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ISOMEDIX

QUALIFICATION TEST OF ELECTRIC CABLES UNDER A SIMULATED LOCA/DBE BY SIMULTANEOUS EXPOSURE TO ENVIRONMENTS OF STEAM/CHEMICAL-SPRAY AND RADIATION

PERFORMED FOR ESSEX INTERNATIONAL, POWER CONDUCTOR DIVISION

LAFAYETTE, INDIANA

QA DOC. INDEX
SER.# EØ0025
DATE 11/75
KEYWORDS
1.
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EXP.

BY THE COMPONENT TESTING DIVISION

ISOMEDIX, INC.

PARSIPPANY, NEW JERSEY

NOVEMBER, 1975

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC GENERATION SECTION AEPSC, N.Y.
ACCEPTED BY: W R Farguharson
DATE: 062677
FILE: E9165 ESSEX INT
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ITEM # 3116

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SECTION 1. INTRODUCTION AND SUMMARY

A qualification test on electric cables was performed in accordance with the suggestions contained in IEEE 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations", and IEEE 383-1974, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

Twenty-five 1/c-12 Awg cable samples were subjected to a 7 day simultaneous thermal/radiation aging exposure, followed by a 30 day simultaneous exposure to environments of radiation steam and chemical-spray, while electrically energized at rated voltage and current loading. This loading consisted of a potential of 600 volts (a.c.) between conductors and to ground and current loading of 15-20 Amps on each conductor.

Approximately 50 feet of each cable sample was subjected to the exposure environments. The samples were irradiated in a Cobalt-60 field of gamma radiation at a rate resulting in a total accumulated exposure of 200 megarads, air equivalent, over the entire test period.

Measurements of insulation resistance were made periodically during the exposure period at 500 volts (d.c.). High voltage withstand tests were conducted at the end of the exposure period following a 40 diameter mandrel bend test with the cables immersed in water.

Thirteen cable samples withstood the entire test exposure and successfully completed the high-pot test performed at the end of the program. The high-pot test was conducted at a voltage level of 2.2 KVAC corresponding to twice the rated voltage plus a 1000 volts A.C. Current leakage measured during the high-pot test varied between 1.2 milliamps and 5.5 milliamps.

The test program was conducted during October and November of 1975 at the test facilities of Isomedix, Inc. in Parsippany, New Jersey.

SECTION 2. DESCRIPTION OF CABLE SAMPLES

Twenty-five cable samples were received from Essex, ranging in sizes from .162OD to .230"OD. The following table describes the samples as they were received from Essex with the sample numbers as affixed to the cable by Essex and the corresponding tag number affixed by Isomedix.

TABLE 1

DESCRIPTION OF SAMPLE

Isomedix Tag No.	Essex Tag No.	Description of Sample
→ 1	2	White, brittle
→ 2	3	Brown, brittle
→ 3	35	White, brittle
4	4	Brown, brittle
→ 5	27	White, brittle
6	6	White, flexible
7	7	Black, flexible
8	8	Black, flexible
9	26	White, flexible
10	10	Black, flexible
11	11	Black, flexible
12	12	Black, flexible
13	13	Grey, spongy
14	14	Brown, brittle
15	15	Brown, brittle
16	16	Purple, brittle
17	17	Black, flexible
18	18	Black, flexible
19	19	Black, flexible

Isomedix Tag No.	Essex Tag No.	Description of Sample
20	20	Yellow, brittle
21	21	Black, flexible
22	22	Brown, flexible
23	23	Black, flexible
24	24	Brown, flexible
25	25	Grey, spongy

SECTION 3. TEST PROGRAM

3.1 PURPOSE.

The purpose of the program was to provide qualification tests on electric cables in accordance with the suggestions contained in IEEE 323-1974, "IEEE Standards for Qualifying Class 1E Equipment for Nuclear Powered Generating Stations", and IEEE 383-1974, "IEEE Standard for Type Test of 1E Electric Cables, Field Splices and Connections for Nuclear Powered Generating Stations".

3.2 DISCUSSIONS.

3.2.1 PHASE 1. THERMAL/RADIATION AGING

The cable samples were installed inside of pressure vessel and placed in a radiation chamber and subjected to a 7 day thermal/radiation aging environment with the temperature inside the vessel maintained at 250°F. Radiation was from

a Cobalt-60 source of gamma radiation at an exposure rate resulting in an accumulated equivalent air dose of 50 megarads during this period.

3.2.2 PHASES II AND III - LOCA SIMULATION AND POST-LOCA COOLDOWN

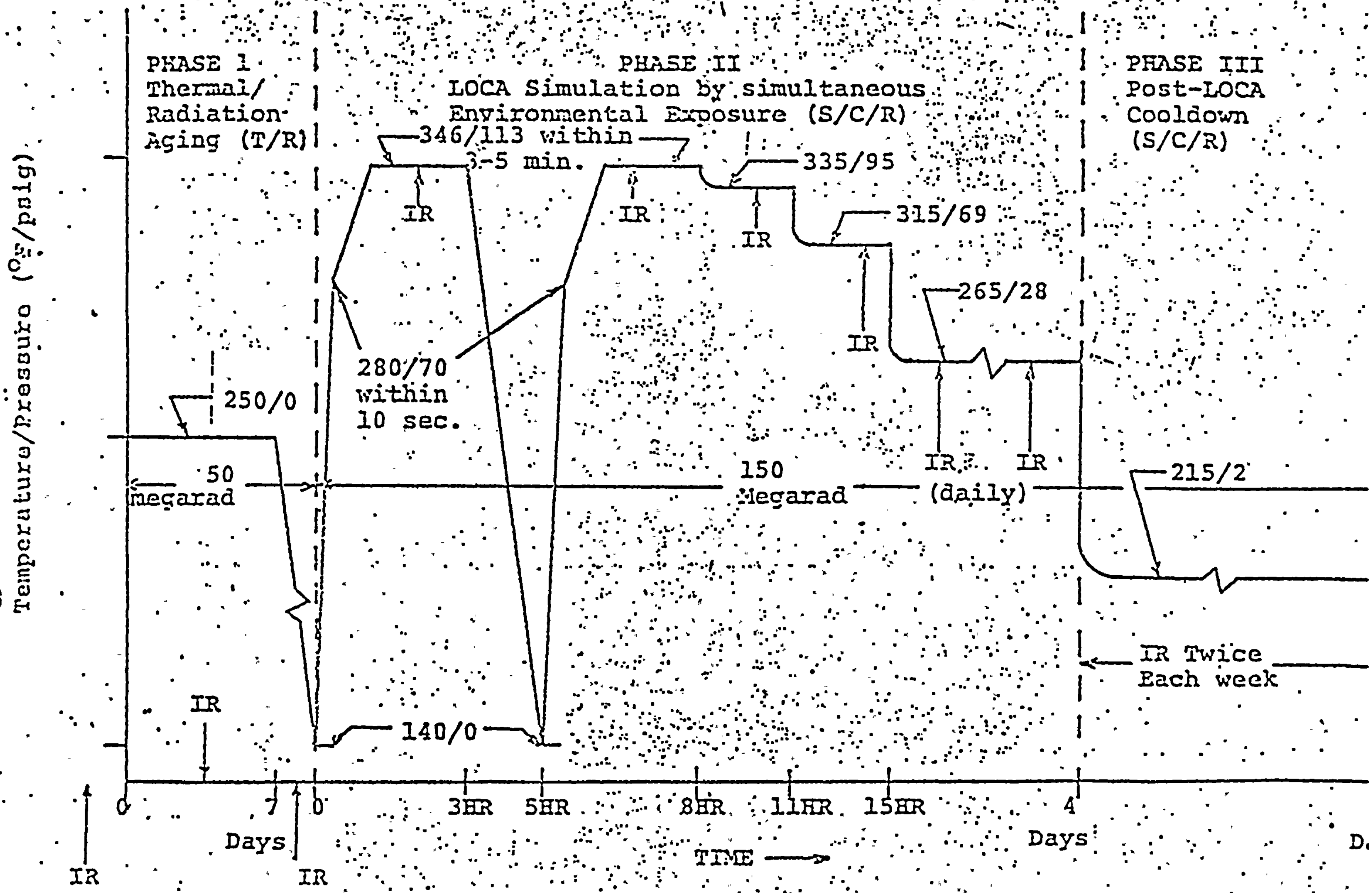
At the conclusion of this simulated installed-life aging cycle, the samples were exposed to a simulated loss-of-coolant accident (LOCA) environment by simultaneous application of radiation/steam and chemical-spray for a period of 30 days in accordance with the temperature profile shown in Figure A1 of Appendix A of IEEE 323 and as shown on Figure 1. The samples were continuously sprayed with a chemical solution consisting of 3000 ppm boron as boric acid in solution with 0.064 molar sodium thiosulfate buffered with sodium hydroxide to a pH between 9 and 11 at room temperature. The spray rate was approximately 2 gpm corresponding to 0.15 gpm/ft^2 of the surface area of the mandrel.

The cable samples received an additional radiation dose of 150 megarads, air equivalent, during this portion of the test program.

3.2.3 POST-LOCA TESTS

At the conclusion of the simulated LOCA event, the vessel was taken out of the radiation chamber. The samples

FIGURE I



Temperature/pressure profile for simulation of loss-of-coolant accident (LOCA) design basis event (DBE) by simultaneous steam/chemical-spray/radiation environmental exposure (after IEEE 323-1974 figure A1 of Appendix A)

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were removed from the mandrel, straightened and recoiled around a mandrel whose diameter was 40 times the cable diameter. While so-wound, the cables were inspected for cracks, immersed in water and subjected to high voltage withstand tests at 80v/mil (a.c.) of insulation.

SECTION 4. TEST PROCEDURE

4.1 CABLE MOUNTING

The cable samples were mounted on holding rods positioned between two end cap flanges of a vertically held metal mandrel, approximately 20 inches in diameter. Steel wire was used to secure the cables in position relative to the vertical rods. Approximately four feet of each cable end was brought up through the middle of the mandrel. These ends were brought through head penetrations in the pressure vessel, sealed and connected to the energizing lead wire. Sealing was effected by securing the cable ends in aluminum tubes with an epoxy compound. The tubes were secured to the vessel by standard tube fittings.

4.2 ELECTRICAL ENERGIZING AND INTERCONNECTIONS

The cable ends were secured to terminal blocks mounted on the vessel head. The lead wire, supplied by Essex International, connected the energizing switch box with the test cables at the terminal block on the vessel

head. The switch box consisted of knife switches arranged so that each cable could be individually monitored, removed from the circuit if a failure occured, or isolated during measurements of insulation resistance.

Figure 2 is a schematic diagram showing the energizing circuitry and cable connections.

4.3 DOSE UNIFORMITY

Dose uniformity was obtained by repositioning the Cobalt-60 source at various stages throughout the exposure cycle and by rotating the vessel. Rotation was performed 3½ days after initiating the seven day thermal/radiation aging and again fifteen days after the initiation of the steam exposure cycle.

Appendix A contains the certification of radiation exposure and describes the dose distribution and source positioning.

4.4 MEASUREMENTS OF INSULATION RESISTANCE (IR)

IR measurements were made periodically during the exposure cycle as a means of monitoring the relative degradation of the test samples.

