TEST REPORT

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

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RAYCHEM CORPORATION
300 Constitution Drive
Menlo Park, CA 92024

26 - Page Report

DATE 24 August 1982

ENVIRONMENTAL QUALIFICATION TEST REPORT
OF
RAYCHEM NPKV NUCLEAR PLANT STUB CONNECTION KIT
FOR
RAYCHEM CORPORATION

REGISTERED PROFESSIONAL ENGINEER
GEORGE D. SHIPWAY
No. 12157
MECHANICAL
STATE OF CALIFORNIA

STATE OF CALIFORNIA }
COUNTY OF RIVERSIDE } ss.

R. C. Myrick, 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. Myrick

SUBSCRIBED and sworn to before me this 24th day of August, 19 82

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

My Commission expires JUL 14, 1983

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

W-867A

DEPARTMENT DYNAMICS

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REGISTERED PROFESSIONAL ENGINEER

DCAS—QAR VERIFICATION

QUALITY ASSURANCE L. Housteau

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1.0 SUMMARY

Seven specimens of the Raychem Nuclear Plant Stub Connection Kit (NPKV) configuration 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 the maximum allowable ampacity of the No. 12 AWG insulated conductors and at full rated voltage (1000V a-c).

The effects of installed life were simulated by the accelerated aging of four 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. These specimens were then exposed to gamma radiation at a level to include both the postulated LOCA accident dose and a dose equivalent to 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 and the unaged specimens received in excess of 2.15×10^8 rads gamma and 1.65×10^8 rads gamma respectively.

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 80 volts per mil based on the wire insulation thickness.

Based upon the satisfactory performance of the specimens during this test program, it was concluded that the Nuclear Plant Stub Connection Kit (NPKV) is suitable for use inside the containment of nuclear power generating stations.

The LOCA/MSLB environmental exposure was performed by Wyle Laboratories, Norco, California. Thermal preconditioning of samples was performed at Raychem Corporation, Menlo Park, California. Radiation sample preconditioning was performed at Isomedix Inc., Parsippany, New Jersey.

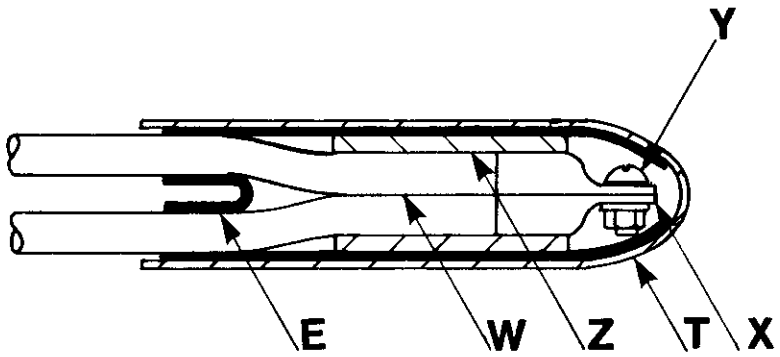
2.0 TEST SPECIMEN

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.

2.1.2 All test specimens were assembled by Raychem personnel in the configuration shown in Figure 1, using Raychem's standard cable preparation

and splice assembly procedures. The cables were cleaned with 1,1,1 Trichloroethane prior to splice assembly and the components were installed using a Raychem CV-5000 Thermogun, Model 750, hot air heater.



Key	Component	Description	Applicable Raychem Specification Component Drawing
E	302A812-52-10/144	Conductor Sealing Breakout	SCD-48019
Z	WCSF-200-1-U	Breakout Body Shim	SCD-37001
T	101A062-52/144	End Cap	SCD-48015
W	1/C-#12 AWG Wire	Rockbestos XLPE 0.03 inch insulation thickness	NA
X	Ring Tongue Terminals	3/4 inch length	NA
Y	Bolt	1/2 inch long x 3/8 inch diameter	NA

Figure 1. Specimen Construction

2.1.3 In addition to these seven 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 7. 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.[7] 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

Four specimens were thermally aged to simulate a service condition of over 40 years based upon Arrhenius data for Raychem's nuclear grade materials as documented in Raychem Report EDR-5040.[6] Two separate time-temperature relationships were used for thermal aging, resulting in two separate installed life equivalents at 90°C (194°F). Two specimens were heat aged to an equivalent of 48.9 years and two specimens were heat aged to an equivalent of 42.8 years. The remaining three specimens were not thermally aged, simulating the condition of product at the beginning of installed life. All thermal conditioning was accomplished at Raychem Corporation. Specimens were placed horizontally in a circulating air oven throughout the aging period. Aging times and temperatures used are presented in Table 1.

