary: Poorvi Patel					
Room: Union CDE	Date: October 30 th 2019	Time: 11:00 am to 12:15 pm					
Members: 136	Present at time of checking: 96	Present to AM System: 106					
Guests present: 125	Membership requested: 12	Membership accepted: 8					

B.1 Chair's Remarks

The Chair briefly highlighted the requirement that while introducing one need to state their employer/ company and sponsor if the difference from the company. The chair also reminded that IEEE and transformer committees are non-commercial organizations and standards shall focus only on developing performance and functional requirement and not design and construction details.

The Unapproved minutes from the Spring 2019 meeting and the agenda for Fall 2019 meeting was sent out to members and guests 14 days before the Fall meeting in Columbus, and it's also posted on the website.

An area that WG and TF have been late with and we need to improve is to send out the Agenda **at least 14 days** before the meeting. This also applies to on-line WG and TF meetings.

All TF and WG **MUST** record the attendance in the AM System- The WG/TF minutes do not need to include the list of attendees. The Roasters circulated in the meetings should not have the email addresses included to follow the data privacy policy. WG/TFs are urged to keep website information current. Any presentation presented during the meetings should be posted

All attendees should have updated information, such as email address in the AM system, as for all correspondence, this system is used.

The Chair reminded the WG and TF leaders to submit their minutes from the meetings within **15 days** to the SC chair and secretary. The SC Secretary then must submit the SC minutes within 45 days of the SC meeting. To minimize revision and errors in the sub-committee level and transformer committee level minutes, please send the final version of your minutes.

The Chair advised the WG/TF leaders to in advance before the DTSC meeting to submit any important motions or new Agenda to be discussed and approved during the meeting to the Chair.

The Chair reminded WGs that call of the patent is required a during every WG meetings including online/Teleconference meeting. If there are any patent claim, it shall be noted but not discussed at the working group meetings. Calls for Patents is not required for TF. There is changes to copyright policy – WG/TF leaders must show the slides for the copyright policy at the beginning of the WG/TF meeting

- Any material submitted during standards development, whether verbal, recorded, or in written form, is a Contribution and shall comply with the IEEE-SA Copyright Policy
- Secretary to record in the minutes of the relevant meeting: That the foregoing information was provided and that the copyright slides were shown (or provided beforehand).

The Subcommittee chair showed the slides of the new copyright policy to the DT subcommittee members and guests.

Per new guidelines from IEEE, Audio/Video recording or photography is not allowed during SC, WG and TF meetings. The secretary could record the meeting for writing the minutes of meeting. The recording must be deleted after the use. The subcommittee Secretary would be recording the audio of the SC meeting for this reason today.

The Chair shared details of upcoming PES sponsored meeting as well as details of next transformer committee. The Spring committee meeting 2018 will be held in Charlotte, NC on the 22nd -26st of March 2020. Fall meeting 2020 will be held in Kansas City, MO on the 18th -22nd of October 2020.

The Current Status of PARs was presented by The Chair.

- C57.127 Guide for the Detection of Acoustic Emissions from Partial Discharges in Oil-Immersed Power Transformers is now approved and published. Congratulations to the WG team. Next revision 2028.
- C57.160 Guide for the Elec. Measurement of PD in HV Bushing and Instrument Transformers is in ballot resolution and a Par extension request has been done for the upcoming NesCom meeting on the 6th of November 2019.
- C57.113 Recommend Practice for Partial Discharge Measurement Power Par expires 2021. There is a risk that this guide expires before the revision is in place.
- C57.98 Guide for Transformer Impulse Tests the WG had their 2nd meeting here in Anaheim. Par expires in 2022
- C57.138 Recommended Practice for Routine Impulse Tests for Distribution Transformers there is no activity on as the guide does not expire until 2026. If new WG needs to be formed earlier, please advise to the chair
- C57.161 Guide for DFR Measurements is approved and published. There is no activity on as the guide as it does not expire until 2026.
- C57.168 Low-Frequency Test Guide is a new guide and had their second meeting here in Anaheim; PAR expires 2022

• C57.200 Bushing Frequency Domain Spectroscopy Guide (ENTITY WG) is a new guide and had their second meeting in Anaheim 2019. PAR expires in 2022.

The Chair reminded the WG on attendance requirement for membership and the continuation and the requirement to have attendance updated in AM system, i.e., to attend two out of last three meetings or three out of five last meetings.

On this Fall DTSC meeting no roaster will be circulated. If you request membership, please contact the DTSC secretary or Chair for a membership request. Important is to badge in yourself in the AM-system as this will be used if quorum is reached.

In Anaheim 14 guests requested membership and 12 members where granted and 11 members were moved to guest status. The total membership of the Dielectric Subcommittee is today 136 members. To obtain Quorum 68 members is required.

B.2 Quorum, Approval of Minutes and Agenda

The membership list was presented, and a quorum of members was established through the AM system. 106 out of 136 members were present. Thus 77.9% of members were present at the meeting, and a quorum was reached. For request of membership, please reach out (at the meeting or email) to the chair or secretary.

