ANNEX A Bushings Subcommittee

April 15, 2015
San Antonio, Texas USA

Chair: Peter Zhao
Secretary: Eric Weatherbee

A.1 Opening of the Meeting

A.1.1 Introductions

The Chair opened the meeting with group introduction.

A.1.2 Attendance

Membership count was taken with the following results: 29 of 37 members were present and 67 guests for a total of **96 attendees**. There were 12 new membership requests. There was a quorum.

A.1.3 Chairman's Remarks

The Chair asked for a motion to approve the F14 Washington DC minutes, motion was made and seconded with no objections

The Chair asked everyone to make a concentrated effort to update their contact information and keep it up to date.

The Chair informed the SC that webinars will be available and can be setup through Erin.

The Chair asked all of the WG chairs to please get their minutes submitted in a timely fashion for hosting on the website. He also requests that the attendance in each meeting needs to be displayed in a clear concise manner so that the appropriate meeting room size can be reserved prior to each meeting.

Six new members were added to the roster, the four in attendance were welcomed into the group and asked to stay active and contribute as much as possible.

The Chair commented that all of the WG chairs need to work together to make sure their titles and scopes are cohesive throughout all the bushing areas so that the readers have a clear path of which document covers which area.

The Chair presented the Standards Status Report for bushings, see Appendix A. He noted that the WG Chair for PC57.19.04 is seeking an extension of the PAR. The Chair reminded the WG chairs that even though the standards are now on a 10 year cycle they need to constantly be working on gathering and validating concerns so that the updates can be submitted to form a new PAR.

A.2 Working Group and Taskforce reports

A.2.1 C57.19.00-2004 – Keith Ellis, Chair

No Meeting was held. Mr. Ellis reviewed the standard and did not find anything in need of updating but asked the group to review and send him anything they deemed necessary to be brought up for discussion as a possible revision.

A.2.2 WG PC57.19.01-2000 – Dr. Shibao Zhang, Chair; David Wallach, Secretary

See complete minutes in Appendix B of this report.

A.2.3 C57.19.100-2012 – Tommy Spitzer, Chair (not present)

The guide was published February 2013, as such no meeting was held.

A.2.4 WG PC57.19.04 – Scott Digby, Chair; JD Brafa, Vice Chair; Secretary, Open

See complete minutes in Appendix C of this report.

A.2.5 IEC/IEEE 65700.19.03 – Les Rechsiedler (IEEE) and John Graham (IEC), Co-Chairs

The first dual logo standard was approved June of 2014, as such no meeting was held.

A.2.6 TF Distribution Transformer Bushings – Steven Shull, Chair

See complete minutes in Appendix D of this report.

A.2.7 TF Composite Bushings –John Graham, Chair

See complete minutes in Appendix E of this report.

A.3 External Liaison Reports

A.3.1 IEC Bushing Standards Activity – John Graham, IEEE Liaison

See complete minutes in Appendix F of this report.

A.3.2 IEEE 693 – Eric Weatherbee, IEEE Liaison

Mr. Weatherbee informed the group that there have not been any official changes since the last Bushing SC meeting as the 693 WG has not yet met to vote on the open issues. He also stated that the PAR expires at the end of this year and that no more extension can be granted. There are many open issues and it may not be possible to reach consensus in time for putting the Recommended Practice up for ballot.

A.3.3 WG PC57.160 Guide for PD Meas. in Bushings and Inst. Trans. – Thang Hochanh, Chair

Mr. Hochanh was unable to attend the SC meeting, however the minutes from the WG can be found in Appendix G of this report.

A.4 Unfinished Business

A.5 New Business

A.5.1 Bushing Reliability – Peter Zhao, SC Chair

The Chair purposed the question to the group, should we strive to form some document on bushing reliability similar to what CIGRE is currently working on? Mr. Keith Ellis commented that he thought it was an excellent idea but should consist only of users at first so they can present their findings to the SC. Mr. Fred Elliott commented that this has to be handled very carefully as this is a standards organization and probably not appropriate for this type of work unless it stays strictly with bushing types and avoids any brand names or obvious relations. Mr. David Geibel commented that he has been working on the CIGRE paper for the last six years and believes it would be more conducive to combined with that currently open and nearly complete work instead of starting over from scratch. Mr. Florian Costa suggested that Mr. Mark Rivers of Doble could help with this type of information. However, Mr. Rivers informed the SC that most utilities do not keep very good, if any records on bushings. They just replace them and throw the old ones out. This was agreed by many to be the largest hurdle this type of work will have to overcome to have any hope of establishing a working document. The SC Chair thanked all for their comments and asked that users send in any comments, suggestions or questions and that all commercial issues need to be avoided at all costs.

