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ENCLOSURE C

Staff Exh. 20

NUCLEAR UTILITY GROUP
ON EQUIPMENT QUALIFICATION

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BRANCH

MEMORANDUM

January 9, 1987

TO: Nuclear Utility Group On Equipment Qualification

FROM: Phil Holzman

SUBJECT: CECo SPLICE QUALIFICATION TEST INFORMATION

This memorandum and its attachments have been prepared to assist Group members in their decision regarding participation in the purchasing of the Commonwealth Edison (CECo) splice qualification test reports. The information in this memo is technical in nature. The contractual information is addressed elsewhere.

The qualification testing was completed in December, 1986. Due to the large number of samples, the testing was conducted in three groups, one PWR group and three BWR groups. The test results will be summarized in two (one PWR and one BWR) test reports. Both preliminary reports have been issued to CECo by Wyle Labs for review and comment. The final reports will be issued in late January or early February, 1987. CECo has requested that distribution of the preliminary reports not be made although they are available for inspection at CECo's Chicago engineering office.

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G PDR

NUCLEAR REGULATORY COMMISSION

Docket No. ______ Official Exh. No. 20

In the matter of ALABAMA POWER CO.

Staff ✓ IDENTIFIED 5/12/92

Applicant ______ RECEIVED 5/12/92

Intervenor ______ REJECTED ______

Cont'g Off'r ______

Contractor ______ DATE 1-9-87

Other ______ Witness ______

Reporter L. Estep

Attachment A is the final revision of the qualification plan for the entire group of tests. The plan contains information on:

1. Normal and accident service conditions
2. Thermal aging and activation energies
3. Splice descriptions
4. Test configuration, including mounting, electrical loading, and test circuitry
5. Acceptance criteria
6. Test measurements

The test reports summarize the test results and provide report data including:

1. Test specimen inspection descriptions pre and post testing.
2. Specimen photographs pre and post testing
3. Description and results of each functional test
4. Data sheets for all IR tests
5. Peak recorded leakage currents for each splice
6. Plots of leakage currents for certain splices
7. Instrument equipment sheets
8. Notices of anomalies and associated discussions

SUMMARY TEST RESULTS

The acceptance criterion was to demonstrate electrical integrity (e.g. the ability to maintain rated voltage and current). Leakage currents were monitored continuously during the LOCA testing for information only. Insulation resistance (IR) measurements were made at the completion of each functional test for information only. The post-LOCA IR measurements were made while the samples were still in the test vessel.

PWR TEST

Specimens Z11 and Z12 (V-type splice: Kerite tape over braided silicon motor leads) and B4 (V-type splice Okonite tape over Okonite cable) were unable to hold their specified voltages without blowing fuses. All other splices met the test acceptance criteria. The peak recorded leakage current for each splice and copies of the post-LOCA IR measurements are provided as Attachment B.

Post test inspections indicate that all the Raychem splices were intact and in good order with the following exceptions:

1. B1 and B3 sleeves had split approximately 3/4 of their length. The internal connection points were visible.
2. Z2 and Z3 sleeve adhesive end seals to Kapton wire "open" on both specimens.

The B1, B2 specimens were "three" wire into one tube splices. The B3 specimen was a "five" wire into one sleeve splice. The splitting of the B1 and B3 tubes may have been caused by the unusual configuration or possible excessive splice holdout.

The Z2 and Z3 splices were apparently unaffected by the lack of full end sealing as evidenced by the leakage current and post test IR values.

BWR TESTS

Splices D18, Q16, and Q18-Q20 (AMP window splices) and L7 (Raychem sleeve with 1/8" overlap over Kapton lead) were unable to hold their specified voltages without blowing fuses. In addition, splices D19, Q13-Q15, AND Q17 were severely damaged, based on post test visual inspections. The failure point of the Raychem splice (L7) was isolated to the Kapton lead wire and judged to be random. The peak recorded leakage current for each splice and copies of the post-LOCA IR measurements are provided as Attachment C.

Post test inspections indicate that all the Raychem splices were intact and in good order with the following exceptions:

1. L1, L2, and L8 did not have good adhesion at the end of tube to the Kapton wires.

The L1, L2 and L8 splices were apparently unaffected by the lack of full end sealing as evidenced by the similarity of their leakage current and post test IR values to the other Raychem splices.

The peak leakage current values for many of the Raychem splices were higher than might have been anticipated. Since the relationship between ac leakage currents at 528 Vac and dc leakage currents for low voltage dc instrument circuits is not well established, the use of some of the test results may be limited to power and control circuits. Specimens Z2 and Z3, with 1/2" and 3/4" overlap respectively, were powered at 36 Vdc and exibited 0 ma. leakage and high post test IR values.

Attachments (3)

WYLE LABORATORIES
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QUALIFICATION PLAN

QUAL PLAN 17859-01
DATE: August 11, 1986
TOTAL PAGES 20

REVISION A - 8/28/86
REVISION B - 9/18/86
REVISION C - 12/3/86

CONFIDENTIAL

DRAFT

ENVIRONMENTAL QUALIFICATION OF RAYCHEM WCSF-N NUCLEAR CABLE SPLICES OKONITE TAPES, SCOTCH TAPES, KERITE TAPES AND AMP SPLICES B

AS INSTALLED ON VARIOUS WIRE INSULATIONS AT COMMONWEALTH EDISON COMPANY'S LASALLE COUNTY, ZION, DRESDEN, QUAD CITIES BYRON, AND BRAIDWOOD NUCLEAR GENERATING STATIONS B

APPROVED BY: A. Horsman 8/11/86
PROJECT MANAGER: A. Horsman

APPROVED BY: F. Johnson 8/11/86
FOR: ENVIRONMENTAL QUALIFICATION
F. Johnson

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PREPARED BY: J. Hazeltine 8-11-86
PROJECT ENGINEER: J. Hazeltine

REVISIONS

(DN398) FORM 1109-1/8

REV NO	DATE	PAGE OR PARAGRAPH AFFECTED	BY	APP'L	DESCRIPTION OF CHANGES
A	8/28/86	All	JTH 8/28/86	8/28/86	Revised to incorporate Interim Procedure Revisions 1 and 2
B	9/17/86	All	JTH 9/17/86	9/18/86	Revised to incorporate Interim Procedure 1 to Rev. A, correct typographical errors, and add details on PWR LOCA test.

REVISIONS

REVISION ______

REPORT NO. 17859-01

DATE: December 5, 19[illegible]

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

REV NO	DATE	PAGE OR PARAGRAPH AFFECTED	BY	APP'L	DESCRIPTION OF CHANGES
C	12/5/86	All	ARH	12/9/86	Incorporate IPRs B-1 and B-2. IPR B1 added instrumentation requirement for PWR LOCA test per Para. 3.3.1., provided details of BWR LOCA test per Para. 3.3 and added various electrical schematic and setup figures. IPR B-2 added Specimens Q13 through Q20, provided basis for activation energies and thermal aging program summary.

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1.0 SCOPE

This document has been prepared by Wyle Laboratories for Commonwealth Edison Company (CECo) for nuclear environmental qualification of various configurations of Raychem nuclear sleeves and kits, Scotch Splice Tape, Kerite Splice Tape, Okonite Splice Tape and Amp splice connectors.

1.1 Objectives

The purpose of this qualification plan is to present the approach, methods and general procedures for qualifying Raychem splices installed over various wires and cables. Parallel qualification shall be attempted on Okonite tapes, Scotch tapes and Kerite tapes over various wires and cables.

Nuclear environmental qualification of any safety-related device to meet the intent of IEEE Std. 323-1974 is usually a three-step process; i.e., 1) radiation exposure; 2) aging; and 3) design basis event qualification. The purpose of the first two steps is to put the sample equipment to be used for qualification into a condition that represents the worst state of deterioration that a plant operator will permit prior to taking corrective action, i.e., its end-of-qualified-life condition. The next step demonstrates that it has adequate integrity remaining to withstand the added environmental stresses of specified design basis events and still perform its safety-related functions.

It is incumbent on CECo to assure that the components and materials contained in the equipment actually placed into service are the same as those qualified.

1.2 Applicable Qualification Standards, Specifications, and Documents

- IEEE Std. 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."
- IEEE Std. 383-1974, "IEEE Standard for Type Testing Of Class 1E Cables, Field Splices, and Connections For Nuclear Power Generating Stations."
- NUREG-0588 "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," Revision 1, dated July 1981.
- Regulatory Guide 1.89.
- 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants"
- Telecopy, Sargent & Lundy, 11 pages from John Regan.
- Commonwealth Edison Company Purchase Order No. 806121.

1.3 Equipment Description

The test specimens shall be as described in Table I and Appendix 1. B

1.4 Qualification Sequence

The test specimen assemblies shall be subjected in order, to the following testing:

- o Visual Inspection
- o Baseline Functional Tests
- o Normal Radiation Exposure
- o Functional Tests
- o Thermal Aging
- o Functional Tests
- o Accident Radiation Exposure
- o Functional Tests
- o Accident (LOCA)/Post-Accident Simulation
- o Post-Test Inspection
- o Functional Tests

2.0 QUALIFICATION REQUIREMENTS

2.1 Definition of Service Conditions

Service conditions as specified by CECo do not include margin. To account for normal variations in commercial production of equipment and variations in service conditions, margins per Paragraph 6.3.1.5 of IEEE 323-1974 shall be added to the applicable conditions.

- o Temperature — +15°F (Accident - peak temperature)
- o Pressure — +10% (not greater than 10 psig)
- o Voltage — +10%
- o Time — +10% (Post-Accident)

2.1.1 Normal Conditions

2.1.1.1 LaSalle, Dresden And Quad Cities

The following normal service conditions are as specified by CECo:

- o Temperat re — 150°F
- o Relative Humidity — 40-90%
- o Radi ion (TID air equivalent) — 1.6E7 rads gamma
- o Pressure — (-) 0.5 to 2.0 psig

Note: Operating temperature of the specimens is equal to amb nt temperature since heat rise is judged to be negligible due to the low current ypical of signal and instrumentation circuitry and due to the short operating ration of valve operator motors.

2.1.1.2 Byron, Braidwood And Zion

The following normal service conditions are as specified by CECo:

- o Temperature — 122°F
- o Relative Humidity — 20-70%
- o Radiation (TID air equivalent) — 3.5E6 rads gamma
- o Pressure — (-) 0.25 to 0.30 psig

Note: Operating temperature of the specimens is equal to ambient temperature since heat rise is judged to be negligible due to the low currents typical of control and instrumentation circuitry and due to the short operating duration of valve operator motors.

2.0 QUALIFICATION REQUIREMENTS (Continued)

2.1.2 Design Basis Event (DBE) Conditions

2.1.2.1 LaSalle, Dresden And Quad Cities

2.1.2.1.1 Accident (LOCA) Conditions Inside the Drywell (Zone H2)

Temperature (°F)	340	320	250	200
Pressure (psig)	-2 to 48.3	-2 to 48.3	0 to 25	0 to 20
Relative Humidity	Steam	Steam	100%	100%
Duration	0-3 hr	3-6 hr	6 hr to 1 day	1 day to 100 days

Radiation 2×10^8 rads gamma (integrated)

Chemical Spray: Continuously spray vertically downward with demineralized water at a rate of 0.15 gal/min./ft.^{2} of horizontal area of the test specimen holding fixtures. Chemical spray commences at the 6-hour point and continues for 24-hours after initiation.

2.1.2.1.2 Byron, Braidwood And Zion

Temperature (°F)	330	270	170-155	155
Pressure	50	50	Saturated Steam	Saturated Steam
Relative Humidity	Steam	Steam	100%	100%
Duration	10-180 sec.	5-20 min.	1-120 days	120-365 days

Radiation 2×10^8 rads (integrated) - See Attachment B

Chemical Spray: Continuously spray vertically downward for first 24 hours with a solution of the following composition at a rate of 0.15 gal/min ft^2 of the horizontal area of the test specimen holding fixture. Chemical spray commences after 3 minutes and continues for 24-hours after initiation.

- 0.28 Molar H3BO3 (3000 ppm)
- 0.064 Molar $Na_2S_2O_3$
- NaOH to make a pH of 10.5 at 77°F

The chemicals shall be mixed according to Wyle Procedure No. 543-100.

2.0 QUALIFICATION REQUIREMENTS (Continued)

2.1.2.2 Seismic

Seismic testing is not required for cable/splice qualification.

2.1.3 Other Service Conditions

- o Voltage — See Table I
- o Current — See Table I

2.2 Safety-Related Functions

The safety classification of this equipment is Class 1E. The subject equipment provides essential services in support of emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or is otherwise essential in providing support to prevent significant release of radioactive material to the environment. The safety-related functions are described in the following paragraph.

2.2.1 Description

The subject splices are installed in various Class 1E power (e. g. valve operator motors), control, and instrumentation circuits at the LaSalle County, Dresden, Quad Cities, Zion, Byron and Braidwood Nuclear Power Generating Stations.

2.2.2 Acceptance Criteria

The acceptance criteria for the test specimen assemblies is to demonstrate, during accident and post-accident simulation, electrical integrity. Circuit currents of Table 1 will be applied while powered at Table 1 voltages to the appropriate fused circuits.

Insulation resistance shall be measured at each functional test for information only.

Leakage currents to ground on each specimen shall be measured continuously for informational purposes only during the LOCA tests.

3.0 QUALIFICATION PROGRAM

3.1 Baseline Functional Tests

3.1.1 Visual Inspection

A visual inspection of the test specimen components shall be performed by Wyle Laboratories. This inspection will ensure that the equipment has no obvious visible damage and that the components are as described in Paragraph 1.3. Specimen assemblies shall be tagged to facilitate their identification throughout the qualification program.

3.1.2 Specimen Preparation

The test specimens shall be prepared by CECo and forwarded to Wyle Laboratories. All specimens prepared at Wyle shall be accomplished with the CECo technical representative present and to his/her instructions. The test specimens shall be prepared in accordance with the splice preparation procedures in Appendix 1.

3.1.3 Functional Test

The insulation resistance of each specimen shall be measured (for information only) by applying 500 VDC for a minimum of 1 minute between conductor and ground.

A megohmmeter with accuracy of ±5% shall be used for measuring insulation resistance. Record insulation resistance values on the data sheet. If the measured resistance is less than 5.0E5 ohms, reduce the megohmmeter voltage until an insulation resistance value can be measured.

