TEST REPORT

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP
WESTERN OPERATIONS, NORCO FACILITY

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RAYCHEM CORPORATION
300 Constitution Drive
Menlo Park, California 92024

29 - Page Report

DATE 9 December 1982

ENVIRONMENTAL QUALIFICATION TEST REPORT
OF
RAYCHEM MOLDED SLEEVE
FOR
RAYCHEM CORPORATION

REGISTERED PROFESSIONAL ENGINEER
HANS PETER BAUSCH
No. NU 000752
NUCLEAR
STATE OF CALIFORNIA

STATE OF CALIFORNIA }
COUNTY OF RIVERSIDE } ss.

R. C. Sadlier, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

R. C. Sadlier

SUBSCRIBED and sworn to before me this 9th day of December, 19 82

Catherine C Kelty
Notary Public in and for the County of Riverside, State of California

My Commission expires the 14th day of July, 19 83

OFFICIAL SEAL
CATHERINE C KELTY
NOTARY PUBLIC - CALIFORNIA
RIVERSIDE COUNTY
My comm. expires JUL 14, 1983

W-867A

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QUALITY ASSURANCE L. Housteau

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1.0 SUMMARY

Six specimens of the Raychem Molded Sleeve were subjected to an environmental qualification type test to demonstrate their capability to maintain functional operability under all service conditions postulated to occur within the containment of nuclear generating stations during the installed life of the product. The qualification program was based upon the methods, procedures and guidelines set forth in IEEE Standards 323-1974[1] and 383-1974[2] as endorsed by USNRC Regulatory Guides 1.89[3] and 1.131[4] respectively.

The test specimens were exposed to a single environmental profile encompassing temperatures up to 228°C (442°F) that enveloped the conditions produced by main steamline break and loss-of-coolant accidents (MSLB/LOCA), in accordance with the simulated environmental profile preferred by
NUREG-0588[5] for qualifying equipment located inside containment. A caustic solution was sprayed on the test specimens throughout the environmental exposure to simulate conditions that would occur when containment spray systems actuate. Extremes in power supply voltage ranges were simulated by energizing the test specimens at 1000 volts and 3n amperes.

The effects of installed life were simulated by the accelerated aging of three test specimens to an equivalent service life in excess of 42 years at 90°C (194°F). Accelerated aging was accomplished via thermal exposure at a rate based upon the Arrhenius data documented in Raychem Report EDR-5040.[6] These specimens were then exposed to gamma radiation at a level to include both the postulated LOCA accident dose and a dose equivalent o an installed assembly containment exposure integrated over a 40-year period. The remaining three specimens received only the postulated accident radiation dose to

simulate beginning of life LOCA/MSLB exposure. The thermally aged specimens received in excess of 2.15×10^8 rads gamma. Thermally unaged specimens received 1.65×10^6 rads gamma.

Acceptance criterion was established as the specimen's ability to maintain rated voltage and current during and after the environmental exposure. Margin was demonstrated by the specimen's ability to pass voltage withstand testing at 2400 Vrms.

Based upon the satisfactory performance of the specimens during this test program, it was concluded that the Raychem molded Sleeve is suitable for use inside the containment of nuclear power generating stations.

The LOCA/MSLB environmental exposure was performed by Wyle Laboratories, Norco, California. Radiation preconditioning of Specimen numbers 4, 5, and 6 and the thermal preconditioning of all specimens was performed at Raychem Corporation, Menlo Park, California. Radiation preconditioning of Specimen numbers 1, 2, and 3 was performed at Isomedix Inc., Parsippany, New Jersey.

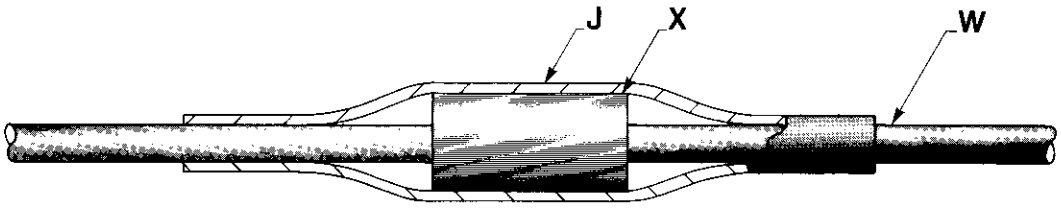
2.0 Test Specimen

2.1 Materials and Construction

2.1.1 Each test specimen was constructed of Raychem's nuclear grade extrusion and molding materials taken from standard production. All components conformed to the applicable Raychem Specification Component Drawings referenced in Figure 1.

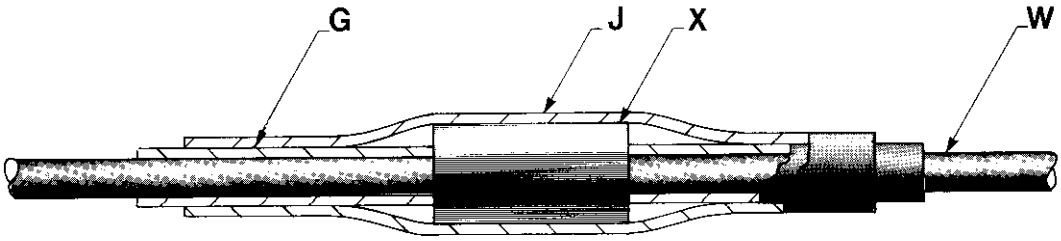
These Molded Sleeves were designed to seal and insulate configurations having large connector diameters relative to the connecting cable diameters, such as coaxial connections. This configuration was simulated using two single conductor wires and an oversized crimp with an internal spacer.