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. The samples simulating the beginning of installed life received only the postulated accident dose plus 10 percent margin for a total dose of 1.65×10^8 rads gamma.

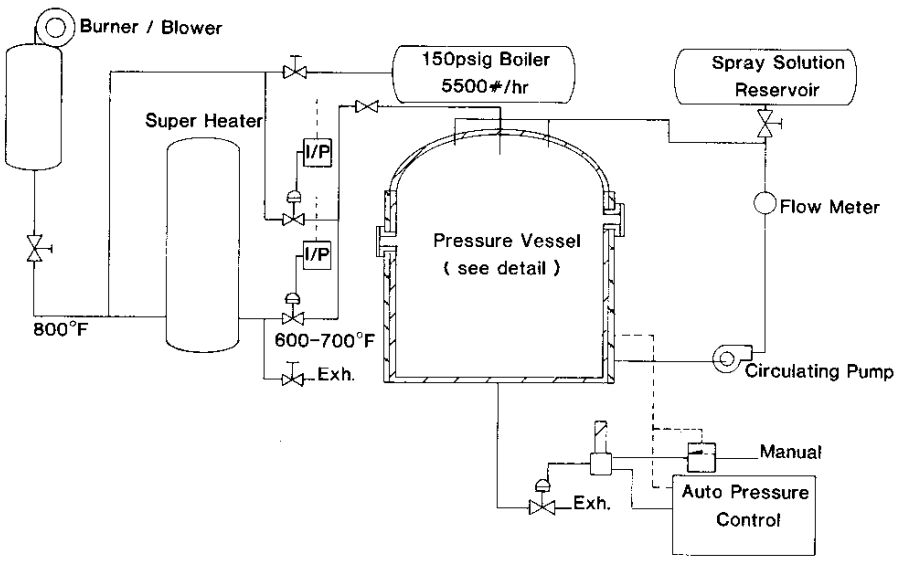
The actual gamma radiation exposures exceeded the required 2.15×10^8 rad and 1.65×10^8 rad levels. Table 1 depicts the actual air equivalent radiation doses and associated dose rates by specimen number. The radiation source utilized was Co^{60} and the Certificate of Radiation is shown in Appendix A.

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 on perforated metal trays inside a pressure vessel. Five specimens (Nos. 1, 2, 4, 6, and 7) were installed horizontally in conduit outlet boxes to simulate field installation in a conduit fitting or box. To allow sample exposure to the environment, the conduit outlet box opening was left uncovered and positioned on the bottom. The remaining two specimens (Nos. 3 and 5) were positioned horizontally upon the tray without the covering. A diagram of the pressure vessel is given in Figure 2. Figure 3 shows the installation of test specimens in the pressure vessel.