3.2 Aging

3.2.1 Normal Radiation Exposure

The worst-case normal radiation requirement, as specified by Commonwealth Edison Company, is 1.6E7 rads gamma. Therefore, the test specimens (except Q13 through Q16) shall be irradiated to a normal radiation exposure of 1.6E7 rads gamma using a Cobalt 60 source. The dose rate shall be approximately 1E6 rads per hour.

The Quad Cities inside containment 40-year normal radiation requirement is 1.4E6 rads, gamma. Five-year Specimens Q13 and Q14 shall be irradiated to 1.75E5 rads, and 10-year Specimens Q15 and Q16 shall be irradiated to 3.5E5 rads (5-and 10-year levels respectively) using a Cobalt-60 source at a dose rate of approximately 1E5 rads per hour.

At the direction of CECo, additional specimens supplied by them shall be irradiated as follows and held by Wyle for possible future testing.

3.0 QUALIFICATION Program (Continued)

3.2.1 Normal Radiation Exposure (Continued)

1. Two specimens (Q17 and Q18) shall be irradiated to 5.25E5 rads (Quad Cities 15-year requirement) at a dose rate of approximately 1E5 rads per hour.

2. The two remaining specimens (Q19 and Q20) shall be irradiated to 7.0E5 rads (Quad Cities 20-year requirement) at a dose rate of approximately 1E5 rads per hour.

The dose rate shall be measured at the geometric centerline of the test specimens. The specimens shall be rotated as necessary during the exposure to ensure a uniform dose distribution.

Dosimetry used shall be traceable to the National Bureau of Standards.

Specimen powering is not required during radiation exposure.

3.2.1.1 Post-Normal Radiation Exposure Functional Tests

The tests of Paragraph 3.1.3 shall be repeated on all specimens.

3.2.2 Time-Temperatue Effects

3.2.2.1 Desired Qualified Life

A literature search of Wyle's Aging Library has been utilized to obtain auditable aging data for the component materials used in the various test specimen splices in this qualification program. Aging temperatures of 266°F, 248°F, and 239°F were selected based on past aging programs for similar materials. The aging times shall be as listed in Table II and in Paragraph 3.2.4.

3.2.2.2 Activation Energies

3.2.2.2.1 Specimens Z-1 - Z-6, Z8-Z10, B1-B3, L1-L10, D1, D2, D5-D17 and Q7-Q12

The activation energy of the limiting material in these specimens is 1.29eV for crosslinked polyolefin which is the material used in Raychem WCSF-N heat shrink tubing. This activation energy is contained in Wyle Library Code (WLC) 036080A.

3.0 QUALIFICATION PROGRAM (Continued)

3.2.2.2.2 Specimens Z7, Z11, Z12, and Z13

The insulating material in the splices in these specimens is Kerite tape which is 180°C rated Scotch Number 70 silicone rubber tape. An activation energy of 1.25eV has been selected. This activation energy is for 50 percent loss of elongation for 180°C G.E. silicone rubber wire insulation. It is judged that the thermal properties of the Kerite tape are equivalent to those of the 180°C silicone rubber wire insulation and the 1.25eV activation energy contained in WLC 067382 shall, therefore, be used to develop the program for these specimens.

3.2.2.2.3 Specimens D3 and D20

It is judged that the Scotch Number 70 tape is the primary insulating material of the test samples splices containing a combination of 3M tapes - Number 70, Number 17, and 130C. Therefore, the activation energy of 1.25eV shall be used to develop the aging program for these specimens per the discussion in the preceding paragraph. This activation energy is contained in WLC 067382.

3.2.2.2.4 Specimens B4-B7 and L11

The activation energy for Okonite T-95 insulation tape (Crosslinked ethylene propylene) is 1.26eV as contained in WLC 051781. This is the primary insulation material used in the above specimens.

3.2.2.2.5 Specimens D4, D21, Q1, Q2, Q3, and Q4

The primary insulation in these specimens is Scotch 33+ tape which is PVC (polyvinyl chloride) with an activation energy of 1.15eV as contained in WLC 049981.

3.2.2.2.6 Specimens D18, D19, Q5, Q6, Q13 through Q20

The insulating material used in the AMP window splices in these test specimens is Nylon (polyamide). The thermal properties of the splice material are judged to be equivalent to those of 125°C Nylon 6/6 (Zytel 101) for 50 percent loss of electrical strength as contained in WLC 003278A. The activation energy of this Nylon is 1.17eV.

3.0 QUALIFICATION PROGRAM (Continued)

3.2.3 Relative Humidity

Relative humidity is not considered an aging mechanism for the cables. For insulation systems, its effect is usually not the primary failure mechanism, as noted in WAL 0255-80 with respect to motor insulations, "However, in most cases, moisture plays only a secondary role in the failure. It does not produce the damage in the insulation, the insulation wears away or cracks for other reasons. Moisture merely provides a direct electrical pathway between these matured devices and ground."

Therefore, the ability of the cables to perform their safety-related functions within their relative humidity environment shall be demonstrated during the accident/post-accident test.

3.2.4 Thermal Aging Program Summary

The specimens shall be aged in accordance with Table II and the following paragraphs. Tolerances on aging temperature are +5, -0 deg. F and on aging time are +2, -0 hours.

3.2.4.1 Specimens Z1-Z6, Z8-Z10, and B1-B3

As specified by CECo, the desired qualified life for these specimens is 40 years. The thermal aging time to simulate 40 years at the Zion and Byron/Braidwood maximum normal ambient temperature of 122°F (50°C) is 149 hours at an aging temperature of 239°F based on an activation energy of 1.25eV.

3.2.4.2 Specimens Z7, Z11, Z12, and Z13

As specified by CECo, the desired qualified life for these specimens is 40 years. The thermal aging time to simulate 40 years at the Zion maximum normal ambient temperature of 122°F (50°C) is 190 hours at an aging temperature of 239°F based on an activation energy of 1.25eV.

3.2.4.3 Specimens B4-37

As specified by CECo, the desired qualified life for these specimens is 40 years. The thermal aging time to simulate 40 years at the Byron/Braidwood maximum normal ambient temperature is 122°F (50°C) is 1"9 hours at an aging temperature of 239°F based on an activation energy of 1.26eV.

3.0 QUALIFICATION PROGRAM (Continued)

3.2.4.4 Specimens L1-L10

As specified by CECo, the desired qualified life for these specimens is 40 years. The thermal aging time to simulate 40 years at the LaSalle maximum normal ambient temperature of 150°F (66°C) is 298 hours at an aging temperature of 266°F based on an activation energy of 1.29eV.

3.2.4.5 Specimen L11

As specified by CECo, the desired qualified life for this specimen is 40 years. The thermal aging time to simulate 40 years at the LaSalle maximum normal ambient temperature of 150°F (66°C) is 352 hours at an aging temperature of 266°F based on an activation energy of 1.26eV.

3.2.4.6 Specimens D1, D2, D5-D17, Q8, Q10, and Q12

As specified by CECo, the desired qualified life for these specimens is 30 years. The thermal aging time to simulate 30 years at the Dresden and Quad Cities maximum normal ambient temperature of 150°F (66°C) is 224 hours at an aging temperature of 266°F based on an activation energy of 1.29eV.

3.2.4.7 Specimen D3

As specified by CECo, the desired qualified life for this specimen is 30 years. The thermal aging time to simulate 30 years at the Dresden maximum normal ambient temperature of 150°F (66°C) is 279 hours at an aging temperature of 266°F based on an activation energy of 1.25eV.

3.2.4.8 Specimens D4, Q2, and Q4

As specified by CECo, the desired qualified life for these specimens is 30 years. The thermal aging time to simulate 30 years at the Dresden and Quad Cities maximum normal ambient temperature of 150°F (66°C) is 482 hours at an aging temperature of 266°F based on an activation energy of 1.15eV.

3.2.4.9 Specimens D18 and D19

As specified by CECo, the desired qualified life for these specimens is 15 years. They have been in service for 10 years and will, therefore, require an additonal 5 years' equivalent aging to bring them up to a total of 15 years. The thermal aging time to simulate 5 years at the Dresden maximum normal ambient temperature of 150°F (66°C) is 170 hours at an aging temperature of 248°F based on an activation energy of 1.17eV.

3.2.4.10 Specimen D20

As specified by CECo, the desired qualified life for this specimen is 15 years. The thermal aging time to simulate 15 years at the Dresden maximum normal ambient temperature of 150°F (66°C) is 140 hours at an aging temperature of 266°F based on an activation energy of 1.25eV.

3.0 QUALIFICATION PROGRAM (Continued

3.2.4.11 Specimens D21, Q1 and Q3

As specified by CECo, the desired qualified life for these specimens is 15 years. The thermal aging time to simulate 15 years at the Dresden and Quad Cities maximum normal ambient temperature of 150°F (66°C) is 241 hours at an aging temperature of 266°F based on an activation energy of 1.15eV.

3.2.4.12 Specimens Q5 and Q6

As specified by CECo, the desired qualified life for these specimens is 40 years. The thermal aging time to simulate 40 years at the Quad Cities maximum normal ambient temperature of 150°F (66°C) is 89 hours at an aging temperature of 248°F followed by 538 hours at 266°F based on an activation energy of 1.17eV.

3.2.4.13 Specimens Q7, Q9, and Q11

As specified by CECo, the desired qualified life for these specimens is 15 years. The thermal aging time to simulate 15 years at the Quad Cities maximum normal ambient temperature of 150°F (66°C) is 112 hours at an aging temperature of 266°F based on an activation energy of 1.29eV.

3.2.4.14 Specimens Q13 and Q14

As specified by CECo, the desired qualified life for these specimens is 15 years. They were removed from Quad Cities Unit 2 drywell penetrations after being in service longer than 10 years. An additional 5 year's equivalent thermal aging will bring them up to a total of actual in-service life plus 5 years. The thermal aging time to simulate 5 years at the Quad Cities maximum normal ambient temperature of 150°F is 170 hours at an aging temperature of 248°F based on an activation energy of 1.17 eV.

3.2.4.15 Specimens Q15 and Q16

As specified by CECo, the desired qualified life for these specimens is 20 years. They were removed from Quad Cities Unit 2 drywell (the same as Specimens Q13 and Q14 above). An additional 10 years' equivalent aging will bring them up to a total of actual in service life plus 10 years. The thermal aging time to simulate 10 years at the Quad Cities maximum normal ambient temperature of 150°F is 339 hours at an aging temperature of 248°F based on an activation energy of 1.17eV.

3.0 QUALIFICATION PROGRAM (Continued)

3.2.5 Post Thermal Aging Functional Tests

The tests of Paragraph 3.1.3 shall be repeated on all specimens except Q17 through Q20.

3.2.6 Accident Radiation Exposure

The worst-case accident radiation requirement is 1.84E8 rads. The test specimens described in Table I (except Specimens Q13 through Q16) shall be exposed to a minimum radiation dose of 1.84E8 rads gamma (air equivalent) using a Cobalt-60 source at a dose rate of approximately 1E6 rads per hour.

The Quad Cities accident radiation requirement is 1.1E8 rads. Specimens Q13, Q14, Q15, and Q16 shall be exposed to a minimum radiation dose of 1.21E8 rads gamma (air equivalent) using a Cobalt 60 source at a close rate of approximately 1E6 rads per hour.

The specimens shall be rotated as necessary during exposure to ensure a uniform dose.

The radiation doses above contains 10% margin on the accident requirement.

Dosimetry utililized during radiation exposure shall be traceable to the National Bureau of Standards (NBS).

3.2.7 Post Accident Radiation Functional Tests

The tests of Paragraph 3.1.3 shall be repeated on all specimens except Q17 through Q20.

3.3 Accident Simulation

3.3.1 PWR Specimens (Byron/Braidwood and Zion) LOCA Test

3.3.1.1 Accident Profile

All test specimens described in Table I (pages 23-31) shall be subjected to a simulated accident. The test profile shall envelop the profile specified by CECo which is described in Paragraph 2.1.2.1.2. It is assumed (for purposes of applying margin) that the accident (DBA) portion of the profile is the first 24 hours and the post-DBA portion is from the 24-hour mark through 365 days. Appropriate margins per Paragraph 2.1 have been added.

The initial transient shall be applied to the test specimens (powered as specified in Table I) as shown in Figure 1 beginning at 122°F and atmospheric pressure.

3.0 QUALIFICATION PROGRAM (Continued)

3.3.1.1 Accident Profile (Continued)

The ramp requirement to 345°F and 55 psig shall be performed on a best-effort basis. Approximately three minutes after equilibrium is achieved at 345°F/55 psig, chemical spray as described in Paragraph 2.1.2.1.2 shall be introduced at a minimum rate of 0.15 gpm/ft^2 of horizontal area of the test specimen enclosure and shall continue for 24 hours. Peak conditions at 345°F/55 psig shall be held for a minimum of five minutes, followed by a decrease in temperature to 270°F saturated conditions. These conditions shall be maintained for a minimum of 5.33 hours at which time the temperature and pressure shall be decreased to 250°F saturated conditions. These conditions shall be maintained for a minimum of 40.5 hours until the 45.83 hour point (end of test).

3.3.1.2 Test Specimen Mounting and Orientation C

The test specimens shall be mounted to a solid bottom cable tray, or inside a NEMA 12 and NEMA 3 enclosure as listed below:

Enclosure/ Tray Type	Specimens
Tray	Z2, Z3 and Z11
NEMA 3	Z1 and Z4-Z10
NEMA 12	B1-B7, Z12 and Z13

C C

The specimens mounted to the cable tray shall be tie wrapped in place at each end of the cable. The specimens mounted in either ther NEMA 3 or NEMA 12 enclosure shall be mounted on the bottom ledge of the enclosure except for Specimen B7 which shall be vertical inside the enclosure. C

Each of the enclosures shall have a 1/4" weephole drilled in the lower right hand corner of the enclosure. A 1-1/4 inch LB fitting shall be mounted to the top center of the enclosures. All wiring shall enter or exit the enclosure through this penetration. A 18-inch conduit nipple shall be mounted to the end of the LB fitting and shall be oriented in the test chamber away from the chemical spray nozzles.

The test specimen cables shall be connected with Wyle supplied 14 AWG Teflon wire through uninsulated butt splices covered with Raychem WCSF-N sleeves. These Teflon leads shall exit the test chamber and shall be sealed per Wyle Laboratories standard practice.