Motion to approve the agenda was made by Dan Sauer and seconded by Arup Chakraborty. The chair presented the agenda, and it was unanimously approved.

The Motion to approve the Spring 2019 minutes was made by Dan Sauer and seconded by Vinay Mehrotra. The minutes of the Spring 2018 meeting at Anaheim meeting was approved unanimously.

B.3 Taskforce and Working Group Reports

B.3.1 Working Group Low-Frequency Dielectric Testing for Distribution, Power and Regulating Transformers

Dan Sauer (Chair), John Foschia (Secretary) Tuesday 29/10/2019, Fairfield room, Columbus, Ohio.

Meeting Attendance

The working group met at 9:30am. There were 58 attendees and 24/45 members present. Quorum was achieved at 53%.

Discussions

- No essential patent claims noted.
- The chair noted that the WG is currently seeking a secretary.
- A review of the roster indicated duplicated members. The chair will review the roster to make corrections as necessary.
- The agenda of the Fall 2019 meeting and the minutes of the Spring 2019 meeting were approved as written.

Old Business

- The chair has previously begun work on normative references within the document and submitted it with the spring 2019 minutes.
- The chair solicited feedback regarding the normative references.
 - Phil Hopkinson noted that the focus on normative references should be handled after the guide is mostly complete. The chair agreed.
- The approved definition of 'low frequency dielectric test' was forwarded by the chair to the C57.12.80 WG.
- A section-by-section review of the guide's draft text was reviewed with the WG.
- Section 4 Introduction (LFDT explanation)
 - Comment was made that 'in the field' should be referred to as "in service"
 - Comment made that 'leakage current' should be removed from section 4.
 - Could include 'complete discharge' in addition to partial discharge
 - Bertrand Poulin noted that a guide cannot use the word "ensure" but could instead use "can reduce the likelihood"
 - The membership agreed. This is to be edited.

- Dave Geibel and Bertrand Poulin noted that the present text is acceptable for the introduction to the guide.
- Section 5 Applied Voltage Withstand Testing
 - Comments provided that the word conductor should be modified to "winding or any live part to ground." Dave Geibel and Ajith Varghese agreed.
 - It was noted that a guide cannot use the word 'verify' but could instead use the word 'demonstrate'
 - Modifications have been made to the section with verbal membership feedback.
 - The chair asked for volunteers to work on section 5.2.
 - Bertrand Poulin volunteered but asked for assistance.
 - Leopoldo Rodreguiz volunteered to contribute with Bertrand.
 - Section 5.3 has been surveyed already; no changes made.
- Section 6 –Induced Testing.
 - Class 1 and class 2 transformers both included per Bertrand.
 - \circ $\;$ The WG should coordinate with the TF class 1 PD tests.
 - Volunteered was Bertrand and Leopolodo Rodreguiz and Ajith Varghese.
 - Information from the C57.12.90 annex should be included in the guide and then removed from C57.12.90
 - Ajith has final approved text that he will forward for inclusion into the document if satisfactory with copyright policy,
 - Salahuddin Shaikh has volunteered to assist Bertrand Poulin with the induced section of the guide.
- The plan is to include an annex with discussion regarding AC voltage measurements This was postponed until a later date.
- Section 7 Insulation power factor.
 - The chair is seeking volunteers for contribution.

New Business

- Phil Hopkinson brought up that there should be a test for transformers connected to inverters that exhibit inter-winding insulation damage.
 - The chair advised that this is outside the scope of this WG and that this should be brought to the DTSC.

Meeting adjourned without a motion.

John Foschia

Discussions/Presentations/Decisions made during DTSC:

F19 Update: WG C57.168 – LFDT Guide

Quorum: Achieved MOM: Approved Agenda: Approved

Highlights:

- The WG reviewed the draft content of the guide in each individual section.
- Multiple volunteers have been identified that will contribute to specific areas of the document.
- The WG is continually seeking information to include the guide and will monitor other test-related group discussions.



B.3.2 WG C57.113 - Recommended Practice for PD Testing,

Ali Naderian – Chair, Janusz Szczechowski – Vice Chair John Foschia – Secretary Columbus, Ohio | October 28th, 2019 | Marion Room @ Hyatt Regency Hotel

Meeting Attendance

The working group met at 9:30am. There were 90 attendees and 15 members present. Quorum was achieved at 51.7%.