A.6 Adjournment 10:28 am

IEEE/PES TRANSFORMERS COMMITTEE
Status Report of Transformers Standards

STANDARD / PROJECT	TITLE	Working Group Chair / Phone / Email	Pub Year / Rev Due Dat	PAR Issue Dat / PAR Expiration	Standard Status / Remark
SubCommittee **BUSHING** Chair **Zhao P.**		(417) 345-5926 peter.zhao@HydroOne.com			
PC57.19.04	Standard Performance Characteristics and Dimensions for High Current Power Transformer Bushings	Digby S. (919) 546-5798 scott.digby@duke-energy.com		6/16/2011 **12/31/2015**	New Project
65700-19-03	Standard Requirements, Terminology, and Test Code for Bushing for DC Applications	Recksiedler 204 474 3192	2014 **12/31/2024**		Approved IEEE /IEC Dual Logo Approved by SASB in June 2014
C57.19.00	Standard General Requirements and Test Procedure for Power Apparatus Bushings	Ellis K. P. (615) 847-2157 keithcota@aol.com	2004 **12/8/2020**		Approved Formally Std. IEEE 21 Previous revision 1991. Errata issued March 2010 Reaffirmation approved 12/8/2010
C57.19.01 PC57.19.01	IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings	Zhang S. 585 768 1273 shibao.zhang@ieee.org	2000 **12/31/2018**	12/8/2010 **12/31/2017**	Approved +PAR for Revision Formally Std. IEEE 24 Reaffirmed in 2005. PAR for Rev first approved Dec 2010 Mar '10: NesCom extended PAR, unitl December 2013 PAR Extension until 2017 approved in March 2014
C57.19.100	IEEE Guide for Application of Power Apparatus Bushings	Spitzer T. (817) 584-6567 t.spitzer@sbcglobal.net	1995 **12/31/2022**		Approved New PAR requested and approved to 12/31/2010. NESCOM approved Extension till Dec 2012 Revision approved Dec 2012

WG Revision C57.19.01 Standard Requirements for Bushings.

MINUTES OF WORKING GROUP MEETING – F14 Washington DC Metro Area

The working group met on Tuesday October 21, 2014, at 9:30 am with a total of 37 participants. Of those, 22 members and 15 guests. Working Group membership is currently 50 members therefore a quorum was not achieved.

The following three guests requested membership and four were granted member status:

Name	Number of recent meetings (3 recent for membership)	Member Status Change
Barry Beaster	3	Changed to member after this meeting
Jose Izquierdo	3	Changed to member after this meeting
Kumar Mani	1	2 more meeting needed

1. Introductions and Distribution of Attendance Rosters
    a. The committee officers were introduced.
    b. Attendance rosters were circulated.
2. Establishment of Quorum
    a. A slide of WG membership was displayed. A count was performed and a quorum was not established as 22 members were present.
3. Minutes Approval
    a. Draft meeting minutes for S13 Savannah minutes were displayed on screen for a couple of minutes as refresher of activity however could not be voted on.
4. Old Business
    a. PAR Extension (to end of 2017) – reviewed timeline
    b. Scope – a slide showing the present PAR scope was displayed. The sentence referring users to 1991 guide for breaker bushings was discussed. One attendee thought it should be moved to body but not in scope and another suggested it remain in scope to allow users to quickly understand where to find breaker bushing guidance. General consensus was to leave the statement about breaker bushings in the scope paragraph. Juan Castellanos questioned if the term "free air" was defined. General consensus was free air meant to mean not inside any enclosure. Keith Ellis recommended that we call out exclusion of bus duct application which is unusual condition.
    c. Voltage Class – preferred and supplementary
        i. Slide was presented with proposed voltages. There was discussion about the 73 kV line-to-ground value that has never been published. The last 30 years it has been 88 kV at 550 kV BIL. Group discussed that 550 kV BIL should be 88 kV line to ground and 650 kV BIL should be 102 kV for 138 kV system applications. The nominal system voltage helps end-users but has drawbacks. There was much discussion but suggestion is to restore to 1991 version and not try to correct rated maximum line to ground voltages. Peter Zhao recommended we consider bushings of the future and not the past however users have legacy transformers with legacy bushings designs to retrofit.
    d. Bushing dimensions of 115 to 345 kV – up to 5,000 A

