

**MINUTES OF MEETING
BUSHING SUBCOMMITTEE
OF THE
IEEE/PES TRANSFORMER COMMITTEE
Porto, Portugal
October 08, 2008**

8.9 Bushing Subcommittee – Fred Elliott, Chair

8.9.1 Introduction/Attendance

Fred Elliott - Chair opened the meeting at 2:30 PM and welcomed the members and guests. There were 22 attendees with 8 members and 14 guests present. Two (2) guests were added to the membership after the meeting.

Copies of the IEEE patent policy summary was circulated with the meeting agenda. The policy was addressed in the meeting and no patent conflicts were reported.

Since Peter Zhao, the subcommittee secretary was unable to attend, Les Recksiedler assisted in taking notes for this meeting.

8.9.2 Approval of Minutes of Last Meeting

The minutes of last meeting in Charlotte, NC were approved as written.

8.9.3 Chairman's Remarks

The chair made the following remarks after attending the Administrative Subcommittee.

- Next meeting of the transformers committee will be held in Miami Florida, April 19-23, 2009.
- It is the responsibility of individual members to keep their contact information updated in the AM system. This system is used for committee communications with participants.
- A new task force chaired by Jeewan Puri is being started in the Standards Subcommittee to prepare a Transformers Committee position paper on IEC harmonization activities. Please contact Jeewan directly if you want to participate.

An additional item regarding Partial Discharge Measurements on Bushings and Instrument Transformers was added to the agenda under New Business.

8.9.4 Working Group (WG) and Task Force (TF) Reports

8.9.4.1 WG - Revision of C57.19.00 - Keith Ellis, Chair

No meeting was scheduled.

8.9.4.2 TF - Revision of C57.19.100 – Tommy Spitzer, Chair

This group did not meet. The chair plans to have a draft revision ready in October 2008. Meeting attendees requested that the draft be posted on the committee website.

8.9.4.3 TF – GSU Bushings – Catherine Hurley

The task force met on October 7, 2008 from 10:30 am – 11:45 am.

1. Attendance: There were 22 people in attendance, as follows: 10 Members; 4 Requesting Membership, and 8 Guests.
2. Agenda: An Agenda was presented by the Chair of the Task Force.
3. Minutes: The Minutes of the last meeting in Charlotte NC were presented and approved.
4. Comments on Title and Scope: Approximately 2 months ago the Chair sent a copy of the Title and Scope via email to participants of the Task Force, and she received comments. The TF proceeded to discuss the comments, as follows:

Title:

- a. There was considerable discussion of the Title, and whether it should include a reference to “Generator Step-Up (GSU).” It was decided that the reference should not be included in the title, but rather, should be included in the Scope.
- b. There was considerable discussion about use of the term “outdoor power apparatus bushings.” The consensus was to remove the phrase apparatus, to avoid confusion with other types of bushings. Instead the phrase will be changed to “outdoor power transformer bushings.”

Scope:

- c. BIL: There was considerable discussion about the reference limiting the scope to bushings that “have basic impulse insulation levels (BIL) of 200 kV and below.” It was noted that one or more manufacturer(s) have reduced the amount of copper in the bushings, such that the BIL is 250 kV. It was decided to remove the reference to the BIL altogether, because the limitation was seen as unnecessary. Also it was noted that C57.19.00-2004 does not contain a limiting reference to the BIL in its Scope. It was decided that the subject of BIL could be addressed or limited in the body of the standard to be drafted. Also, inclusion in the scope could require future revision of the PAR.
- d. Reference to “Oil Filled” vs. “Liquid Filled” Power Transformers. After considerable discussion it was decided that the term “Liquid Filled” should be utilized, in recognition of the industry trend to use this term, and also as a practical matter many people think of oil filled transformers as mineral oil-filled transformers. This change will avoid confusion. Also, a point of clarification, the reference is to liquid filled power transformers, as opposed to liquid or oil filled bushings.