Specifically, the IR measurements were made at the following times during the program:

1. Upon receipt of samples, prior to radiation aging, while wrapped on the mandrel and immersed in water.

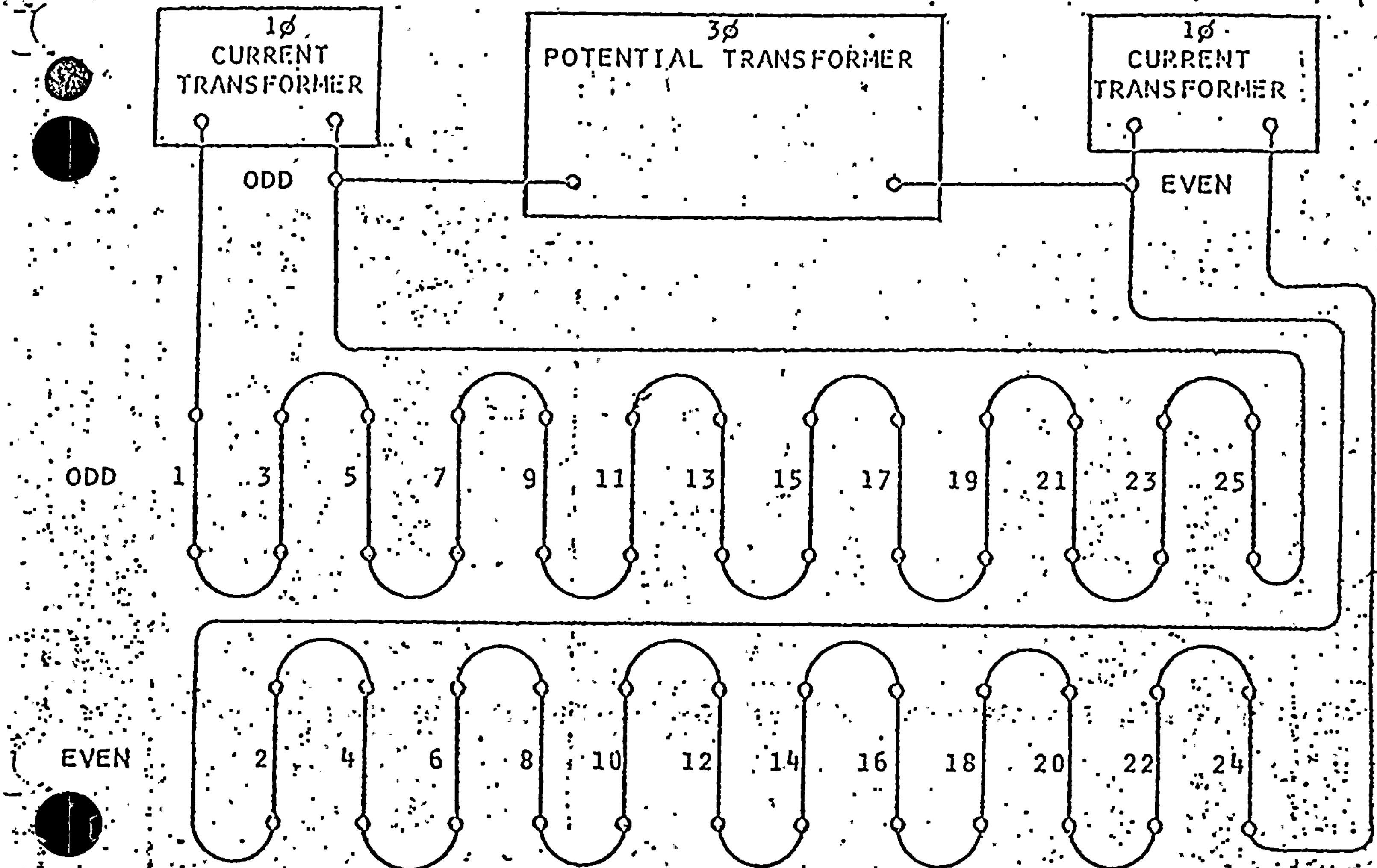


FIGURE 2 SCHEMATIC REPRESENTATION OF ENERGIZING CIRCUITRY

2. Halfway through the seven day thermal/radiation aging period.
3. At the end of the thermal/radiation aging period.
4. At each dwell during the high temperature phases of the Steam/Chemical/Radiation exposure period.
5. Once each day during the four day dwell at 265°F.
6. Twice per week during the balance of the 30 day period and at the conclusion of the exposure cycle.

The measurements were made after application of 500 Vdc held for one minute, unless specifically noted otherwise, by reading between the conductor directly to ground.

Prior to actually making the measurements, the current and potential load were removed for approximately ten to fifteen minutes. At the conclusion of the IR measurements, all cables were put back into the circuiting unless excessive leakage was observed that prohibited the application of the full potential load or if short-circuit to ground had occured.

4.5 HIGH VOLTAGE WITHSTAND TESTS (HI-POT)

Samples that performed satisfactorily during the environmental exposure period were removed from the vessel, straightened and wound around a mandrel having a diameter 40 times the cable diameter.

The samples, while wound on the mandrel, were immersed in water with the ends free. The conductor was connected to the high voltage lead and the ground wire inserted directly in the water. The required test voltage was 2200 Vac, or twice rated voltage, plus 1000V.

The specified voltage level was applied for a period of 5 minutes after which time the charging current was recorded.

SECTION 5. TEST RESULTS

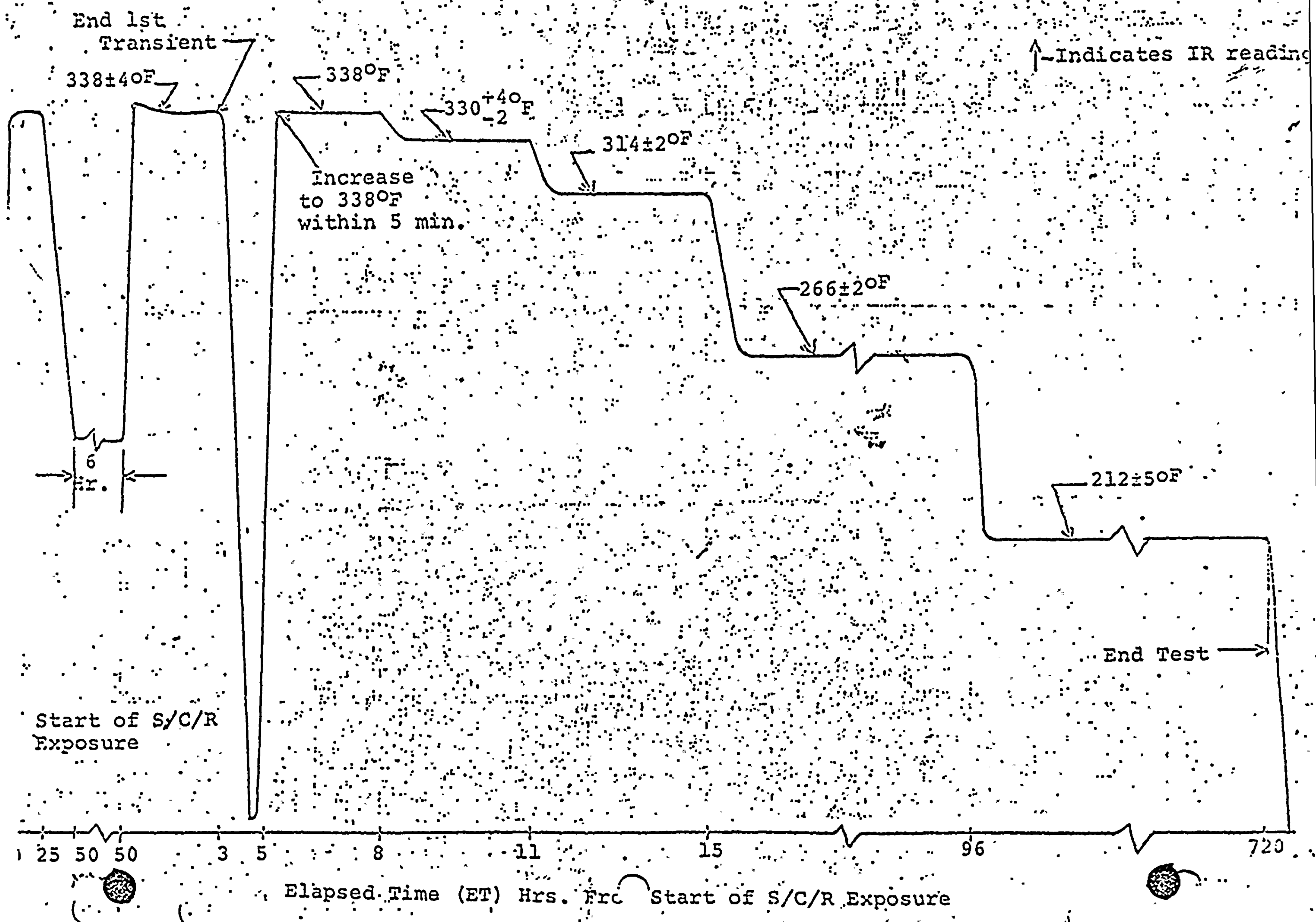
5.1 ACTUAL TEMPERATURE PROFILE

5.1.1 Thermal/Radiation Aging

The temperature profile obtained during the actual test phases is shown in Figure 3. The test was initiated by energizing the cables and placing the cobalt source in position.

Strip heaters on the vessel were utilized in conjunction with the cable current heating loads to raise the temperature from room ambient to the aging level. Heater controls and current loads were adjusted so that the temperature remained at 250 ± 10^{O}F throughout the remainder of the seven day

ACTUAL TEMPERATURE PRC LE OBTAINED DURING
SIMULTANEOUS STEAM/CHEMICAL-SPRAY/RADIATION
ENVIRONMENTAL OSURE



period. Four and one-half days after starting, the system was shut down so that IR measurements could be made.

5.1.2 Phases II and III - LOCA Simulation and Post-LOCA Cooldown

At the start of the steam exposure, the cables were energized and the ambient temperature was 140°F. The cobalt source remained down until the exposure was underway.

To initiate the exposure, steam was rapidly admitted raising the temperature and pressure to 338°F and 112 psig within 10 minutes. Approximately fifteen minutes later, a leak was detected in a pressure fitting that necessitated a drop in pressure to atmospheric during the next twenty-five minutes.

The steam remained off for a period of 6 hours, while the temperature was maintained at 240°F using electric heaters to avoid a severe thermal shock when the steam was reinitiated.

The necessary repairs were made to the fitting and the exposure was resumed by reintroducing steam that increased the temperature from 260°F to 340°F during the next five minutes. The temperature was maintained at 338±4°F for the remainder of the three hour period of the transient.

At the end of this period, a controlled temperature drop was initiated that reduced the temperature to 124°F over the next 1.5 hours.

The second transient was then initiated by introducing steam that raised the temperature to 338°F within five minutes and held it at that point for the next three hours.

The temperature was then reduced to 330°F and held for three hours before reducing to 314°F and held for an additional four hours.

At that time, a controlled drop was initiated that reduced the temperature to 268°F over the next twenty minutes and was maintained at 266±2°F for the balance of four days at which time the temperature was reduced over the next half hour to 212°F, nominal, for the remainder of the exposure period.

The spray solution was injected into the chamber within one minute of starting the exposure at a rate of approximately 1.5 gpm and was recirculated within the next seven minutes.

The spray solution pH was between 9.5 and 10.5. The spray was turned off during the six hour repair period and turned back on when the exposure was reinitiated. The spray remained on throughout the remainder of the

exposure.

At an Elapsed Time (ET) of 539 hours, the system was shut down and the vessel rotated 180° to maintain uniformity of the dose distribution.

At a total test time of 37 days, the last set of readings were made and the system shut down. The vessel was removed from the cell, the samples removed from the vessel, inspected and measurements of withstand voltage made.

5.2 PERFORMANCE OF TEST CABLES

The cables were electrically energized at a potential of 600 Vac between conductors throughout the entire exposure period except during vessel rotation and periods when IR measurements were made.

The current loads were maintained within 15.5 and 19.5 Amps during the entire test period. Table 2 shows the times when the cables were removed from the energizing circuitry.

5.3 INSULATION RESISTANCE MEASUREMENTS

Measurements of IR were made at the times previously mentioned and the results are shown in Table 3 as a function of the environmental parameters.

TABLE 2

SUMMARY OF CABLE REMOVAL FROM ENERGIZING CIRCUITRY

Sample No.	Elapsed Time (hours)	Phase of Test
3, 18, 24*	185.3	During 1st transient of S/C simultaneous phase.
1	191.2	During 2nd transient.
23*	226.5	During dwell at 265°F.
20	282.1	During Post-LOCA Cooldown.
4, 2	285.1	During Post-LOCA Cooldown.
14	322.7	During Post-LOCA Cooldown.
5, 15, 16	325.7	During Post-LOCA Cooldown.
10	355.1	During Post-LOCA Cooldown.
12	658.7	During Post-LOCA Cooldown.
13	778.0	During Post-LOCA Cooldown.

*Put back into circuit at elapsed time of 253.0 hours.

TABLE 3 (1).

MEASUREMENTS OF INSULATION RESISTANCE (1)

Elapsed (2) Time (hrs.)		Phase (3)	Temp °F	Press psig.	1	2	3
---		Pre	70	0	$1.1x10^{12}$	$1.4x10^{12}$	$0.68x10^{12}$
91.7		TIR	240	0	$0.78x10^{9}$	$0.78x10^{9}$	$3.5x10^{7}$
184.5	END	TIR	101	0	$2.1x10^{9}$	$1.8x10^{9}$	$2.4x10^{7}$
187.3		LOCA	339	110	$0.51x10^{6}$ (4)	$1.1x10^{7}$	4000 (7)
192.9		LOCA	336	105	11 (7)	$1.2x10^{7}$	2000 (7)
197.5		LOCA	316	74	14 (7)	$3.1x10^{7}$	$7.5x10^{2}$ (7)
204.1		LOCA	268	25	13 (7)	$1.3x10^{8}$	2.8 (7)
227.3		LOCA	266	30	13 (7)	$1.5x10^{8}$	800 (7)
251.2	Post	LOCA	268	30	13 (7)	$1.6x10^{8}$	900 (7)
282.5	Post	LOCA	214	0	16 (7)	$13x10^{4}$ (7)	800 (7)
325.4	Post	LOCA	218	2	13 (7)	400 (7)	75 (7)
420.0	Post	LOCA	206	0	13 (7)	480 (7)	1000 (7)
[illegible]15.3	Post	LOCA	194	0	17 (7)	1300 (7)	1200 (7)
[illegible]92.1	Post	LOCA	216	0	13 (7)	550 (7)	---
683.1	Post	LOCA	205	0	12 (7)	600 (7)	1.10^{4} (7)
756.4	Post	LOCA	204	0	13 (7)	500 (7)	---
906.6	Post Test	LOCA	70	0	$1.9x10^{11}$	$0.55x10^{11}$	$0.9x10^{11}$

(1) All measuremens made at 500 Vdc, held for 1 minute, and all resistance values in ohms, unless otherwise noted.
(2) Elapsed Time (ET); total test time from the start of Thermal Radiation
(3) Test phases per outline described in section.
(4) Measurement made at 300 Vdc.
(5) Measurement made at 100 Vdc.
(6) Measurement made at 75 Vdc.
(7) Measurement made at 3 Vdc.
(8) Measurement made at 200 Vdc.
(9) Measurement made at 10 Vdc.