Discussions

- A larger room will be requested for the next meeting due to high attendance.
- The essential patent slides were shown and no patent claims were noted.
- The chair reiterated that the changes to the present guide are planned to be minimal and mostly informative.
- The chair presented the results of the survey, sent to the WG, after the spring 2019 meeting.
 - \circ >50% of the respondents were representing manufacturers and >20% were consultants.
 - \circ >70% of the respondents were in favor of measuring PD on all terminals of the transformer.
 - \circ >80% of the respondents were in favor of the addition of cross calibration information to the guide.
 - \circ >70% of the respondents supported an increase of the upper frequency limit.
- Discussion was held regarding the frequency limits and bandwidth.
 - A minimum of 300 kHz bandwidth and alignment with IEC was recommended by Bertrand Poulin.
 - Bertrand Poulin and Detlev Gross both stated that they are flexible to modification of the lower frequency limit.
- Raja Kuppuswamy provided a thorough presentation covering phase resolved partial discharge patterns.
 - Emphasis was identifying 'key markers' to visually compare to a known source of partial discharge.
 - Raja has currently written over 15 pages of information to be included in Annex
 G (PD pattern recognition) and will continue development.
 - The working group provided positive feedback to the presentation and contributions to the revision of Annex G.
- Detlev Gross recommended that chapters 4 and 5 of C57.113 may be useful for inclusion into the IEEE document regarding partial discharge measurements of dry type transformers. Members and the chair agreed to this recommendation.
- The chair noted that the vice chair will be providing a technical presentation on Thursday 10/31/19, titled '*Tutorial on CIGRE WG D1.29: Partial Discharges in Transformers.*'

- The minutes of the Spring 2018 WG meeting and the agenda of the Fall 2019 meeting were unanimously approved by the WG.
- The meeting was adjourned at 10:30am.

John Foschia

Discussion/Presentation/Decision Taken during DTSC:



Thang Hochanh raised a question – Cross calibration is mostly done for diagnostic purposes more than factory acceptance test- was this discussed. Ali answered it had been done several times in the meeting that was what generated the survey to get formal results and presented at the meeting.

B.3.3 Working Group for Impulse Guide – PC57.98

WG Secretary: John Foschia; WG Chair: Thang Hochanh; WG Vice Chair: Reto Fausch Columbus, OH October 28th, 2019 | Union AB Room @ Hyatt Regency Hotel

Meeting Attendance

The working group met at 1:45pm. There were 82 attendees and 17/34 members present. Quorum was achieved at 50%.

Discussions

- No essential patent claims noted.
- Bertrand Poulin noted that we can only illustrate the high frequency peak overshoot issue in the C57.98 guide but that the test code can only make requirements. He noted that IEEE Std-4 and C57.12.90 mandates the use of k-factor.



- Jim McBride suggested that even with the IEC 60-1, none of the waves on page 7/8 of the chair's presentation meet the peak voltage requirements. (see attached)
- The chair provided examples of poor waveforms and the means of which they were improved.
- Secretary noted to the chair that the quorum was achieved.
- Chair presented a slide of proposals:
 - Mandatory use of k-factor
 - Test circuit set up to ideal waveform 1.2/50
 - No limitations to relative overshoot, even if calculated relative overshoot is >10%.
 - \circ $\,$ Considerations to be made to the chop wave.
- Pierre noted that C57.12.90-2015 allows for up to 2.5 micro-second front times and that the overshoot at that point must be accepted.
- JMX noted that there are two methods of chop wave evaluation.
 - Tail patch method IEEE Std-4, A.2.4.2 (only method in IEC)
 - Voltage reduction method IEEE Std-4, A.2.4.1
 - "If peak reduced by 4% on previous full wave, do the same for the chop wave"

- Jim McBride stated that in order to measure the voltage of a chop wave using kfactor, the tester must have a previous full wave before. All software should be using a previous full-wave for the tail patch method.
- Discussion was held between Bertrand Poulin, Yang Baitun and Jim McBride regarding how to measure chop wave impulses. Jim brought up the fact that depending on overshoot magnitude that the chop wave voltage could be less than the full wave magnitude, if the k-factor is not used during the chop-wave.
 - Issues also exist about the inability to chop depending wave shape oscillations.
- The vice chair brought up that you could simply use the linear relationship between charging voltage and applied voltage for chop waves.
 - Pierre Riffon said that it is important to use the voltage divider at the transformer terminal and that you cannot rely on the accuracy of the stage voltage's voltage measurements.
 - Yang Baitun stated that the charging voltage not being linear to the applied voltage.
 - Pierre disagreed with the charging voltage approach and stated that you would need a calibrated charging voltage divider.
 - Jim McBride agreed and said that the use of k-factor on the waveform applied to the transformer will achieve the same goal.
- The chair stated that he will compile text for the next meeting regarding the use of k-factor for the guide.
 - Jitka Fuhr and Jim McBride volunteered to provide examples of waveform overshoots.
- Jim McBride stated that IEEE Std-4 published the frequency filtration characteristics but left it to the apparatus groups to determine the applicability of waveform evaluation.

Adjournment

A motion to adjourn the meeting was made by Jim McBride and seconded by Ajith Varghese. The meeting was adjourned at 3:00pm.