- e. Current Rating: The question was raised whether the reference to bushings with rated continuous current of 5000 Amps, is too restrictive, since there are some GSU and Auxiliary Power Transformers with 3000 Amp rating. No decision was made to change the reference, because the general intent is to provide a standard for large power transformers.
 - f. "Outdoor": The point was raised that in the hydroelectric plant, the step-up transformer may not be physically installed outdoors. It was decided however that because the power transformer itself was an outdoor class, the term would be kept.
 - g. Reference to "GSU": There was considerable discussion. It was noted that the general intent is to write a standard that also applies to large Autotransformers. But for the sake of indexing and helping users locate the standard for GSU, it was agreed that some reference to GSU should be included in the scope. It was agreed that the phrase "including but not limited to generator step-up (GSU) transformers," should be added. With all the foregoing amendments, the sentence will now read "Bushings covered by this standard are intended for use as components of liquid-filled transformers, including but not limited to generator step-up (GSU) transformers."
5. Discussion of IEC/IEEE Dual logo: The question was asked whether we should work on the standard with the idea of certifying it for the dual logo. It was noted, however, that the standard to be drafted will include dimension specifications, and that generally IEC standards do not include dimensions, and so it may be impractical to seek a dual logo. John Graham from Trench will be attending the upcoming IEC meeting in November and he volunteered to make an informal inquiry about the subject, to see if the IEC is nonetheless receptive to a dual logo for our standard.
6. PAR: The Chair's intent is to draft the PAR and send it out for comment before it is formally submitted. The draft version of the PAR will be sent via email to participants of this meeting as well as the prior Charlotte meeting. Comments should be sent back to cahurley@aep.com. It was decided that the PAR should request the maximum time (5 years), although work on the standard could be completed sooner.
7. Adjournment: The meeting was formally adjourned.

8.9.4.4 C57.19.03 – DC Bushing Standard – Les Recksiedler, Chair

The WG met on October 7, 2008. This was the second meeting of the WG. Fourteen (14) members and four (4) guests attended the meeting. The meeting was chaired by Mr. Les Recksiedler and the secretary was Pierre Riffon.

The agenda has been reviewed and accepted as written.

The first technical subject on the agenda was a presentation made by Pierre Riffon regarding different aspects to DC converter bushings that may need to be considered since the actual edition of IEEE C57.19.03 does not cover these specific technical considerations. The topics discussed were:

- Determination of an heat run test equivalent current by considering extra losses produced by the specified harmonic current spectrum. A method based on the one given in Annex A of IEEE C37.23 has been presented for future consideration by the WG membership.
- Influences of high air ambient temperature and low humidity level normally prevailing in DC valve halls of HVDC converters on temperature rise performance and on dielectric withstand capability of the indoor air insulation. For the temperature rise test, simulation of the high ambient valve hall air temperature may need to be simulated by erecting a special enclosure since no correction factors are available for the time being. Moreover, special attention has to be paid on operating temperature of bushing terminals located in the valve hall. For dielectric tests, IEEE Std. 4 atmospheric correction factors have to be applied during tests or test at elevated air temperature may be needed to demonstrate the voltage withstand capability of the indoor air insulation of DC bushings.
- Needs of performing DC applied test and polarity reversal test for DC bushings intended for back-to-back converter stations having relatively low rated DC voltage (< 100 kV dc). The proposal was to change the test requirement from a routine test to a sample test since the added value of such test is questionable (very few failures have been found up to now for this voltage level) and that the risk involved for delaying a project is relatively low since delivery time of this type of bushing is significantly better than for higher rated DC voltage bushings (e.g. 500 or 800 kV DC bushings).

These three topics and suggestions were presented for future considerations by the WG membership and will be discussed in future meetings.

The second item on the agenda was related to the need of standardization of insulation level values for 800 kV DC system bushings. A joint IEC-CIGRE group has been created to discuss this subject. For the time being, the WG will wait for their report and recommendations before implementing specific rated values in the next edition of C57.19.03.