Auxiliary Equipment

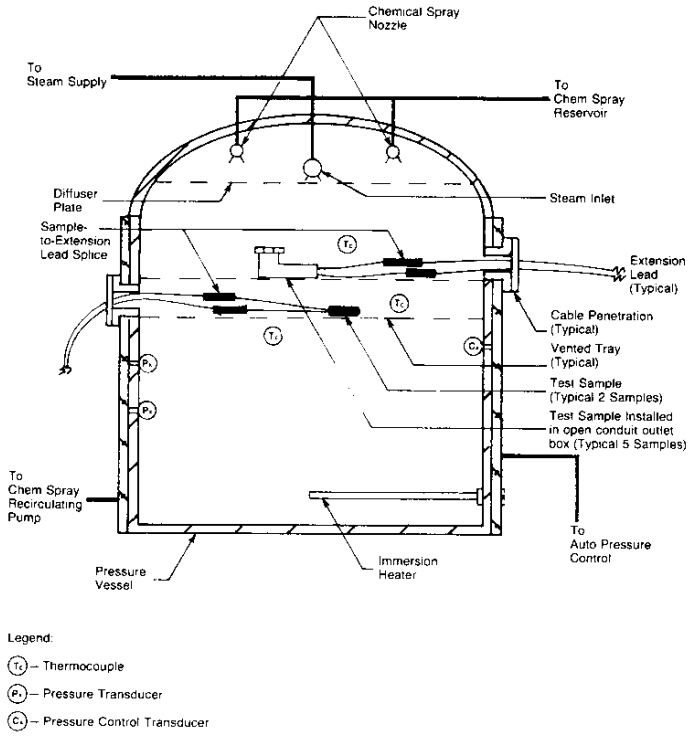


Figure 2. LOCA/MSLB Pressure Vessel and Auxiliary Equipment

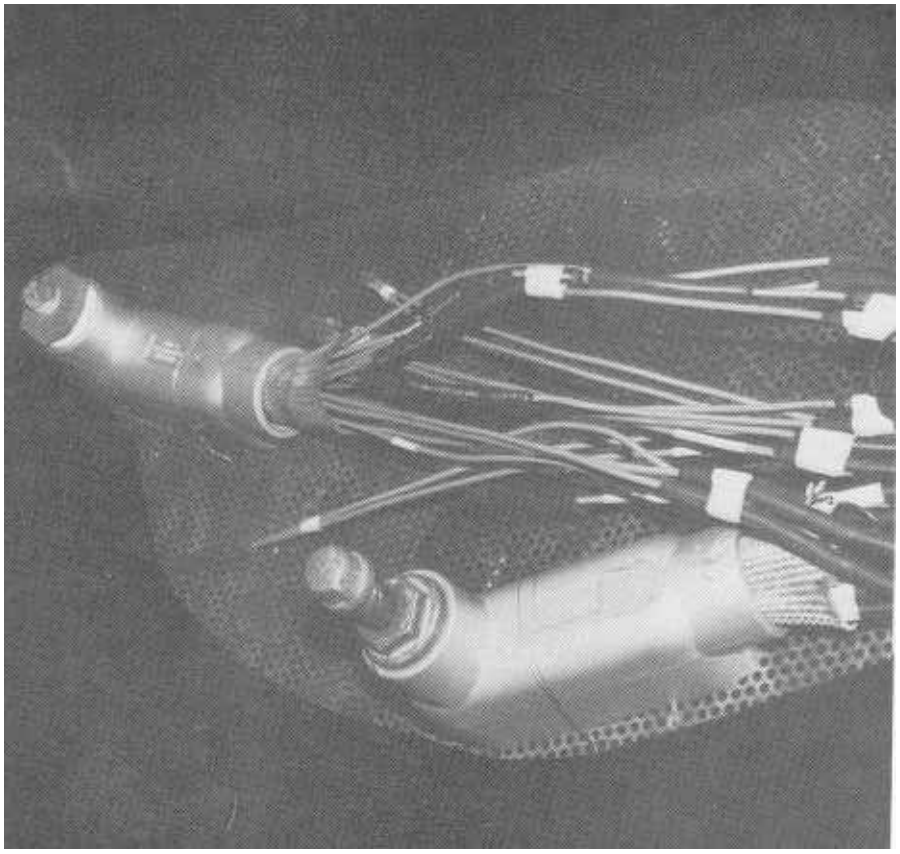


Figure 3. Specimen Installation

Extension leads were spliced to the test specimens 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. 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 test 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 4.

