MINUTES OF MEETING
BUSHING SUBCOMMITTEE
OF THE
IEEE/PES TRANSFORMER COMMITTEE
MINNEAPLOS, MN
OCT 17, 2007

8.9 Bushing Subcommittee – Fred Elliott, Chair

8.9.1 Introduction/Attendance

Fred Elliott - Chair opened the meeting at 3:00 PM and welcomed the members and guests. There were 44 attendees with 13 members and 31 guests present. Two (2) guests requested for membership

IEEE patent policy was addressed and no patent conflicts were reported. The Chair informed the participants please review information on Transformers Committee website for details.

8.9.2 Approval of Minutes of Last Meeting

The minutes of last meeting in Dallas, TX were approved as written.

8.9.3 Chairman's Remarks

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

- Next meeting will be held in Charlotte, North Carolina, March 16-20.
- To join in balloting process, one must be a member of IEEE Std Association.
- References used in the documents shall be properly addressed and referred.

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

C57.19.100 Bushing Application Guide

Tuesday, Oct 16, 2007.

The meeting was called to order at 3:15 pm with 15 members and 5 guests. After introductions, no one had any patent disclosers. The minutes from the spring meeting were approved.

Draft 1 of the revision was distributed before the meeting and Trench and PCORE both had comments and changes to the draft. These will be included in Draft 2. The Chair plans to continue to distribute these by e-mail and have a final document in time for the next meeting and proceed to balloting.

The meeting was adjourned at 4:30 pm.

8.9.4.3 TF – GSU Bushings – Catherine Hurley, Acting Chair for Les Recksiedler

Catherine reported as follows:

Task Force – GSU Bushings Standardization
9:30 – 10:45 AM, Tuesday, Oct 16, 2007

1. Introduction – Everyone
2. Sign in Lists – Attendance 37 – 13 members
3. Titles for the standard
    a. Discussion about limiting MVA or current for this standard, this will not occur
    b. It was determined that this standard would follow a similar title as C57.19.01 since these bushings are specifically excluded from this standard
    c. Hurley will prepare this final title and send out to all members for comments
4. Discussions over if this should be a guide or a standard. Concerns about agreement between all parties if it becomes a standard. It was determined that it was most beneficial to proceed with a standard.
5. It was determined that this standard would be a companion standard to C57.19.01 with references to C57.19.00. This standard will include LV bushings only with high current that are excluded from C57.19.01
6. Scope of Work
    a. It was discussed to have a similar detailed scope as C57.19.01 has
    b. C Hurley will draft this an send out a copy to all members for comments
7. IEC bushing standard
    a. Volunteers were requested to compare to the IEC bushing standard
    b. IEC bushing standard also excludes these bushings but will be updated in the next revision
    c. John Graham volunteered to correspond with the IEC on this information
8. List of GSU bushings available
    a. C Hurley volunteered to get the information for AEP
    b. Keith Ellis volunteered to provide a list for manufacturers to compare

8.9.4.4 C57.19.03 – DC Bushing Standard – Fred Elliott, Chair

No meeting was scheduled.

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

IEC BUSHINGS STANDARDISATION

Revision of IEC60137 "Insulated Bushings for Alternating Voltages above 1000V"

A Committee Draft was passed at the IEC TC36: Insulators meeting in Berlin in September 2006. The document had a majority positive vote but there were strong objections again from TC14: Transformers.

At their meeting in South Africa and subsequently in Mexico TC14 made a decision that testing of transformer bushings in IEC60137 should cover all the requirements for transformer tests in IEC60076-3: 2000 with an additional 10% on test voltage. This requirement would mean all bushings >72.5kV rated would be subject to lightning impulse tests with additional switching impulse and long duration AC withstand required for some higher voltage bushings. SC36A have continued to object to this requirement on the basis of technical justification and cost.