   i. 230 kV add 5000 A. 345 kV and above a 5000 A bushing is likely not needed in the standard because of very low demand. Shibao will circulate a spreadsheet with voltage classes and ratings for comment.
- e. Transformer Breaker Interchangeability (TBI) cantilever test requirement
   i. Table 4 has cantilever requirements. Annex A proposed to cover TBI as information which does not apply. The scope says the standard is not for breakers. Since it is not it applicable for breakers that we should not give treatment of TBI.
- f. RIP power factor limit
   i. Table 6 has power factor limits including 0.85% for RIP and whether it should be reduced to 0.5%. Comments from the study group were shared. Limit was established for end users to have confidence and have reference.

5. New Business
   a. Power Factor Test Voltage – no time to discuss at this meeting.
6. Adjournment
   a. Meeting was adjourned at 10:50 am.

Minutes by: David Wallach, WG Secretary.
e-mail: david.wallach@ieee.org
Sheraton Tysons Hotel, October 21, 2014.

Minutes: WG PC57.19.04 – LV Bushings rated >5000A and applied in Bus Enclosures
Date: April 13, 2015 @ 11:00am – San Antonio, TX USA

1) Attendance: 43 Attendees
   a) 14 of 21 Members were present (>50%). A quorum was reached.
   b) 29 Guests
      i) 17 repeat, 12 new
   c) 7 guests requested membership. 4 were approved - Eduardo Garcia (Siemens MX), David Geibel (ABB Inc.), James Campbell (Dominion), Sebastien Riopel (ECI)
   d) 1 member requested removal from WG = J. Arturo Del Rio (Trench)
   e) Total number of members following this meeting = 24
2) Summary:
   a) Meeting opened w/ introduction of all participants and their affiliation
   b) Announcement of volunteer, Jim Campbell (Dominion), new Secretary
   c) Meeting minutes from Fall 2014 meeting were reviewed and unanimously approved. Motion to approve made by K. Ellis and seconded by A. Natale.
   d) Membership was reminded par expires Dec. 31, 2015. We have until October 2015 to file for a par extension or complete the standard.
   e) Reviewed action items and activities from minutes in Fall 2014 meeting
   f) Product of those task forces allowed for circulation of revision 1.1 prior to meeting. 19 comments were received and reviewed in this meeting.
   g) Comments and resolution for each will be posted to the transformers committee website following the Spring 2015 meeting:
      - Motion to change the phrase "in Bus Enclosures" in the document title to "located within Bus Enclosures" in order to correct the grammatical issue that was noted in reviewer comment was made by M. Locarno and seconded by K. Ellis. The members present unanimously accepted with no objections.
      - D. Geibel volunteered to provide new dimensional figure related to reviewer comments as well as S. Riopel new comment that current figure only represents bushings rated up to 14,000A.
      - Agreement was reached to change description in table for column "W" (min. oil level) to duplicate column header from current revision of C57.19.01 (min. oil level and CT pocket)
        - D. Geibel – concerns with loss of cooling on lower end when bushing application is with minimum oil level at lowest allowable level. TF was formed to evaluate and determine what the minimum oil level should be during type testing. See action item generated from this comment.
      - Two reviewer comments centered on the statement in the Thermal Basis of Rating section related to grandfathering in of existing acceptable bushing designs. D. Geibel discussed briefly commercial considerations of performing type testing of high current bushings and volunteered to create/invent a replacement statement because the WG agrees this is too big of a loop hole to leave open. Prelim idea is to allow proof by calculation/models for a limited period of time to lessen the financial impact on bushing manufacturers.

- Reviewer comment questioned test method for cantilever testing. Resolved by referring to cantilever test procedure in C57.19.00
- Reviewer comment requested each manufacturer to specify the temperature withstand value for all bushing materials. New thermal basis of rating section addresses this request in the temperature index.
- A request will be made for reviewer to revise their submitted comment related to C1 tap for clarity
- A reviewer comment related to flange material/strength and a reviewer comment related to whether or not this standard includes (or excludes) non-condenser graded bushings were reviewed but not addressed.