Configuration A



Key	Component	Description	Applicable Raychem Specification Component Drawing
J	202B811-52/144	Outer Sealing Sleeve	SCD-48032
X	Crimp & Spacer	2-3/8 inches long x 0.88 inch diameter	N/A
W	I/C - #4 AWG Wire	Rockbestos XLPE 0.045 inch insulation thickness	N/A

Configuration B



Key	Component	Description	Applicable Raychem Specification Component Drawing
G	WCSF-300-3-N	Cable Shim	SCD-37001
J	202B821-52/144	Outer Sealing Shim	SCD-48032
X	Crimp & Spacer	2-3/8 inches long x 0.88 inch diameter	N/A
W	I/C - 44 AWG Wire	Rockbestos XLPE 0.45 inch insulation thickness	N/A

Figure 1. Specimen Constructions

2.1.2 Specimen numbers 1, 2, 3, and 6 were assembled in the "A" configuration shown in Figure 1. Specimen numbers 4 and 5 were assembled in the "B" configuration shown in Figure 1. All specimens were assembled by Raychem personnel using Raychem's standard cable preparation and splice assembly procedures. The cables were cleaned with 1,1,1 Trichloroethane prior to splice assembly and installed using a Raychem FH-2609, LPG portable flame heater.

2.1.3 In addition to these six specimens, several other types of products were tested in this program. The other constructions are the subject of separate reports. For clarity of data presentation, the seven constructions reported herein are referenced as specimen numbers 1 through 6. These specimen numbers are cross-referenced with actual Raychem specimen identification numbers in Table 1.

3.0 TEST PROGRAM

3.1 Test Sequence

In conformance with Section 6.3.2 of IEEE Standard 323-1974[1], test specimens were neither modified nor altered after assembly and each specimen was used throughout the entire test sequence. The test sequence comprising this qualification type test is listed below:

Sequence	Test Description
1.	Functional Tests
2.	Specimen Preconditioning
3.	Functional Tests
4.	LOCA/MSLB Environmental Exposure
5.	Functional Tests

3.2 Functional Test Procedures

Functional tests were repeated three times during the test program as shown in Section 3.1. Prior to the performance of each functional testing cycle, all test specimens were immersed in tap water at room temperature for a minimum of 16 hours. Each splice assembly being tested was submerged 12 or more inches below the water's surface during the 16 hour soak. All functional tests were performed with the specimens immersed in the water bath. Test values are summarized in Table 2. Equipment calibration data is provided in Appendix B.

3.2.1 Insulation Resistance (I.R.)

After the 16 hour immersion, while still in the water bath, the I.R. of each specimen was measured. Measurements were made at 500 volts d-c after one minute of electrification. The water bath was used as the ground plane during this test.

3.2.2 Voltage Withstand

After the I.R. of each specimen was measured and while still in the water bath, a 2400 volt a-c voltage withstand test was performed on each test specimen in accordance with ICEA S-61-402, 6.11.2. Using the water bath as ground, the voltage was applied to the conductor in each specimen.

3.3 Specimen Preconditioning

3.3.1 Thermal Aging

Three specimens were thermally aged to simulate a service condition of over 4n years based upon Arrhenius data for Raychem’s

nuclear grade materials as documented in Raychem Report EDR-5040 [6].
These specimens were aged to an equivalent of 42.8 years installed life at 90°C (194°F). The remaining three specimens were not thermally aged, simulating the product at the beginning of installed life. All thermal aging was accomplished at Raychem Corporation. Specimens were situated horizontally in a circulating air oven throughout the aging period. Table 1 presents the aging time and the aging temperature used during specimen conditioning.

3.3.2 Radiation Aging

The radiation dose determined to represent the gamma exposure to installed assemblies within containment over a 40 year period was 5.0×10^7 rads. The postulated accident gamma radiation dose was 1.5×10^8 rads.

Thermally aged specimens were exposed both to the postulated accident dose, plus 10 percent margin, and the dose representing 40 years of installed life totaling 2.15×10^8 rads gamma. This radiation aging was performed at Isomedix Inc., Parsippany, New Jersey. The samples simulating the beginning of installed life received only the postulated accident dose plus 10 percent margin for a total dose of 1.65 x 108 rads gamma. This radiation aging was performed at Raychem Corporation, Menlo Park, California.

The actual gamma radiation exposures exceeded the required 2.15×10^8 rad level. Table 1 depicts the air equivalent radiation doses and associated dose rates by specimen number. The radiation source utilized was Co^{60} and the Certificates of Radiation are provided in Appendix A.

3.3.3 Functional Tests

The functional tests were again performed after specimen preconditioning as described in Section 3.2. Test values are listed in Table 2.

3.4 LOCA/MSLB Environmental Exposure

The test specimens were placed horizontally on perforated metal trays inside a pressure vessel. Extension leads were spliced to the test specimen inside the pressure vessel and insulated with Raychem WCSF-N tubing. The extension leads were brought out of the test vessel through penetrations installed in the pressure vessel wall to allow for electrical connection and monitoring. A diagram of the pressure vessel is given in Figure 2. The specimens were energized at 1.0 kV a-c to ground and carried a current of 30 amperes. Current values were sampled throughout the environmental exposure and are presented in Table 3. The voltage energization circuit for each test specimen was separately fused at 1/4 amp. A schematic of the energizing circuit is given in Figure 2.