In September 2007 a meeting of the officers of SC36A, TC14 and SC17C: Switchgear was held in Geneva. A compromise was reached on changes to bushing tests as follows:

<table>
<tr><th></th><th colspan="2">Type Test</th><th>Routine Test</th></tr>
<tr><td>Lightning Impulse</td><td colspan="2"></td><td></td></tr>
<tr><td>≤72.5kV</td><td colspan="2">FW ± ve 100%</td><td>Not Applicable</td></tr>
<tr><td rowspan="3">>72.5 to <245kV</td><td>FW + ve 100%</td><td rowspan="3">On 3 bshgs</td><td rowspan="3">Not Applicable</td></tr>
<tr><td>FW – ve 110%</td></tr>
<tr><td>CW – ve 121%</td></tr>
<tr><td>≥245kV</td><td colspan="2">FW + ve 100%</td><td>FW – ve 100%
(CW – ve 11%)</td></tr>
<tr><td>AC Withstand</td><td colspan="2"></td><td></td></tr>
<tr><td>≤72.5kV</td><td colspan="2">1min wet 100%</td><td>1min dry 110%</td></tr>
<tr><td>>72.5 to ≤245kV</td><td colspan="2">1min wet 100%</td><td>1min dry 110%</td></tr>
<tr><td>≥170kV</td><td colspan="2">ACLD</td><td>1min dry 110%</td></tr>
<tr><td>Switching Impulse</td><td colspan="2"></td><td></td></tr>
<tr><td>< 245kV</td><td colspan="2">Not Applicable</td><td>Not Applicable</td></tr>
<tr><td rowspan="2">245kV</td><td colspan="2">Dry + ve 100%</td><td rowspan="2">Not Applicable</td></tr>
<tr><td colspan="2">Dry – ve 110%</td></tr>
<tr><td rowspan="2">≥ 300kV</td><td colspan="2">Wet ± ve 100%</td><td>Not Applicable</td></tr>
<tr><td colspan="2">Dry – ve 110%</td><td></td></tr>
</table>

These changes will be included in a final draft (FDIS) to go to vote by the end of 2007 with probable publication in 2008.

Review of IEC61464 "Dissolved Gas Analysis of Oil Impregnated Paper Bushings"

This document was published as a Guide in 1998. SC36A will join TC10: Insulating Fluids to review this document and incorporate in the wider guide IEC60599: Interpretation of DGA from oil filled equipment. TC14 may also join this work.

John Graham
12 October 2007

8.9. 5.Old Business

IEEE 693 Bushing Update

A. Next IEEE 693 Meeting October 23-24, 2007

Main Topic: Discussion of an early draft of a proposal to change the qualification procedure for bushings.

Brief outline of the proposal:

I. The bushing manufacturer would perform a shake table test, using modified IEEE 693 requirements, to determine a failure rating based on a g-level at the "Critical Center of Gravity" and the basic IEEE 693 spectral shape. The g-level reported would be that which causes failure of the bushing (independent of the traditional 0.25g or 0.5g values). The bushing manufacturer would develop a structural, finite element, model for the bushing that is validated by the shake table tests.

II. The transformer manufacturer would develop a "detailed" finite element model of the transformer, including the bushing model information, and perform a time history analysis. The analysis would be required to show that:

a. The bushing has not exceeded a specified level at the Critical Center of Gravity.
b. The transformer maximum input ground motion g-level at the specified bushing level.

(Example, the shake table test shows the bushing will fail at 1.2g at the Critical Center of Gravity. The bushing manufacturer reports to the transformer manufacturer a bushing design level of 0.6g, 50% of the failure value, applied at the Critical Center of Gravity. The transformer model shows that a 0.25g ground motion input causes a 0.6g bushing acceleration at the Critical Center of Gravity.)

III. The utility would specify a required transformer input ground motion. The transformer manufacturer would design the transformer to satisfy the Utility's input ground motion requirement and the bushing manufacturer's g-level requirement at the Critical Center of Gravity.

The Critical Center of Gravity is the bushing CG only considering the upper portion of the bushing, above the flange connection to the tank.

B. 500 kV Bushing Shake-Table Research

MCEER (University of Buffalo, New York) is still conducting 500 kV bushing shake table test research. This project could receive additional funding from the California Energy Commission.

Reported by Fred Elliott based on input from others.
Oct 17, 2007

8.9.6 New Business

No new business was reported.

8.9.7 Technical Papers

No activity was reported for this mtg.

8.9.8 Adjournment

The meeting adjourned at 4:15 PM.

Minutes submitted respectively by,

Peter D. Zhao

Secretary
Bushing Subcommittee