4	5	6	7	8	9
$0.7x10^{12}$	$3x10^{11}$	$0.88x10^{12}$	$1.3x10^{12}$	$0.64x10^{12}$	$2.2x10^{11}$
$0.8x10^{9}$	$5x10^{7}$	$4.4x10^{7}$	$1.0x10^{8}$	$1.25x10^{8}$	$4.9x10^{6}$
$3.2x10^{9}$	$0.74x10^{7}$	$1.8x10^{7}$	$2.2x10^{9}$	$1.5x10^{9}$	$1.57x10^{8}$
$0.7x10^{7}$	$0.52x10^{6}$ (5)	$1.3x10^{6}$	$0.8x10^{6}$	$1.2x10^{6}$	$1.2x10^{5}$ (6)
$0.7x10^{7}$	$0.58x10^{6}$ (5)	$1.7x10^{6}$	$0.55x10^{6}$	$0.56x10^{6}$ (8)	$1.3x10^{5}$ (6)
$1.4x10^{7}$	$1x10^{6}$ (5)	$3.5x10^{6}$	$0.7x10^{6}$	$0.61x10^{6}$ (8)	---
$0.68x10^{8}$	$5x10^{6}$	$1.3x10^{7}$	$5.7x10^{6}$	$2.4x10^{6}$	$8x10^{4}$ (7)
$0.68x10^{8}$	$5.2x10^{7}$ (5)	$1.7x10^{7}$	$5.0x10^{6}$	$2.2x10^{6}$	$2.2x10^{5}$ (6)
$0.58x10^{8}$	$2.1x10^{6}$ (6)	$2.1x10^{7}$	$4.5x10^{6}$	$2.0x10^{6}$	$1.1x10^{5}$ (9)
$2.8x10^{7}$	$1.1x10^{6}$	$5.0x10^{7}$	$5.0x10^{7}$	$1.5x10^{7}$	$5.0x10^{5}$ (6)
1700 (7)	6 (7)	$5.0x10^{7}$	$3.0x10^{7}$	$1.4x10^{7}$	$1.1x10^{5}$ (6)
2200 (7)	7 (7)	$1.6x10^{8}$	$4.5x10^{7}$	$2.2x10^{7}$	$3.0x10^{5}$ (6)
6000 (7)	10 (7)	$0.54x10^{9}$	$2.4x10^{8}$	$1.3x10^{8}$	$1.2x10^{5}$ (6)
1100 (7)	7 (7)	$2.0x10^{8}$	$5.0x10^{7}$	$3.0x10^{7}$	$1.2x10^{5}$ (6)
[illegible]00 (7)	7 (7)	$4.6x10^{8}$	$1.0x10^{8}$	$4.5x10^{7}$	$2.2x10^{5}$ (6)
2200 (7)	8 (7)	$0.64x10^{9}$	$1.1x10^{8}$	$0.52x10^{8}$	$0.76x10^{5}$ (6)
$4.3x10^{10}$	$1.5x10^{7}$	$4x10^{11}$	$5x10^{10}$	$4x10^{10}$	$3x10^{11}$

T/R) aging.

10	11	12	13	14	15
$.66\times10^{12}$	0.78×10^{12}	4.5×10^{11}	3.5×10^{11}	1.7×10^{12}	5×10^{11}
$.4\times10^{8}$	2.2×10^{8}	5.2×10^{9}	3.2×10^{7}	1.2×10^{9}	5.10^{8}
$.0\times10^{9}$	1.7×10^{9}	2.2×10^{9}	4.0×10^{8}	1.5×10^{10}	2.0×10^{9}
$.8\times10^{7}$	5.0×10^{6}	1.2×10^{7}	1.2×10^{6}	1.7×10^{7}	0.74×10^{7}
$.5\times10^{6}$	5.0×10^{6}	1.3×10^{7}	1.8×10^{6}	$2\ \times10^{7}$	0.92×10^{7}
$.82\times10^{6}$	6.8×10^{7}	1.7×10^{7}	3.0×10^{6}	5×10^{7}	2×10^{7}
$.0\times10^{7}$	3.5×10^{7}	1.6×10^{8}	1.1×10^{7}	2.4×10^{5}(6)	1.1×10^{8}
$.2\times10^{7}$	2.1×10^{7}	2.0×10^{8}	1.3×10^{7}	3.4×10^{8}	1.1×10^{8}
$.25\times10^{7}$	1.56×10^{7}	2.0×10^{8}	1.3×10^{7}	3.4×10^{8}	1.1×10^{8}
$.1\times10^{8}$	1.2×10^{8}	0.94×10^{9}	0.60×10^{8}	1.4×10^{9}	0.53×10^{9}
$.0\times10^{7}$	0.82×10^{8}	0.9×10^{9}	3.0×10^{7}	14 (7)	12 (7)
5 (7)	0.83×10^{8}	0.9×10^{9}	0.84×10^{7}	24 (7)	10 (7)
0 (7)	4.0×10^{8}	1.8×10^{9}	4.0×10^{6}	40 (7)	13 (7)
5	0.8×10^{8}	1.05×10^{9}	0.92×10^{6}	34 (7)	7.5 (7)
0	1.4×10^{8}	240 (7)	280 (7)	36 (7)	8 (7)
5 (7)	1.3×10^{8}	300 (7)	2200 (7)	35 (7)	8.3 (7)
$.5\times10^{10}$	4.4×10^{7}	0.95×10^{11}	---	2.8×10^{10}	5×10^{10}

16	17	18	19	20	21
3.5×10^{11}	0.8×10^{12}	0.9×10^{12}	1.2×10^{12}	1.59×10^{11}	5×10^{11}
3.4×10^{7}	1.2×10^{8}	1.1×10^{7}	0.6×10^{9}	1.7×10^{7}	5×10^{6}
5.0×10^{9}	1.7×10^{9}	1.0×10^{7}	2.6×10^{9}	0.64×10^{8}	1.6×10^{8}
6500 (7)	1.4×10^{6}	8000 (7)	2.1×10^{7}	9000 (7)	0.7×10^{6}
1.5×10^{4} (7)	0.8×10^{6}	1.2×10^{4} (7)	1.5×10^{7}	$1. \times 10^{4}$ (7)	3.5×10^{5} (6)
---	1.1×10^{6}	1.5×10^{4} (7)	1.5×10^{7}	---	5.1×10^{5} (6)
2.6×10^{5}	0.7×10^{7}	15×10^{3}	1.3×10^{7}	42×10^{3} (7)	2.6×10^{5} (6)
2.4×10^{5} (6)	0.7×10^{7}	16×10^{3} (7)	1.4×10^{7}	30×10^{3} (7)	2.1×10^{5} (6)
2.1×10^{5} (6)	0.56×10^{7}	12×10^{3} (7)	1.4×10^{7}	28×10^{3} (7)	2.2×10^{5} (6)
4.5×10^{6}	5.0×10^{7}	13×10^{3} (7)	1.1×10^{8}	120 (7)	0.52×10^{6} (5)
4 [illegible] (7)	3.5×10^{7}	4500 (7)	1.4×10^{8}	120 (7)	1.6×10^{5} (6)
4 [illegible] (7)	5.0×10^{7}	120 (7)	2.1×10^{8}	150 (7)	2.1×10^{5} (6)
8 (7)	1.6×10^{8}	190 (7)	0.88×10^{9}	500 (7)	0.82×10^{6}
5.4 (7)	4.5×10^{7}	70 (7)	2.4×10^{8}	300 (7)	1.7×10^{5} (6)
5.5 (7)	0.78×10^{8}	70 (7)	4.5×10^{8}	100 (7)	2.2×10^{5} (6)
6.5 (7)	0.74×10^{8}	65 (7)	4.4×10^{8}	90 (7)	2.5×10^{5} (6)
3.5×10^{10}	0.55×10^{9}	3.5×10^{10}	0.7×10^{11}	---	1.9×10^{11}

22	23	24	25
1.5×10^{12}	0.9×10^{12}	5×10^{11}	1.8×10^{10}
0.53×10^{9}	3×10^{7}	0.8×10^{7}	1.4×10^{7}
1.1×10^{10}	0.72×10^{8}	2.8×10^{7}	0.52×10^{9}
0.96×10^{7}	0.8×10^{5}(6)	1.5×10^{5}(6)	1.3×10^{5}(6)
1.05×10^{7}	0.71×10^{5}(6)	1.2×10^{5}(5)	0.8×10^{5}(6)
2.5×10^{7}	0.8×10^{5}(6)	1.5×10^{5}(5)	1.2×10^{5}(6)
1.4×10^{8}	1.4×10^{5}(6)	55×10^{3}(7)	1.6×10^{5}(6)
1.35×10^{8}	$2. \times 10^{4}$(7)	2.0×10^{5}(6)	1.8×10^{5}(6)
1.3×10^{8}	1.15×10^{5}(6)	3.0×10^{5}(6)	1.5×10^{5}(6)
0.58×10^{7}	2.8×10^{5}(6)	3.5×10^{5}(6)	4.4×10^{5}(6)
5.0×10^{8}	2.6×10^{5}(6)	1.8×10^{5}(6)	1.8×10^{5}(6)
3.6×10^{8}	0.86×10^{6}(6)	4.0×10^{5}(6)	5.4×10^{6}(6)
1.35×10^{9}	1.6×10^{6}	1.1×10^{6}	2.0×10^{6}
3.0×10^{8}	2.6×10^{5}(6)	0.88×10^{5}(6)	2.8×10^{5}(6)
0.51×10^{9}	1.4×10^{5}(6)	0.9×10^{5}(6)	1.7×10^{5}(6)
0.54×10^{9}	3.0×10^{5}(6)	0.9×10^{5}(6)	2.0×10^{5}(6)
0.7×10^{11}	5×10^{10}	0.57×10^{11}	5×10^{10}

4 HIGH VOLTAGE WITHSTAND TESTS (HI-POT)

Table 4 presents the results of the hi-pot tests performed at the conclusion of the test program.

TABLE 4

Results of Hi-pot Tests
Performed at Conclusion of 37 Day Environmental Exposure

Sample No.	Required	Actual	Current (mA)	Comments
3	2.2	2.2	5.5	Held for 5 min.
5	2.2	1.5	>15	Did not hold.
6	2.2	2.2	1.5	Held for 5 min.
7	2.2	2.2	2.1	Held for 5 min.
8	2.2	2.2	2.2	Held for 5 min.
9	2.2	2.2	1.6	Held for 5 min.
11	2.2	2.2	1.9	Held for 5 min.
17				Splice in water
[illegible]	2.2	2.2	1.9	Held for 5 min.
19	2.2	2.2	2.1	Held for 5 min.
21	2.2	2.2	2.0	Held for 5 min.
22	2.2	2.2	1.9	Held for 5 min.
23	2.2	2.2	2.4	Held for 5 min.
24	2.2	2.2	1.9	Held for 5 min.
25	2.2	2.2	1.2	Held for 5 min.

CTION 6. CERTIFICATION

The undersigned certifies that this report presents a true account of the test conducted and the results obtained.

Nissen M. Burstein
Manager, Component Testing

APPENDIX A

RADIATION CERTIFICATION

ISOMEDIX

November 21, 1975

Inter Company Memo

To : Nissen M. Burstein
Manager, Qualification Testing

From: George R. Dietz
Manager, Radiation Services

This will summarize the parameters pertinent to the recent simultaneous steam, chemical spray and radiation exposure test conducted for Essex International, Inc.

Irradiation for the Phase I 7 day test was begun on October 10, 1975 and concluded on October 18, 1975. During Phase I, the cables received a minimum dose of 51.1 Mrad and maximum of 53.4 Mrad. Where possible, we utilized the irradiator to process other products concurrently with the test, which necessitated occasional short periods where the radiation field was reduced to zero. The details of source positioning, dose rates and total dose is shown in Figure 1.

Phase II of the test began on October 21, 1975 and concluded on November 20, 1975. During the approximately 705 hour radiation exposure, with simultaneous steam/chemical spray per your profile, cables received an additional minimum dose of 148.8 Mrad and maximum dose of 152.0 Mrad. The details of irradiation are shown in Figure 2.