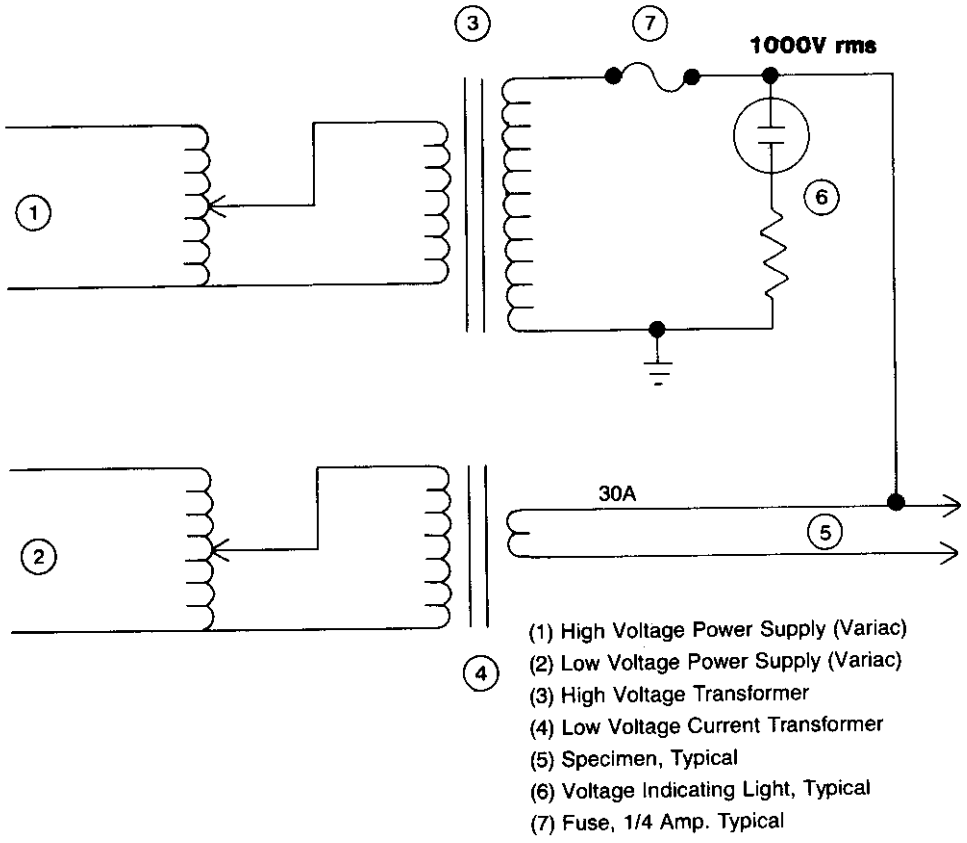
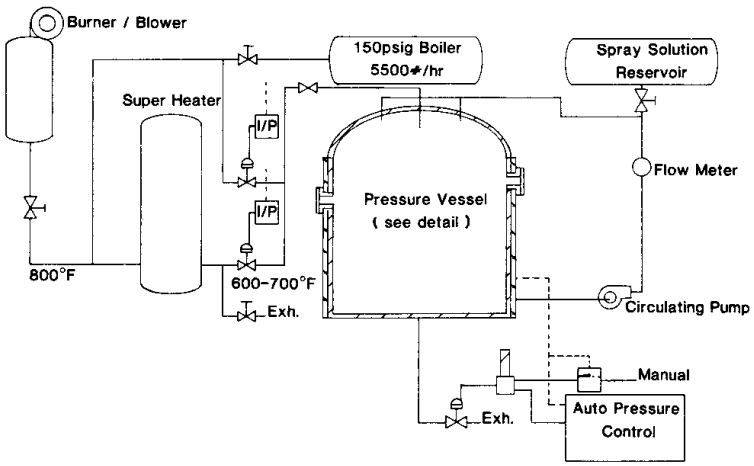
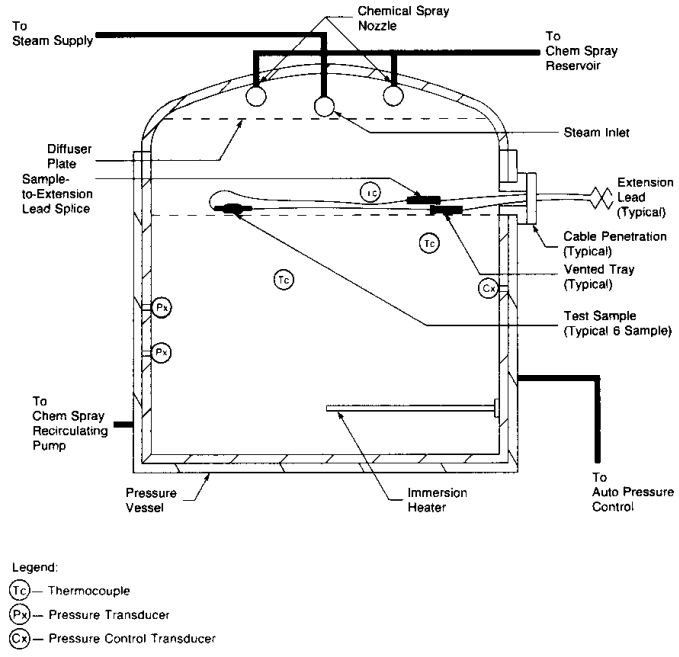


Figure 2. Test Schematic for Energizing Specimens

A chemical spray solution consisting of 0.28 molar H_3B0_3 (3000 ppm boron), 0.064 molar $Na_2S_2O_3$, buffered with NaOH to a pH of 10.5 at 25°C (77°F) was provided in a separate reservoir. This solution was sprayed through two nozzles from the top of the vessel at a rate in excess of 0.15 gpm/ft^2 beginning immediately after the second temperature transient and ending upon completion of the 30-day environmental exposure (actual flow was 34 gpm). A diagram of the pressure vessel is given in Figure 3. The temperatures, pressures, and spray duration throughout the test period are given in Figure 4.