3.0 QUALIFICATION PROGRAM (Continued)

3.3.1.2 Test Specimen Mounting and Orientation (Continued)

The test specimens shall be powered as described in Table I. The circuitry used to accomplish the electrical setup shall be as shown in Figures 7 and 8. The instrumentation channels utilized shall be as listed below:

DAYTRONICS DATA AQUISITION SYSTEM CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored
1	N/A	°F	Chamber control thermocouple
2	N/A	°F	Chamber control thermocouple
3	N/A	°F	Chamber control thermocouple
4	N/A	psig	Chamber pressure control transducer
5	N/A	°F	Average chamber temperature -average of channels 1, 2 and 3
6	N/A	GPM	Chemical Spray Flowrate (3.5-4.0 GPM)
7	N/A	PH	Chemical Spray PH(10.2-10.8)
8	Z2, Z3	psig	Input pressure to Wyle Omega PX114 transmitter used as a load
9	B1	mA	Leadage current to ground
10	B2	mA	Leakage current to ground
11	B3	mA	Leakage current to ground
12	B4	mA	Leakage current to ground
13	B5	mA	Leakage current to ground
14	Z1	mA	Leakage current to ground
15	Z2	mA	Leakage current to ground
16	Z3	mA	Leakage current to ground
17	Z4	mA	Leakage current to ground
18	Z5	mA	Leakage current to ground
19	Z6	mA	Leakage current to ground
20	Z7	mA	Leakage current to ground
21	Z8	mA	Leakage current to ground
22	Z9	mA	Leakage current to ground
23	Z10	mA	Leakage current to ground
24	Z11	mA	Leakage current to ground
25	Z12	mA	Leakage current to ground
26	Z13	mA	Leakage current to ground

3.0 QUALIFICATION PROGRAM (Continued)

3.3.1.2 Test Specimen Mounting and Orientation (Continued)

FLUKE 2240 DATTALOGGER CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored (Range)
1	B1	VAC	Input Voltage (132-136 VAC)
2	B1	Amps	Load Current (6.0-7.4A)
3	B2	VAC	Input Voltage (132-136 VAC)
4	B2	Amps	Load Current (6.0-7.4A)
5	B3	VAC	Input Voltage (132-136 VAC)
6	B3	Amps	Load Current (5.0-7.0A)
7	B4	VAC	Input Voltage (528-544 VAC)
8	B4	Amps	Load Current (6.0-7.4A)
9	B5	VAC	Input Voltage (528-544 VAC)
10	B5	Amps	Load Current (6.0-7.4A)
11	B6	VAC	Input Voltage (528-544 VAC)
12	B6	Amps	Load Current (9.0-11.0A)
13	B7	VAC	Input Voltage (528-544 VAC)
14	B7	Amps	Load Current (13.5-16.5A)
15	Z1	VAC	Input Voltage (132-136 VAC)
16	Z1	Amps	Load Current (6.0-7.4A)
17	Z2	VDC	Input Voltage (34.5-37 VDC)
18	Z2	mA	Load Current (36-44 mA)
19	Z3	VDC	Input Voltage (34.5-37 VDC)
20	Z3	mA	Load Current (36-44 mA)
21	Z4	VAC	Input Voltage (132-136 VAC)
22	Z4	Amps	Load Current (6.0-7.4A)
23	Z5	VAC	Input Voltage (132-136 VAC)
24	Z5	Amps	Load Current (6.0-7.4A)
25	Z6	VAC	Input Voltage (528-544 VAC)
26	Z6	Amps	Load Current (6.0-7.4A)
27	Z7	VAC	Input Voltage (528-544 VAC)
28	Z7	Amps	Load Current (6.0-7.4A)
29	Z8	VAC	Input Voltage (132-136 VAC)
30	Z8	Amps	Load Current (6.0-7.4A)
31	Z9	VAC	Input Voltage (132-136 VAC)
32	Z9	Amps	Load Current (6.0-7.4A)
33	Z10	VAC	Input Voltage (132-136 VAC)
34	Z10	Amps	Load Current (6.0-7.4A)
35	Z11	VAC	Input voltage (528-544 VAC)
36	Z11	Amps	Load Current (6.0-7.4A)
37	Z12	VAC	Input Voltage (528-544 VAC)
38	Z12	Amps	Load Current (6.0-7.4A)
39	Z13	VAC	Input Voltage (528-544 VAC)
40	Z13	Amps	Load Current (6.0-7.4A)

3.3.2 BWR Specimens (LaSalle, Quad Cities and Dresden) LOCA Test

3.3.2.1 Accident Profile

The test specimens described in Table I, pages 23 through 31 shall be subjected to a simulated accident. The test profile shall envelop the profile specified by CECo which is described in Paragraph 2.1.2.1.1 It is assumed (for purposes of applying margin) that the accident (DBA) portion of the profile is the first 24 hours and the post-DBA portion is from the 24-hour mark through 100 days. Appropriate margins per Paragraph 2.1 have been added.

The initial transient shall be applied to the test specimens (powered as specified in Table I) as shown in Figures 2 and 2A beginning at 150°F and atmospheric pressure. The ramp requirement to 355°F and 53.3 psig shall be performed on a best-effort basis. Approximately 6 hours after equilibrium is achieved at 355°F/53.3 psig, demineralized water spray as described in Paragraph 2.1.2.1 shall be introduced at a minimum rate of 0.15 gpm/ft^2 of horizontal area of the test specimen enclosure and shall continue for 24 hours. Peak conditions at 355°F/53.3 psig shall be held for a minimum of 3 hours, followed by a decrease to 320°F/53.3 psig. These conditions shall be maintained for a minimum of 3 hours at which time the temperature and pressure shall be decreased to 250°F, saturated conditions. These conditions shall be maintained for a minimum of 114 hours or until the 120 hour point (end of test).

(Handwritten margin note:) The following description applies to BWR Tests #1 and #2 only.

3.3.2.2 Test Specimen Mounting and Orientation

The test specimens shall be mounted to a solid bottom cable tray, or inside a NEMA 3 enclosure as listed below:

Enclosure/ Tray Type	Specimens
Tray	D1, D2, D5-D15, L1-L10 and Q7-Q12
NEMA 3	Q1-Q6, Q13-Q20, D3, D4, D16-D21 and L11

The specimens mounted to the cable tray shall be tie wrapped in place at each end of the cable. The specimens mounted in the NEMA 3 enclosure shall be mounted on the bottom ledge of the enclosure, or as specified by the CECo technical representative.

The enclosure shall have a 1/4" weep hole drilled in the lower right hand corner. A 1-1/4 inch LB fitting shall be mounted to the top center of the enclosure. All wiring shall enter or exit the enclosure through this penetration. An 18-inch conduit nipple shall be mounted to the end of the LB fitting and shall be oriented in the test chamber away from the chemical spray nozzles.

3.0 QUALIFICATION PROGRAM (Continued)

3.3.2.2 Test Specimen Mounting and Orientation (Continued)

The test specimen cables shall be connected with Wyle supplied 14 AWG Teflon wire through uninsulated butt splices covered with Raychem WCSF-N sleeves. These teflon leads shall exit the test chamber and shall be sealed per Wyle Laboratories standard practice.

The test specimens shall be powered as described in Table I. The circuitry used to accomplish the electrical setup shall be as shown in Figures 7 and 8. The instrumentation channels utilized shall be as listed below:

*Note: Due to instrumentation limitations, the BWR specimens shall be tested in ~~two~~ three tests. The specimens in each test shall be as listed in the following tables.

BWR TEST #1
DAYTRONICS DATA AQUISITION SYSTEM CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored
1	N/A	°F	Chamber control thermocouple
2	N/A	°F	Chamber control thermocouple
3	N/A	°F	Chamber control thermocouple
4	N/A	psig	Chamber pressure control transducers
5	N/A	°F	Average chamber temperature -average of channels 1, 2 and 3
6	N/A	GPM	Chemical spray flowrate (3.5-4.0 GPM)
7	Q1	mA	Leakage current to ground
8	Q2	mA	Leakage current to ground
9	Q3	mA	Leakage current to ground
10	Q4	mA	Leakage current to ground
11	Q5	mA	Leakage current to ground
12	Q6	mA	Leakage current to ground
13	D3	mA	Leakage current to ground
14	D4	mA	Leakage current to ground
15	D5, D7	mA	Leakage current to ground
16	D6	mA	Leakage current to ground
17	D8	mA	Leakage current to ground
18	D9	mA	Leakage current to ground
19	D10	mA	Leakage current to ground
20	D11	mA	Leakage current to ground
21	D16	mA	Leakage current to ground
22	D17	mA	Leakage current to ground
23	D18	mA	Leakage current to ground
24	D19	mA	Leakage current to ground
25	D20	mA	Leakage current to ground
26	D21	mA	Leakage current to ground

3.0 QUALIFICATION PROGRAM (Continued)

3.3.2.2 Test Specimen Mounting and Orientation (Continued) C

PLUKE 2240 DATALOGGER CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored (Range)
1	Q3	VAC	Input Voltage (132-135 VAC)
2	Q3	Amps	Load Current (6.0-7.4A)
3	Q4	VAC	Input Voltage (132-136 VAC)
4	Q4	Amps	Load Current (6.0-7.4A)
5	Q5	VAC	Input Voltage (132-136 VAC)
6	Q5	Amps	Load Current (6.0-7.4A)
7	D9	VAC	Input Voltage (132-136 VAC)
8	D9	Amps	Load Current (6.0-7.4A)
9	D19	VAC	Input Voltage (132-136 VAC)
10	D19	Amps	Load Current (6.0-7.4A)
11	Q1	VAC	Input Voltage (528-544 VAC)
12	[illegible]	Amps	Load Current (6.0-7.4A)
13	Q2	VAC	Input Voltage (528-544 VAC)
14	Q2	Amps	Load Current (6.0-7.4A VAC)
15	Q6	VAC	Input Voltage (528-544 VAC)
16	Q6	Amps	Load Current (6.-7.4A)
17	D3	VAC	Input Voltage (528-544 VAC)
18	D3	Amps	Load Current (6.0-7.4A)
19	D4	VAC	Input Voltage (528-544 VAC)
20	D4	Amps	Load Current (6.0-7.4A)
21	D5, 7	VAC	Input Voltage (528-544 VAC)
22	D5, 7	Amps	Load Current (6.0-7.4A)
23	D6	VAC	Input Voltage (528-544 VAC)
24	D6	Amps	Load Current (6.0-7.4A)
25	D8	VAC	Input Voltage (528-544 VAC)
26	D8	Amps	Load Current (6.0-7.4A)
27	D10	VAC	Input Voltage (528-544 VAC)
28	D10	Amps	Load Current (6.0-7.4A)
29	D11	VAC	Input Voltage (528-544 VAC)
30	D11	Amps	Load Current (6.0-7.4A)
31	D16	VAC	Input Voltage (528-544 VAC)
32	D16	Amps	Load Current (6.0-7.4A)
33	D17	VAC	Input Voltage (528-544 VAC)
34	D17	Amps	Load Current (6.0-7.4A)
35	D18	VAC	Input Voltage (528-544 VAC)
36	D18	Amps	Load Current (6.0-7.4A)
37	D20	VAC	Input Voltage (528-544 VAC)
38	D20	Amps	Load Current (6.0-7.4A)
39	D21	VAC	Input Voltage (528-544 VAC)
40	D21	Amps	Load Current (6.0-7.4A)

3.0 QUALIFICATION PROGRAM (Continued)

3.3.2.2 Test Specimen Mounting and Orientation (Continued)

BWR TEST #2

DAYTRONICS DATA AQUISITION SYSTEM CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored
1	N/A	°F	Chamber control thermocouple
2	N/A	°F	Chamber control thermocouple
3	N/A	°F	Chamber control thermocouple
4	N/A	psig	Chamber pressure control temperature
5	N/A	°F	Average chamber temperature -average of channels 1, 2 and 3
6	NA	GPM	Chemical spray flow rate (3.5-4.0 GPM)
7	L1	mA	Leakage current to ground
8	L2, L4, L10	mA	Leakage current to ground
9	L3	mA	Leakage current to ground
10	L5	mA	Leakage current to ground
11	L6	mA	Leakage current to ground
12	L7	mA	Leakage current to ground
13	L8	mA	Leakage current to ground
14	L9	mA	Leakage current to ground
15	L11	mA	Leakage current to ground
16	Q7	mA	Leakage current to ground
17	Q8	mA	Leakage current to ground
18	Q9	mA	Leakage current to ground
19	Q10	mA	Leakage current to ground
20	Q11	mA	Leakage current to ground
21	Q12	mA	Leakage current to ground
22	D1	mA	Leakage current to ground
23	D2	mA	Leakage current to ground
24	D12	mA	Leakage current to ground
25	D 13, 14, 15	mA	Leakage current to ground

3.0 QUALIFICATION PROGRAM (Continued)

3.3.2.2 Test Specimen Mounting and Orientation (Continued) C

FLUKE 2240 DATALOGGER CHANNELS

Channel No.	Specimen No.	Units	Signal Monitored (Range)
1	L1	VAC	Input Voltage (528-544 VAC)
2	L1	Amps	Load Current (0.9-1.1A)
3	L2, 4, 10	VAC	Input Voltage (528-544 VAC)
4	L2, 4, 10	Amps	Load Current (0.9-1.1A)
5	L3	VAC	Input Voltage (528-544 VAC)
6	L3	Amps	Load Current (5.0-7.0A)
7	L5	VAC	Input Voltage (528-544 VAC)
8	L5	Amps	Load Current (6.0-7.4A)
9	L6	VAC	Input Voltage (528-544 VAC)
10	L6	Amps	Load Current (6.0-7.4A)
11	L7	VAC	Input Voltage (528-544 VAC)
12	L7	Amps	Load Current (6.0-7.4A)
13	L8	VAC	Input Voltage (528-544 VAC)
14	L8	Amps	Load Current (6.0-7.4A)
15	L9	VAC	Input Current (528-544 VAC)
16	L9	Amps	Load Current (0.9-1.1A)
17	L11	VAC	Input Voltage (528-544 VAC)
18	L11	Amps	Load Current (0.9-1.1A)
19	Q7	VAC	Input Voltage (528-544 VAC)
20	Q7	Amps	Load Current (6.0-7.4A)
21	Q8	VAC	Input Voltage (528-544 VAC)
22	Q8	Amps	Load Current (6.0-7.4A)
23	Q9	VAC	Input Voltage (132-136 VAC)
24	Q9	Amps	Load Current (6.0-7.4A)
25	Q10	VAC	Input Voltage (132-136 VAC)
26	Q10	Amps	Load Current (6.0-7.4A)
27	Q11	VAC	Input Voltage (132-136 VAC)
28	Q11	Amps	Load Current (6.0-7.4A)
29	Q12	VAC	Input Voltage (132-136 VAC)
30	Q12	Amps	Load Current (6.0-7.4A)
31	D1	VAC	Input Voltage (528-544 VAC)
32	D1	Amps	Load Current (6.0-7.4A)
33	D2	VAC	Input Voltage (528-544 VAC)
34	D2	Amps	Load Current (6.0-7.4A)
35	D12	VAC	Input Voltage (528-544 VAC)
36	D12	Amps	Load current (6.0-7.4A)
37	D13, 14, 15	VAC	Input Voltage (528-544 VAC)
38	D13, 14, 15	Amps	Load Current (6.0-7.4A)