3) Action items:
   a) Input into max, min, and 24hr average air temperature in metal enclosed bus from IEEE C37.23 was not concluded. D. Sharma advises C37.23 is currently in ballot for next revision and in this latest draft there is no advice as to limitations for the air temperature in the bus. TF consisting of D. Sharma (lead), D. Geibel, S. Riopel, J. Graham, S. Zhang, and M. Williams was formed to resolve before next meeting.
      a. S. Zhang recommended air temp in bus should be limited to ~65-70C.
   b) D. Geibel to provide new dimensional figure related to reviewer comments before next draft circulation
   c) TF consisting of D. Geibel (lead), M. Williams, S. Zhang, S. Riopel, and K. Mani to evaluate and determine what the max oil level should be during type testing of bushings covered by this standard.
   d) D. Geibel - volunteered to create a replacement statement in response to the reviewer comment on the statement related to the grandfathering in of existing acceptable bushing designs.
   e) S. Digby to ask member/guest to revise reviewer comment related to C1 tap for clarity

4) Adjournment: Motion to adjourn made by A. Natale & seconded by M. Williams @ 12:15p

Distribution Transformer Subcommittee
Task force / Working Group Report

Document #:	**NA**
Document Title:	**Task Force – Distribution Transformer Bushings**
Chair:	**Stephen Shull**
Vice-Chair	**Ed Smith**
Secretary	**Ed Smith**
Current Draft Being Worked On:	**NA**
Dated:	**NA**
Meeting Date:	**04/14/2015**
Time:	9:30am to 10:45am

Attendance:		
	Members	**35**
	Guests	**13**
	Guests Requesting Membership	
	Total	**48**

Meeting Minutes / Significant Issues / Comments:

Steve Shull called the meeting to order at 9:30am

The Agenda was passed out for review and acceptance. A motion was made by Ron Stahara and seconded by Jerry Murphy to accept the agenda.

Agenda:

1. Welcome
2. Roster
3. Introduction of Members and Guests
4. Old Business: How did we get here?
5. New Business:
    a. Determine the Title of the new Standard
    b. Determine the Scope of this new work
6. Adjourn

Motion was passed unanimously.

The roster was circulated. It was highlighted that immediate membership was possible due to this being the first meeting of the TF.

Steve reviewed "How we got here". He pointed out the there are no standards pertaining to this style or BIL level bushings. The primary reason that caused an interest in this subject was generated from a study of cantilever concerns in C57.12.20, Overhead Type Distribution Transformers. Peter Zhao reviewed the history behind a previous attempt to develop a standard of this nature. He said that the impedances to this work was caused by the following reasons;

- Proliferation of bushing designs
- Manufacturers and User Specifications
- Mounting
- Dimensions
- Requirements & Specifications

Steve suggested a name for the new Standard:

IEEE C57.19.02 Standard Design and Performance Requirements for Bushings Applied to Liquid Immersed Distribution Transformers

There was discussion concerning the need to include Pad Mounted Transformer Bushings. No conclusion was drawn. Extensive discussion centered on the specific requirements for this standard. Steve commented that the primary emphasis of this document would be the

Distribution Transformer Subcommittee
Working Group Report

performance characteristics of the bushing HV and LV. There was some discussion that this could get into dimensional specifications but Steve indicated that this wasn't currently the intent since these items vary widely.

Steve suggested a scope for this document.

> **This standard covers electrical, mechanical, dimensional, and related requirements for non-condenser bushings used in liquid immersed distribution transformers covered by C57.12.20, C57.12.34, C57.12.36, and C57.12.38 and that have basic impulse insulation levels (BILs) of less than or equal to 200 kV. These are to be interpreted, measured, or tested in accordance with IEEE Standard C57.19.00.**

There was a lot of discussion on this item. There was real interest to make sure we get the solid dielectric and condenser bushings defined in the document so there would be no possibility of misinterpretation. It was emphasized that condenser bushings would not be included in this standard. A lot of comments were fielded to such an extent that it was not possible to record them all.

Steve asked that each person who requesting membership to put together a list of suggested items that they would like to be consider as content in this standard. These should be sent to Ed Smith, TF Vice Chair. Ed would provide a summary for the next meeting. Ed's email address is edsmith@h-j.com.

It was decided to delay establishing the final Title and Scope until everyone has had a chance to digest the proposed Title and Scope put forth at this meeting and see the summary of ideas sent to Ed.

Motion for adjournment was made by Ali Ghaforurian and seconded by Ron Stahara. The motion pasted unanimously.