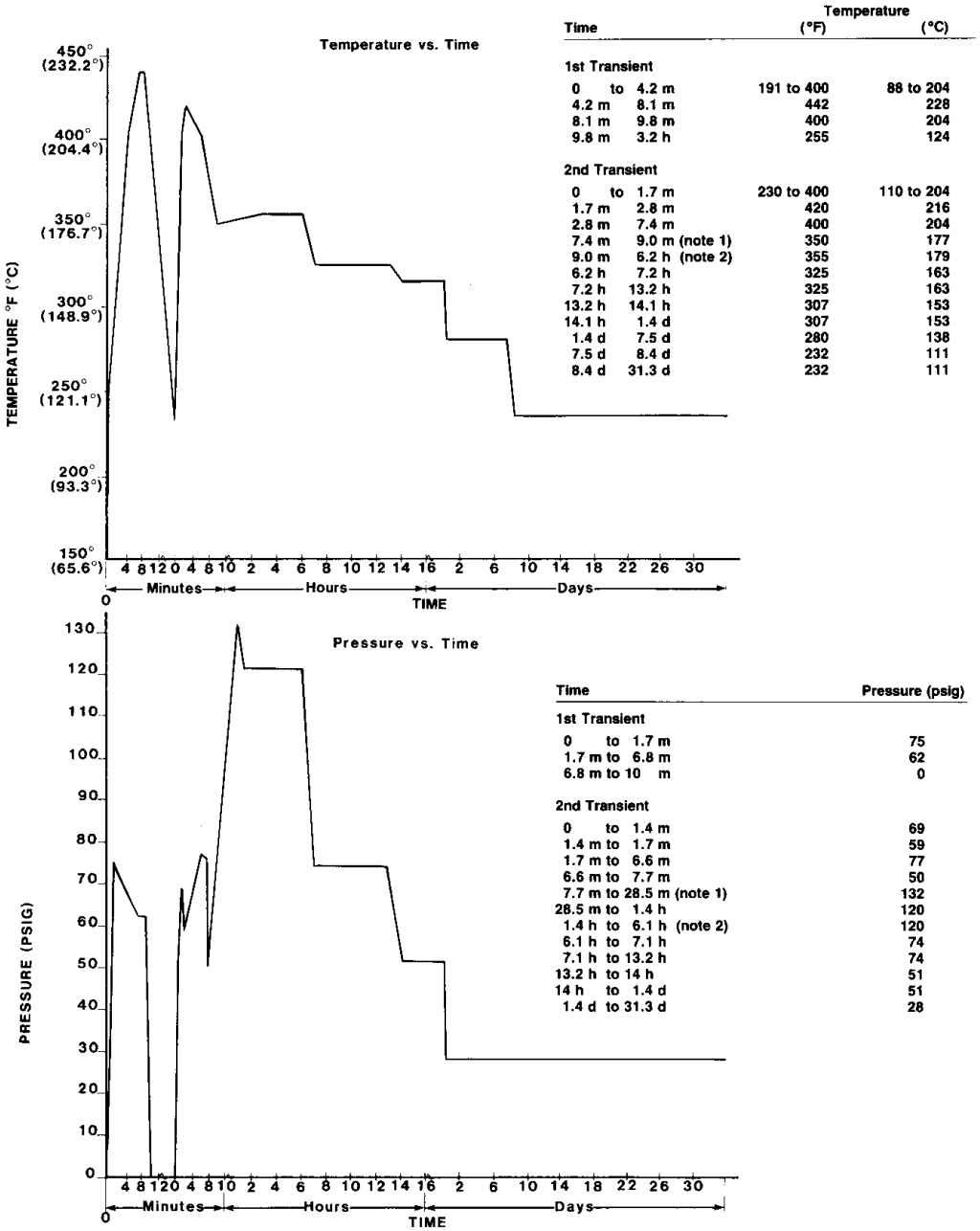


Auxiliary Equipment



Pressure Vessel Detail

Figure 3. LOCA/MSLB Pressure Vessel and Auxiliary Equipment



Time	Temperature (°F)	Temperature (°C)
1st Transient		
0 to 4.2 m	191 to 400	88 to 204
4.2 m 8.1 m	442	228
8.1 m 9.8 m	400	204
9.8 m 3.2 h	255	124
2nd Transient		
0 to 1.7 m	230 to 400	110 to 204
1.7 m 2.8 m	420	216
2.8 m 7.4 m	400	204
7.4 m 9.0 m (note 1)	350	177
9.0 m 6.2 h (note 2)	355	179
6.2 h 7.2 h	325	163
7.2 h 13.2 h	325	163
13.2 h 14.1 h	307	153
14.1 h 1.4 d	307	153
1.4 d 7.5 d	280	138
7.5 d 8.4 d	232	111
8.4 d 31.3 d	232	111

Time	Pressure (psig)
1st Transient	
0 to 1.7 m	75
1.7 m to 6.8 m	62
6.8 m to 10 m	0
2nd Transient	
0 to 1.4 m	69
1.4 m to 1.7 m	59
1.7 m to 6.6 m	77
6.6 m to 7.7 m	50
7.7 m to 28.5 m (note 1)	132
28.5 m to 1.4 h	120
1.4 h to 6.1 h (note 2)	120
6.1 h to 7.1 h	74
7.1 h to 13.2 h	74
13.2 h to 14 h	51
14 h to 1.4 d	51
1.4 d to 31.3 d	28

NOTES: (1) Problems encountered with test vessel pressure seals necessitated interrupting the test after 9.0 minutes. Test was resumed at the 177°C *(350°F)* temperature plateau and the chemical spray was initiated.

(2) Problems encountered with the test specimen extension leads and the test vessel pressure seals necessitated interrupting the test after 5 hours. The test was resumed at the 177°C *(350°F)* temperature plateau to complete the required exposure at this temperature level.