Instrumentation Setup (Continued)

BWR TEST #3

Channel No.	Specimen No.	Units	Signal Monitored
1	N/A	°F	Chamber control thermocouple
2	N/A	°F	Chamber control thermocouple
3	N/A	°F	Chamber control thermocouple
4	N/A	°F	Average chamber temperature -average of channels 1, 2 and 3
5	N/A	psig	Chamber pressure control transducer
6	N/A	GPM	Chemical Spray Flowrate (3.5-4.0 GPM)
7	Q17	VAC	Input Voltage (132-136 VAC)
8	Q17	Amps	Load Current (6.0-7.4A)
9	Q17	mA	Leakage current to ground
10	Q18	VAC	Input Voltage (132-136 VAC)
11	Q18	Amps	Load Current (6.0-7.4A)
12	Q18	mA	Leakage current to ground
13	Q19	VAC	Input Voltage (528-544 VAC)
14	Q19	Amps	Load Current (6.0-7.4A)
15	Q19	mA	Leakage current to ground
16	Q20	VAC	Input Voltage (528-544 VAC)
17	Q21	Amps	Load Current (6.0-7.4A)
18	Q21	mA	Leakage current to ground

3.0 QUALIFICATION PROGRAM (Continued)

3.3.3 Post-DBA Functional Tests

The functional tests (insulation resistance) of Paragraph 3.1.3 shall be performed with the specimens inside the chamber.

3.3.4 Post-Test Inspection

Upon completion of the qualification program, the specimens shall be visually inspected. The specimens shall be disassembled to the extent necessary to perform the inspection. The condition of the specimens shall be recorded.

3.4 In-Process Inspection

The test items shall be examined for possible damage following all severe tests. All noticeable test effects shall be logged.

Photographs shall be taken of any noticeable physical damage that may occur.

The records shall be checked for quality of performance after each test. CECo and S&L representatives shall be provided access to Wyle facilities and records for QA program evaluation and auditing and inspection/surveillance subject to prior scheduling through Wyle Contracts and QA Departments.

3.5 Instrumentation

All test equipment and instrumentaion to be used in the performance of this program shall be calibrated in accordance with Wyle Laboratories' Quality Assurance Manual, which conforms to the applicable portions of ANSI N 45.2, 10 CFR 50/Appendix B, and Military Specification MIL-STD-45662. Standards used in performing all calibrations shall be traceable to the National of Standards.
L. Bureau

3.6 Report

The report shall describe the qualification requirements, procedures, and results. The report shall also include rationale and justification required for the qualification and shall certify the qualification of those test items which passed the tests of IEEE Standard 323-1974. The customer shall receive ten bound copies and one reproducible copy of the test report.

3.0 QUALIFICATION PROGRAM (Continued)

3.7 References

1. DuPont U.L. File No. 41938, Library Code 032-78A

2. Industrial Motor Users' Handbook of Insulation for Rewinds, L. J. Rejda and Kris Neville, Elsevier, 1977, Library Code 255-80

3. "Raychem Corporation WCSF Thermal Aging Data," EDR-2001, Library Code 360-80A

4. Qualification Report, Westinghouse Electric Corporation, Type AB Circuit Breaker, Rev. 2, dated 11/30/79, Library Code 499-01

5. "Qualification Tests of Flame Guard FR-EP Instrumentation and Control Class 1E Electrical Cables in a Simulated Steam Line Break and Loss-of-Coolant Accident Environment," and Attachment AT-1, Franklin Institute Research Laboratory/The Anaconda Company, F-C4836-2, Library Code 517-81

6. BIW Cable Systems, Inc., Letter dated September 2, 1982 with Thermal Aging Data for GE Silicone Rubber Attached, BIW, Library Code 673-82

C

TABLE [illegible]: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
B-1	Raychem WCSF-N	Single conductor #14 Rockbestos to 2-1 conductor #14 Rockbestos - WCSF-N splice	1/2"	40 yrs	NEMA 12 w/weephole	132 VAC	Byron/ Braidwood	6.7A
B-2	Raychem WCSF-N	Single conductor #14 Rockbestos to 3-1 conductor #14 Okonite - WCSF-N splice	1/2"	40 yrs	NEMA 12 w/weephole	132 VAC	Byron/ Braidwood	6.7A
B-3	Raychem WCSF-N	2 conductor #16 Rockbestos to 3-1 conductor #16 Rockbestos - WCSF-N splice	1/2"	40 yrs	NEMA 12 w/weephole	132 VAC	Byron/ Braidwood	5.0A
B-4	Okonite	#14 Okonite to #14 Okonite (lugged back to back) V-type splice with Okonite tape and no insulation tape in crotch	-	40 yrs	NEMA 12 w/weephole	528 VAC	Byron/ Braidwood	6.7A
B-5	Okonite	#14 Okonite to #14 Kemax (pigtail from Limitorque) (lugged back to back) V-type splice with Okonite tape and no insulation in crotch	-	40 yrs	NEMA 12 w/weephole	528 VAC	Byron/ Braidwood	6.7A
B-6	Okonite	#10 Okonite to #10 Okonite (lugged back to back) V-type splice with Okonite tape and no insulation in crotch	-	40 yrs	NEMA 12 w/weephole	528 VAC	Byron/ Braidwood	10.A
B-7	Okonite	500 — Okonite to 500 — Okonite type splice with Okonite tape.	-	40 yrs	NEMA 12 w/weephole	528 VAC	Byron/ Braidwood	75A

TABLE 5: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
D-1	Raychem WCSF-N	14 ga. Rockbestos to 14 ga. Rockbestos. Oversized Raychem splice (WCSF-200).	2"	30 yrs	-	528 VAC	Dresden	6.7A
D-2	Raychem WCSF-N	12 ga. Rockbestos to 12 ga. Rockbestos. Undersized Raychem splice (WCSF-070).	2"	30 yrs	-	528 VAC	Dresden	6.7A
D-3	Scotch	12 ga. SIS wire to 12 ga. SIS wire. Scotch taped pigtail splice -Bechtel Procedure EP-12 -For in-drywell use Scotch 130C, 70, 17.	-	30 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A
D-4	Scotch	12 ga. SIS wire to 12 ga. SIS wire Scotch taped pigtail splice -Bechtel Procedure EP-12 -For outside drywell use Scotch 130C, 33+.	-	30 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A
D-5	Raychem WCSF-N	14 ga. Rockbestos to solenoid non-impregnated braided jacket coil wire. Inline splice with Raychem WCSF-115.	2" (4" sleeve)	30 yrs	-	528 VAC	Dresden	6.7A
D-6	Raychem WCSF-N	14 ga. Rockbestos to solenoid non-impregnated braided jacket coil wire. Inline splice with Raychem WCSF-115.	1"	30 yrs	-	528 VAC	Dresden	6.7A
D-7	Raychem WCSF-N	14 ga. Rockbestos to impregnated braid coil wire inline splice with Raychem WCSF-115	2"	30 yrs	-	528 VAC	Dresden	6.7A
D-8	Raychem WCSF-N	14 ga. Rockbestos SIS to impregnated braid coil wire. I inline splice with Raychem WCSF-115.	1"	30 yrs	-	528 VAC	Dresden	6.7A
D-9	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS. Inline splice with Raychem WCSF-115 with min bend violation.	2"	30 yrs	-	132 VAC	Dresden	[illegible].7A
D-10	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS Raychem WCSF-115 over insulated butt splice (in range).	2"	30 yrs	-	528 VAC	Dresden	6.7A

TABLE 5: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
D-11	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga Rockbestos SIS. Raychem WCSF-115 over insulated butt splice (outside range).	2"	30 yrs	-	528 VAC	Dresden	6.7A
D-12	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS. Inline splice with Raychem WCSF-115.	1/4"	30 yrs	-	132 VAC	Dresden	6.7A
D-13	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS. Inline splice with Raychem WCSF-115.	1/2"	30 yrs	-	132 VAC	Dresden	6.7A
D-14	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS inline WCSF-115.	3/4"	30 yrs	-	132 VAC	Dresden	6.7A
D-15	Raychem WCSF-N	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS. Inline splice with Raychem WCSF-115.	1"	30 yrs	-	132 VAC	Dresden	6.7A
D-16	Raychem NMCK	14 ga. Rockbestos SIS to 14 ga. Rockbestos SIS. Raychem NMCK kit with butt tab trimmed by 1/2".	-	30 yrs	NEMA 3 w/weephole	520 VAC	Dresden	6.7A
D-17	Raychem NMCK	12 ga. braided motor lead to 12 ga. braided motor lead (silicon wire). Ins[illegible]de drywell - Raychem NMCK kit.	-	30 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A
D-18	AMP	G.E. Vulkene SIS 14, (#204M), Unit 3 drywell sample with Amp window splice.	-	15 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A
D-19	AMP	G.E. Vulkene SIS #14, #204M 15 years only Unit 3 drywell sample with Amp window splice	-	15 yrs	NEMA 3 w/weephole	132 VAC	Dresden	6.7A
D-20	Scotch	12 ga. SIS wire to 12 ga. SIS wire Scotch taped pigtail splice -Bechtel Procedure EP-12 -For in-drywell use: Scotch 130C, 70, 17.	-	15 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A
D-21	Scotch	12 ga. SIS wire to 12 ga. SIS wire Scotch taped pigtail splice -Bechtel Proce[illegible]re EP-12 -For outs[illegible]de drywell use: Scotch 130, 30+.	-	15 yrs	NEMA 3 w/weephole	528 VAC	Dresden	6.7A

TABLE 1: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
L-1	Raychem WCSF-N	Kapton insulated #16 AWG wire connected to Eaton Corp. (Samuel Moore Dekoron) #16 AWG wire. Overlap of Raychem sleeve on each wire insulation is 1/8".	1/8"	40 yrs	-	132 VAC	LaSalle	1.0A
L-2	Raychem WCSF-N	Kapton insulated #16 AWG wire connected to Eaton Corp. (Samuel Moore Dekoron) #16 AWG wire. Overlap of Raychem sleeve on each wire insulation is 1/4".	1/4"	40 yrs	-	132 VAC	LaSalle	1.0A
L-3	Raychem WCSF-N	Eaton Corp. (Samuel Moore Dekoron) #16 AWG XLPE insulated wire, 2 lengths. Overlap of Raychem sleeve on each wire insulation is 1/8".	1/8"	40 yrs	-	132 VAC	LaSalle	1.0A
L-4	Raychem WCSF-N	Eaton corp. (Samuel Moore Dekoron) #16 AWG, XLPE insulated wire, 2 lengths. Overlap of Raychem sleeve on each wire insulation is 1/4".	1/4"	40 yrs	-	132 VAC	LaSalle	1.0A
L-5	Raychem WCSF-N	Okonite #14 AWG EPR insulated wire, 2 lengths. Overlap of Raychem sleeve on each wire insulation is 1/8".	1/8"	40 yrs	-	528 VAC	LaSalle	6.7A
L-6	Raychem WCSF-N	Okonite #14 AWG EPR insulated wire, 2 lengths. Overlap of Raychem sleeve on each wire insulation is 1/4".	1/4"	40 yrs	-	528 VAC	LaSalle	6.7A
L-7	Raychem WCSF-N	Kapton insulated #14 AWG wire connected to Okonite #14 wire EPR insulated wire. Overlap of Raychem sleeve on each wire insulation is 1/8".	1/8"	40 yrs	-	528 VAC	LaSalle	6.7A
L-8	Raychem WCSF-N	Kapton insulated #14 wire AWG wire connected to Okonite #14 wire EPR insulated wire. Overlap of Raychem sleeve on each wire insulation is 1/4".	1/4"	40 yrs	-	528 VAC	LaSalle	6.7A
L-9	Raychem WCSF-N	Raychem Flamtrol #16 AWG XLPO insulated wire connected to Eaton Corp. (Samuel Moore Dekoron) #16 AWG XLKPE insulated wire. Overlap of Raychem sleeve on each wire insulation is 1/8".	1/8"	40 yrs	-	132 VAC	LaSalle	1.0A

TABLE 5 TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
L-12	Raychem WCSF-N	Raychem Flamtrol #16 AWG XLPE insulated wire connected to Eaton Corp. (Samuel Moore Dekoran) #16 AWG XLPE insulation wire, overlap of Raychem on each wire is 1/4"	1/4"	40 yrs	-	132 VAC	LaSalle	1.0A
L-11	Okonite	Eaton Corp. (Samuel Moore Dekoran) #16 AWG XLPE, 2 lengths. Okonite #T-95 insulating tape and No. 35 jacketing tape. Spliced in accordance with procedure HPFCO-WI-500.	-	40 yrs	NEMA 3 w/weephole	132 VAC	LaSalle	1.0A