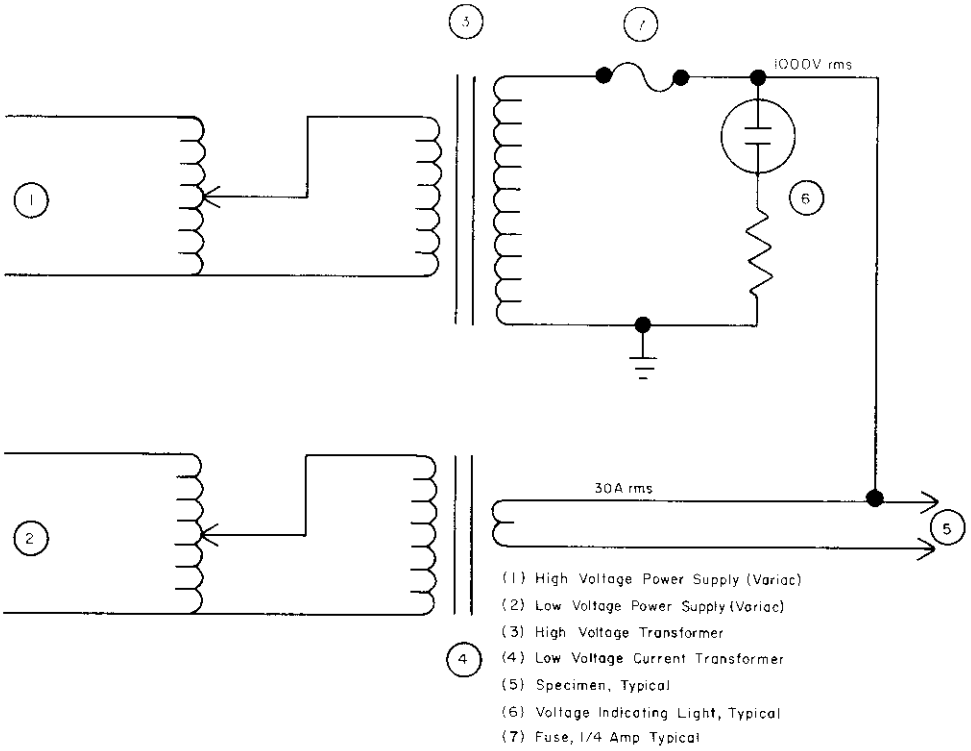
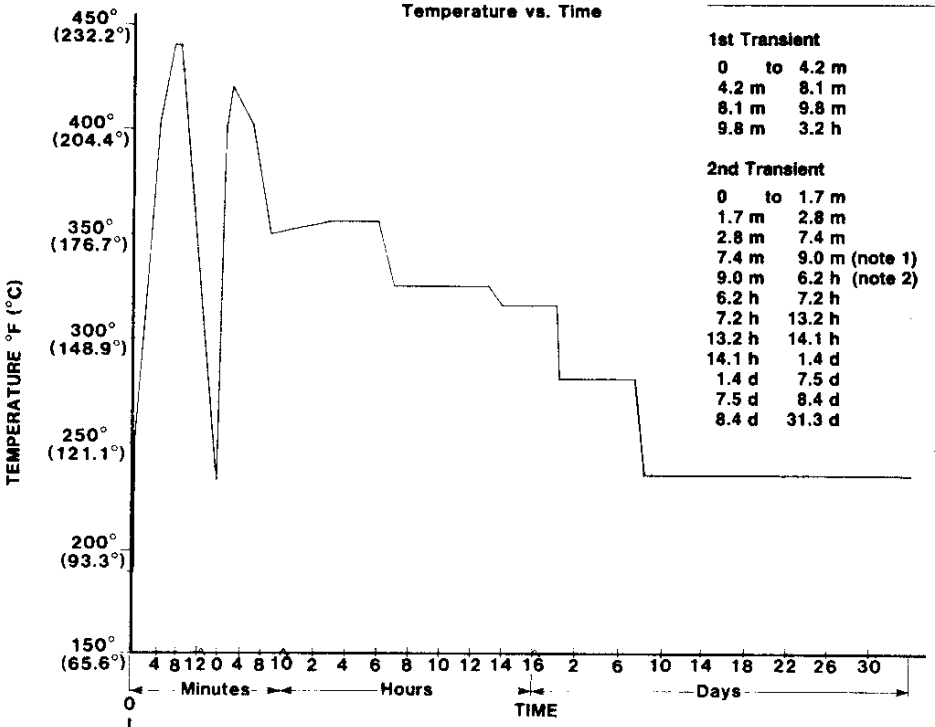
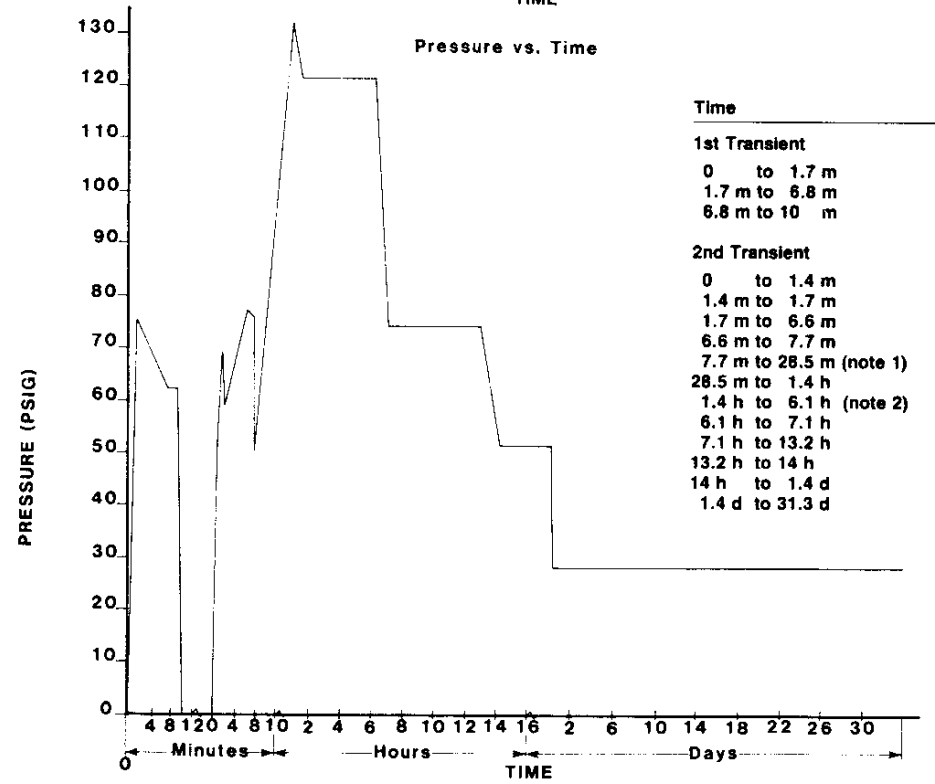


