

ESSEX GROUP

POWER CONDUCTOR DIVISION
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FILE

QUALIFICATION TEST
OF
AGED AND UNAGED

UNDER A
SIMULATED LOCA/DBE
BY
SEQUENTIAL EXPOSURE
TO
RADIATION, STEAM AND CHEMICAL SPRAY
ENVIRONMENTS

SEQUOYAH

80-827320-1

<p>APPROVED</p> <p>This approval does not relieve the Contractor from any part of his responsibility for the correctness of design, details and dimension.</p> <p>TENNESSEE VALLEY AUTHORITY</p> <p>Date SEP 23 1980</p> <p>W.W. CHANDLER</p>

JUNE 1979

Subsidiary of
8204090465 820407
PDR ADCK 05000327
P PDR

DISCUSSION & CONCLUSION

This section will serve to expand on the conclusion drawn by Isomedix as shown in paragraph 7.0.

To preface the testing conducted at Isomedix all the samples of cable that were submitted were tested according to the requirements of paragraph 2.5 of IEEE Standard 383-1974 and passed. Further, all the specimens identified in the test report as aged were confined to a circulating air oven for a period of 149 hours at a temperature of 162C. This aging time and temperature coincides as a point to a line drawn parallel with a line that intersects the four (4) temperature points developed by long term aging and plotting according to the Arrhenius Technique. The parallel line intersects the point on the Arrhenius chart of 90C for 40 years. Typically, the aged specimens are identified on the Sample Description list be even numbers.

Both aged and unaged specimens were then submitted to Isomedix and were placed on test mandrels. The cables, thus mounted, were subjected to gamma radiation from a Cobalt 60 Source at a dose rate of approximately 0.7 Megarads per hour to an accumulated dose of approximately 205 MRads.

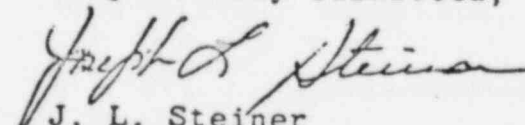
The mandrels with cables were then installed in the pressure vessel and the pressure, temperature, spray profile was then begun.

Upon completion of the 34 day profile period, the specimens were then straightened & recoiled around a mandrel 40 times their respective diameter and subjected to an AC high potential test of 80 volts/mil of insulation for five (5) minutes.

Any specimen to withstand the complete test profile including 600 Vac energization during the 34 day steam profile and the final hi-pot is judged to have been qualified for Class 1E service.

By these criteria samples identified as numbers 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, and 17 have comformed in all respects. The failure of samples 6, 14 and 18 was due to "cracking" of the cables during the terminating operation as the cables were placed in the pressure vessel after irradiation. Cable 15 was mechanically damaged during insertion of the cables into the pressure vessel. Cable 16 did-as far as could be determined - fail to withstand the rigors of the test.

Respectively submitted,


J. L. Steiner
Chief Engineer

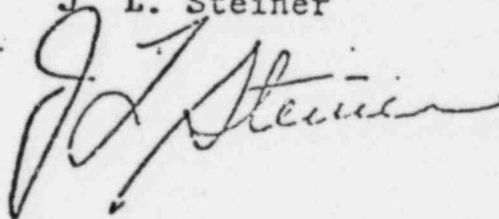
Power Conductor Division
Essex Group, Inc.

JLS/jc

LOCA SIMULATION
TEST SCHEDULE

1. Specimens (aged and unaged) at Isomedix by:
January 22, 1979
2. Mount on mandrels and subject to irradiation:
Start - January 24, 1979
Finish - February 10, 1979
3. Place in cell & terminate ends:
Week of February 11, 1979
4. Start T/P/S/ profile:
February 16, 1979
5. End T/P/S Cooldown:
March 22, 1979
6. Final test:
March 23, 1979
7. Final Report issue:
April 22, 1979 (latest)

J. L. Steiner

A handwritten signature in cursive script, appearing to read 'J. L. Steiner', is written over the typed name.

LOCA SIMULATION
TEST FORMAT

- Done At Essex -

1. Collect samples of cable according to Sample ID list.
2. Subject cable to IEEE 383 Fire Test or ULVW-1 Test depending on Sample Make-up.
3. Age in circulating air oven one each of the samples proposed for LOCA Test.
Age for 149 hours at 162C even numbered samples
4. Package & ship to Isomedix, Inc. to arrive by:
January 22, 1979.