TABLE 1: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
Q-1	Scotch	#14 Rockbestos SIS to #14 Eaton Dekoren (Samuel Moore). Scotch taped splice 130C, 33+ (Reference QC #5).	-	15	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q-2	Scotch	#14 Rockbestos SIS #14 Eaton Dekoren (Samuel Moore). Scotch taped splice 130C, 33+ (Reference QC #5).	-	30	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q-3	Scotch	#14 Rockbestos SIS to #14 Eaton Dekoren (Samuel Moore). Scotch taped splice 130C, 33+ (Reference QC #5).	-	15	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q-4	Scotch	#14 Rockbestos SIS to #14 Eaton Dekoren (Samuel Moore). Scotch taped splice 130C, 33+ (Reference QC #5).	-	30	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q-5	AMP	#14 Rockbestos SIS to #14 Eaton Dekoren (Samuel Moore) Amp Commercial grade window splices (PIDG splice, Model 320570) in NEMA 3 enclosure w/weepholes (Ref. QC #1)	-	40	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q-6	AMP	#14 Rockbestos SIS to #14 Eaton Dekoran (Samuel Moore). Amp Commercial grade window splices (PIDG splice, Model 320570) in NEMA 3 enclosure w/weephole (Ref. QC #1).	-	40	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q-7	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoran (Samuel Moore). Raychem sleeve WCSF-70 over Amp window splices (PIDG splice Model 320570) (Ref. QC #4).	2"	15	-	132 VAC	Quad Cities	6.7A
Q-8	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoran (Samuel Moore). Raychem sleeve WCSF-70 over AMP window splices (PIDG splice, Model 320570) (Ref, QC #4).	2"	30	-	132 VAC	Quad Cities	6.7A
Q-9	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoran. Raychem sleeve WCSF-115 over 1/2" bolted connection (Ref. QC #2).	1-1/2"	15	-	132 VAC	Quad Cities	6.7A
Q-10	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoran Raychem sleeve WCSF-115 over 1/2" bolted connection (Ref. QC #2).	1-1/2"	30	-	132 VAC	Quad Cities	6.7A

TABLE 8: TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
Q-11	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoron. Raychem sleeve WCSF-106 over 1/2" bolted connection (Ref. QC #3).	1-1/2"	15	-	132 VAC	Quad Cities	6.7A
Q-12	Raychem WCSF-N	#14 Rockbestos SIS to #14 Eaton Dekoron. Raychem sleeve WCSF-106 over 1/2" bolted connection (Ref. QC #3).	1-1/2"	28	-	132 VAC	Quad Cities	6.7A
Q13	AMP	G.E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	15	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q14	AMP	G.E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	15	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q15	AMP	G. E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	28	NEMA 2 w/weephole	132 VAC	Quad Cities	6.7A
Q16	AMP	G. E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	28	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q17	AMP	G.E Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	1	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q18	AMP	G.E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	1	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A
Q19	AMP	G. E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	1	NEMA 3 w/weephole	132 VAC	Quad Cities	6.7A
Q20	AMP	G. E. Vulkene SIS #14 one end only. Specimen removed from Unit 2 drywell penetration after in service a minimum of 10 years. AMP window splice.	-	2	NEMA 3 w/weephole	528 VAC	Quad Cities	6.7A

TABLE 5. TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
Z1	Raychem NPKV	#14 BIW (Boston Insulated Wire) single conductor to ASCO solenoid valve lead wire w/non-impregnated braid - Raychem stub type connector NPKV-2-10A	-	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z2	Raychem NPKS	#14 BIW to #15 Kapton insulated wire - Raychem NPKS-1-11A	1/2"	40 yrs	-	36 VDC	Zion	20mA*
Z3	Raychem NPKS	#14 BIW to #16 Kapton insulated wire - Raychem NPKS-1-11A	3/4"	40 yrs	-	36 VDC	Zion	20 mA*
Z4	Raychem NPKS	#16 BIW single conductor to Static-O-Ring switch lead wire w/impregnated braid - Raychem NPKS-1-11A	1/2"	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z5	Raychem NPKS	#16 BIW single con[illegible]ctor to Static-O-Ring switch lead wire w/impregnated bra[illegible]chem NPKS-1-11A	3/4"	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z6	Raychem NPKV	#14 field conductor BIW [illegible] silicone hi-temp braid motor lead - Raychem NPKV-2-10A	-	40 yrs	NEMA 3 w/weephole	528 VAC	Zion	[illegible]7A
Z7	Kerite	#14 BIW to #14 BIW - V-type splice with Kerite tape	-	40 yrs	NEMA 3 w/weephole	528 VAC	Zion	6.7A
Z8	Raychem NPKS	#14 BIW to #14 BIW - Raychem NPKS-1-11A with 180 degree bend	1/2"	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z9	Raychem NPKS	#14 BIW to #14 BIW - Raychem NPKS 1-11A with 180 degree bend	1"	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z10	Raychem NPKS	#14 BIW to #14 BIW - Raychem NPKS 1-11A with 180 degree bend	2"	40 yrs	NEMA 3 w/weephole	132 VAC	Zion	6.7A
Z11	Kerite	#16 BIW to silicone hi-temp braid motor lead - Kerite tape over bolted V connector with putty in crotch	-	40 yrs		528 VAC	Zion	6.7A

*Full scale output of a Omega differential pressure transmitter.

Qualification Plan No. 17859-01

REVISION 0

TABLE 6 TEST SPECIMEN DESCRIPTION

Specimen Number	Splice Material	Configuration	Overlap	Age	Enclosure	Test Voltage	Station	Test Current
Z12	Kerite	#14 BIW to silicone hi-temp brand motor lead - Kerite tape over bolted V connector with putty in crotch	–	40 yrs	NEMA 12 w/weephole	528 VAC	Zion	6.7A
Z13	Kerite	#14 BIW to #14 BIW - V type splice with Kerite tape	–	40 yrs	NEMA 12 w/weephole	528 VAC	Zion	6.7A

TABLE II: CECO 17850 AGING MATRIX

Specimen	Splice Material	Ea,(eV)	QL Goal(yrs)	Baseline Temp.(C)	Aging, Temp.(C)	Aging Time, (hrs)	Comments
Z-1 - Z-6	Raychem WCSF-N	1.29	40	50	115	149	
Z7, Z11, Z13	Kerite Tape	1.35	40	50	115	190	Kerite tape in Scotch silicone rubber
Z8, - Z10	Raychem WCSF-N	1.29	40	50	115	149	
B1 - B3	Raychem WCSF-N	1.29	40	50	115	149	
B4 - B7	Okonite Tapes	1.26	40	50	115	179	Okonite T-95 is insul. tape
L1 -L10	Raychem WCSF-N	1.29	40	65.56	130	298	
L 11	Okonite Tapes	1.26	40	65.56	130	352	Okonite T-95 is insul. tape
D1, D2, D5-D17	Raychem WCSF-N	1.29	30	65.56	130	224	
D3	Scotch 130C, 70, 17	1.38	30	65.56	130	279	Assume Scotch 70 is limiting
D4	Scotch 130C, 33+	1.15	30	65.56	130	482	33+ is insulation per CECo plus additional
D18, D19	AMP window splice	1.17	9	65.56	120	170	*10 years in service Nylon - 1.17 eV is 50% of eject. str
D20	Scotch 130C, 70, 17	1.25	15	65.56	130	170	Same as D3
D21	Scotch 130C, 33+	1.15	15	65.56	130	241	Same as D4
Q1, Q3	Scotch 130C, 33+	1.15	15	65.56	130	241	Same as D4
Q2, Q4	Scotch 130C, 33+	1.15	30	65.56	130	482	Same as D4
Q5	AMP PIDG splice	1.17	40	65.56	120/130	89/530	Nylon
Q6	AMP PIDG splice	1.17	40	65.56	120/130	89/530	Same as Q5
Q7, Q9, Q11	Raychem WCSF-N	1.29	15	65.56	130	112	
Q8, Q10, Q12	Raychem WCSF-N	1.29	30	65.56	130	224	
Q13, Q14	AMP window splice	1.17	15	65.56	120	170	Same as D18 and D19
Q15, 16	AMP window splice	1.17	20	65.56	120	330	Same as D18 and D19
Q17-Q20	AMP window splice	1.17	1	65.56	115	53	

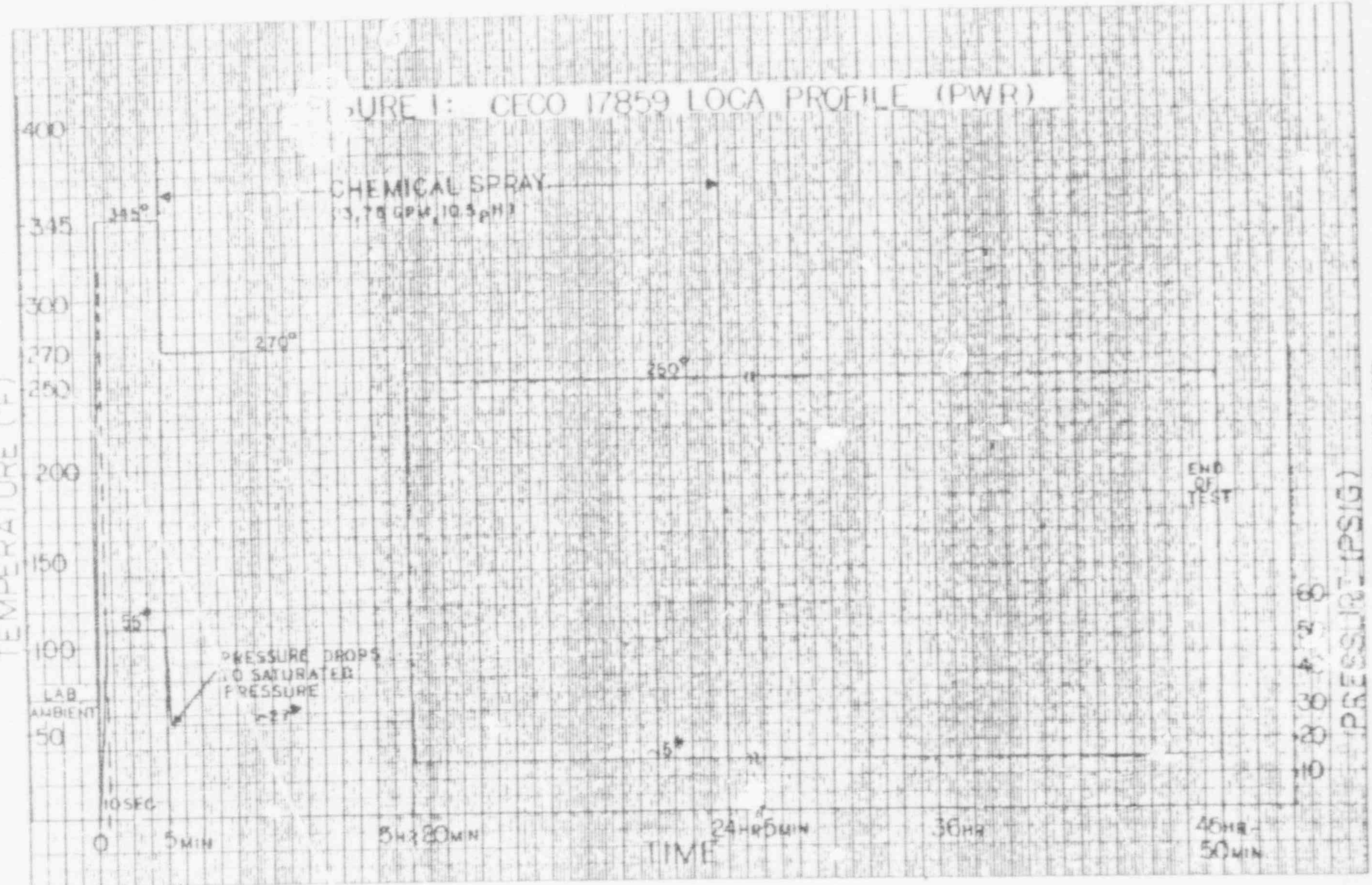


FIGURE 1: CECO 17859 LOCA PROFILE (PWR)

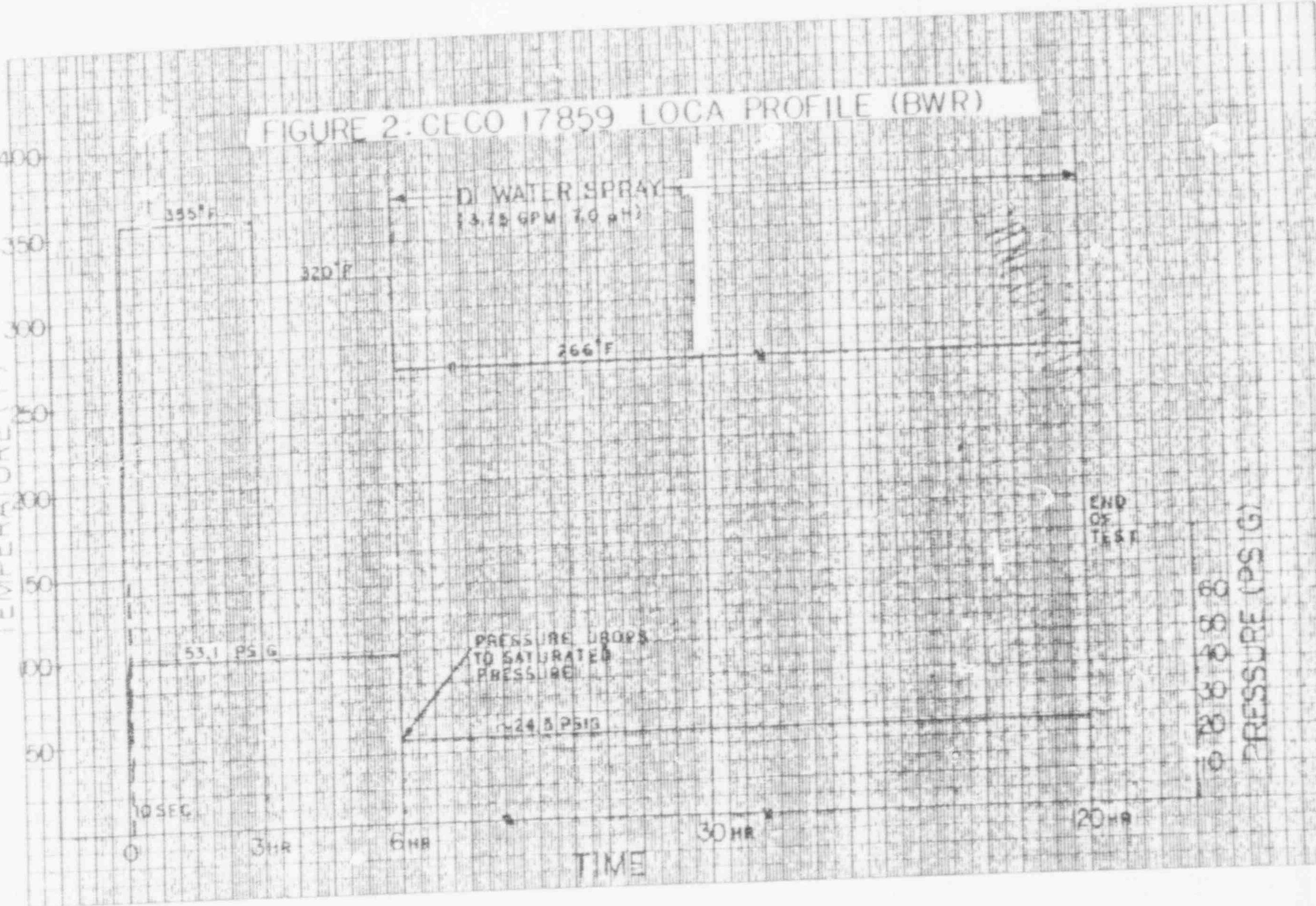


FIGURE 2: CECO 17859 LOCA PROFILE (BWR)
DI WATER SPRAY
(3.75 GPM 7.0 pH)
355°F
320°F
266°F
53.1 PSIG
PRESSURE DROPS TO SATURATED PRESSURE
24.5 PSIG
END OF TEST
TEMPERATURE (°F)
400
350
300
250
200
150
100
50
PRESSURE (PSIG)
60
50
40
30
20
10
TIME
0
10 SEC
3 HR
6 HR
30 HR
120 HR