Submitted by: Ed Smith

Date: 04/14/2015

Annex A, Appendix E

TF Composite Bushings

MINUTES OF TASK FORCE MEETING – S15 San Antonio

The task force met on Monday April 13th at 3.15pm with 11 participants. Of those 8 requested membership.

At the F14 meeting in Washington DC the Bushing Sub-committee called for a Task Force to consider how emerging bushing technologies are covered by the main busing standards C57.19.00 and C57.19.01.

ACTION The task force has not been officially set up with IEEE and Peter Zhao (Chairman Bushing SC) agreed to complete ths formallity.

The questions put to the task force are:

1. Do present IEEE bushing standards adequately cover the emerging technologies?
2. What does the industry understand by the definition of "Composite Bushing"?

Some preliminery work has been done by email and John Graham gave a presentation summarising the discussions (this will be posted on the website).

New technologies considered in this review are;

A. High voltage solid dielectric epoxy capacitance graded bushings.
B. Resin impregnated fiber glass condenser bushings with silicone rubber external insulation.

Composite Bushing Definition

Present definition of Composite bushing in C57.19.00 3.11 " A bushing with an insulating envelope consiting of a resin impregnated fiber tube with or without rubber covering".

- Neither technology A or B follow this deinition.
- Technology B would comply with the addition of a note (as in IEC60137) stating that the rubber may be applied directly to the major insulation.
- The definition infers a composite bushing is a bushing using a composite insulator regardless of the major insulation type (OIP, RIP or other).
- Industry understanding of Composite Bushing was discussed, moving towards – non-ceramic, oil-free, dry-type, siesmic-proof or non-catastrophic failure.
- It was agreed to prepare a survey to determine the Utility Industry understanding or expectation of the term "Composite Bushing". **ACTION**
- Mark Rivers (Doble Engineering) agreed to circulate. Task force members to agree survey content. **ACTION**.
- A draft revision of the definition was discussed to cover these assumptions and include technologies A and B.
  "A bushing with an outdoor insulating envelope consiting of polymer applied to or integral with the bushing major insulation or applied to a resin impregnated fiber tube"

Annex A, Appendix E

Other Points

Definitions for bushing insulation material systems:

- Resin impregnated synthetics (RIS) – definition to be introduced by IEC for non-celluose condenser, is a similar definition required in C57.19.00?
- Resin impregnated fibre-glass (RIF) – Technology B (RIF) is a registered mark and cannot be used in the standards, could this technology be included in RIS?
- Cast insulation – Technology A is a condenser version of C57.19.00 – 3.10 "cast insulation bushing". A note may be necessary to include this version.
- **ACTION** – TF comments and opinion to Bushing SC and C57.19.00 Working Group.

Power Factor.

- Resin impregnated paper (RIP) – refer to previous discussions on differences between IEEE and IEC in requirements for RIP bushings for power factor. Can the limits in C57.19.01 Table 6, i.e. 0.85% be reduced?
- Can RIS and RIF be categorised with RIP?
- Cast insulation - is the present limits in C57.19.01, Table 6, i.e. 1% also applicable to condenser version.
- **ACTION** – TF comments and opinion to Bushing SC and C57.19.01 Working Group.

Partial Discharge.

- Can RIS and RIF be categorised with RIP, i.e. 10pC?
- Cast insulation - is the present limits in C57.19.01, Table 5, i.e. 25pC also applicable to condenser version.
- **ACTION** – TF comments and opinion to Bushing SC and C57.19.01 Working Group.

Thermal Basis of Rating.

- C57.19.00 – 5.4.1 includes wording – "For insulating materials with temperature index greater than 105, the hottest spot temperature rise should be chosen accordingly and agreed between purchaser and supplier.
- RIP (generally), Cast Insulation, RIS and RIF all have thermal index greater than 105 and values should be included in the standard to avoid continued discussion.
- **ACTION** – TF comments and opinion to Bushing SC and C57.19.00 Working Group.

John Graham

Chairman TF Composite Bushings

April 14th 2015

Annex A, Appendix F

IEC BUSHINGS STANDARDISATION

IEC Meetings
The IEC bushing committee SC36A met during the IEC General Session in New Delhi, India on October 19th 2013. The next committee meeting is planned for October 2016 in Frankfurt Germany.
Subcommittee Chair – John Graham, Siemens UK.
Secretary – Gian Franco Giorgi, CEDESPA, IT.