Figure 4. Test Schematic for Energizing Specimens

A chemical spray solution consisting of 0.28 molar H_3BO_3 (3000 ppm boron), 0.064 molar $Na_2S_20_3$, 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 beginning immediately after the second temperature transient and ending upon completion of the 30-day environmental exposure (actual flow was 34 gpm). The temperatures, pressures, and spray duration throughout the test period are given in Figure 5.



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 5 - 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. All specimens passed voltage withstand tests and measured high insulation resistance throughout the test sequence specified in Section 3.1. Three test specimens (Nos. 3, 4 and 7) were unable to pass post environmental exposure functional tests while installed in the test vessel. These specimens passed functional tests after removal from the test vessel and exclusion of faulty extension leads from test.

4.2 LOCA/MSLB Environment Exposure

The following details of the profile depicted in Figure 5 are noted:

a. The temperature of 204°C (400°F) was not reached in 10 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. All specimens appeared to be in good condition.

Replacement of the vessel penetration seals was required at this point which necessitated replacement of test specimen extension leads. The specimens themselves were not modified or changed in any way. The test was resumed at the 177°C (350°F) temperature plateau to complete the required specimen exposure at this level.

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 some test circuits 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. The specimens unable to pass voltage withstand testing were retested in a water bath and again insulation resistance measurements were made.

Specimen No.2 did not hold rated voltage throughout the environmental exposure. However, it passed the voltage withstand test and had a high insulation resistance while immersed inside the test vessel. This specimen was retested in a water bath and again passed voltage withstand and measured high insulation resistance.