John Foschia

Discussions/Presentations/Decision made during DTSC:



B.3.4 Working Group for PD in bushings, PTs and CTs – PC57.160, WG Secretary: Thomas Sizemore; WG Chair: Thang Hochanh -Meeting Minutes Columbus, Ohio

This working group did not meet in Columbus, Ohio. The document was submitted for ballot. The return rate and the approval were above the minimum. The comments will be addressed and the document will be revised and recirculate for balloting.

At this time PAR extension is requested for the next NesCom meeting November 6th.

Discussions/Presentations/Decision made during DTSC:



B.3.5 Task Force for Bushing DFR – PC57.12.200, TF Secretary: Diego Robalino; TF Chair: Poorvi Patel; TF Vice Chair: Charles Sweetser
 Meeting Minutes October 29th, 2019, at 3.15pm – Columbus, OH, Fairfield,

Minutes of the 1st TF Meeting

- 1. Meeting was called to order at 3:16PM. First meeting of this TF with 27 attendees.
- 2. Poorvi Patel introduced the TF to observe the work carried out by the Entity working group from China. This TF will be able to discuss and review the information developed by the WG.
- 3. The 4th WG meeting will be in China end of November and the 5th WG meeting will be in Charlotte NC. This meeting is mainly informative.
- 4. Agenda provided for this meeting
- 5. TF Chair presented to the attendees the IEEE SA Copyright statement
- 6. TF Chair presented the patent disclosure statement from IEEE SA. No patent was brought up to the attention of this TF.
- 7. Peter Werelius attended 3rd meeting of the WG in China and upon request of the TF Chair, the work done so far was summarized.
 - a. PAR expires on December 2022
 - b. Last meeting was held on July 1st, 2019
 - c. Minutes from the meeting were presented where attended 60 participants including utilities and manufacturers.
 - d. Peter briefly went on each chapter of the latest revision of the draft guide.
 - e. One important agreement on changing FDS to DFR
 - f. Most of the comments and discussion has been already incorporated in the draft
- 8. Malia was asked to clarify what information is possible to be shared. Malia informed that this is an Entity WG, therefore in order to have access to the draft guide and minutes, the company needs must be an entity member or a technical expert.
- 9. Mark Lachman inquired about the process to receive the information for basic entity members. Malia will verify the process with the WG Chair and will communicate through TF Chair.
- 10. Poorvi showed the Table of Contents.
 - a. The document provides a big chapter on safety precautions
 - b. Several cases were added to illustrate the application of DFR on bushings
- 11. Peter Zhao asked if the scope covers only OIP bushings. Poorvi replied that the scope of the WG is not limited to only OIP.
- 12. Peter Zhao raised concern about accuracy of data provided for the examples in the guide.
 - a. TF Chair to see the option of getting raw data for review
 - b. Mark questioned the source of data. Upon discussion, it is requested to clarify/incorporate:
 - i. Bushing nameplate
 - ii. Temperature

- iii. Test conditions
 - 1. Laboratory / field
 - 2. In-oil or without oil
- 13. Diego Robalino explained the shifting of the DFR shape as a function of temperature and the possibility of missing information with just line frequency power factor
- 14. Peter Werelius is working with the WG on the calibration of instrumentation to be included in Annex G of the draft.
- 15. Charles Sweetser presented few case studies in limited frequency range obtained at 2Kv.
 - a. Zhang Shibao asked if the data as observed in his examples would be indicative of failure mode. How much deviation is needed to say a bushing is bad and need replacement.
 - b. The data is of a limited frequency band not full DFR
- 16. David Geibel questioned the sensitivity of the method to the characteristics of the bushings
- 17. Ronald Hernandez questioned if there was any limit to the voltage to be applied for the test. Peter Werelius indicated that there is no specific statement. It is references to 140Vrms and 1400Vrms.
- 18. With no additional topics of discussion, motion was moved by David Geibel and seconded by Peter Werelius to adjourn the meeting.
- 19. Meeting adjourned at 4:30 PM.

Discussion/Presentation/Decision taken during DTSC:



B.3.6 TF on Revision of Low-Frequency Tests

Columbus, OH – October 29th, 2019, 1:45 p.m.,

Chair: Bill Griesacker, Vice Chair: Daniel Blaydon (acting secretary), Secretary: Myron Bell.

- 1. The meeting was called to order at 1:45 PM.
- 2. Attending members were counted and quorum was verified by the RFID system report, which is provided in summary below:

	RFID
Total Attendees	97
Total # Of Members	58
Members Present	42
Quorum Present	72.4%

Attendance

Note that paper

rosters were not used at

this meeting, however a signup sheet was provided to guests who wanted to request membership.

- 3. A motion was made to approve the meeting agenda by Akash Joshi, which was seconded by Dan Sauer. There were no objections to unanimous approval of the agenda.
- 4. A motion was made to approve the meeting minutes from the 2019 Spring meeting in Anahiem by Hugo Flores which was seconded by Phil Hopkinson. There were no objections to unanimous approval of the meeting minutes.