IEC60137 "Insulated Bushings for Alternating Voltages above 1000V"
A revision of the standard is being carried out by SC36A JMT5 with Convenor Lars Jonsson from ABB, Sweden. The last meeting was held in Geneva in August 2014 the main proposal are;

- Extension of test values to cover UHV bushings. Values are proposed for transformers following IEC60076, other values for switchgear are required.
- Extension of routine impulse testing following IEC60076-3 for bushings greater than 72.5kV rating was agreed.
- Thermal classification of resin impregnated synthetics (RIS) insulation is introduced.
- Temperature rise test conditions need further clarification. Application of thermal modelling was discussed in preference to the existing calculation which is seen as limited validity.
- The validity of the 120% rated current rule to cover overload currents needs clarification. All current ratings are based on daily mean ambient temperature.
- Altitude correction.
- A survey of the group has been made on the definition and characteristics for RIP, see attachement.

A Committee Draft (36A/176/CD) has been circulated with a closing date for comments at the end of February 2015. Comments received are yet to be reviewed.

IEC/IEEE6570.19.03 "Bushings for DC Application"
The document was published in July 2014.

IEC61463 "Seismic qualification of bushings"
SC36A MT6 has been formed with Paolo Cardano, Alstom P&V as convenor. The team has reviewed other existing standards including IEEE693 to strengthen the document. The second working group draft was considered strong enough to go directly to a vote which was circulated (36A/178/DTS) for comment by April 2015.

Other Work –
IEC61464 Dissolved gas analysis of oil impregnated paper bushings – No work done.
IEC62271-pt211 Bushings for direct connection transformer/GIS – re-numbered from IEC61693. Document published in April 2104. IEEE Bushing subcommittee is discussing any need for a similar document covering transformer/gas bushings.

Cigré:
Cigré working group A2: 43 Bushing Reliability, chaired by Antun Mikulecky from Hungary, a further meeting is to be held in Poland April 21st.
The group has three task forces;
It is aimed to publish the brochure during 2015.

John Graham
8th April 2015

WG PD in Bushings & PTs/CTs – PC57.160

Meeting Minutes April 13, 2015

The meeting of this Working Group was led by Thang Hochanh. The WG secretary is Thomas Sizemore.
A check was made to determine if a quorum was present. A total of 15 over 24 WG members were presents which did fulfill the quorum requirements. 42 people attend the meeting and 2 requested membership.
The meeting began with the remarks from the WG chair.

- The chair presented the draft 5.2. This draft was sent to the WG members one week before. As it was mentioned, this document and the discussion during this Spring 2015 meeting will be incorporated to the next Draft shortly and will be sent to WG members shortly. The working group members are encouraged to return the comments in before and in advance of the next Fall meeting in Memphis.
- The chair also explain the two mains topics that will be covered at this meeting :
    - Presentation of the latest PD patterns submitted to the chair
    - Review the complemented Draft 5.2

1. A review on the section related to instrument transformers was discussed.
2. Presentation of the latest received patterns:
    a. Pattern of PD caused by "*Wrinkled paper in the head insulation of a CT*".
    b. Patterns, displayed over an ellipse. This type of PD representation was very common in the 90's. It was proposed to put more emphasis on the new PD pattern representation as PRPD (phase resolve partials discharges).
    c. Pattern representing PD due to *a case of bad impregnation*
    d. Pattern due to a *loose bushing cap*.
    e. Patterns due to *defects in resin bushings*
    f. Patterns not yet identified

3. Acceptation criteria vs ambient-partial-discharge noise :
    a. The calibration is performed at the PicoCoulomb limit (100%).
    b. The 50% of the limit level is then injected for verification as well a 200% of the limit is applied.
    c. The calibration is successful if the "50% level" calibration pulse is visible and above the noise level.
    d. NOTE:
        i. In case of the random high frequency noise is higher than the 50% level, the calibration has failed and the calibration process should be corrected and resubmit.

ii. In case that, the high frequency noise is higher than the 50% level, the noise pattern is correlated to the frequency of the test source AND the 50% level calibration pulses is clearly visible, then in agreement with the customer, the calibration process is acceptable and the PD test can be performed.

4. There were agreement on the representation on the bushing that can be represented as C1-C2 and C1-C2-C3. This agreement is conditional to a note following the paragraph. This note should mention that the type of bushing with C1, C2, C3 (with test tap and voltage tap) is a known practice in Europe and is more and more in use in North America.
5. The WG chair presented calibration circuits in balanced and unbalanced configurations.

The meeting concluded due to time constraints.