Figure 4. Temperature and Pressure Profiles for Simulation of LOCA/MSLB Environment

4.0 TEST RESULTS

4.1 Functional Test Results

The results of all voltage withstand tests and insulation resistance measurements are listed in Table 2. Test specimen current loading values during the environmental exposure are presented in Table 3. Specimen number 4 was unable to maintain voltage throughout the environmental exposure. This specimen's loss of ability to maintain voltage occurred between the fifth and ninth hour of the LOCA/MSLB exposure. All remaining specimens maintained voltage and current throughout the exposure and passed all functional tests specified in Section 3.1.

4.2 LOCA/MSLB Environment Exposure

The following details of the profile depicted in Figure 4 are noted:

a. The temperature of 204°C (400°F) was not reached in l0 seconds as proposed in Raychem Test Plan No. NPE-TP-81-03.[8] Attainable rise times were governed by the apparatus selected to encompass the entire scope of the Raychem test plan and precluded meeting the proposed temperature rise time.

   However, during the temperature transients, both the peak temperatures and temperature durations exceeded those proposed.

b. Problems encountered with test vessel pressure seals and the test specimen extension leads necessitated interrupting the test after the second temperature transient and again after five hours of specimen exposure at the 177°C (350°F) temperature plateau. During the

interruption at the 177°C (350°F) plateau, the specimens were visually inspected. It was found that a large section of the Steam Diffuser Plate had fallen a distance of approximately three feet from the top of the pressure vessel onto the Raychem test specimens (see Figure 5). Since replacement of the vessel penetration seals was required, this necessitated replacement of test specimen extension leads. The specimens themselves were not modified nor changed in any way. There was no apparent damage to the test specimens from either the impact of the Diffuser Plate upon the test specimens or from the effects of the environmental exposure. However, the visual examination was necessarily cursory because excessive handling and manipulation of specimens was prohibited until completion of the test program.

c. The test specimens were exposed to the LOCA/MSLB environment for 31.3 days rather than the 30 days proposed in Raychem Test Plan No. NPE-TP-81-03.[8]

4.3 Post LOCA/MSLB Inspection

At the conclusion of the environmental exposure, the test vessel was flooded with tap water. The test specimens were then given a voltage withstand test and the insulation resistances were measured. Test values are listed in Table 2. The vessel was then opened and the cause for Specimen number 4 being unable to hold rated voltage throughout the environmental exposure investigated.

At this point, specimen extension wires were severed inside the vessel and the specimens were removed for examination. With the exception of Specimen number 4, all samples were intact with no signs of cracking or splitting. Specimen number 4 exhibited

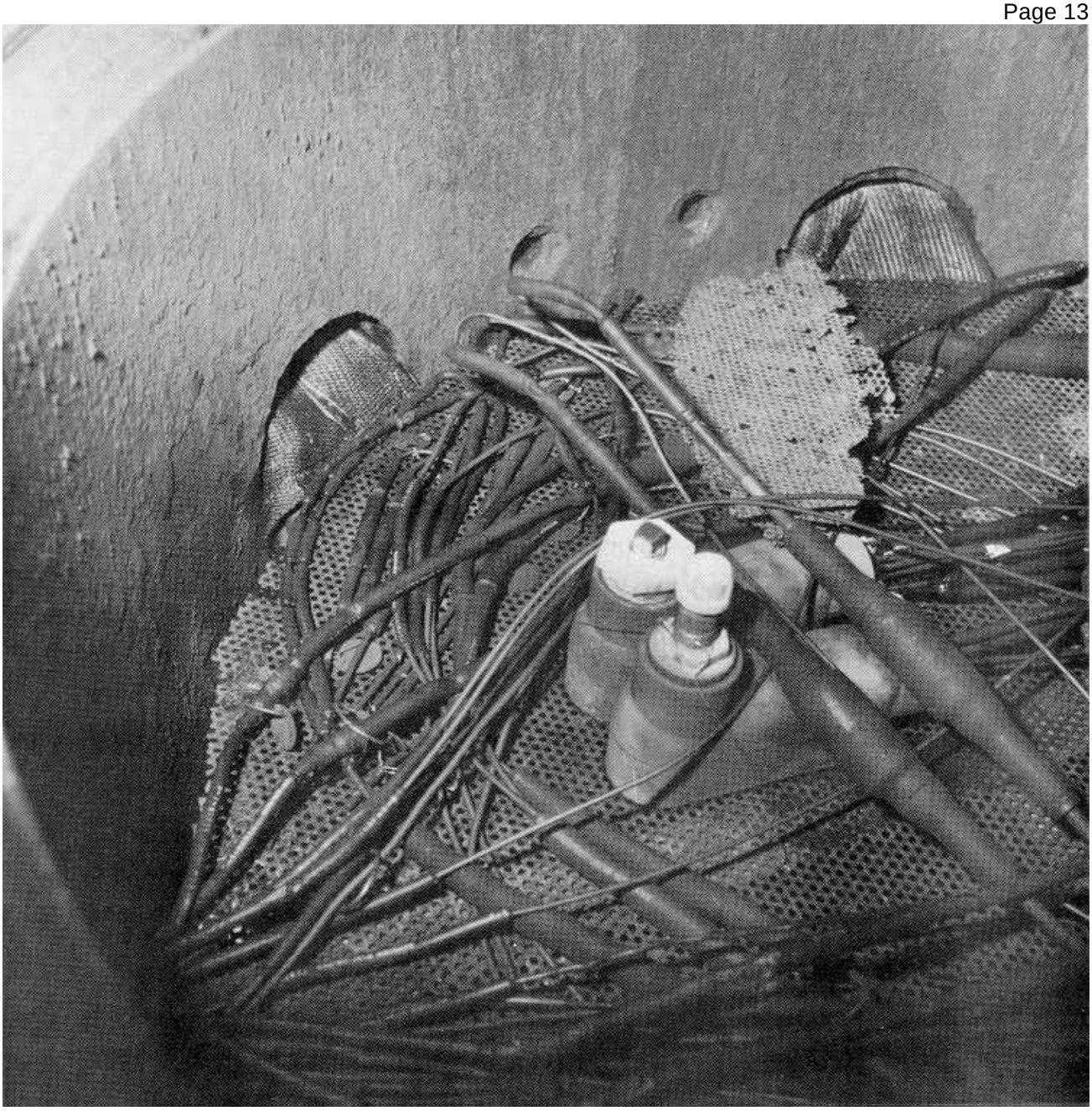


Figure 5 Installed Test Specimens After Five Hours Exposure at 177° C (350° F). [Note fallen portion of Diffuser Plate in upper right hand corner].