Specimens 3, 4, and 7 did not hold rated voltage throughout the environmental exposure nor did they pass the voltage withstand test while immersed inside the test vessel. These specimens were retested in a water bath. All specimens

were found to have cracks in the wire insulation of the test loops. Specimen No. 3 had cracks in the wire insulation too close to allow immersion of the specimen in the water bath. Therefore, this specimen was wrapped with a cotton cloth saturated with water as the ground electrode. With the cracked wire insulation excluded from the test, this specimen passed the voltage withstand test and had high insulation resistance. Specimen Nos. 4 and 7 had cracks in the wire insulation sufficiently distant from the specimen area to allow immersion of the specimens. Both specimens passed the voltage withstand tests and had high insulation resistances.

A summary of these findings is given in Table 4.

5.0 CONCLUSIONS

Seven specimens of Raychem's NPKV configuration 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 energized at maximum rated current and voltage. 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.

The NPKV product configuration demonstrated the ability to insulate and seal stub connections when subjected to LOCA/MSLB environmental conditions. All specimens had the ability to maintain rated voltage and current throughout the environmental exposure and demonstrated satisfactory electrical performance at the conclusion of the test program. Although specimen No. 2

did not hold voltage throughout the environmental exposure, it passed functional testing at the conclusion of the test both while installed in the pressure vessel and when removed and tested in a water bath. It was therefore concluded that the inability of the specimen to hold rated voltage was due to a transient electrical fault associated with the specimen energization circuitry. Specimen Nos. 3, 4 and 7 did not hold voltage throughout the exposure. Both visual examination and specimen retest evidenced that the specimen test loops were unable to hold voltage due to cracks in the test loop wire insulation. In all cases, functional testing subsequent to the environmental exposure substantiated the ability of the NPKV configuration to maintain electrical integrity throughout the test program. All specimens demonstrated performance margin at the conclusion of the test, having passed the voltage withstand test and measuring high insulation resistance.

The results of this comprehensive test program provide reasonable assurance, by type test, that the Raychem NPKV configuration can perform its intended function of insulating and sealing stub connections in the most limiting environment in which it is expected to function. Therefore, it is concluded that the NPKV is 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[4]			Radiation Aging[3]	
		Temperature	Duration	Installed[2] Life Equivalent	Dose (rads)	Rate (rads/hr)
1.	15	150°C (302°F)	916 hrs.	42.8 yrs	2.2×10^8	5.7×10^5
2.	16	150°C (302°F)	916 hrs.	42.8 yrs	2.2×10^8	5.7×10^5
3.	199	175°C (347°F)	138 hrs.	48.9 yrs	2.2×10^8	5.7×10^5
4.	200	175°C (347°F)	138 hrs.	48.9 yrs	2.2×10^8	5.7×10^5
5.	147	Unaged	-	Day 1	1.7×10^8	4.7×10^5
6.	148	Unaged	-	Day 1	1.7×10^8	4.7×10^5
7.	146	Unaged	-	Day 1	1.7×10^8	4.7×10^5

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

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

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

(4) Both the 916 and 138 hour Thermal Aging exceeded the required aging time to simulate 40-year life for the cable.