- Done At Isomedix -

5. Wrap specimens onto test cell mandrels.
6. Subject to Gamma irradiation (Co 60 Source) to a total dose of 200 Megarads at a dose rate no greater than 1 Megarad per hour.
7. Insert test cell mandrels with cable still in place into test cell and terminate specimens.
8. Fill cell with water and measure and record insulation resistance (IR). Drain water.
9. Connect cable conductors to voltage and current sources to provide 600 volts to all specimens and 20 amperes to all #12 AWG conductors.
10. Connect necessary steam and spray lines and all thermo, pressure and volume sensing units.
11. Energize cable and commence Temperature/Pressure/Spray (T/P/S) profile according to the attached sketch (SK-L-2-1).
12. The spray shall consist of the following constituents:
Boric Acid -- 0.28 Molar
Sodium Thiosulphate-- 0.094 Molar
Sodium Hydroxide to maintain a pH of 8.0 to 11.0 throughout the test.
The spray volume shall be adjusted to produce a spray rate of 0.25 gpm/ft² of exterior specimen surface.

13. Insulation Resistance (IR) shall be measured as in Step 8 and as follows:

- A) At each dwell during the high temperature phase of the profile;
- B) Once each day during the seven (7) day dwell at 265°F;
- C) Twice per week during the twenty-seven (27) day cooldown (3 psig period); and,
- D) At end of exposure.

Measurements will be made with a suitable DC measuring device whose source voltage does not exceed 500 Vdc.

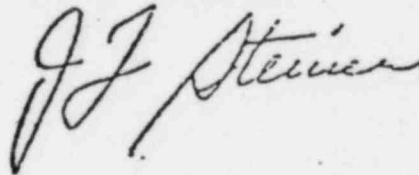
14. At the conclusion of the test T/P/S profile the specimens shall be removed from the test cell mandrel(s) and wound onto a mandrel whose diameter is 40 times the specimen OD. The specimens thus prepared shall be immersed in water - except for the ends and shall withstand the application of a final high potential 60 Hz test voltage equal to 80 volts/mil of insulation thickness for five (5) minutes.

Specimens 1 thru 18, incl. 2400 volts

15. The specimens will be packaged and returned to the Essex High Voltage Laboratory.

16. A complete report shall be provided describing the test occurrences and results.

J. L. Steiner



ESSEX
LOCA SIMULATION
SAMPLE ID

<u>SAMPLE #</u>	<u>XP#</u>	<u>DESCRIPTION</u>
1	1061	.030" EP 1/C Unaged
2	1061	.030" EP 1/C Aged 149 hours at 162C
3	1062	.030" EP 1/C Unaged
4	1062	.030" EP 1/C Aged 149 hours at 162C
5	1063	.030" EP 1/C Unaged (Colorable)
6	1063	.030: EP 1/C Aged 149 hours at 162C (Colorable)
7	1064	.030" EP 1/C Unaged (Colorable)
8	1064	.030" EP 1/C Aged 149 hours at 162C (Colorable)
9	1065	.030" EP/.015" HYP 1/C Unaged
10	1065	.030" EP/.015" HYP 1/C Aged 149 hours at 162C
11	1066	.030" EP/.015" HYP 1/C Unaged
12	1066	.030" EP/.015" HYP 1/C Aged 149 hours at 162C
13	1067	.030" EP/.060" HYP overall 7/C Unaged
14	1067	.030" EP/.060" HYP overall 7/C Aged 149 hours at 162C
15	1068	.030" EP/.060" EP overall 7/C Unaged
16	1068	.030" EP/.060" EP overall 7/C Aged 149 hours at 162C
17	1069	.030" EP/.015" HYP/.060" HYP overall 7/C Unaged
18	1069	.030" EP/.015" HYP/.060" HYP overall 7/C Aged 149 hours at 162C

ARRHENIUS AGING PLOT

CLASS 1E EP
INSULATION

-COLORABLE-

40yr

TEST
CURVE

TRANSPOSED
CURVE

AGING
POINT
149 hrs @ 162C

177 162 150 136

20

ESSEX
GRO

TEMPERATURE (°C)

$\times 10^5$

$\times 10^4$

$\times 10^3$

$\times 10^2$

$\times 10$

TIME

HOURS

AS 21119-40

SEMI-LOGARITHMIC, 5 CYCLES & 20 DIVISIONS

ESSEX GRO

ESSEX GRO

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