In summary, total dose to the cables over the entire test period ranged from 200 to 205.4 Mrad, with an estimated source positioning error of ±5% in dose rate.

Dosimetry was performed using a Victoreen Model 555, Integrating Dose Rate Meter and Probe. The unit was calibrated on October 16, 1975 by the Victoreen Instrument Company, using cobalt-60 and cesium-137 whose calibrations are traceable to the U.S. National Bureau of Standards. Backup dosimetry using a Red Perspex system provided by Atomic Energy of Canada, Ltd. confirmed the Victoreen readings.

George R. Dietz
Manager, Radiation Services

Enclosures
D:km

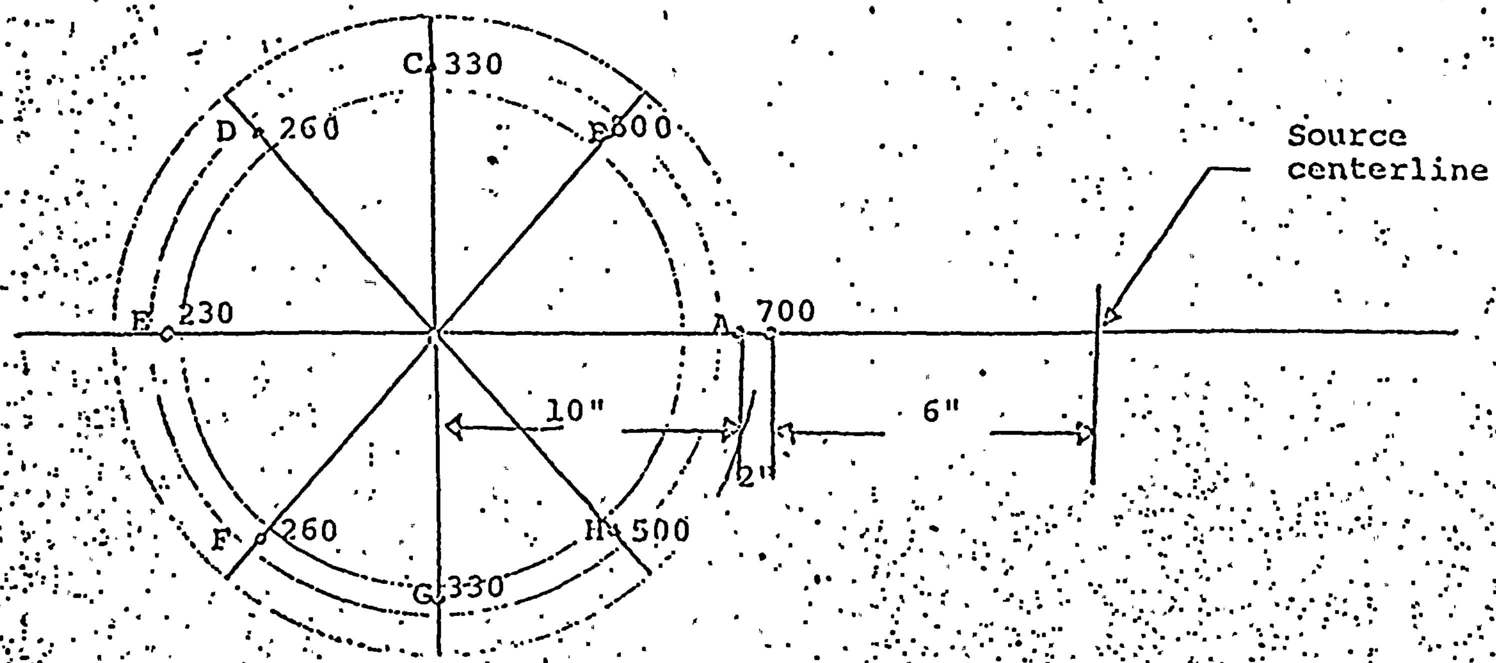
Isomedix Inc. • 25 Eastmans Road, Parsippany, New Jersey (201) 887-4700
Mailing Address: Post Office Box 177, Parsippany, New Jersey 07054

CHICAGO DIVISION • 7828 Nagle Ave., Morton Grove, Illinois 60053 (312) 966-3160

Dose - 50 Mrad

Fig 1

Dose Rates and Total Dose



Numbers on figure represent dose rates (kilorad/hr) at lettered points when t source is located as shown, relative to the cables.

Irradiation was conducted by locating the source at 4 quadrants of the irradiation chamber, with a typical location shown above. When equal irradiation times are administered in each of the source locations, the average dose rate at a point is the average of the sum of the dose rates received in each position. Rotation of the vessel and positioning the source in two quadrants each time had the same effect as if the source were relocate four times.

Average Dose rates at A,C,E and G are:

$1/4 \Sigma A,C,E,G = 1/4 \Sigma\ 700+330+330+230 = \frac{1590}{4} = 397$ Krad/hr

and at B,D,F and H

$1/4 \Sigma B,D,F$ and $H, = 1/4 \Sigma 500+260+260+500 = \frac{1520}{4} = 380$ Krad/hr

Considering irregularities in the actual containment vessel, a 12% absorption factor was applied. Hence actual dose rates at A,C,E and G were .88x397 or 349.0 Krad/hr (maximum dose rate) and at B,D,F and H, .88x380 or 334 Krad/hr (minimum dose rate).

The minimum dose administered over the 7 day period to positions B,D,F and H from the 153 hour exposure was

$153\ hr \times .334\ \frac{Mrad}{hr} = 51.1\ Mrad$

and the maximum dose, to positions A,C,E and G, was

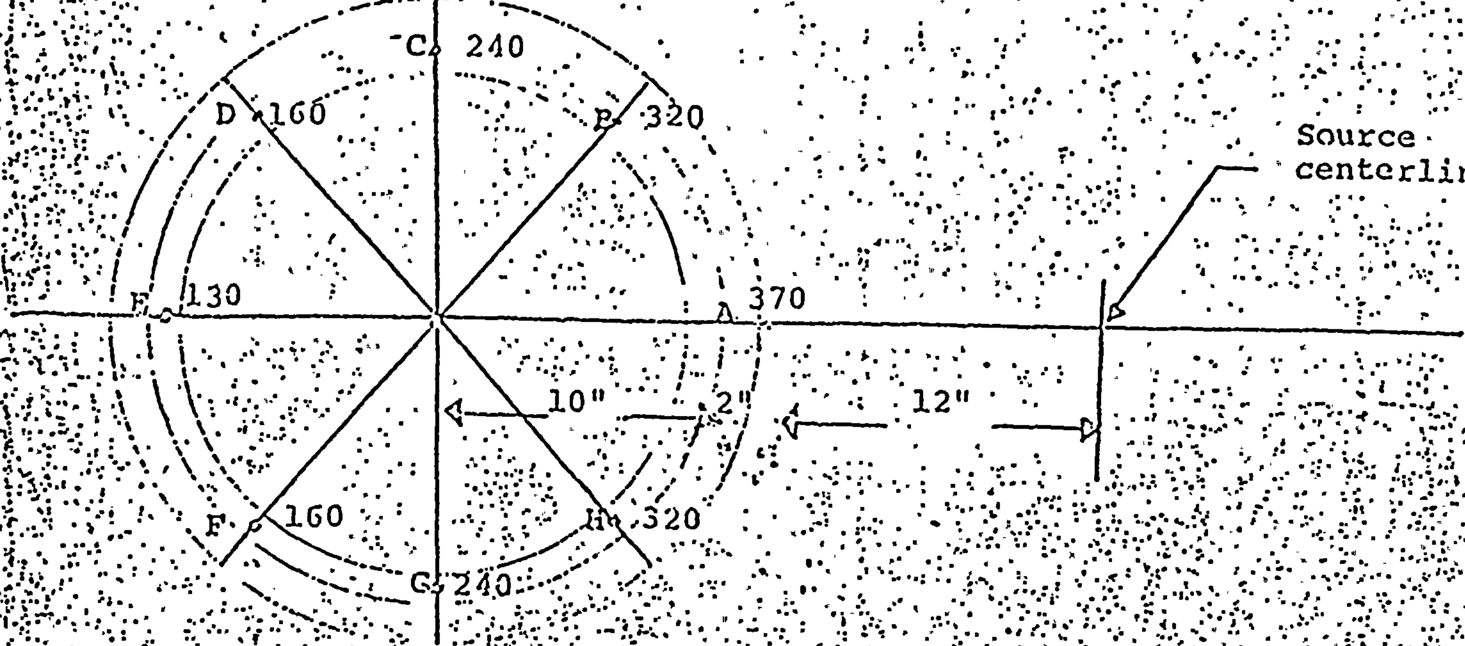
$153\ hr \times 349\ \frac{Mrad}{hr} = 53.4\ Mrad$

Attenuation or buildup factors for the contents of the chamber (mandrel, cables, etc.) were not considered in the above because of the randomness of their locations.

Phase II - 30 days

Fig 2

Dose Rates and Total Dose



Numbers on figure represent dose rates (kilorad/hr) at lettered points when the source is located as shown, relative to the cables.

Irradiation was conducted by locating the source at 4 quadrants of the irradiation chamber, with a typical location shown above. When equal irradiation times are administered in each of the source locations, the average dose rate at a point is the average of the sum of the dose rates received in each position. Rotation of the vessel and positioning the source in two quadrants each time had the same effect as if the source were relocated four times.

Average Dose rates A,C,E and G are:

$$1/4 \Sigma A,C,E,G = 1/4 \Sigma\ 370+240+130+240 = \frac{980}{4} = 245 \text{ Krad/hr}$$

and at B,D,F, and H,

$$1/4 \Sigma B,D,F,H, + 1/4 \Sigma\ 320+160+160+320 = \frac{960}{4} = 240 \text{ Krad/hr}$$

Considering irregularities in the actual containment vessel, a 12% absorption factor was applied. Hence actual dose rates at A,C,E and G were .88x245 or 215.6 Krad/hr (maximum dose rate) and at B,D,F and H, .88x240 or .211 Krad/hr (minimum dose rate).

The minimum dose administered over the 30 day (705 hrs. of irradiation) period was

$$705 \text{ hr.} \times .211 \frac{\text{Mrad}}{\text{hr}} = 148.8 \text{ Mrad.}$$

and the maximum dose

$$705 \text{ hr.} \times .215.6 \frac{\text{Mrad}}{\text{hr}} = 152.0 \text{ Mrad.}$$

Attenuation or buildup factors for the contents of the chamber (mandrel, cables, spray, liquid, etc.) were not considered in the above because of the randomness of their locations.

Rete 0

Cyprus Wire & Cable Company

Quality Assurance Department
Certification

INVOICE TO

Indiana & Michigan Power Co.
D.C. Cook Plant Construction
P.O.Box 458
Bridgeman, Mi. 49106

SHIP TO

Indiana & Michigam Power Co.
D.C. Cook Plant Construction
5-Miles North of Bridgeman
Michigan

Customer's Order No. 05526-821-5
Rome Cable Order No. ENN 03422
Date 6/16/76

MILL ORDER NO. 78668
78669

Item No.	Quantity	Description	Applicable Specification
1	51,790 Ft. ITEM # 324	3/C Triplexed 12-7/.0305 Tin Copper, .030" EPR .015" Neoprene Jacketed Power Cable 600 Volt.	A.E.P. DCCEE-171-QCN Sept. 8, 1975
2	4,815 Ft. ITEM # 325	3/C Triplexed 10-7/.0385 Tin Copper, .030" EPR .015" Neoprene Jacketed Power Cable 600 Volt	

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC
GENERATION SECTION AEPSC, N. Y.
ACCEPTED BY: W. R. [illegible]
DATE: 6-21-76
FILE: 8916-5 Cyprus [illegible]

I hereby certify that the material described above was inspected under my general supervision and complies with the test requirements of A.E.P. Spec DCCEE-171-QCN Sept. 8, 1975 as interpreted by Rome Cable Quality Assurance Procedures prior to being placed into stock or released for shipment.

Test records will be kept on file Two years from date of test, and will be made available for examination by authorized persons upon request.

QA DOC. INDEX
SER.# EQ0038
DATE 6/16/76
KEYWORDS
1. 055268215
2.
3.
4.
5.
REF. EE
EXP.

Signed [signature]
Title ~~Senior Analyst Q.A.~~

QA -- 232

Cyprus Wire & Cable Company

421 Ridge Street
Rome, New York 13440
Telephone 315) 337-3000

Post Office Box 71
TWX 510) 243-9732

June 16, 1976

Indiana & Michigan Power Co.
D.C. Cook Plant Construction
P.O. Box 458
Bridgeman, Mi. 49106

Gentlemen:

We certify that a radiation resistance qualification test has been performed on cable samples of similar construction employing identical insulating materials to the cables on this order. The test procedure used was that in IEEE Std. 383-1974 Para. 2.3.3 but with a 2×10^8 rd radiation dose rather than 5×10^7 rd. All cable samples passed the test. The radiation qualification test conducted was more severe than that required in Para. VI.A.3 of Specification DCCEE-171-QCN.