6. Old business

- Class I Partial Discharge Testing Don Ayers Don presented a summary report on the TF meeting that occurred on Monday, and the results of his survey concerning test levels for class I partial discharge testing. Don's full report can be found in the attached annex.
- Gassing issue for certain types of transformers with wound cores The Chair presented the proposed changes concerning IEEE C57.12.00, Section 6.7.2.1 language, and additions to Table 17. The Chair then presented the proposed additions to C57.12.90, which would form sections 10.7.7, and 10.7.7.1 through 10.7.7.4.

Phil Hopkinson motioned to approve the proposal. The motion was seconded by Gary Hoffman.

The Chair requested a vote on the motion, the results of which are provided below:

- 24 Approved
- 6 Disapproved

10 Abstained

The motion passed

The new proposal will be submitted to 4 of the Sub Committees.

3. Factory PD Limit survey results

The Chair presented the proposed text changes concerning IEEE C57.12.90, Clause 10.8.5. All comments from "rejected" survey results were reviewed. Multiple comments requested an additional test, after the one-hour test, at 1.2 pu voltage, with measurements below 100 pC. This will not be added to the proposal at this time.

Ali Naderian motioned to vote on the proposed language, for submission to the Dielectric Test SC. The motion was seconded by Akash Joshi.

The Chair requested a vote on the motion, the results of which are provided below:

- 32 Approved
- 6 Disapproved
- 5 Abstained

The motion passed

The new proposal will be submitted to the Dielectric Test Sub Committee.

- 4. PD in bushings during transformer factory testing A survey was conducted and results compiled, however the meeting was adjourned due to a lack of time to cover this topic.
- 7. New business

There were no new business items.

8. The meeting was adjourned at 2:59pm.

Appendix A

Minutes for Task Force on PD Testing of Class 1 Power Transformers

Document:	Partial Discharge Testing of	Class 1 Power Transformers
Vice Chair:	Javier Arteaga	
Secretary:	Israel Barrientos	
Meeting Date:	Monday 28th of October 201	9
Time:	16:45	
Attendance:	Requesting membership:	36
	Total attendance:	60

The meeting was called to order at 4:45 p.m. in the Morrow meeting room.

Meeting Agenda was presented and a motion by John Forcia was made to accept. It was seconded by Carlos Gaytan the vote was unanimous to accept.

Membership requirements were presented and it was indicated that everyone at this initial meeting was granted membership of the TF. Two paper rosters were handed out to the attendance for backup of the AMS and to request voting membership.

A Scope for the TF was presented. Carlos Gaytan asked about including Test Evaluation Criteria and Don Ayers responded that it is already included as a point to be discussed later.

John Foscia moved to accept the scope and Leopoldo Guerra seconded. After a brief explanation of what a Class I Power Transformer is, Carlos Gaytan asked if this scope was to include Distribution Transformer Wound core PD Testing. Chairman indicated that the current TF scope is only for Class I Power Transformers. After a brief discussion, the motion was modified slightly by a friendly amendment by Neil Kranich and Detlev Gross, it was voted and passed unanimously.

The next item in the agenda, the Enhanced Voltage Level was discussed. After a spirited discussion a motion was made by Neil Kranich and seconded by John Foscia that the Enhanced Voltage Level to be set at 200% of the Nominal System Voltage (NSV) as per Table 6, Col 6 of C57.12.00. After further discussion, the vote was 3 in favor, 22 against, thus the motion did not pass.

A new motion was made by Ajith Varghese and seconded by Neil Kranich, to set the Enhanced Voltage Level the same as for Class II Transformers. The motion passed unanimously.

The Voltage Level for the Extended Time Test was discussed. A motion by Gross and seconded by Kranich to keep the voltage level of the extended time test at 1.58 NSV, the same as Class II transformers. After no further discussion the motion carried unanimously.

Length of Time of the extended test was discussed. A motion was made by Gross and Guerra seconded, to maintain the 1 hour at 158%, identical as Class II transformers. After a brief discussion, the motion passed unanimously.

The next item in the agenda, Voltage Level for First PD Reading. Kranich and Gross moved and seconded a proposal for first reading to be at 158% of NSV for first PD reading level. The motion was voted and passed unanimously.

Acceptance Levels was the last item on the agenda to be dealt. Kranich motioned that we use the same PD acceptance criteria as in 10.8.5 of C57.12.00, Gross seconded this motion. Gamboa indicated that this levels needed to be reviewed by the WG for Distribution Bushings, and a Liasion with this group should be made. After a long discussion by Arteaga, Gross, Ayers, Gamboa, Varghese and Mollenkopf, the motion was amended to "Use a Separate Paragraph but retain the wording from Paragraph 10.8.5."

As time ran out, a vote was not held, and will be discussed at the next scheduled meeting. This is expected to take place in Charlotte N.C. in March 2020.

The presentation will be made available in the TC Website.

Meeting was adjourned on time at 18:00 Hrs.