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.	7.
Functional Tests Before Conditioning (Note 1)	Ambient		-	5.1×10^{9}	3.5×10^{10}	6.0×10^{10}	7.0×10^{10}	5.8×10^{9}	1.3×10^{11}	4.0×10^{9}
Functional Tests After Conditioning (Note 1)	Ambient		-	6.6×10^{11}	6.4×10^{11}	1.1×10^{12}	1.4×10^{12}	1.7×10^{12}	1.4×10^{12}	2.8×10^{11}
Functional Test During LOCA/MSLB Exposure										
After 3 hours	177	350	120	7.0×10^{7}	7.0×10^{7}	Note 2	Note 2	1.4×10^{8}	1.2×10^{8}	1.1×10^{8}
After 9 hours	163	320	74	7.0×10^{6}	7.6×10^{6}	4.0×10^{6}	6.0×10^{6}	1.3×10^{7}	1.2×10^{7}	9.0×10^{6}
After 23 hours	153	300	51	6.2×10^{6}	7.8×10^{6}	5.0×10^{6}	1.5×10^{7}	2.4×10^{7}	1.7×10^{7}	1.6×10^{7}
After 82 hours	138	280	28	5.0×10^{7}	Note 3	Note 4	Note 4	5.2×10^{7}	4.2×10^{7}	Note 4
After 132 hours	138	280	28	5.0×10^{7}				5.2×10^{7}	4.0×10^{7}	
After 272 hours	111	232	28 (Note 5)	3.6×10^{8}				2.4×10^{8}	1.9×10^{8}	
After 363 hours	111	232	28	2.8×10^{8}				2.5×10^{8}	1.6×10^{8}	
After 454 hours	111	232	28	3.0×10^{8}				2.8×10^{8}	1.8×10^{8}	
After 546 hours	111	232	28	3.4×10^{8}				3.8×10^{8}	2.2×10^{8}	
After 637 hours	111	232	28	4.0×10^{8}				4.6×10^{8}	2.8×10^{8}	
Test vessel filled with water (Note 1)	Ambient		-	4.5×10^{9}	5.8×10^{9}			8.4×10^{9}	2.0×10^{10}	
Samples 2,3,4 & 7 removed from vessel and retested (Note 1)	Ambient		-	NA	5.0×10^{11}	2.0×10^{11}	3.0×10^{9}	NA	NA	3.5×10^{11}

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

(2) Specimen was re-fused and held 1.0 kV. Reason fuse opened is unknown.

(3) Subsequent test found no insulation damage in wire insulation or test specimen. Although this specimen's 1/4 amp fuse opened between 23 and 82 hours after start of test, it passed voltage withstand testing and had high insulation resistance.

(4) Subsequent test showed inability to hold voltage due to cracks in wire insulation.

(5) 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)	(°F)	Vessel Pressure (psig)	1	2	3	4	5	6	7
Pre-LOCA/MSLB (Note 1)	84	183	-	28	29	28	28	28	27	27
After 3 hours	177	350	120	Note 2	29	28	28	29	27	29
After 26 hours	153	307	51	Note 2	28	28	27	29	25	Note 3
After 2 days	138	280	28	27	30	29	28	30	27	
After 3 days	138	280	28	30	Note 3	Note 3	Note 3	30	28	
After 6 days	138	280	28	30				30	29	
After 8 days	111	232	28 (Note 4)	30				29	28	
After 9 days	111	232	28	28				28	25	
After 13 days	111	232	28	30				30	23	
After 15 days	111	232	28	28				29	23	
After 17 days	111	232	28	27				30	24	
After 20 days	111	232	28	29				29	25	
After 22 days	111	232	28	27				29	25	
After 24 days	111	232	28	27				30	26	
After 27 days	111	232	28	29				30	25	
After 28 days	111	232	28	29				29	28	
After 29 days	111	232	28	29				30	25	
After 30 days	111	232	28	30				28	24	
After 31 days	111	232	28	29				29	28	

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

(2) Specimen was re-fused and held 1.0kV throughout remainder of test. Reason fuse opened is unknown.

(3) Current was terminated on specimens when the 1/4 amp fuse opened.

(4) 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 visible damage to test specimen or wire insulation.
2.	3 days	Visible cracks in wire insulation in close proximity to specimen. Passed subsequent VWT* with high I.R.
3.	3 days	No visible damage to test specimen or wire insulation. Passed VWT* both while immersed in test vessel and water bath. Failure was external to test vessel.
4.	3 days	Cracks in wire insulation. Passed VWT* in water bath with high I.R.
5.	31 days	Maintained voltage and current throughout environmental exposure. No visible damage to test specimen or wire insulation.
6.	31 days	Maintained voltage and current throughout environmental exposure. No visible damage to test specimen or wire insulation.
7.	1 day	Cracks in wire insulation. Passed VWT* in water bath with high I.R.

*VWT - Voltage Withstand Test

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.

Mr. Joe Connolly -2- February 18, 1982

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

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		ACCY.
					LAST	DUE	
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 0-1 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 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.

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.		12-31-81	6-31-82	± 0.1%
CHART RECORDER	HONEYWELL	154201212 6927	0-500 mV		10-15-81	4-15-82	± 1%

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.