extensive surface tracking (carbonized path formations) and surface erosion (material removal). A circumferential crack approximately 2.5 inches long was observed in the area of the specimen showing the highest degree of tracking. Adjacent to the crack (0.2 inches distant) was a horseshoe-shaped puncture of the material 0.08 inches wide and 0.19 inches long. A summary of these findings is given in Table 4.

5.0 CONCLUSIONS

Six specimens of Raychem's Molded Sleeves were subjected to an environmental qualification type test program designed to simulate the service conditions produced by main steamline break and loss-of-coolant accidents (MSLB/LOCA). The test specimens were exposed to the LOCA/MSLB environmental extremes of temperature, humidity, pressure and chemical spray while electrically energized. These test specimens were conditioned to simulate both the beginning of installed life and over 40 years of installed life. They were exposed to LOCA/MSLB levels of radiation to include both accident dose margin and the postulated containment radiation dose integrated over 40 years of installed life.

Five of the specimens passed all functional tests throughout the entire qualification program, evidencing the configuration's ability to maintain electrical and physical integrity during LOCA/MSLB design basis events occurring both at the beginning and end of power plant life. One of the non-heat aged specimens failed between the fifth and ninth hour of exposure to the environmental profile. Inspection of the failed specimen revealed the failure occurred through the wall of the Raychem Sealing

Sleeve and not at the cable-to-sleeve interface. It was concluded that this specimen had been damaged by the impact of the fallen diffusion plate which occurred during the first five hours of the LOCA/MSLB environmental exposure. The failure could not be attributed to either the Raychem splice components or to the splice configuration. All remaining specimens demonstrated performance margin at the conclusion of the test by passing voltage withstand testing.

The results of this comprehensive test program provide reasonable assurance, by type test, that the Raychem Molded Sleeve can perform its intended function of insulating and sealing in the most limiting environment in which it is expected to function. Therefore, it is concluded that the tested configurations are suitable for use on Class IE systems within the containment of nuclear power generating stations.

REFERENCES

1. IEEE Standard 323-1974, "IEEE Standard for Qualifying IE Equipment for Nuclear Power Generating Stations."

2. IEEE Standard 383-1974, "IEEE Standard for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

3. USNRC Regulatory Guide 1.89, “Qualification of Class IE Equipment for Nuclear Power Plants."

4. USNRC Regulatory Guide 1.131, “Qualification Tests of Electric Cables and Field Splices for Light-Water-Cooled Nuclear Power Plants."

5. NUREG-0588, “Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment."

6. EDR-5040, Raychem Report "Analysis of Heat Aging Data on -52 Molding Material to Determine Pre-Aging Conditions for Nuclear qualification Testing,"

7. ICEA S-61-402, "ICEA/NEMA Standards Publication Thermoplastic-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy."

8. NPE-TP-81-03, "Environmental qualification Test Plan of Raychem Nuclear Cable Splice Assemblies."

TABLE 1

TEST SPECIMEN CONDITIONING SUMMARY

Specimen Number	Raychem I.D.[1] Number	Thermal Aging[2]			Radiation Aging[4]	
		Temperature	Duration	Installed[3] Life Equivalent	Dose (rads)	Rate (rads/hr)
1.	10	150°C	916 hrs.	42.8 yrs	2.2×10^8	5.7×10^5
2.	11	150°C	916 hrs.	42.8 yrs	2.2×10^8	5.7×10^5
3.	12	155°C	916 hrs.	42.8 yrs	2.2×10^8	5.7×10^5
4.	501	Unaged	-	Day 1	1.65×10^8	1.0×10^6
5.	502	Unaged	-	Day 1	1.65×10^8	1.0×10^6
6.	503	Unaged	-	Day 1	1.65×10^8	1.0×10^6

Notes: (1) Raychem Specimen Identification Numbers are referred to by adjacent Specimen Numbers throughout this report for clarity and ease of comprehension.

(2) The 916 hour Thermal Aging exceeded the required aging time to simulate 40-year life for the cable.

(3) Installed Life Equivalent is based upon Arrhenius data documented in Raychem Report EDR-5040[6] for continuous conductor temperature of 90°C (194°F).

(4) All Radiation Aging values are air equivalents of gamma radiation from a Co^{60} source.