Submitted by:	Israel Barrientos
Date:	28/Oct/2019

Discussion/Presentation/Decision taken during DTSC:



During DTSC, Bill Griesacker (TF chair) motioned proposed wording (see here below) and test procedure for Core gassing to be included into C57.12.00 and C57.12.90

Second Ali Naderian.

PD Test for Gassing in Wound Cores Proposed wording to insert into IEEE C57.12.00

6.7.2.1 Grounding of Wound Cores

PES

In transformers with wound cores, five-legged three phase and three-legged single phase, Low Voltage-High voltage winding construction and a high voltage winding greater than or equal to 25 kV (15 kV to ground), the transformer core shall be properly grounded to the tank. Said grounding may be from the inside or outside of the core as long as there are not two ground locations in the same core. In order to validate that the core will not be susceptible to partial discharges during normal operation, a design test, specific for this type of wound core transformer, is specified in Table 17, and the procedure is described in C57.12.90-2015 Clause 10.7.7.

Note: Partial Discharge (PD) generation in transformers can possibly occur due to various other factors which may be internal and/or external to the transformer and the capacitive coupling of the core is one of these factors. 100

PD Test for Gassing in Wound Cores Proposed wording to insert into IEEE C57.12.90

10.7.7 Special Induced-Voltage Test for distribution and class I power transformers with a wound core, Low-High winding construction and having a high voltage winding voltage of 25 kV, (15 kV to ground) or greater to detect improper core grounding. Note that this test is intended only for detection of inadequate core grounding issues and not for accessories like dead front bushings, tap changers, current limiting fuses or dual voltage switches, which may have difficulty passing the test at 100 pC. The transformer may or may not contain such components. If the transformer fails the test with such components, the components may be removed or bypassed and the test re-run. The Design Test shall be conducted on a transformer with functionally similar core grounding, set P_{EF}

100 PES

PD Test for Gassing in Wound Cores

10.7.7.2 Test Frequency

PES

As an induced-voltage test applies greater-than-rated volts per turn to the transformer, the frequency of the impressed voltage shall be high enough to limit the flux density in the core to that permitted by 4.1.6.1 of IEEE Std.C57.12.00-2010. The minimum test frequency to meet this condition is given in Equation (27):

- E, is the induced voltage across winding (V) E
 - is the rated voltage across winding (V)

PD Test for Gassing in Wound Cores C57.12.00, Table 17 - Revision inserted under Dielectric beneath core insulation resistance:										
Tests	Distribution		Class I		Class II		I	Commonte		
			Power		Power		r			
	Routine	Design	Other	Routine	Design	Other	Routine	Design	Other	comments
Partial discharge test for core gassing		*			*					Test only applies to wound cores see Clause 6.7.2.1
Priver 6 Energy Society*										THE Per THE PE

PD Test for Gassing in Wound Cores

10.7.7.1 Minimum test duration and application of voltage

- 1. Voltage shall be raised to 100% of rated volts for 30 seconds and PD shall be measured and recorded. 2. Voltage shall be raised to 110% of rated volts for 30 seconds and PD shall be
- measured and recorded. 3. Voltage shall be raised to 150% of rated volts, held for 1 minute and PD shall be measured and recorded.
- 4. Voltage shall be lowered to 140% of rated volts, held for 1 minute and PD shall be measured and recorded.
- 5. Voltage shall be lowered to 130% of rated volts, held for 1 minute and PD shall be measured and recorded.
- 6. Voltage shall be lowered to 120% of rated volts, held for 1 minute and PD shall be measured and recorded. 7. Voltage shall be lowered to 110% of rated volts, held for 10 minutes and PD shall
- be measured and recorded PD is to be measured as apparent charge in pico-coulombs (pC). One reading shall

be made at the end of each interval EEE PES



PD Test for Gassing in Wound Cores

10.7.7.3 Grounding of Windings

When a transformer has one end of the high-voltage winding grounded, the other windings should be grounded during the induced-voltage test. This ground on each winding may be made at a selected point of the winding itself or of the winding of a step-up transformer that is used to supply the voltage or that is connected for the purpose of furnishing the ground.





Results: The motion unanimously approved. 9 Abstentions

• Bill Griesacker (TF chair) motioned changes to PD-limits in C57.12.90 (see below) that was surveyed (with 90% approval- 10% answered) within DTSC and Approved by RLFT.



• Second Raj Ahuja.

Discussion:

- 1) Sanjib Som- questioned the survey approval rate stating that survey included guest and not just members. Chair clarified survey can have guest but for proposal to move forward, members approval is required from RLFT and DSTC. RLFT had already approved and only members will vote on this motion today.
- 2) Shamun Hakim- Wanted to know if proposal was approved in RLFT. Chair clarified that per report presented by RLFT chair, RLFT had approved the motion for changes to limits as presented earlier this week.
- 3) Detlev Gross- 50pC increase can sometime be problematics as you have fluctuation which is nature of PD measurement without a cause of concern. Clarified he still agree with proposal as is.
- 4) Vijayan Krishnamurthy- the difference of having 500 pC and 250 pC is not making the transformer better. The issue is if you have a case where the PD is more than 250 pC and less than 500 pC- to correct the issue or find the issue is a very difficult task. Acoustic are not sensitive enough. This is not adding value (changing between 500 pC to 250 pC) to the transformer quality. Other issue is on LTC and DETC can produce PD. PTI voted to reject the change.