L.A. Doyle

L.A. Doyle
Senior Analyst, Q.A.

LAD:cs

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC
GENERATION SECTION [illegible]
ACCEPTED BY: [illegible]
DATE: [illegible]
FILE: [illegible]

CYPRUS

Ref. 40

QA - 248

M.O. 78668

CYPRUS Cyprus Wire & Cable Company

Quality Assurance Department

Test Data

REPORT NO. 3525 DATE 6/16/76
SHEET 1 OF 5
CUSTOMER Indiana & Michigan Power Co.
ORDER NO. ENN 03422
C. O. NO. 05526-821-5
SPECIFICATION A.E.P. DCCEE-171-QCN- Sept. 8, 19

DESCRIPTION 3/c Triplexed, 12-7/.0305 Tin Copper, .030" EPR, .015" Neoprene Jacketed Power Cable 600 Volt.

PHYSICAL PROPERTIES

	Insulation Test Value	Insulation Specified Min	Jacket Test Value	Jacket Specified Min
ORIGINAL				
Tensile, psi	1156	700		
Stress at % Elongation, psi				
Elongation, %	300	250		
Set, Inch		max		max
AFTER AGING				
Oxygen Pressure Test: hrs. at C and psi				
Tensile, % of original				
Elongation, % of original				
Air Oven Test: hrs. at C				
Tensile, % of original	94.1	75.0		
Elongation, % of original	83.3	75.0		
Air Pressure Heat Test: hrs. at C and psi				
Tensile, % of original				
Elongation, % of original				
OIL IMMERSION TEST				
hrs at				
Tensile, % of original				
Elongation, % of original				

ACCELERATED WATER ABSORPTION TESTS

Electrical Method: Immersed at C at an average stress of volts and volts per mil. cycles	Test Value	Spec
Increase in SIC, 1-14 days, %		
Increase in SIC, 7-14 days, %		
Stability Factor after 14 days, %		
Gravimetric Method: Immersion for 7 days at 70°C		
Moisture Absorption, milligrams per square inch Insulation	2.47	10.0

CAPACITY AND POWER FACTORS TESTS

Measured at 60 cycles after Day(s) in water at C		
Specific Inductive Capacity		
Power Factor, %		

MISCELLANEOUS TESTS

INSULATION

3 Hr. Ozone Resistance @ .030% - No Cracking

JACKET

Vertical Flame Test Passed Per Para VI-A-2 of Spec. DCCEE 171-QCN

QA DOC. INDEX
SER.# EP0040
DATE 6/16/76
KEYWORDS
1. 3525
2.
3.
4.
5.
REF. EE
EXP.

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC GENERATION SECTION AEPSC, N. Y.
ACCEPTED BY: W. R. Farquharson
DATE: 6-21-76
FILE: EE 16-5 CYPRUS W&C C

NOTE: Data from samples of the cable described above.

M.O. 786

Q.A.—247

Rome Cable
DIVISION OF
CYPRUS MINES CORPORATION

Quality Assurance Department
Electrical Test Data

REPORT NO. 3525 DATE 6/16/76
SHEET 2 OF 5
CUSTOMER Indiana & Michigan Power Co.
ORDER NO. ENN 03422
C. O. NO. 05526-821-5
SPECIFICATION A.E.P. DCCEE-171-QCN Sept. 8, 1975

DESCRIPTION 3/C Triplexed 12-7/.0305 Tin Copper, .030" EPR, .015" Neoprene Jacketed Power Cable 600 Volts

REEL NUMBER	CONSTRUCTION				LENGTH FEET	A-C VOLTAGE		D-C VOLTAGE		INSULATION RESISTANCE (60F) megohms—1000'		CORONA LEVEL kv		MISCELLANEOUS TESTS
	SIZE	NO. STDS.	DIA. STDS.	WALL		kv	TIME	kv	TIME	ACTUAL	SPEC	ACTUAL	SPEC	
73639	12 3/C	7	.0305	.030 .015	4040	4.0	5			12435(3)	2617			
73251					2525					17693(3)				
37251					2065									
37507					1385					5832(3)				
73249					660									
73306					340					7456(3)				
73252					1500									
73250					465					8045(3)				
73246					420									
73245					450									
73305					810					18108(3)				
73256					1520									
37508					920					18812(3)				
37528					1820									
37504					425					15300(3)				
37297					710					8818(3)				
2085					2085					47538(3)				CONTINUITY OK

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC
GENERATION SECTION AEPSC, N. Y.
ACCEPTED BY: C. R. Farquhar
DATE: 6-21-76
FILE: EE Cyprus W&C

Q.A. – 247

M.O. 7

Rome Cable
DIVISION OF
CYPRUS MINES CORPORATION

Quality Assurance Department

Electrical Test Data

REPORT NO. 3525 DATE 6/16/76
SHEET 3 OF 5
CUSTOMER Indiana & Michigan Power Co.
ORDER NO. ENN 03422
C. O. NO. 05526-821-5
SPECIFICATION A.E.P. DCCEE-171-QCN Sept 8, 1975

DESCRIPTION 3/C Triplexed, 12-7/.0305 Tin Copper, .030" EPR, .015 Neoprene Jacketed Power Cable 600 Volt

REEL NUMBER	CONSTRUCTION				LENGTH FEET	A-C VOLTAGE		D-C VOLTAGE		INSULATION RESISTANCE (60F) megohms – 1000'		CORONA LEVEL kv		MISCELLANEOUS TESTS
	SIZE	NO. STDS.	DIA. STDS.	WALL		kv	TIME	kv	TIME	ACTUAL	SPEC	ACTUAL	SPEC	
37543	12	7	.0305	.030	2855	4.0	5				2617			
	3/C			.015						6182(3)				
37505					3545									
73540					4040					93324(3)				
37503					1740					28752(3)				
37509	(540)				540									
37295					1730									
37510					1610					27311(3)				
37296					1970									
73307					1260					49140(3)				
37294					2775									
37506	(3500)				3580					21588(3)				CONTINUITY OK
73244					4005									

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC
GENERATION SECTION AEPSC, N. Y.
ACCEPTED BY: *W. B. Fergulkesm*
DATE: *6-21-76*
FILE *EE-15-5 Cyprus W&C G*

*Not required by applicable specification.

Q.A – 246

M.O. 78669

CYPRUS Cyprus Wire & Cable Company

Quality Assurance Department

Test Data

REPORT NO. 3525 DATE 6/16/76
SHEET 4 OF 5
CUSTOMER Indiana & Michigan Power Co.
ORDER NO. ENN 03422
C. O. NO. 05526-821-5
SPECIFICATION A.E.P. DCCEE-171-QCN Sept. 8,

DESCRIPTION 3/C Triplexed 10-7/.0385 Tin Copper, .030" EPR, .030" Neoprene Jacketed Power Cable 600 Volts

PHYSICAL PROPERTIES

	INSULATION TEST VALUE	INSULATION SPECIFIED MIN.	JACKET TEST VALUE	JACKET SPECIFIED MIN.
ORIGINAL				
TENSILE, psi	1104	700		
STRESS at 200% Elongation, psi				
ELONGATION, %	350	250		
Set in Tensile, % of length, inch		max		max
AFTER AGING				
OXYGEN PRESSURE TEST: hrs. at C and psi				
TENSILE, % of original				
ELONGATION, % of original				
AIR OVEN TEST: days at °C				
TENSILE, % of original	99.0	75.0		
ELONGATION, % of original	90.6	75.0		
AIR PRESSURE HEAT TEST: hrs at C and psi				
TENSILE, % of original				
ELONGATION, % of original				
OIL IMMERSION TEST				
hrs at				
TENSILE, % of original				
ELONGATION, % of original				

ACCELERATED WATER ABSORPTION TESTS

ELECTRICAL METHOD: Immersed at C at an average stress of volts and volts per mil. cycles	TEST VALUE	SP[ECIFIED]
INCREASE IN SIC, 1-14 days, %		
INCREASE IN SIC, 7-14 days, %		
STABILITY FACTOR AFTER 14 DAYS, %		
GRAVIMETRIC METHOD: Immersion for 7 days at 70°C		
MOISTURE ABSORPTION, milligrams per square inch	1.24	10.

CAPACITY AND POWER FACTORS TESTS

Measured at 60 cycles after Day(s) in water at C		
SPECIFIC INDUCTIVE CAPACITY		
POWER FACTOR, %		

MISCELLANEOUS TESTS

INSULATION

3 Hr. Ozone Resistance @ .030% No Cracking

JACKET

Vertical Flame Test Passed per Para VI-A-2 of Spec. DCCEE 171-QCN

DONALD C. COOK NUCLEAR PLANT
ACCEPTED FOR Q/A BY ELECTRIC
GENERATION SECTION AEPSC, N.Y.
ACCEPTED BY: W. A. [illegible]
DATE: 6-21-76
FILE: EE 16-5 Cyprus 6 9 C 6

M.O. 78669

Q.A.—247

Rome Cable
DIVISION OF
CYPRUS MINES CORPORATION

Quality Assurance Department
Electrical Test Data

REPORT NO. 3525 DATE 6/16/76
SHEET 5 OF 5
CUSTOMER Indiana & Michigan Power Co.
ORDER NO. ENN 03422
C. O. NO. 05526-821-5
SPECIFICATION A.E.P. DCCEE-171-QCN Sept. 8, 1975

DESCRIPTION 3/C Triplexed 10-7/.0385 Tin Copper, .030" EPR, .015" Neoprene Jacketed Power Cable 600 Volt

REEL NUMBER	CONSTRUCTION				LENGTH FEET	A-C VOLTAGE		D-C VOLTAGE		INSULATION RESISTANCE (60F) megohms—1000'		CORONA LEVEL kv		MISCELLANEOUS TESTS
	SIZE	NO. STDS.	DIA. STDS.	WALL		kv	TIME	kv	TIME	ACTUAL	SPEC	ACTUAL	SPEC	
37293	10 3/C	7	.0385	.030 .015	1580	4.0	5			33180(3)	2173			
37292 37502 88880					1365 510 1360 }					26128(3)				
														CONTINUITY OK
														DONALD C. COOK NUCLEAR PLANT ACCEPTED FOR Q/A BY ELECTRIC GENERATION SECTION AEPSC, N.Y. ACCEPTED BY: W.B. Ferguson DATE: 6-21-76 FILE: EE 16.5 Cyprus WQC6

Not required by applicable specification

EGQ #98

*See also Ref. #7

DONALD C. COOK NUCLEAR PLANT

EQUIPMENT QUALIFICATION FILE UPDATE TRANSMITTAL FORM

1. TO BE COMPLETED BY COGNIZANT AEPSC SECTION RFC DC

Attached Forms checked: ~~EGQ 96-1☐, EGQ 96-2☐, EGQ 97-1☐, EGQ 97-2☐.~~ NA LFC

ORIGINATED BY: LF Case DATE: 11/20/81
(System Engineer Signature)

APPROVED BY: [signature] DATE: 112081.
(Cog. Engineer Signature)

: [signature] DATE: 112081.
(EGS Manager Signature)

2. TO BE COMPLETED BY AEPSC NS&L SECTION

☐ ACCEPTED-TRANSMIT TO AEPSC QUALITY ASSURANCE

☐ REJECTED- RETURN TO COGNIZANT AEPSC SECTION MANAGER

REASON FOR REJECTION: ____________________

IS NRC SUBMITTAL REQUIRED? ☐ YES ☐ NO

IF YES, GIVE SUBMITTAL LETTER NUMBER AEP:NRC: ________

APPROVED BY: ____________ DATE: ________

3. TO BE COMPLETED BY AEPSC QUALITY ASSURANCE

TRANSMITTAL FORM AND DATA RECEIVED BY: ________ DATE: ________
(Initials)

CEEQF FILE INDEX UPDATED BY: ________ Date ________
(Initials)

DATA FILED BY: ________ Date ________
(Initials)

CEEQF FILE NUMBER OF DOCUMENT: ________

4. COPY OF COMPLETED FORM TO BE RETURNED TO ORIGINATOR ELEC. GENERATION SECTION.

To be incorporated in RFC file at close-out.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AMERICAN ELECTRIC AEP POWER SYSTEM

DATE: November 20, 1981

SUBJECT: Addendum to Environmental Qualification for Electrical Cables Outside the Reactor Containment (Ref. #65)

FROM: L. F. Caso

TO: NRC IE Bulletin 79-01B Central File

In reference to Table I in the original document, we have contacted the cable manufacturers therein listed (Anaconda, Continental, and Essex); our request for information and their responses are attached to this addendum.

In summary, Anaconda advised that their cable was qualified under FIRL test report F-C4350-3 (200 Mrads); Essex advised that their cable was qualified for 100 Mrads; Continental answered that they did not have radiation data on the subject cable.