TABLE 2

SUMMARY OF INSULATION RESISTANCE MEASUREMENTS

Test Conditions	Temperature (°C)	Temperature (°F)	Vessel Pressure (psig)	Test Specimen Insulation Resistance (ohms) 1.	2.	3.	4.	5.	6.
Functional Tests Before Conditioning (Note 1)	Ambient		-	5.6×10^{11}	4.5×10^{11}	3.5×10^{11}	1.3×10^{11}	4.2×1011	5.0×10^{11}
Functional Tests After Conditioning (Note 1)	Ambient		-	2.2×10^{11}	2.2×10^{11}	2.2×10^{11}	1.4×10^{11}	1.3×10^{11}	2.0×10^{11}
Functional Tests During LOCA/MSLB Exposure									
After 3 hours (Note 2)	177	350	120	-	-	1.0×10^{8}	1.5×10^{8}	4.0×10^{7}	-
After 9 hours	163	325	74	2.3×10^{6}	1.8×10^{6}	1.7×10^{6}	Note 3	2.0×10^{6}	3.0×10^{6}
After 23 hours	153	307	51	3.5×10^{6}	2.6×10^{6}	3.0×10^{6}	-	3.0×10^{6}	4.0×10^{6}
After 82 hours	138	280	28	8.4×10^{6}	7.5×10^{6}	7.7×10^{6}	-	7.6×10^{6}	9.5×10^{6}
After 132 hours	138	280	28	8.4×10^{6}	7.8×10^{6}	8.0×10^{6}	-	7.8×10^{6}	1.0×10^{7}
After 272 hours	111	232	28 (Note 4)	5.2×10^{7}	4.8×10^{7}	3.5×10^{7}	-	2.3×10^{7}	3.3×10^{7}
After 363 hours	111	232	28	4.4×10^{7}	3.7×10^{7}	3.0×10^{7}	-	3.7×10^{7}	2.7×10^{7}
After 454 hours	111	232	28	5.0×10^{7}	4.2×10^{7}	3.5×10^{7}	-	1.5×10^{7}	2.6×10^{7}
After 546 hours	111	232	28	5.0×10^{7}	4.0×10^{7}	3.4×10^{7}	-	1.1×10^{7}	3.2×10^{7}
After 637 hours	111	232	28	5.5×10^{7}	4.5×10^{7}	3.6×10^{7}	-	1.1×10^{7}	4.0×10^{7}
Test vessel filled with water (Note 1)	Ambient		-	8.2×10^{9}	9.6×10^{9}	1.7×10^{10}	-	2.2×10^{7}	1.4×10^{10}

Notes: (1) All specimens listing an insulation resistance value also passed voltage withstand testing per section 3.2.2

(2) Due to test interruption at this temperature plateau [reference Section 4.2(b)], meaningful Insulation Resistance measurements could not be performed upon all samples.

(3) This test specimen could not pass functional testing due to extensive surface tracking and erosion attributed to external damage [reference Sections 4.2(b), 4.3, and 5.0].

(4) Test vessel was externally pressurized with air to maintain a minimum pressure of 28 psig.

TABLE 3

CURRENT MONITORING OF TEST SAMPLES

DURING LOCA/MSLB ENVIRONMENTAL EXPOSURE

Test Conditions	Temperature (°C)	Temperature (°F)	Vessel Pressure (psig)	Sample Number 1	2	3	4	5	6
Pre-LOCA/HELB (Note 1)	85	185	-	26	26	26	26	27	27
After 3 hours	177	350	120	30	25	26	Note 2	25	28
After 26 hours	153	307	51	30	25	26	-	25	27
After 2 days	138	280	28	30	24	25	-	27	29
After 3 days	138	280	28	30	27	27	-	26	28
After 6 days	138	280	28	29	26	28	-	27	27
After 8 days	111	232	28 (Note 3)	28	26	28	-	27	28
After 9 days	111	232	28	28	25	26	-	26	26
After 13 days	111	232	28	30	28	28	-	26	26
After 15 days	111	232	28	30	27	27	-	25	27
After 17 days	111	232	28	31	28	27	-	26	29
After 20 days	111	232	28	29	26	26	-	26	26
After 22 days	111	232	28	29	27	27	-	25	27
After 24 days	111	232	28	30	26	27	-	24	26
After 27 days	111	232	28	30	26	28	-	24	26
After 28 days	111	232	28	29	25	32	-	24	25
After 29 days	111	232	28	30	26	26	-	26	25
After 30 days	111	232	28	30	27	27	-	24	25
After 31 days	111	232	28	30	27	26	-	24	26

Notes: (1) Pre-LOCA/HELB current measurements were made during test vessel preheat.

(2) Current was terminated on specimen when the 1/4 amp fuse opened.

(3) Test vessel was externally pressurized with air to maintain a minimum pressure of 28 psig.

TABLE 4

POST LOCA/MSLB INSPECTION SUMMARY

Specimen Number	Duration of Sample Energization	Results of Inspection
1.	31 days	Maintained voltage and current throughout environmental exposure. No evidence of cracking or splitting.
2.	31 days	Maintained voltage and current throughout environmental exposure. No evidence of cracking or splitting.
3.	31 days	Maintained voltage and current throughout environmental exposure. No evidence of cracking or splitting.
4.	<3 hours	Visible burns over 25 percent of the specimen. Electrical stress tracking throughout entire damaged area. Apparent 1/4-inch long puncture parallel to 2-inch long crack.
5.	31 days	Maintained voltage and current throughout environmental exposure. No evidence of cracking or splitting.
6.	31 days	Maintained voltage and current throughout environmental exposure. No evidence of cracking or splitting.

Appendix A

Certification of Radiation Dose

ISOMEDIX

February 18, 1982

Mr. Joe Connolly
Ray Chem Corporation
300 Constitution Drive
Menlo Park, California 94025

Dear Mr. Connolly:

This will summarize parameters pertinent to the irradiation of two (2) containers of cable splice samples, as per your Purchase Order #AO7349. Specimens were identified as follows:

Group I - R-24593- 165 megarad box

Group II - R-24591 - 215 megarad box

The specimens in Group I were exposed to a Cobalt 60 gamma source for a period of 362 hours at a nominal dose rate of 0.47 megarads per hour. The calculated dose based on dosimetry is 170 megarads. Halfway through the exposure, the specimens were rotated 180 degrees to give a more uniform dose distribution.

The specimens in Group II were exposed to a Cobalt 60 gamma source for a period of 386 hours at a nominal dose rate of 0.57 megarads per hour. The calculated dose based on dosimetry is 220 megarads. Halfway through the exposure, the specimens were rotated 180 degrees to give a more uniform dose distribution.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeters, utilizing a Bausch and Lomb Model 710 spectrophotometer as the readout instrument. This system is calibrated directly with NBS, with the last readout calibration being September 08, 1981. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the specimens somewhat, but the temperature did not exceed 130 degrees F, as indicated by previous measurements on an oil solution in the same relative position.