5) Based on the comments from floor, Chair requested RLFT chair to read out the some of the key negative comments

Bill Read out the negative comments, which can be categorized into two -1) Not satisfied with reduction and wanted to have lower limits and 2) wanted to retain the existing limits.

- 6) Baitun Yang- the 50 pC limit should be higher.
- 7) Kushal Singh- users perceptive- What is the difference between 250 pC and 500 pC? I would than ask what is the difference between 500 pC and 750 pC- What actions would be taken if the transformer had 600 pC? Would you go inside the transformer probably not because the difference is too small between 500 pC and 600 pC. From the user's perspective, this is the right change.
- 8) Detlev- Sensitivity of Acoustic depending on how it is installed you can detect problem lower than 250 pC to as low as 10 pC.
- 9) Ali Naderian- the Survey showed that most of the responders wanted 300 pC. Discussion in the TF in IEC the limit is 250 pC (latest version). It was decided to go with 250 pC to be closer to IEC and there is not much difference between 250 pC and 300 pC.
- 10) Pugazhenthi Selvaraj- on paper Design is below 100 pC. The 250pC or 500 pC is how the transformer is manufactured. It tells the reliability of the transformer. 250 pC is a good number to have for a new transformer.

Voting results:

- 66 Approved
- 07 Disapproved
- 13 Abstentions

Motion approved. Subjected to standards SC approval, New Text (PD Limits) will be included in next version of C57.12.90 as when it will be balloted.

B.3.7 Task Force Winding Insulation Power Factor & Winding Insulation Resistance Limits, Diego Robalino (Chair) and Aniruddha Narawane (Secretary) at the meeting Tuesday 26/4/2019, California Ballroom A, Anaheim, CA.

- Meeting was called to order at 8.00 am by Diego Robalino (TF Chairman).
- Activity Name: TF Winding Insulation PF/Resistance Limits
- Activity ID: 2186
- Number of Members in Activity = 41
- Number of Members Present = 27
- Quorum Present = 65.9%
- Number of attendees = 84
- Number of Guests = 57
- Number of guests requesting membership = 14
- Motion to approve agenda was moved by Dan Sauer Seconded by James Antweiler. Motion passed unanimously.
- Motion to approve minutes of Spring 2019 meeting was moved by Dan Sauer Seconded by Don Dorris. Motion passed unanimously.
- D. Robalino presented patent statement from IEEE SA, checked for any patents and there were none from the attendees.
- Chair presented and read the Copyright statement from IEEE SA. Chair mentioned there was no Copyright issue in the information to be discussed during the agenda since there was no data relative to any possible publication or copyright material
- Chair mentioned that there is large amounts of data received and IT section of IEEE is currently working on setting it up and analyzing it to put it in a preliminary format. Chair also presented first section of data corresponding to 255 transformers. Data was analyzed to show the peak, min and average values of power factor.
- Tauhid Ansari asked the question if data was corrected to 20 deg C and chair responded that the data as presented by manufacturers is not always corrected to 20C. Most factory and acceptance tests were performed at values close to 20C where manufacturers prefer not to provide any correction but the "as tested" temperature value
- Question was asked if the limit would be set as average of the values of CH, CL and CHL or separate, to which chair's response was that the TF is not going to set up the limits and it may possibly be a task for working group.
- There were questions and suggestions on how to classify the data to set the limits and which factors affecting the PF need to be considered for setting up the limits s.g.: voltages, core construction, 2 or more windings, etc.
- Tauhid Ansari and Akash joshi expresses concerns about possible difficulties in meeting the limits on a power transformer with auxiliary winding with smaller voltage. Don Dorris commented that they have not seen significant differences between the different windings. Moreover, Don confirmed that the universe of data brought to analysis shows correlation with his field experience.