The Cyprus Company cable listed in Table II is used for applications outside the reactor containment. It has been qualified for radiation to the extent of 200 Mrads and it has passed an air over test of 250°F for seven days and an immersion test for seven days. The arguments developed in the original issue of this reference #65 fully applies as well to the Cyprus Company cable. Therefore, we conclude that this cable is fully qualified for its application outside the reactor containment.

L. F. Caso

LFC/jal

APPROVED J. M. INTRABARTOLA

TABLE II

Cable Description	Location in Plant	Cable Insulation/ Jacket Material	Cable Qualification
Cyprus Cable 3 1/C #12 Item #324 600 Volt	Outside Containment	EPR/Neoprene	Cyprus Report #3525 Cyprus statement of 6/16/76
Cyprus Cable 3 1/C #10 Item #325 600 Volt	" "	EPR/Neoprene	Cyprus Report #3525 Cyprus statement of 6/16/76
Cyprus Cable 3 1/C #2 Item #3102 5 kV	" "	EPR/CSPE	Cyprus Report #3658 Cyprus statement of 8/14/76

AMERICAN ELECTRIC POWER *Service Corporation*

AEP

2 Broadway, New York, N. Y. 10004
(212) 440-9000

Cable for Cook Nuclear Plant

September 16, 1981

Mr. J. L. Steiner, Chief Engineer
Essex Group
Power Conductor Division
P.O. Box 1000
Lafayette, Indiana 47902

Dear Mr. Steiner:

Cable which we purchased from Essex some time ago is installed in our D. C. Cook Nuclear Plant. The cable is outside the containment and, thus, was not required to be qualified in accordance with our nuclear environment for containment use.

However, due to recent directives from the NRC, we now must provide additional test or engineering data to confirm qualification of the cable for outside containment service for the following conditions: 250°F for 10 seconds, plus 18.26 megarads of radiation, total accumulated dose.

We would be most grateful if you would review your records and files, and furnish test or engineering data which meets or exceeds the above criteria, for the cable listed on the attached sheet.

Your prompt attention to this request and earliest reply would be greatly appreciated.

Very truly yours,

TJ Massar

T. J. Massar
Electrical Engineering Division

TJM/jal
cc: H. N. Scherer, Jr. - Columbus
S. H. Horowitz
J. M. Intrabartola
T. E. King
L. F. Caso ✓
A. Volk
R. F. Kroeger
K. Shiu

AEP PO#03694-821-3 dated 5/29/73

Essex Order #114-2548

Essex Certification of Compliance dated 2/13/74, 2/28/74, 5/31/74, 11/18/74, 12/20/74 and 6/11/75

100,000 ft. 3-1/C twisted #12 AWG stranded copper .030" EPR insulation, .015" Neoprene jacket, 600 V. AEP Item 324.

UNITED TECHNOLOGIES
ESSEX GROUP

East Union St. & Sagamore Parkway
P.O. Box 7000
Lafayette, Indiana 47903
317/447-9464

Power Conductor Division

October 8, 1981

American Electric Power
2 Broadway
New York, N.Y. 10004

Attn: Mr. T. J. Massar-EE Div.

Subj: Cable Radiation & Thermal Resistance

Ref: Cook Nuclear Plant
AEP Ord. 03694-821-3, item 324
Essex Ord. 114-2548

Dear Mr. Massar:

We are in receipt of your letter of 9-16-81 requesting radiation and thermal resistance data on the 3 x 1/C #12 EP insulated/neoprene jacketed subject cable.

Attached to and made a part of this letter are data generated on the insulation material and the jacketing material used on this cable. These data show suitability for use after 100 Megarads (gamma) radiation plus 7d at 136C (276F) for the EP insulation and 50 Megarads (gamma) radiation plus 7 days at 121C (250F) for the neoprene. These test levels readily envelope the requirements of 20 Mrads and 10 seconds at 121C(250F).

We trust this material will be adequate for your present needs.

Very truly yours,

Joseph L. Steiner
Chief Engineer

JLS/fb

cc: E.K. Duffy
J.C. Rose
A.W. Reczek
P. Bernard

TEST DATA

ESSEX GROUP INC

DC Cook Plant
AEP/EP-Neoprene (non-containment)

	EP (T035)
Unaged	
Tensile Strength (psi)	1200
Elongation (%)	350
Aged 7d at 136C	
Tensile Strength (psi)	1000
Elongation (%)	350
Aged 100 M Rads	
Tensile Strength (psi)	900
Elongation (%)	30
Aged 7d at 136C and 100 M Rads	
Tensile Strength (psi)	1100
Elongation (%)	24

Actual data typical values

J. L. Steiner

J. L. Steiner

TEST DATA

ESSEX GROUP INC

DC Cook Plant

AEP/EP-Neoprene (non-containment)

	Neoprene (T 450)
Unaged	
Tensile Strength (psi)	1800
Elongation (%)	450
Aged 7d at 121C	
Tensile Strength (psi)	1500
Elongation (%)	110
Aged 50 M Rads	
Tensile Strength (psi)	1300
Elongation (%)	120
Aged 7d at 136C and 50 M Rads	
Tensile Strength (psi)	2000
Elongation (%)	35

Actual data typical values

J. L. Steiner

J. L. Steiner

REF #70

DONALD C. COOK NUCLEAR PLANT

EQUIPMENT QUALIFICATION FILE UPDATE TRANSMITTAL FORM

1. TO BE COMPLETED BY COGNIZANT AEPSC SECTION

SUBJECT: Kerite Power Cable Environmental Qualification

ORIGINATED BY: LFCoy (Signature) DATE: 5/25/82

APPROVED BY: [signature] (Signature) DATE: 052582

[signature] (Signature) DATE: 5/25/82

2. TO BE COMPLETED BY AEPSC NS&L SECTION

☐ ACCEPTED-TRANSMIT TO AEPSC QUALITY ASSURANCE

☐ REJECTED- RETURN TO COGNIZANT AEPSC SECTION MANAGER

REASON FOR REJECTION: ____________________

IS NRC SUBMITTAL REQUIRED? ☐ YES ☐ NO

IF YES, GIVE SUBMITTAL LETTER NUMBER AEP:NRC: __________

APPROVED BY: ______________ DATE: ______________

3. TO BE COMPLETED BY AEPSC QUALITY ASSURANCE

TRANSMITTAL FORM AND DATA RECEIVED BY: ______ (Initials) DATE: ______

CEEQF FILE INDEX UPDATED BY: ______ (Initials) Date ______

DATA FILED BY: ______ (Initials) Date ______

CEEQF FILE NUMBER OF DOCUMENT: ______________

49 Day Street
Seymour, Connecticut 06483
(203) 888-2591

the kerite company

April 18, 1980

American Electric Power Service Corporation
2 Broadway
New York, New York 10004

Attention: L. F. Caso

Re: A.E.P. Purchase Order No. 05601-821-2
A.E.P. Cable No. 3127
Kerite No. B-3230
Radiation Qualification
D.C. Cook Nuclear Generating Station

Gentlemen:

Per the request of your Mr. W. R. Farquharson and your telephone conversation with our Mr. J.M. Parks, we are enclosing the documentation for the above referenced item.

If we may be of any further assistance, please do not hesitate to call.

Yours truly,

THE KERITE COMPANY

Robert J. Henry

Robert J. Henry
Customer Service Representative

RJH:sal
Enc.

the kerite company July 27, 1979

AMERICAN ELECTRIC POWER SERVICE CORPORATION

DONALD C. COOK NUCLEAR GENERATING STATION

RADIATION QUALIFICATICN

Samples of Kerite unaged and aged 600 volt and 1000 volt HTK, FR jacketed power cables, with and without splices, have been type-tested to 200 megarads at a rate of less than 1.0 megarads per hour in a Cobalt 60 Gamma Field.

On the basis of this testing, it is concluded that the Kerite 1000 volt HTK FR jacketed cables, as supplied for the subject installation, will operate after exposure to radiation levels up to the severity of those simulated in the test. The 200 megarad test level is 1.33 times the 150 megarad level given in the May 30, 1979 letter to the Kerite Company from William R. Farquharson, American Electric Power.

R. E. Fleming
Nuclear Development Engineer

REF/lc

APPROVED J. B. Gardner, V.P. of Engineering

Subscribed and sworn to before me this 27th day of July, 1979.

Notary Public

AMERICAN ELECTRIC POWER Service Corporation

AEP

2 Broadway, New York, N.Y. 10004
(212) 422-4800

AEP PO#05601-821-2
AEP Cable #3127 (Kerite B-3230)

May 30, 1979

The Kerite Company
49 Day Street
Seymour, Conn. 06483

Attention: Mr. J. W. Campbell, Jr.

Gentlemen:

Subject power cable, 3-1/C twisted #2 AWG stranded copper with H.T.K. insulation and FR jacket was qualified to 120 Mrads of radiation in your report of April 30, 1970 entitled, "Report on the Effects of Gamma Radiation and Autoclaving on Kerite Power and Control Cables".

We would very much like to have in our file an additional report which will qualify the subject cable to 150 Mrads of radiation. Do you have such a report available? If so, please respond by forwarding a copy at your earliest convenience. If not, please advise.

Your prompt attention to this correspondence will be much appreciated.

Very truly yours,

William R. Farquharson

William R. Farquharson
Electrical Engineering Division

WRF/jal
APPROVED J. M. Intrabartola /JEK
J. M. INTRABARTOLA

cc: L. F. Caso

AMERICAN ELECTRIC POWER *Service Corporation*

AEP

2 Broadway, New York, N. Y. 10004
(212) 440-9000

AEP PO#05601-821-2
AEP Cable #3127 (Kerite B-3230)

July 23, 1979

The Kerite Company
49 Day Street
Seymour, CN 06483

Attention: Mr. C. A. Lundy

Gentlemen:

On May 30, 1979, I wrote you (copy of that correspondence attached).

On June 19, 1979, you called re my letter and advised "you would get back to me".

I wonder if at this time you are in a position to forward either a report (as requested in attached) or an "offical" Kerite statement (letter) attesting that the cable identified above will, or will not, withstand 150 Mrads of radiation.

Your response one way or the other is critical to a research project being conducted by us (AEPSC), therefore a prompt reply from you will be very much appreciated.

Thanking you in advance, I am,

Very truly yours,

William R. Farquharson

William R. Farquharson
Electrical Engineering Division

WRF/jal
APPROVED J M Intrabartola / TEK.
J. M. INTRABARTOLA

cc: L. Caso

AMERICAN ELECTRIC POWER Service Corporation

AEP

2 Broadway, New York, N.Y. 10004
(212) 440-9000

Previous Correspondence on Kerite
Power Cable Environmental Qualifications

April 10, 1980

Mr. C. A. Lundy
The Kerite Company
49 Day Street
Seymour, CT 06483

Dear Mr. Lundy:

Attached for your reference, find our communications of 5/30/79 and 7/23/79 that Mr. S. H. Horowitz refers to in his recent telephone conversation with you.

Very truly yours,

L. F. Caso
Electrical Engineering Division

LFC/jal
APPROVED J. M. INTRABARTOLA

cc: S. H. Horowitz
T. E. King

REF #70

DONALD C. COOK NUCLEAR PLANT

EQUIPMENT QUALIFICATION FILE UPDATE TRANSMITTAL FORM

1. TO BE COMPLETED BY COGNIZANT AEPSC SECTION

SUBJECT: Kerite Company Cable Environmental Qualification

ORIGINATED BY: [signature] (Signature) DATE: 9/28/82

APPROVED BY: [signature] (Signature) DATE: 092882

: [signature] (Signature) DATE: 9/28/82

2. TO BE COMPLETED BY AEPSC NS&L SECTION

☐ ACCEPTED-TRANSMIT TO AEPSC QUALITY ASSURANCE

☐ REJECTED- RETURN TO COGNIZANT AEPSC SECTION MANAGER

REASON FOR REJECTION: ____________________

IS NRC SUBMITTAL REQUIRED? ☐ YES ☐ NO

IF YES, GIVE SUBMITTAL LETTER NUMBER AEP:NRC: ________

APPROVED BY: ____________ DATE: ____________

3. TO BE COMPLETED BY AEPSC QUALITY ASSURANCE

TRANSMITTAL FORM AND DATA RECEIVED BY: ____________ (Initials) DATE: ________

CEEQF FILE INDEX UPDATED BY: ____________ (Initials) Date ________

DATA FILED BY: ____________ (Initials) Date ________

[illegible]

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AMERICAN ELECTRIC AEP POWER SYSTEM

DATE: September 28, 1982

SUBJECT: The Kerite Company Cable Environmental Qualification

FROM: L. F. Caso

TO: 79-01B Central File

The attached letter from the Kerite Company dated 9/21/82 should be made part of our equipment qualification document reference numbers 63, 68, 70 and 72.