The third subject was the need of incorporating special requirements related to DC converter bushings used in conjunction with VSC converters. After discussion, since this type of converters is more and more in use, specific requirements applicable to these bushings need to be implemented into the next edition of C57.19.03. Mr. Cristoph Ploetner and Mr. Ulf Radbrandt will make a proposal.

Finally, the scope of the next edition of C57.19.03 has been reviewed and needs to be reworded. It shall include gas-insulated DC bushings since they are more and more in use. Pierre Riffon will make a proposal for discussion. If accepted, the PAR has to be modified in line with the changes that will be agreed upon. Harmonization with IEC 62199 will also be considered.

The meeting adjourned at 4:00 pm on October 7, 2008.

8.9.4.5 IEC Bushing Standards Activity - John Graham of Trench Ltd., UK

IEC60137 “Insulated Bushings for Alternating Voltages above 1000V”

Edition 6 was published in July 2008 following a majority positive vote by National Committees. The content of the document was previously agreed with IECTC14 Transformers regarding an increased level of testing described in detail in my report at Minneapolis. Nevertheless, the German National Committee returned a negative vote contrary to this agreement. It is expected that during future revisions TC14 will take a firmer stand on the demand for routine lightning impulse testing of all transformer bushings at a 10% enhanced level.

This work by SC36A MT5 is now closed.

IEC62199 “Bushings for DC Application”

This standard is the IEC equivalent of IEEE C57.19.03 currently under review.

A corrigendum was published in June 2008 to correct an error in the formula for calculating the applied AC test voltage.

It is proposed that SC36A MT5 take over the review of this document.

IEC Meetings

The IEC committees TC36 “Insulators” including SC36A “Bushings” will meet during the IEC General Session in Sao Paulo, Brazil during the week of November 17th 2008.

For general interest the standard IEC60815 “Selection and dimensioning of insulators” is being revised in several parts to cover AC and DC, Porcelain and Composite. The first parts have been published with changes in the guide away from the previous simple specific creepage distances (16, 21, 25, 31..mm/kV) used in the previous document to rules more specific to site conditions.

8.9. 5.Old Business

8.9.5.1 IEEE 693 Bushing Update -

The IEEE 693 working group met in April, 2008 in conjunction with the Substations Committee. The group is actively revising the base document in many areas. Those specific to bushings are discussed here. The working group is also working on a Commentary, which is not an official part of the document, but which includes the background to the decisions which shaped the document.

A presentation on Japanese seismic design standards and practices was given by guests, Dr. S. Murase and Dr. Y. Shumuta

As discussed in previous reports, one of the major topics is the interaction between bushings and transformers. It is believed that present qualification methods do not adequately address this issue. Research aimed at this is proceeding, based on recommendations from the Bushing Advisory Committee. Still welcome more involvement from transformer manufacturers – results will affect design requirements.

Testing as described in previous reports proceeding at MCEER in Buffalo, New York. Planned testing includes two major methods.

One is to investigate the affect of cover flexibility, bushing position, etc. by means of direct shake-table tests. A bushing will be mounted to a plate with some flexibility, the plate will be mounted to a rigid frame, and parameters such as size, bushing position, etc. will be varied.

The second is to combine Finite Element Analysis with physical testing of a bushing on the shake-table. A simplified FEA model of a transformer tank will be fed the inputs normally used for the shake-table. This will be solved in real-time, and the output used to control the shake-table to simulate motion at the bushing.

Additional research activities include the following:

Additional testing performed on hollow-core composite insulators in attempt to come up with better acceptance criteria.

Research effort being started to study base isolation of transformers as a means of improving their seismic performance.

A related research effort is being started to look at conductor-induced loads as associated with base isolation of the transformers.

8.9.6 New Business

The history and status of C57.19.01-2000 was discussed. Action on the status of this document is required by the end of 2010.

8.9.7 Technical Papers

No activity was reported for this mtg.

8.9.8 Adjournment

The meeting adjourned about 4:15 PM.

Minutes submitted respectively by,

Fred E. Elliott

Chair
Bushing Subcommittee