- Chair and most of the attendees agreed that this analysis and classification needs to be taken up as a discussion in a working group. The question was asked if any one provided an example of this specific condition and there was no response, therefore no data to be considered.
- There were three participants who agreed to share some more data within 30 days. It was decided to form a small group to review the received data once it is analyzed according to the current method. Some members/ attendees agreed to volunteer for this task and it was decided to be reviewed in Jan 2020 through a webex meeting pending the analysis by IT team of IEEE.
- Poorvi Patel brought to attention of Chair that the information presented showed only PF data and the TF should cover IR as well. Chair indicated that the data dispersion is quite significant. There seems not to be consistency on the way the test is performed. Don Dorris confirmed this statement and discussion in the group leads to a possible guideline for IR testing. Sets of data A, B and C will be analyzed and brought to discussion of the group.
- Tim Raymond requested to consider the analysis using bar charts.
- Chair requested the TF to provide the best suggestion to classify the data to be presented to the Dielectrics SC. The agreement was to use Class I and Class II.
- Regarding new topics:
- K. Vijayan mentioned currently C 57.12.90 requires manufacturers to do a PF test after dielectric and impulse tests. He mentioned that there could be change in the PF values before and after the test and the final value could still be within limits but currently there is no provision to evaluate that change. Chair response was to take it up in C57.12.90 WG.
- There was discussion about the interpretation of the limits, if set, on PF and if these limits would be interpreted as a pass fail criteria for acceptance of a transformer.
- Chair's response and opinion was that this would be discussion point in WG however he is of the opinion that this will be a guide and may not be the only criteria to reject the unit. it could indicate that further evaluation/ investigation is needed if the values exceed the limit. Don Dorris shared his experience about higher PF transformers being dielectrically weak and have a reduced working life.
- With no additional new business and a plan to move forward, motion to adjour was moved by Akash Joshi and seconded by K Vijayan and meeting was adjourned at 9.10am.
- Volunteers To review the data
- Rhea Montpool, James Antweiler, Akash Joshi, Don Dorris, Dan Sauer, Poorvi Patel, Bradley E Staley, Charles Sweetser, Cornelius Plath, Tauhid Ansari, Salahuddin Shaikh, Cihangir John Sen, Lorne Gara, Stephanie Denzer, Samragni Datta
- Business meeting was adjourned at 8.50 am.

Discussion/Presentation/Decision taken during DTSC:

- Meeting was called to order at 8.00 am
 - Quorum Present = 65.9% Number of attendees = 84
- 14 guests requesting membership.
- Agenda for F19 meeting and minutes from S19 were approved.
- Three sets of data were received by IEEE SA
 - Set A = 255 units Set B = 68k units Set C = 80k units
- Action plan for this TF:
 - Data analysis carried out on Set A for PF around 20C
 - Agreed to present data separately for Class I and Class II
 - Requested to present bar charts and standard deviation analysis
 - High dispersion of IR data observed. Waiting on additional data analysis
 - Additionally, other attendees want to contribute with more data. Deadline is Nov. 30, 2019
 - Formed a group of volunteers to review the information before it is brought up to the SC with recommendations. Meeting to be arranged in January 2020 via webex (EEPEr)

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Meeting was adjourned at 9.10 am.

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B.4 Liaison Reports

IEEE High-Voltage Testing Techniques Subcommittee Liaison Report to Dielectric Tests Subcommittee of IEEE Transformers Committee Submitted by Jeff Britton (HVTT Subcommittee Chair) March 27th, 2019 Anaheim, CA

- Subcommittee met at JMX Services in Fayetteville, GA September 17-19th, 2019
- ✤ <u>Active Projects Include</u>
- IEEE P1122 Impulse Digitizer Standard. Draft 3 in development. PAR extended to 2020 – Chair: Jeff Britton, Phenix Technologies, Inc.
- IEEE P510 High Voltage Safety Guide. The Guide is presently in draft development. Expected to Ballot in 2020 – Chair: Jeff Hildreth, Bonneville Power Administration
- IEEE P2426 Field Measurement of Fast Front and Very Fast Front Overvoltages in Electric Power Systems (Entity PAR). In draft development, PAR expires and of 2021. WG will meet at JTCM in January 2020 Chair: Shijin Xie, State Grid Corporation China
- WG P454 "Guide for the Detection, Measurement and Interpretation of Partial Discharges", Chair: Detlev Gross, Power Diagnostix
- WG P4.1 "Guide for the Practical Implementation of IEEE Std 4 on High-Voltage and High-Current Measurement Systems", Chair: Bill Larzelere, Evergreen High Voltage
- ✤ IEEE 4 Revision to begin in 2020: Topics for Revision of IEEE Standard 4 2013
- ✤ <u>Next HVTT Meetings</u>
- ✤ Scheduled during week of January 12th 16th, 2019 JTCM Jacksonville, FL
- Electronic attendance is offered for most HVTT SC, WG and TF meetings via web meeting, so physical attendance is not required to participate and qualify for membership
- Contact Jeff Britton (jeff@phenixtech.com) or Jim McBride (jim@jmxhv.com) to participate

B.5 Old/ Unfinished Business

No Old business at this time was brought up and discussed.

B.6 New Business

STLI/ Special Termination Lightning Impulse

This is a new Business requested by Pierre Riffon.

Chair Comment: Topic is under discussion with Task force on Impulse Failure Mitigation (within C57.142 WG); This business will be parked for now till TF is ready with the recommendations.

B.7 Adjournment

Meeting adjourned 12.20 PM. Motion to adjourn made by Dan Sauer and Diego Robalino.

Minutes respectfully submitted by: **Poorvi Patel** Secretary DTSC.