L. F. Caso

2.4/LFC:jal

APPROVED

J.M. INTRABARTOLA

49 Day Street
Seymour, Connecticut 06483
(203) 888-2591

Mail All Correspondence To:
P.O. Box 452
Seymour, Connecticut 06483

the kerite company

9/24 TJM

September 21, 1982

American Electric Power Service Corporation
2 Broadway
New York, NY 10004

ATTENTION: T.J. MASSAR -
ELECTRICAL ENGINEERING DIVISION

Dear Sir:

SUBJECT: DONALD C. COOK NUCLEAR PLANT

REFERENCE: QUALIFICATION UPDATE

1975 per N. Duke 9/27/82

We have enclosed LOCA profile (excerpted from "Tests of Electrical Cables Under Simultaneous Exposure to Gamma Radiation, Steam and Chemical Spray While Electrically Energized" - March, 1985; Final Report #F-C4020-2; Figure 1) which describes a 100-day test conducted by the Franklin Institute Research Laboratories. This test provided a sodium borate chemical spray with a pH of 10.5 for 100 days continuously. The attached profile and the following results are offered as documentation of Kerite insulation and jacket materials' "Long-Term" (three months) immersion performance in a sodium borate solution.

The two cable samples (tested in referenced report) are representative of each 1/C which form the 3/C cable. Both samples (aged and unaged) are described as follows:

> 1/C, #6 AWG, 65 mil HTK (N-98) insulation and 65 mil FR (HC-711) jacket.

Each sample was irradiated to 200 megarads while installed in the autoclave. In summary, both cables maintained their electrical loading (1000v ac, 50 amps) throughout the test. Each cable passed the 5 minute voltage withstand test of 80 volts ac per mil of conductor insulation. Thi test was performed after completion of the LOCA exposure and prior to di assembly of the test vessel while the cables were still on the mandrel.

We trust that this is sufficient information to enable you to answer the inquiry of the NRC.

Very truly yours,

THE KERITE COMPANY

From the office of: C.A. Lundy
Metropolitan Sales Manager

Signee: Norma H. Dube
Administrative Sales Assistant

CAL/NHD/ss
Enclosure

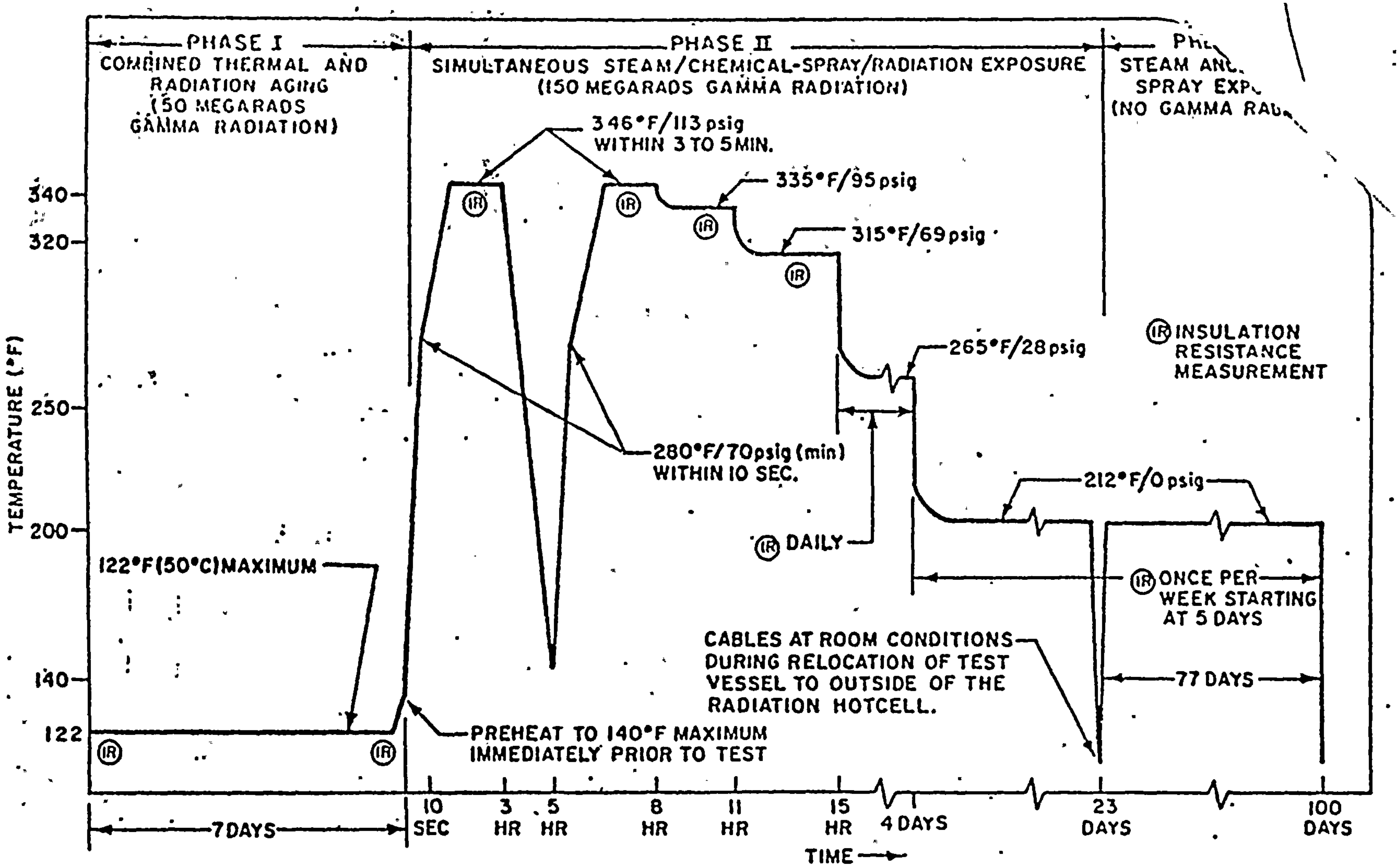


Figure 1. Specified Temperature, Pressure and Radiation Test Profile

REF #72

DONALD C. COOK NUCLEAR PLANT

EQUIPMENT QUALIFICATION FILE UPDATE TRANSMITTAL FORM

1. TO BE COMPLETED BY COGNIZANT AEPSC SECTION

SUBJECT: Kerite Company Cable Environmental Qualification

ORIGINATED BY: ______________ DATE: 9/28/82
(Signature)

APPROVED BY : ______________ DATE: 092882
(Signature)

: ______________ DATE: 9/28/82
(Signature)

2. TO BE COMPLETED BY AEPSC NS&L SECTION

☐ ACCEPTED-TRANSMIT TO AEPSC QUALITY ASSURANCE

☐ REJECTED- RETURN TO COGNIZANT AEPSC SECTION MANAGER

REASON FOR REJECTION: ______________

IS NRC SUBMITTAL REQUIRED? ☐ YES ☐ NO

IF YES, GIVE SUBMITTAL LETTER NUMBER AEP:NRC: ______________

APPROVED BY: ______________ DATE: ______________

3. TO BE COMPLETED BY AEPSC QUALITY ASSURANCE

TRANSMITTAL FORM AND DATA RECEIVED BY: ______________ DATE: ______________
(Initials)

CEEQF FILE INDEX UPDATED BY: ______________ Date ______________
(Initials)

DATA FILED BY: ______________ Date ______________
(Initials)

CEEQF FILE NUMBER OF DOCUMENT: ______________

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AMERICAN ELECTRIC AEP POWER SYSTEM

September 28, 1982

SUBJECT: The Kerite Company Cable Environmental Qualification

FROM: L. F. Caso

TO: 79-01B Central File

The attached letter from the Kerite Company dated 9/21/82 should be made part of our equipment qualification document reference numbers 63,68,70 and 72.

L. F. Caso

2.4/LFC:jal

APPROVED

J.M. INTRABARTOLA

the kerite company

49 Day Street
Seymour, Connecticut 06483
(203) 888-2591

Mail All Correspondence To:
P.O. Box 452
Seymour, Connecticut 06483

9/24 TJM

September 21, 1982

American Electric Power Service Corporation
2 Broadway
New York, NY 10004

ATTENTION: T.J. MASSAR -
ELECTRICAL ENGINEERING DIVISION

Dear Sir:

SUBJECT: DONALD C. COOK NUCLEAR PLANT

REFERENCE: QUALIFICATION UPDATE

1975 per N. Dube 9/27/82

We have enclosed LOCA profile (excerpted from "Tests of Electrical Cables Under Simultaneous Exposure to Gamma Radiation, Steam and Chemical Spray While Electrically Energized" - March, 1985; Final Report #F-C4020-2, Figure 1) which describes a 100-day test conducted by the Franklin Institute Research Laboratories. This test provided a sodium borate chemical spray with a pH of 10.5 for 100 days continuously. The attached profile and the following results are offered as documentation of Kerite insulation and jacket materials' "Long-Term" (three months) immersion performance in a sodium borate solution.

The two cable samples (tested in referenced report) are representative of each 1/C which form the 3/C cable. Both samples (aged and unaged) are described as follows:

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Each sample was irradiated to 200 megarads while installed in the autoclave. In summary, both cables maintained their electrical loading (1000v ac, 50 amps) throughout the test. Each cable passed the 5 minute voltage withstand test of 80 volts ac per mil of conductor insulation. This test was performed after completion of the LOCA exposure and prior to disassembly of the test vessel while the cables were still on the mandrel.

We trust that this is sufficient information to enable you to answer the inquiry of the NRC.

Very truly yours,

THE KERITE COMPANY

From the office of: C.A. Lundy
Metropolitan Sales Manager

Signee: Norma H. Dube
Administrative Sales Assistant

CAL/NHD/ss
Enclosure

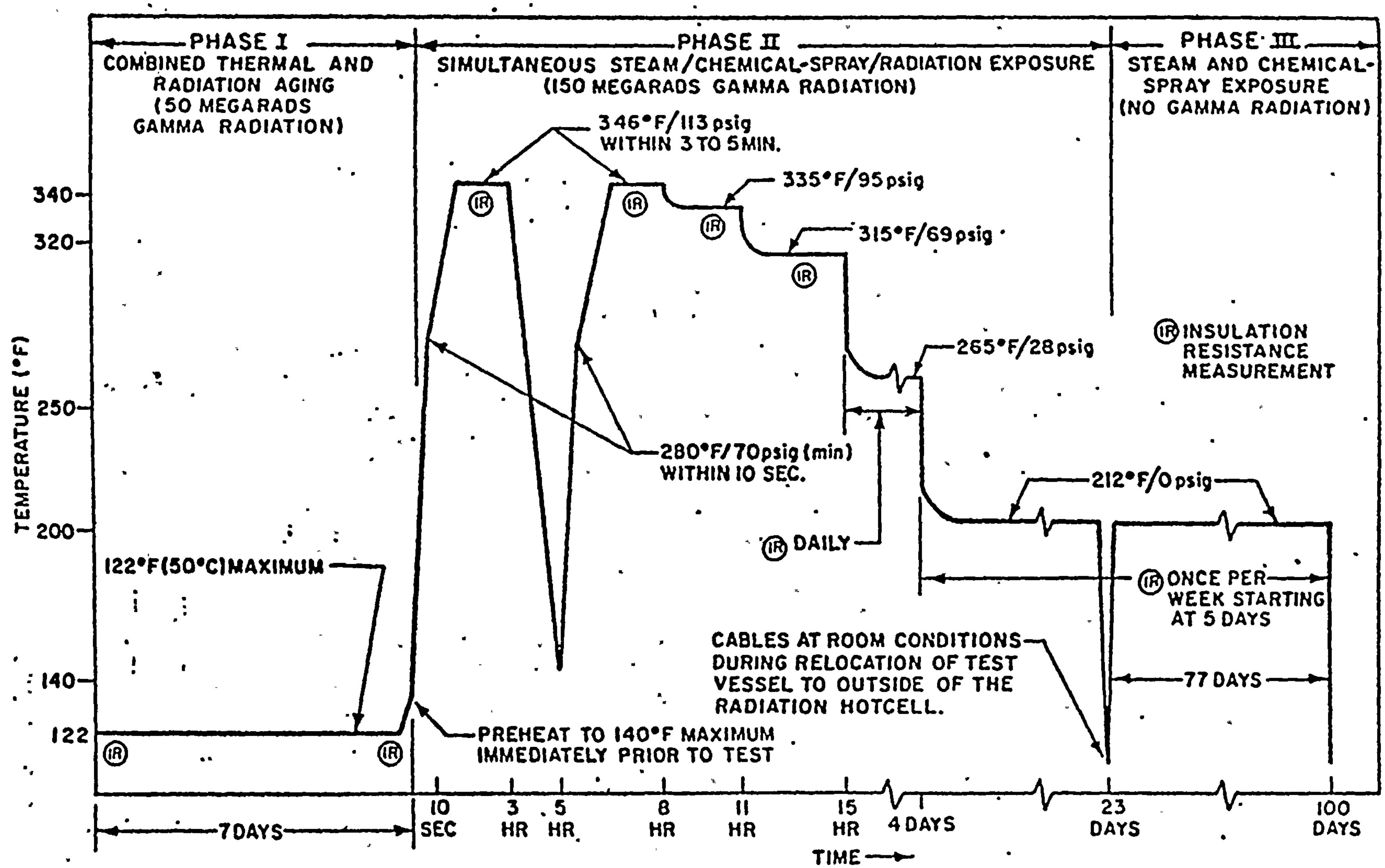

Figure 1. Specified Temperature, Pressure and Radiation Test Profile

3-6

Ref. 1

EGQ #98

Chemical Spray PH Envi: Qualific
Ref # 72

DONALD C. COOK NUCLEAR PLANT

EQUIPMENT QUALIFICATION FILE UPDATE TRANSMITTAL FORM

1. TO BE COMPLETED BY COGNIZANT AEPSC SECTION RFC DC

Attached Forms checked: ~~EGQ-96-1~~ ☐, ~~EGQ-96-2~~ ☐, ~~EGQ-97-1~~ ☐, ~~EGQ-97-2~~ ☐