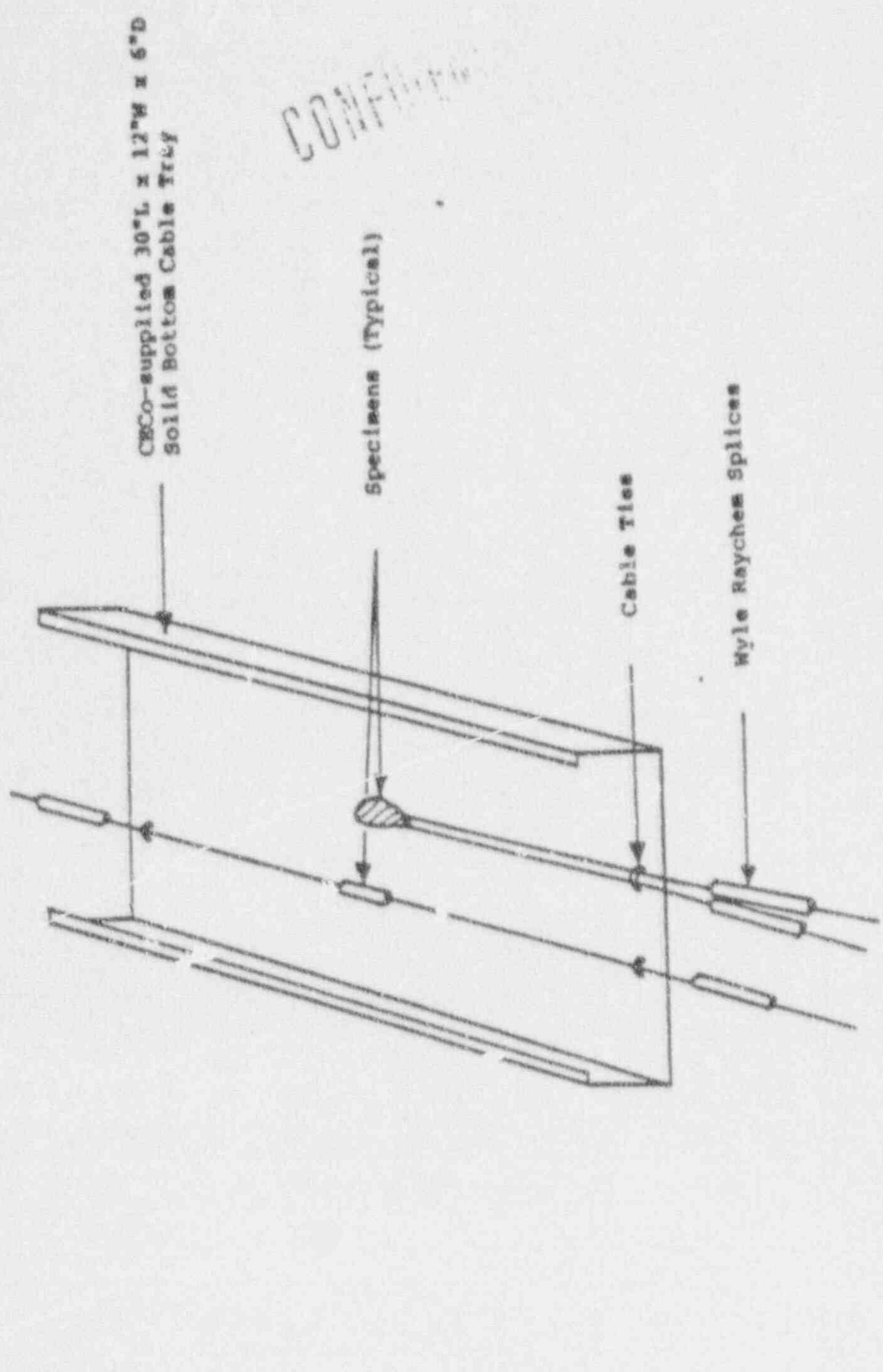


FIGURE 3. TYPICAL CABLE TRAY SETUP

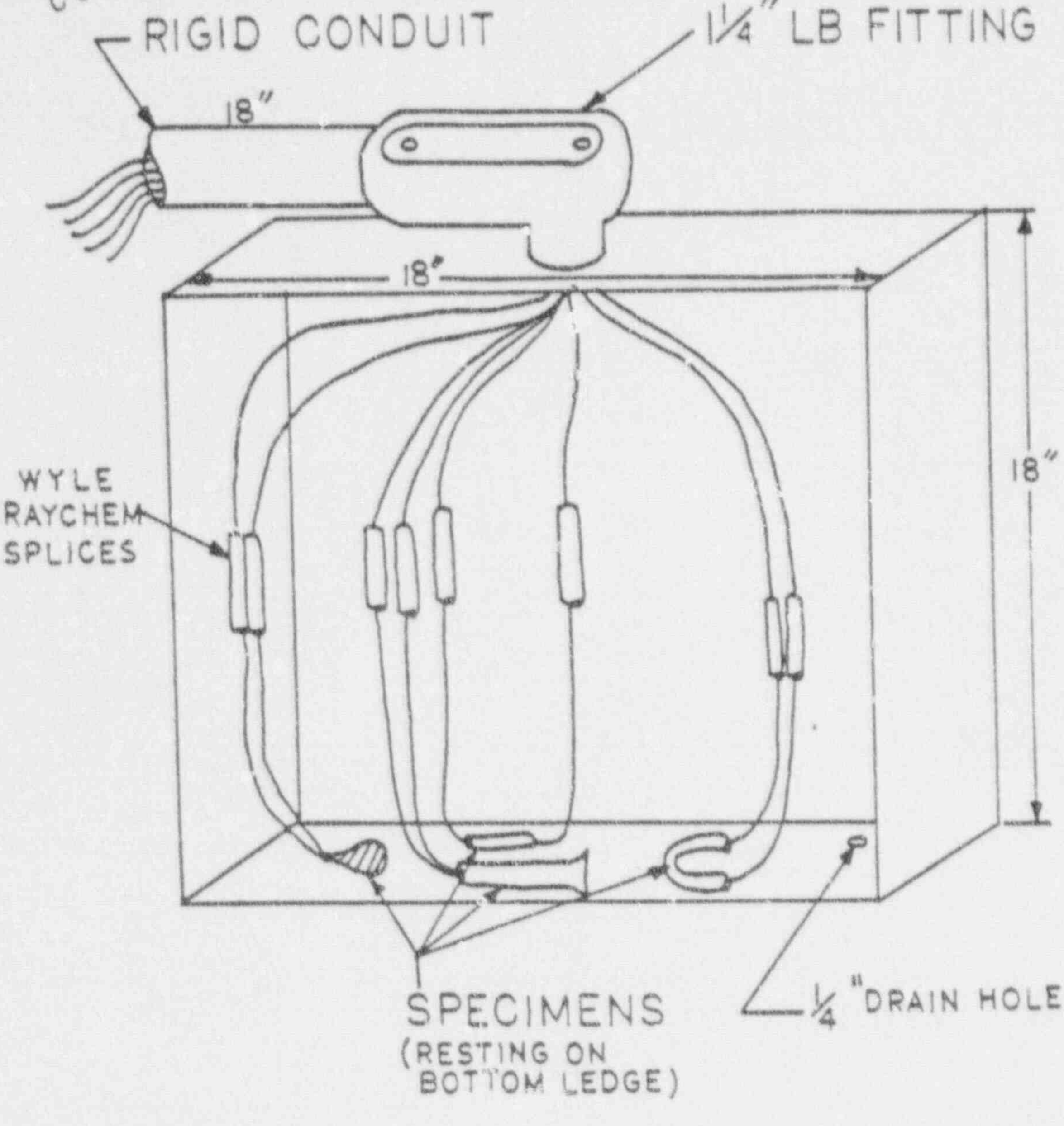


FIGURE 4. TYPICAL NEMA 3 ENCLOSURE TEST SETUP

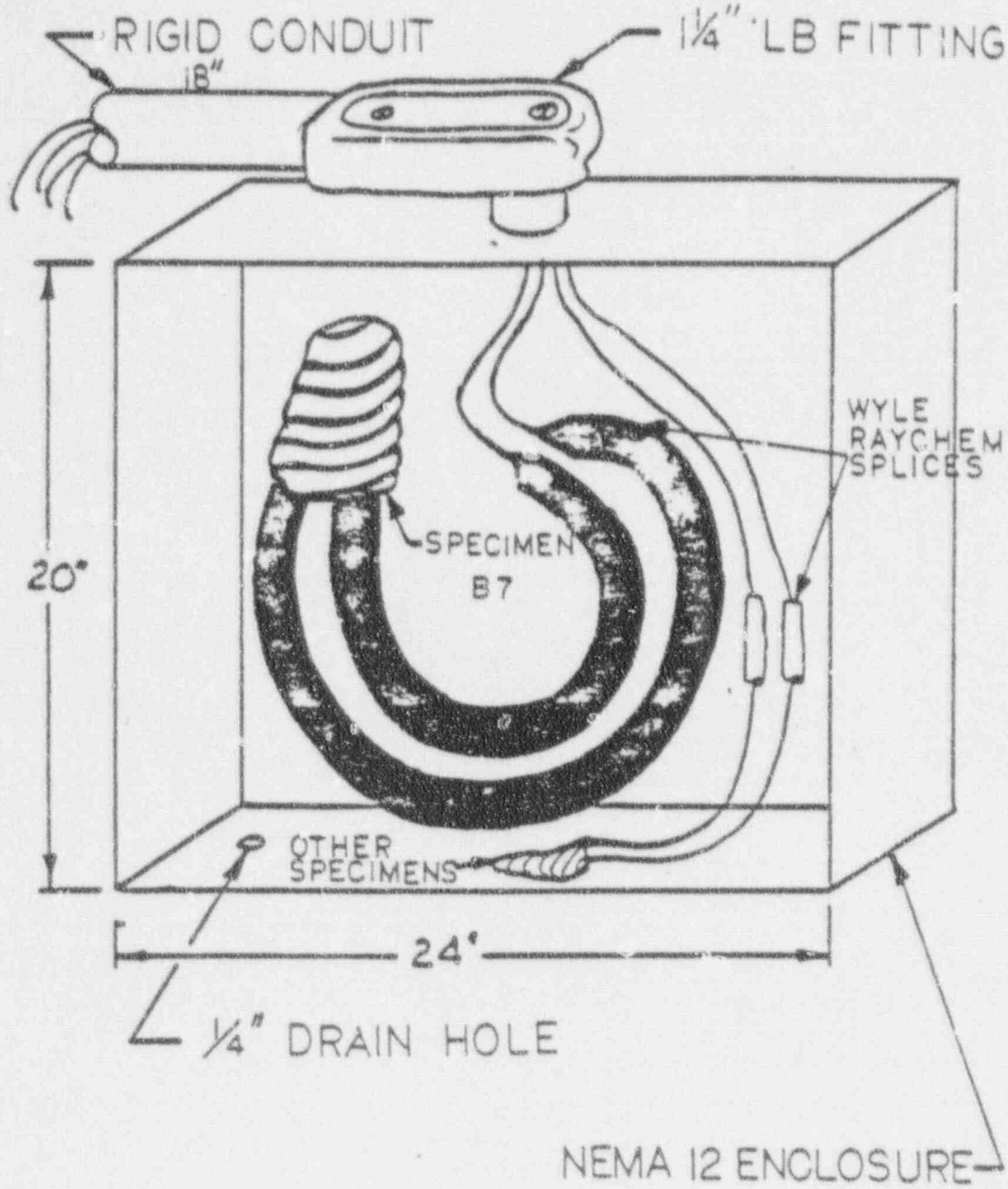
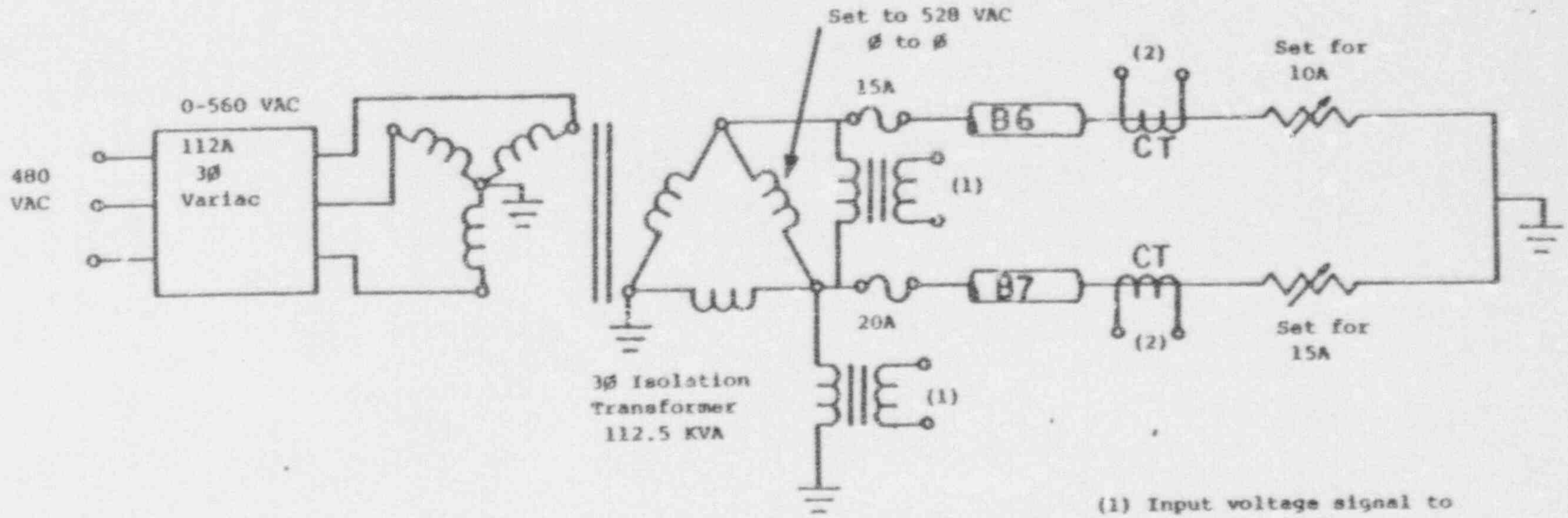


