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Attention: Mr. Bob Vojtila

REPORT
Dielectric and Mechanical Tests on Aged E/Bus Support Cover and E/Bushing Covers

Items Supplied:
1. E/Bus Support Cover; in service for 18 years.

E/Bus Support Cover

2. E/Bushing Cover-Large; in service for 14 years.

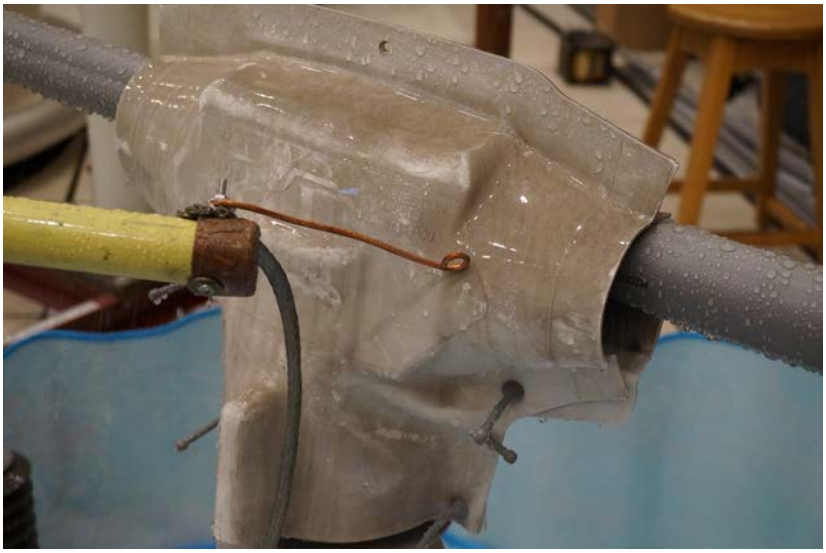
E/Bushing Cover-Large

Purpose of Tests: To determine if E/Bus and E/Support covers meet the design requirements of IEEE 1656 after, respectively, 18 and 14 years of service, as tested in the "as received condition".

Date performed: October 21 & 22, 2020
Tests performed by: Mohana Krishnan
Witnessed by: E.A. Cherney

Laboratory conditions: Temperature - 22 ^{0}C
Relative humidity – 58 %
Barometric pressure **–** 750 mm Hg

Test 1: Moving Electrode Test (Clause 5.2 of IEEE Std. 1656, Wet withstand – Option 1)
IEEE Std. 1656 refers to IEEE Std. 4 for the specification of the rain rate and resistivity, being 5 ±0.5 mm/min and 178 Ω.m. The rain rate was measured as ~ 5 mm/min and the water resistivity was 13 Ω.m.



E/Bus Support Cover applied to a 34.5 kV station post

The E/Bus Support Cover was applied to a 34.5 kV station post, with 1 inch bus conductor, and with E/Insulation applied to the bus at each cover exit. The insulator was tested at 26 kV (phase-to-ground) (120% of the phase-to-ground rated voltage).

Remarks: No puncture or flashover occurred.

E/Bushing-Large Cover applied to a 34.5 kV transformer bushing.

The E/Bushing-Large Cover was applied to a 34.5 kV transformer bushing and tested at 26 kV (phase-to-ground) (120% of the phase-to-ground rated voltage).

Remarks: No puncture or flashover occurred.

Test 2: Wet Power Frequency Flashover (Clause 5.3 of IEEE Std. 1656)

A 34.5 kV polymer station post was tested for wet power frequency flashover, first without the E/Bus Support cover and then with the cover installed. For the cover test, a 1 inch bus conductor, with E/Insulation was applied to the bus at each cover exit. Three flashovers were obtained and the average for the uncovered post insulator was 120 kV; but somewhat lower at 87 kV with the cover installed. The flashovers took place along the post and on the inside of the E/ Bus Support cover. The wet contamination on the inside of the E/Bus Support cover contributed to the lower wet flashover. However, the insulation margin is still quite high.

Similarity, a 34.5 kV transformer bushing was tested for wet power frequency flashover, first without the E/Bushing-Large cover and repeated with the cover installed. The average of three flashovers of the bushing was 93 kV and with the bushing cover applied, it was 60 kV. Once again, the flashovers took place along the inside of the cover and the wet contamination on the inside of the cover contributed to the lower wet flashover. As with the station post test, the insulation margin was high.

Contamination on inside of E/Bus Support cover.

Contamination on inside of E/Bushing cover.

Test 3: Dielectric Strength as per ASTM D149

Dates performed: November 3 and 30, 2020
Tests performed by: Mohana Krishnan

Laboratory conditions: Temperature - 22 ^{0}C
Relative humidity – 34 %

Barometric pressure – 750 mm Hg

Sample	Breakdown Strength kV/mm		
	New Bus Cover	Aged Bushing Cover	Aged Bus Cover
1	17.9	16.6	16.8
2	17.8	15.6	16.2
3	16.0	16.2	16.5
4	15.6	15.5	16.3
5	15.8	16.7	14.8
Average	**16.6**	**16.1**	**16.1**

*Sample thickness between 2.1 and 3.0 mm

Remarks: No discernible reduction in dielectric strength was observed with age.

Test 4: Physical Properties

Dates performed: November 25, 2020 and January 14, 2021
Tests performed by: Waterloo Mechanical Engineering laboratory

A MINIMAT 2000 tensile tester was used to measure the tensile strength and elongation at break and these tests were performed in accordance with ASTM D3039. For each test, the number of samples was 5. These results are shown in the table below. Hardness gives an indication of the change that occurs in RTV rubber that results from oxidation. A type-A durometer tester with an accuracy of ±1 point was used following the procedure in ASTM D2240. The thickness of samples was 0.243 in and five measurements were carried out spaced on the surface of the samples and the range of hardness is reported in the table below.

	Item	Sample Thickness (in)	Sample Width (in)	Average Breaking Strength* (lb/in^2)	Elongation* at Break (%)	Shore A Hardness*
14 yrs	Aged Bushing Cover	0.243	0.109	459.3 ± 38.6	81.1 ± 9	74 - 78
18 yrs	Aged Bus Cover	0.243	0.099	0211.2 ± 59.9	42	76 - 81
	Unaged Bus Cover	0.243	0.100	682 ± 29	266	60

*Average of 5 measurements

Remarks: An increase in the hardness, a reduction in breaking strength and in elongation at break was observed on the aged covers.

Professor E.A. Cherney
High Voltage Electrical Laboratory Industry Liaison