ORIGINATED BY: [signature] DATE: 1/15/82
(System Engineer Signature)

APPROVED BY : [signature] DATE: 012082
(Cog. Engineer Signature)

: [signature] DATE: 1/20/82
(EGS Manager Signature)

2. TO BE COMPLETED BY AEPSC NS&L SECTION

☐ ACCEPTED-TRANSMIT TO AEPSC QUALITY ASSURANCE

☐ REJECTED- RETURN TO COGNIZANT AEPSC SECTION MANAGER

REASON FOR REJECTION: ______

IS NRC SUBMITTAL REQUIRED? ☐ YES ☐ NO

IF YES, GIVE SUBMITTAL LETTER NUMBER AEP:NRC: ______

APPROVED BY: ______ DATE: ______

3. TO BE COMPLETED BY AEPSC QUALITY ASSURANCE

TRANSMITTAL FORM AND DATA RECEIVED BY: ______ (Initials) DATE: ______

CEEQF FILE INDEX UPDATED BY: ______ (Initials) Date ______

DATA FILED BY: ______ (Initials) Date ______

4. COPY OF COMPLETED FORM TO BE RETURNED TO ORIGINATOR ELEC. GENERATION SECTION.

To be incorporated in RFC file at close-out.

JAN 8 1982

AMERICAN ELECTRIC POWER SERVICE CORPORATION

D. January 7, 1982

SUBJECT: 79-01B Submittal
Equipment Qualification
Containment Spray pH

FROM: P. A. Fisher

TO: ~~1. R. F. Dodd~~ 1/8/82
~~2. S. H. Steinhart~~ SHS 1/8/82
3. J. Gist /ana/S. Toth
1/13/82 c.c. SHS a/p, 1/8/82

We have reviewed the attached list of electrical materials with respect to the stated test report pH's vs the postulated 8.5 to 11 pH range for the containment spray following a LOCA. The postulated pH brackets all but three of the thirty five pH values listed. Of the three items, one was tested at a pH range of 7.67 to 10.5. The upper value, falls within the postulated pH range. The other two items tested at a stated pH of 7.67, are listed as "steel or cast Iron enclosure". These materials would definitely not be affected anymore significantly at a postulated upper pH limit of the spray solution than at the lower 7.67 pH test value.

Therefore it is the Chemical Engineering Section's considered opinion that the differences between the pH's listed for the test reports and that postulated for the spray are insignificant. Consequently, for all practical purposes, the pH values listed meet the postulated spray pH criterion.

M. O'Keefe's memo of November 3, 1981 addressed the subject of electrical and mechanical materials in more detail. This memo, therefore, is to be considered as pertinent reference information on this subject, particularly in regard to instrument component materials' compatability with the postulated pH range of the containment spray.

Paul F.
P. A. Fisher

PAF:mm

cc: L. Caso

DONALD C. COOK NUCLEAR PLANT:
ACCEPTED FOR Q/A BY [signature]
OF ELECT. CHEM. SECT. AEPSC, N.Y.

DATE: 012082 X
E. G. SECT. FILE: IE Bull. 79-01B (REF. 172)

INTRA-SYSTEM

Ref. pg.#	Device Description	Material	Qual Doc. Ref#	Test Report #	Chemical Spray (Qual	
					PPM B	PH
CC-1	Continental 3119	XLPE/Asbestos braid	8	IPS-348	2500	9-10
CC-2	Continental 3120	XLPE/Asbestos braid	8	IPS-348	2500	9-10
CC-3	GE-3120	Vulkene/Asbestos braid	8	IPS-348	2500	9-10
CC-4	Anaconda 3120	EPR/CSPE	5	F-C 3341	3000	9.5
CC-5	Continental 3121	XLPE/Asbestos braid	8	IPS-348	2500	9-10
CC-6	GE 3121	Vulkene/asbestos braid	8	"	"	"
CC-7	Continental 3122	XLPE/Asbestos braid EPR/CSPE	8	"	"	"
CC-8	G.E 3122	Vulkene/Asbestos braid	8	"	"	"
CI-1	Boston 3064	XLPE/CSPE	32	Boston test #73C212	2000	8-8.5
CI-2	Rockbestos 3064	Firewall III	34	Rockbestos qual of Firewall III	3000	9-11
CI-5	Samuel Moore 3075	CSPE/CSPE	11	Isomedix report of 5/76	3000	9-11
CI-7	Boston 3075	CSPE/CSPE	8	IPS-348	2500	9-10
CI-8	Cerro 3077	XLPE/Hypalon	12	Cerro report of 5/1976	3000	9-11
CI-9	Samuel Moore 3077	EPDM-Hypalon/Hypalon	11	F-C 3683	3000	9-11
CI-11	Boston 3077	CSPE/CSPE	8	IPS-348	2500	9-10

Ref. pg. #	Device Description	Material	Qual Doc. Ref #	Test report #	Chemical Spray PPM B	Chemical Spray P.H
CP-2	Okonite 324	Okonite / Okoprene	49	Okonite Qual of 7/3/78	3000	10.5
CP-4	Cyprus 347	EPR / Hypalon	35	F-C 3016	2000	9.0
CP-5	Anaconda 347	EPR / Hypalon	5	F-C 3341	3000	9.5
CP-6	Okonite 399	Okogard / Okolon	6	F-C 3674	2000	9-11
CP-9	Anaconda 3116	EPR / CSPE Hypalon Duraseath / EP Triplexed	5	F-C 3341	3000	9.5
CP-10	Essex 3116	EP / Hypalon	25	Isomedix report of 11/75	3000	9.5-10.5
unit 1 CP-11	Kerite 3127	H.T Kerite / FR (HC711)	7	Kerite report	2600	9.5
unit 4 CP-11	Kerite 3116	HTK / FR (HC711)	7	"	"	"
EP-01	ELECT. Penetration	Poly sulfon Sealant Stainless Steel	3	IPS-137	1.2% WT. BA 2000	9.5
EP-02	Elect. Penetration	"	3	"	"	9.5
—	Flood-up Tube	stainless steel	13	CWAPD-332	2500	9.5
F 1	Fan Motor	steel or cast iron enclosure	21	WCAP-7829	2500	9.5-10
LS-1	Limit Switch	"	43	Qual. of Namco Lim. Sw.	3000	10.5
V 1	Valve operator	"	22	Limitorque report # 600198	2600	7.67
V 2	Valve operator	"	16	Limitorque # 600456	3000	10.5
[illegible]	Valve op[illegible]					

Ref. Pg #	Device Description	Material	Qual Doc Ref#	Test Report #	Chemical Spray (Qual.	
					PPMB	P.H.
H-1	Hydrogen Recombiner	300-Series Stainless Steel Carbon Steel Inconel 600 Magnesium oxide insulation sheathed in Incoloy 800	20	WCAP-7709L Suppl. 2	2500	10
TC	control cable Termination	Combination of control cable insulation and jacket material + Raychem WCSF-070-X-N Heat Shrink tubing (Radiation crosslinked Polyolofin).	Various	Various	2500-3000	7.67-10.5 and P.H due to 3000 PPMB with .064 M $NA_2S_2O_3$.
TI	Instrument cable splice	Combination of instrument cable insulation and jacket material + Chemelex adhesive sealant RTVW. Raychem WCSF-70-12-N, WCSF-115-GN and WCSF-200-12-N heat shrink tubing	62	Inst. cable termination qual	2000	9-11
TP	Exited Power cable terminations	Scotch #23 tape or	13	CWAPD-332	2500	9.5

XLPE – crosslinked Polyethylene

CSPE – clorosulphonated Polyethylene

EPDM – Ethylene Propylene Rubber

EPR – Ethylene Propylene Rubber

EP – Ethylene propylene Rubber

HTK – (high temperature Kerite) Synthetic rubber

FR – Fire Retardant

okoprene – Neoprene (synthetic rubber)

okonite – Ethylene propylene Rubber

Okolon – Hypalon

Okogard – Ethylene Propylene base thermosetting compound

Okotherm – Silicone Rubber

Firewall III – Crosslinked Polyethylene

Vulkene – Crosslinked Polyethylene

AMERICAN ELECTRIC POWER SERVICE CORPORATION (AEP) POWER SYSTEM

ATE: November 3, 1981

JB: Equipment Qualification Meeting

OM: M. J. O'Keefe

O:
1. P. A. Fisher [signature] 11/3/81
2. R. F. Dodd [initials] 11/3/81
3. S. H. Steinhart
4. S. M. Toth

This memo is in response to questions raised during the October 2 Equipment Qualification Meeting. The pH range of 8.5 to 11.0 used to assess the resistance of various materials to the containment spray is given in both Unit 1 and Unit 2 Technical Specifications. There is no need to consider the corrosion effects of demineralized water since during and after an accident the water in the containment will contain chemical additives.

The "alkaline" spray in the containment will be a weakly basic sodium borate (borax) solution formed by the reaction between the boric acid in the reactor coolant and the sodium hydroxide spray additive. The long term effect of this solution on stainless steel, copper wire, and polysulfone would be minimal. Polysulfone, a Union Carbide Corp. product, is used as a sealant for containment penetrations. Union Carbide recommends polysulfone for use up to 250° F in a 50% sodium hydroxide solution, which has a pH of approximately 14. This solution would be much more aggressive than the containment spray.

The components of the Hydrogen Recombiner specified by Electrical Engineering Division are 300-Series stainless steel, carbon steel, Inconel-600, Incoloy-800, and magnesium oxide. The magnesium oxide is an insulating material sheathed in the Incoloy-800. The spray solution would not adversely affect the stainless steel, Inconel-600 or Incoloy-800. The magnesium oxide because it is contained in the Incoloy-800 will not be contacted by the spray and will not be affected. The carbon steel components would rust, unless coated, as they would in any moisture laden atmosphere, such as would exist in the containment after a loca.

Neoprene, crosslinked polyethylene, chlorosulfonated polyethylene, and ethylene-propylene elastomer which are used inside the containment as cable insulation, all exhibit long term resistance to basic solutions. Chlorosulfonated polyethylene and ethylene-propylene whose trade names are Hypalon and Nordel respectively, along with Neoprene are recommended for use in boric acid, sodium borate, and sodium hydroxide solutions.

The com[illegible] instru[illegible] [illegible] steel, brass, and ethylene-propylene have corrosion resistance to basic solutions. The carbon steel and cast iron components of the instruments are coated with Amercoat 66. This coating is an epoxy-polyamide resistant to basic solutions.

INTRA-SYSTEM

This submittal input was prepared using the sources of information shown on the attached SSDL and is, to the best of my knowledge, technically ccurate, factual, and complete.

M. J. O'Keefe

M. J. O'Keefe

MJO:mm

cc: J. A. Kobyra
J. Castresana
TBW/GWP/File AEC

I have reviewed this document and have verified that it is factual by: review of information sources on SSDL; discussions with preparer; and discussions with other parties. To the best of my knowledge, this submittal input is technically accurate, responsive to the "Action Item" and complete.

R. F. Dodd 11/3/81

NRC SUBMITTAL
SOURCE DOCUMENT LIST

TION ITEM Environmental Qualification of S.R. Equipment

IDENT. NO. NRC-0578B

THE FOLLOWING DOCUMENTS HAVE BEEN USED AS SOURCES OF INFORMATION FOR PREPARATION OF THE ATTACHED NRC SUBMITTAL. COPIES OF THESE DOCUMENTS ARE AVAILABLE FOR REVIEW AT THE LOCATION SPECIFIED.

SUBMITTAL STATEMENT		SOURCE DOCUMENT DESCRIPTION - TITLE, NUMBER, REVISION, ETC.	CURRENT SOURCE DOC. LOCATION	
PAGE	PARA.			
1	1	FSAR Technical specifications	1036	
1	2	Union Carbide Corp brochure on polysulfone	1036	
		Lange's Handbook of Chemistry 11th edition	1037	
1	3,4,5	Corrosion Engineering Fontana and Greene	1040	
1	4,5	Interpace Corporation brochure ITT Grinnel brochure	1040	
1	5	Chemical Engineers Handbook 5th edition	1040	
		AEP Paint Manual		