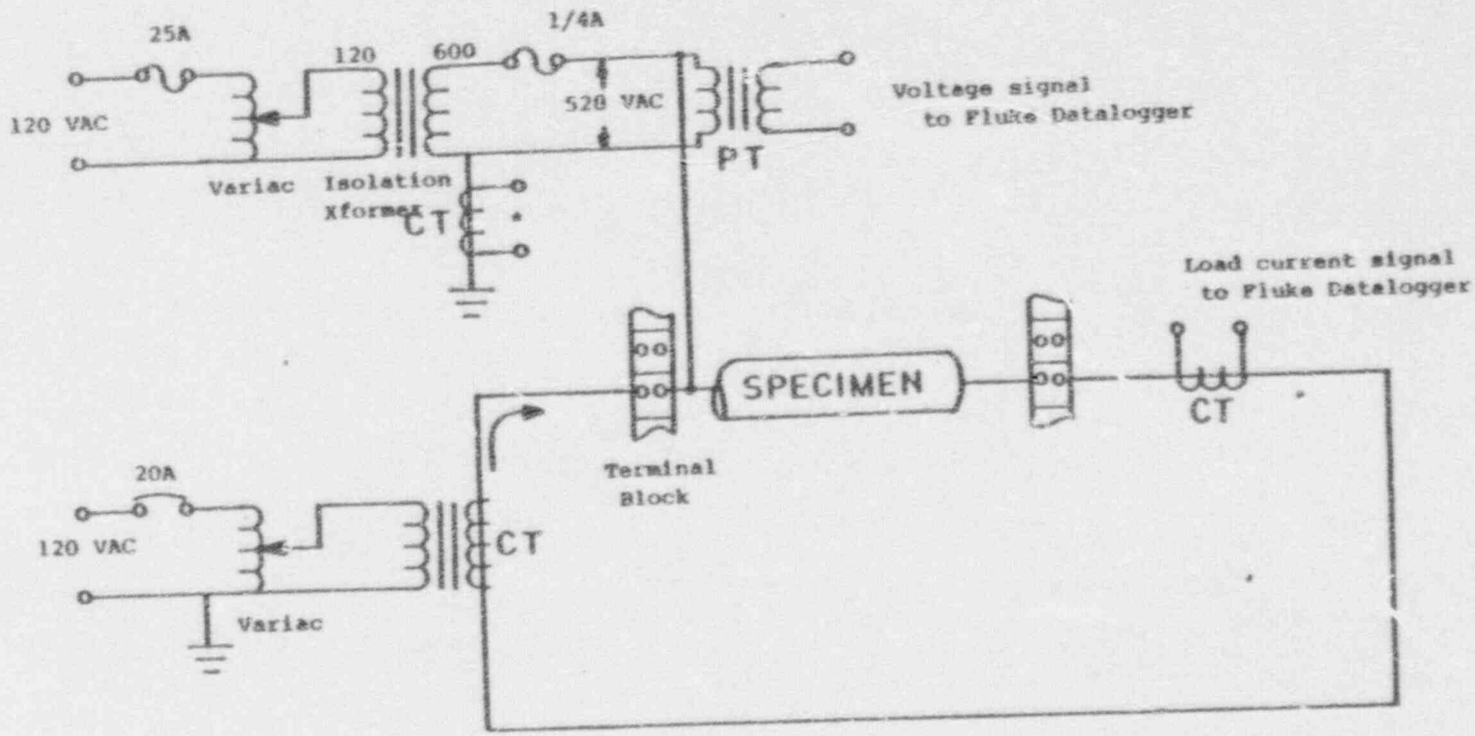
FIGURE 5. NEMA 12 ENCLOSURE TEST SETUP



(1) Input voltage signal to Fluke Datalogger

(2) Applied current signal to Fluke Datalogger

FIGURE 6. ELECTRICAL SETUP FOR SPECIMENS B6 AND B7



*Leakage current to ground signal to Daytronics Data Acquisition System.

FIGURE 7. TYPICAL ELECTRICAL SETUP FOR 528 VAC AND 6.7A OR 5A CIRCUITS

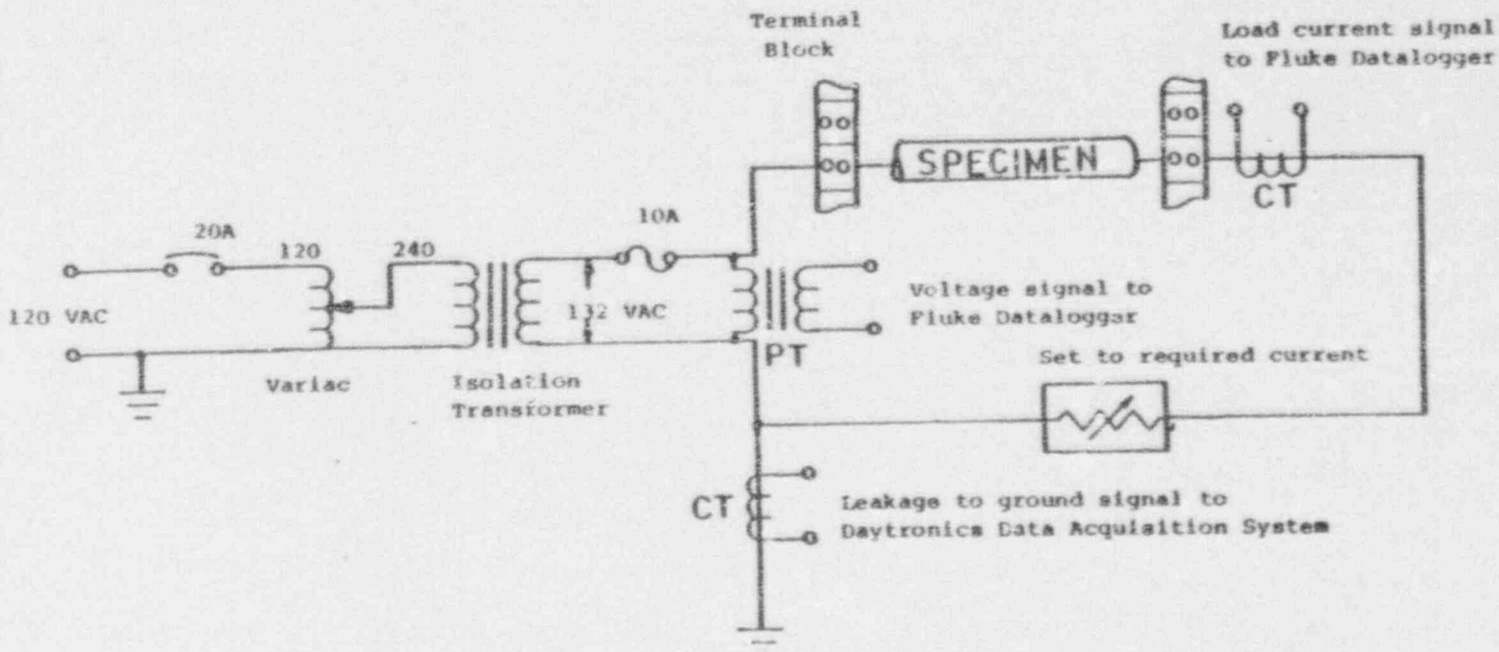


FIGURE 8. TYPICAL ELECTRICAL SETUP FOR 132 VAC CIRCUITS

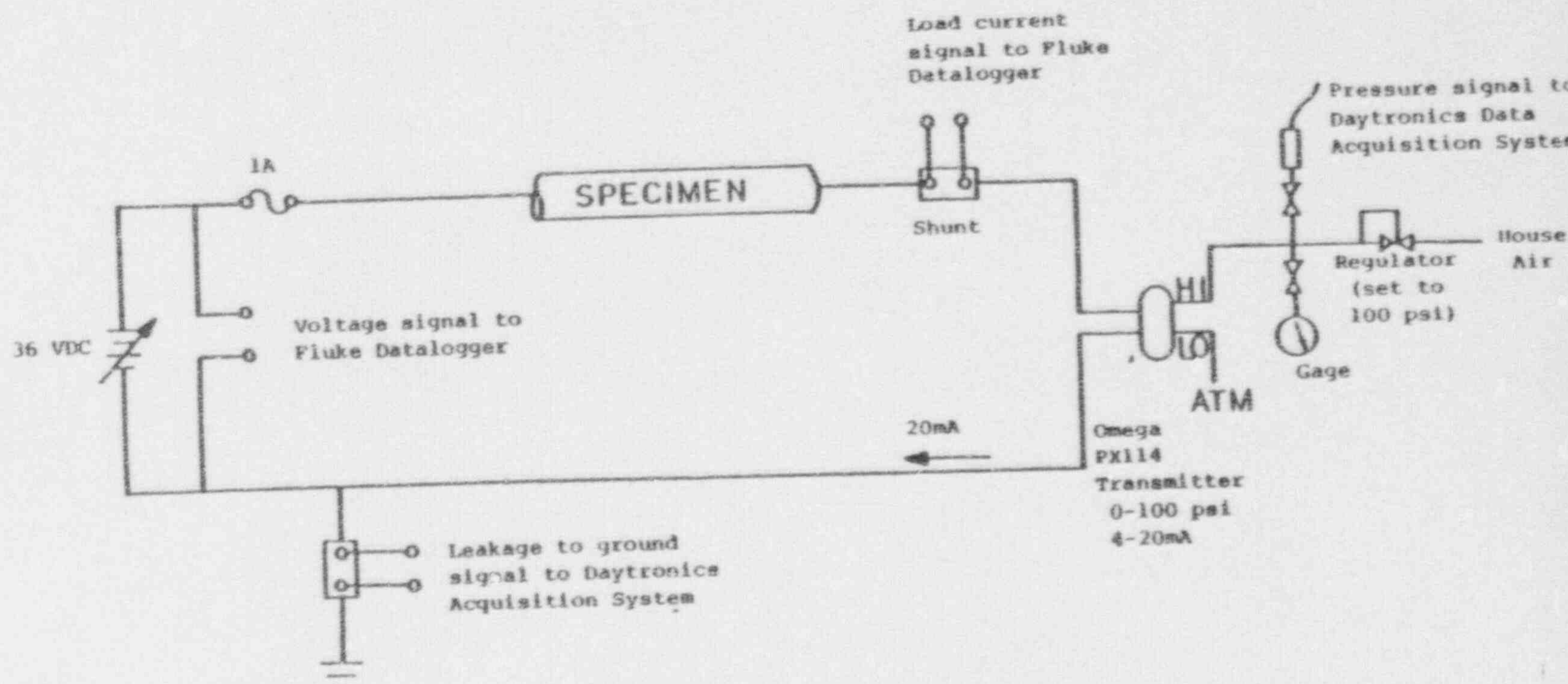


FIGURE 9. TYPICAL ELECTRICAL SETUP FOR SPECIMENS Z2 AND Z3

APPENDIX I

Splice Preparation Procedures

R-1

WI-500 Addendum #3
Rev. 1

Procedure No: WI-500

Revision No: N/A

TITLE: ADDENDUM ON FIELD TEST OF T-95 & #35 OKONITE T

Prepared by: Ronald W. Ramm Date 2-11-83

Reviewed by: [signature] Date 2-11-83
Manager, Quality

Approved by: A.O. Liles Date 2-14-
Project Manager

Approved by: B. Hurst Date 2-16-
Director, Quality Assurance

CECo Acceptance: Per CECo letter dated 4/4/83

THE
HOWARD P. FOLEY
COMPANY

R-1

ADDENDUM - WI-500

ADDENDUM ON FIELD TEST OF T-95 & #35 OKONITE TAPE

The shelf life for T-95 Okonite tape is 12 months from date of manufacture. The shelf life for #35 Okonite tape is 24 months from date of manufacture. Okonite tapes remain usuable beyond shelf life expiration date, provided the following two (2) in-field tests can be passed.

1. When stretching the tape to 3/4 of its original width, the tapo should not rupture or tear.

2. Wrap several half-lapped layers around a dowel or any other object to simulate a cable. The layers should be applied under a tension described above. After lightly squeezing the half-lapped layers, slice open the taped mass along the axis of the dowel. If the taped layers are inseparable, (fused together), the tape is acceptable for use.

The Craft shall notify Quality Control prior to performing the test. Quality Control shall monitor the tests through in-process inspections.

References:

Mark Teras memo dated 1/14/83.

R-1

PROCEDURE CLARIFICATION

Terminations made at motors 480V and below are to be performed in the following manner:

1. Lugs are to be bolted together with the appropriate bolt type and associated hardware. Bolting material for bolt diameter of 3/8" and larger are to be stainless steel in accordance with CECo Standard C-849.

2. Any voids that exist between the attached lugs are to be filled by the use of Okonite rubber cement and sufficient layers of Okonite T-95 tape as applicable to prevent moisture seepage.

3. Apply Okonite rubber cement over both lugs and exposed conductor area. Let dry until cement becomes tacky.

4. Using Okonite T-95 tape, wrap both lugs a minimum of two half-laps, paying attention to completely softening the bolt attachment.

5. Apply a minimum of two half-laps of Okonite O-35 tape. The layers of O-35 should extend approximately one inch past the boundary of the lugs on to the cable jacket.