Irradiation for Group I was initiated on December 31, 1981, and was completed on January 20, 1982.

Irradiation for Group II was initiated on December 31, 1981 and was completed on January 22, 1982.

Very truly yours,

ISOMEDIX, INC.

David P. Constantine

David P. Constantine
Production Manager

DC/mjb

IRRADIATION CERTIFICATION

FACILITY: Raychem Co^{60} Facility

LOCATION: R&D Building, Menlo Park, CA.

CUSTOMER: Energy Division of Raychem

P.O./JOB NUMBER: MRS # 40024

SAMPLE DESCRIPTION: Cylindrical Dia. 1 to 3 inch
length 5 to 8 inches
1982 LOCA/MSLB Test Samples
NEIS Samples: 2A1H, 2A2H, 2A3H, 3B1H, 3B2H, 3B3H
Coaxial Splice Samples: 501, 502, 503

RADIATION SOURCE: Co^{60}

DOSE RATE: 1 M Rad/hr

CUMULATIVE DOSE: 165 M Rads

DATE SAMPLES RECEIVED: 08 Jan. 82

DATE SAMPLES SHIPPED: 15 Jan. 82

CERTIFIED BY:

Lloyd H. Thurman

Associate Staff Member

GEOMETRY OF SAMPLES AND SOURCE:

Source: Cylindrical 12 Tubes @ 27.5 cm dia.

Samples: Samples were suspended on the outside approx. 4 inches from the Co^{60}.

CALIBRATION CERTIFICATION:

Dosemeters: FWT-60 Radiochromis dye film manufacture "Far West Technology"

Calibrated By: National Bureau of Standards
Washington, D.C. 20234

Report No.:
Test 533/225797
DB8291046
XRG-136
August 6, 1981

Appendix B

List of Data Acquisition Instruments

SPECIMEN CABLE SPLICE ASSEMBLIES

CUSTOMER RAYCHEM

PART NO. SEE REC. INSP.

S/N SEE REC. INSP.

TEST: LOCA

JOB NO. 58722

DATE 1-25-82

TEST BY G. ADAIR

WITNESS

WYLE LABORATORIES

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
VOM	BECKMAN	330	VARIOUS	8892	5-4-81	5-2-82	DATA
RECORDER	KAYE	DR-2B	VARIOUS	8750	1-28-82	8-1-82	± 0.05%
DIGITAL THERMOMETER	FLUKE	2160A	-350°F to +752°F	8401	12-7-81	6-13-82	± 2.0°F
DIGITAL THERMOMETER	FLUKE	2160A	-350°F to +752°F	8290	1-26-82	5-30-82	± 2.0°F
DIGITAL THERMOMETER	FLUKE	2160A	-350°F to +752°F	8032	12-29-81	5-2-82	± 2.0°F
A/C D/C HYPOT	ASSOCIATED RESEARCH	4045	0-5K VOLTS	9092	12-11-81	6-13-82	± 2%
RECORDER	HEWLETT PACKARD	7132A	1-500 mV	8674	SYSTEM CALIBRATION		
RECORDER	HEWLETT PACKARD	7132A	1-500 mV	8672	SYSTEM CALIBRATION		
VOM	BECKMAN	330	VARIOUS	8893	7-1-81	7-4-82	DATA
GAUGE	ASHCROFT	7320	0-100 psi	4435	1-22-82	4-25-82	-
X-DUCER	VALIDYNE	DP-15	0-100 psi	19937	2-2-82	8-1-82	± 1%
X-DUCER	VALIDYNE	DP-15	0-100 psi	32738	2-2-82	8-1-82	± 1%
MEGOHMMETER	GENERAL RADIO	1864	100-500V 0-5 x 10^{13} Ω	L99838	12-16-81	6-16-82	± 5%
FLOW GAUGE	BARTON	D4-49053-1	0-80" H_2O	7784	1-11-82	7-18-82	± 0.5%
DIGITAL T/C METER	THERMO ELECT	DIGIMITE	0-400°F	7890	2-2-82	6-6-82	LABEL
DMM	BECKMAN	330	0-50 VDC 0-150 ACA	8892	5-4-81	5-2-82	DATA
CURRENT CLAMP	BECKMAN	CT-231	0-150 ACA	9065	10-7-81	7-4-82	LABEL

W614D Q.A. Approval

Where applicable, the listed test equipment has been calibrated using standards which are traceable to the National Bureau of Standards. Certificates and reports of all calibrations are retained in the Wyle Laboratories QA files and are available for inspection upon request.

SPECIMEN CABLE SPLICE ASSEMBLIES
CUSTOMER RAYCHEM
PART NO. SEE REC. INSP.
S/N SEE REC. INSP.
TEST: LOCA

JOB NO. 58722
DATE 1-25-82
TEST BY G. ADAIR
WITNESS

WYLE LABORATORIES

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
GAUGE	ASHCROFT	7322	0-200 PSI	30190	2-24-82	5-30-82	0.5% FULL SCALE
A. C. HIGHPOT	ASSOCIATED RESEARCH	4030	0-5kV A.C.	L30106	12-31-81	6-31-82	± 0.1%
CHART RECORDER	HONEYWELL	154201212 6927	0-500 mV	L30107	10-15-81	4-15-82	± 1%

W614D Q.A. Approval RCH

Where applicable, the listed test equipment has been calibrated using standards which are traceable to the National Bureau of Standards. Certificates and reports of all calibrations are retained in the Wyle Laboratories QA files and are available for inspection upon request.