Richard Duzta
Manager, Quality (HPFCo)

K. Steele 10/24/79
CECo Project Engineer

References:

HPFCo WI-500, Rev. 7
S&L Std. EA-209
S&L Dwg. 1E-0-3089
CECo Std. C-849

OKONITE COMPANY

WI-500 Addendum #3
Rev. 1

R-1

January 11, 1983

Mr. Jim Phelan
Principal Engineer
Commonwealth Edison Company
Post Office Box 767
Chicago, Illinois 60690

RE: T-95, #35 Okonite Tapes

Dear Mr. Phelan:

The shelf life for the subject tapes remains as stated below and as in my previous December 21, 1982 letter:

T-95 -- 12 months from date of manufacture

#35 -- 24 Months from date of manufacture

However, the term shelf life must be further defined so that unnecessary restrictions are not invoked regarding the use of Okonite tapes. Okonite tapes remain useable provided that the following two (2) in-field tests can be passed:

1. When stretching the tape to 3/4 of its original width, the tape should not rupture or tear.

2. Wrap several half-lapped layers around a dowel or any other object to simulate a cable. The layers should be applied under the tension described above. After lightly squeezing the half-lapped layers, slice open the taped mass along the axis of the dowel. If the taped layers are inseparable, (fused together), the tape is acceptable for use.

Due to the many varying conditions under which tapes are stored in the field, the "shelf life" parameter is used to assist the the customer in keeping fresh, useable tape on the jobsite. Expiration of the recommended shelf life does not mandate that the tape is not suitable for use.

Please advise this office if you have further questions in this matter.

Very truly yours,

THE OKONITE COMPANY

Donald W. Martin
District Manager

DWM:rc

3.0 ACTIVITIES INVOLVED (con't.)

R-10 21. All wiring shall be complete, supported, neat in appearance and shall comply with the latest revision of the A/E's wiring diagrams. Any unique termination problems will be referred to the Owner and A/E for disposition.

R-10 22. The bending radii of cables trained in place shall not exceed values given in Table A.

3.3 Cable Terminations Revisions

1. When a termination is changed per drawing revision a new termination card is filled out noting the reason for the termination change in the comment section of the termination cards. All revisions to cables terminated must be coordinated under the direction of Commonwealth Edision's Operational Analysis Department.

3.4 Power Terminations

1. Manufacturers termination kits are required for 6900 and 4160 V cables per S&L drawings 1E-0-3088, 3089, and 3089A.

2. Terminations of 600v and below made with uninsulated lugs are to be taped with the "Okonite Method" (see section 3.4.3 for lug to lug connections and uninsulated butt splices). The cable, insulation and jacket shall be cleaned with a suitable solvent and allowed to dry. The entire surface to be taped shall be coated with Okonite cement. The lug barrel and conductor shall be wrapped or softened by two half-lapped layers of Okonite T-95 tape, followed by sufficient but not less than 2 half-lapped layers of Okonite O-35 insulation tape. The total insulation thickness should be approximately 1½ times the thickness of the factory applied cable jacket insulation. (See Addendum #3)

R-10

3. Lug to lug terminations (both insulated and uninsulated) of 600V and below need not be individually insulated prior to connection. Only the total bolted connection requires insulation by the Okonite method. If lugs are connected in such a manner as to leave a void area between the lugs, this area is filled in with Okonite T-95 taping material to prevent moisture creepage. Uninsulated butt splices are to be taped to the Okonite method or covered by WCSF Racham shrink tubing. (See Addendum #4)

R-10

PWR TEST LEAKAGE CURRENT RESULTS

The peak recorded leakage currents recorded during this test were as follows:

Specimen Number	Peak Leakage Current (mA)	Notes
Z1	157	
Z2	0	
Z3	0	
Z4	0	
Z5	0	
Z6	5	
Z7	1	
Z8	0	
Z9	0	
Z10	0	
Z11	>250	(1)
Z12	>250	(1)
Z13	1	
B1	1	
B2	38	
B3	35	
B4	>250	(1)
B5	7	
B6	Not measured	(2)
B7	Not measured	(2)

Notes: (1) Specimen blew, repeatedly, a 1/4 ampere fuse to ground.

(2) Leakage current to ground signals were not measured because these specimens would not be overly affected by small current signals.

DATA SHEET

WYLE LABORATORIES

Customer CECo
Specimen Cables and Splices
Part No. Various
Spec WLQP 17859-01
Para. 3.1.3
S/N N/A
GSI No

Amb. Temp. 76°F
Photo YES
Test Med. Air
Specimen Temp. ~~Ambient~~ 205°F

Job No. 17859
Report No. 17859-02
Start Date 9-20-96

Test Title POST-LOCA FUNCTIONAL TEST

INSULATION RESISTANCE AT 500 VDC

ACCEPTANCE CRITERIA: DATA COLLECTED FOR INFORMATION ONLY

SPECIMEN NO.	READING
B1	$5.0 \times 10^6 \Omega$
B2	$2.0 \times 10^5 \Omega$ @ 109 VDC
B3	$2.2 \times 10^5 \Omega$ @ 109 VDC
B4	$< 5.0 \times 10^4 \Omega$ @ 10 VDC
B5	$< 5.0 \times 10^4 \Omega$ @ 10 VDC
B6	$1.6 \times 10^5 \Omega$ @ 109 VDC
B7	$1.6 \times 10^7 \Omega$

WHEN TAKEN OUTSIDE TEST CHAMBER WITH Wyle TEST LEADS Cut off (~~Ambient~~ SPECIMEN Temp ~76°F)

B4	$6.4 \times 10^4 \Omega$ @ 109 VDC
B5	$9.7 \times 10^4 \Omega$ @ 109 VDC
B6	$2.4 \times 10^5 \Omega$ @ 109 VDC

Tested By [signature] Date: 9/20/96
Witness [signature] Date: 9-20-96
Sheet No. of
Approved [signature] 9/20/96

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '94

DATA SHEET

WYLE LABORATORIES

Customer: CECo
Specimen: Cables and Splices
Part No.: Various
Spec.: WLQP 17859-01
Para.: 3.1.3
S/N: N/A
GSI: No

Amb. Temp.: 76°F
Photo: YES
Test Med.: Air
Specimen Temp.: ~~Ambient~~ 205°F

Job No.: 17859
Report No.: 17859-02
Start Date: 9-20-86

Test Title: POST-LOCA FUNCTIONAL TESTS

INSULATION RESISTANCE AT 500 VDC

ACCEPTANCE CRITERIA: DATA COLLECTED FOR INFORMATION ONLY

SPECIMEN NO.	READING
Z1	$2.4 \times 10^{10}\ \Omega$
Z2	$4.5 \times 10^{10}\ \Omega$
Z3	$3.0 \times 10^{9}\ \Omega$
Z4	$4.3 \times 10^{9}\ \Omega$
Z5	$8.0 \times 10^{9}\ \Omega$
Z6	$7.0 \times 10^{8}\ \Omega$
Z7	$1.1 \times 10^{9}\ \Omega$
Z8	$1.7 \times 10^{10}\ \Omega$
Z9	$1.9 \times 10^{10}\ \Omega$
Z10	$8.5 \times 10^{9}\ \Omega$
Z11	$3.0 \times 10^{7}\ \Omega$
Z12	$< 5.0 \times 10^{4}\ \Omega$ @ 10 VDC
Z13	$3.2 \times 10^{6}\ \Omega$

Notice of Anomaly: None

Tested By: John H Magee Date: 9/20/86
Witness: [signature] Date: 9-20-86
Sheet No. ___ of ___
Approved: [signature] 9-20-86

Wyle Form WH 614A, Rev. APR '84

BWR TEST LEAKAGE CURRENT RESULTS

Results of BWR Test #1

The peak recorded leakage on each specimen (or group of specimens) were as follows:

Specimen No.	Peak Leakage Current
Q1	29 mA
Q2	2 mA
Q3	0 mA
Q4	5 mA
Q5	1 mA
Q6	81 mA
D3	12 mA
D4	53 mA
D5 and D7 in series	7 mA
D6	2 mA
D8	2 mA
D9	0 mA
D10	8 mA
D11	2 mA
D16	4 mA
D17	6 mA
D18	>2000 mA*
D19	1474 mA
D20	263 mA
D21	217 mA

*Specimen D18 blew two 2 ampere fuses immediately after insertion into the circuit.

DRAFT

Results of BWR Test #2

The peak recorded leakage currents on each specimen (or group of specimens) during this test were as follows:

Specimen No.	Peak Leakage Current
L1	10 mA
L2, L4 and L10 in series	18 mA
L3	11 mA
L5	16 mA
L6 and L8 in series	24 mA
L7	219 mA
L9	1 mA
L11	0 mA
Q7, Q9 and Q11 in series	15 mA
Q8	0 mA
Q10	9 mA
Q12	1[illegible] mA
Q13	23 mA
Q14	9 mA
Q15	0 mA
Q16	353 mA
D1	1 mA
D2	0 mA
D12	1 mA
D13, D14 and D15 in series	0 mA

Results of BWR Test #3

The peak recorded leakage currents on each specimen during this test were as follows:

Specimen No.	Peak Leakage Current
Q17	845 mA
Q18	[illegible]30 mA
Q19	4737 mA
Q20	>25 amperes*

*Specimen blew a 25 ampere fuse.

DATA SHEET

DRAFT

WYLE LABORATORIES

Customer: CECo

Specimen: Cables and Splices

Part No.: Various

Spec.: WLQP 17859-01

Para.: 3.1.3

S/N: N/A

GSI: No

Amb. Temp.: 72°F

Photo: YES

Test Med.: Air

Specimen Temp.: ~~Ambient~~ 171°F

Job No.: 17859

Report No.: 17859-02

Start Date: 10-7-86

Test Title: Post-BWR #1 LOCA Functional Test

INSULATION RESISTANCE AT 500 VDC

ACCEPTANCE CRITERIA: DATA COLLECTED FOR INFORMATION ONLY

SPECIMEN NO.	READING	SPECIMEN NO.	READING
D1	NA	D16	$1.4 \times 10^{10}\ \Omega$
D2	NA	D17	$1.0 \times 10^{7}\ \Omega$
D3	$1.5 \times 10^{6}\ \Omega$	D18	$2.8 \times 10^{5}\ \Omega$ @ 109
D4	$3.0 \times 10^{6}\ \Omega$	D19	$1.6 \times 10^{5}\ \Omega$ @ 109V
D5	$1.0 \times 10^{11}\ \Omega$	D20	$9.4 \times 10^{4}\ \Omega$ @ 109V
D6	$3.0 \times 10^{10}\ \Omega$	D21	$2.4 \times 10^{5}\ \Omega$ @ 109
D7	$5.0 \times 10^{10}\ \Omega$		
D8	$3.0 \times 10^{10}\ \Omega$		
D9	$2.6 \times 10^{11}\ \Omega$		
D10	$3 \times 10^{10}\ \Omega$		
D11	$5 \times 10^{10}\ \Omega$		
D12	NA		
D13	NA		
D14	NA		
D15	NA		

Tested By: [signature] Date: 10/7/86

Witness: Date:

Sheet No. 2 of 2

Approved: [signature] 10/7/86

Notice of Anomaly: None

DRAFT

DATA SHEET

WYLE LABORATORIES

Customer CECo
Specimen Cables and Splices
Part No. Various
Spec. WLQP 17859-01
Para. 3.1.3
S/N N/A
GSI No

Amb. Temp. 72°F
Photo YES
Test Med. Air
Specimen Temp. ~~Ambient~~ 71°F

Job No. 17859
Report No. 17859-02
Start Date 10-7-96

Test Title Post- BWR #1 LOCA FUNCTIONAL TEST

INSULATION RESISTANCE AT 500 VDC

ACCEPTANCE CRITERIA: DATA COLLECTED FOR INFORMATION ONLY

SPECIMEN NO.	READING
Q1	2.2×10^{6} Ω
Q2	8×10^{5} Ω
Q3	2.2×10^{7} Ω
Q4	5.0×10^{4} Ω
Q5	2.5×10^{6} Ω [illegible]
Q6	5.2×10^{5} Ω
Q7	NA
Q8	NA
Q9	NA
Q10	NA
Q11	NA
Q12	NA

Tested By [signature] Date: 10/7/96
Witness [illegible] Date: [illegible]
Sheet No. 2 of 2
Approved [signature] 10/7/96

Notice of Anomaly None

Wyle Form WH 614A, Rev. APR '86

DATA SHEET

DRAFT

WYLE LABORATORIES

Customer: Commonwealth Edison Company
Specimen: Cables and Splices
Part No.: Various
Spec.: WLQP 17859-01, Rev B
Para.: 3.3.3
S/N: NO
GSI: N/A

Amb. Temp.: 72°F
Photo: YES
Test Med.: Steam
Specimen Temp.: 250°F

Job No.: 17859
Report No.: 17859-02
Start Date: 11-26-86

Test Title: Post-LOCA Insulation Resistance Test
Insulation Resistances at 500 VDC. (BUR #2)

Acceptance Criteria: Data Collected for Information Only

Specimen No	Insulation Resistance
L1	9.0×10^7 Ω erratic
L2	7.2×10^{10} Ω
L3	3.0×10^{10} Ω
L4	1.1×10^9 Ω
L5	2.4×10^8 Ω
L6	2.9×10^3 Ω erratic
L7	3.0×10^7 Ω
L8	2.4×10^7 Ω
L9	4.5×10^{10} Ω
L10	6.4×10^9 Ω
L11	1.5×10^8 Ω
Q7	4.5×10^{10} Ω
Q8	2.4×10^9 Ω
Q9	1.1×10^8 Ω
Q10	1.1×10^8 Ω
Q11	1.9×10^8 Ω

Tested By: [signature] Date: 11/26/86
Witness: [signature] Date: 11-26-86
Sheet No. 1 of 2
Approved: J. Hazlett 11/26/86

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

DRAFT

WYLE LABORATORIES

Customer: Commonwealth Edison Company

Specimen: Cables and Splices

Part No.: VARIOUS

Spec.: WLQP 17859-01, REV B

Para.: 3.3.3

S/N: NO

GSI: NO

Amb. Temp.: 72°F

Photo: YES

Test Med.: Steam

Specimen Temp.: 250°F

Job No.: 17859

Report No.: 17859-02

Start Date: 11-26-86

Test Title: POST-LOCA INSULATION RESISTANCE TEST (CONTINUED) (BWR #2)

SPECIMEN NO.	INSULATION RESISTANCE
Q12	$1.9 \times 10^{9}\ \Omega$
Q13	$9.8 \times 10^{5}\ \Omega$
Q14	$1.6 \times 10^{11}\ \Omega$
Q15	$1.2 \times 10^{8}\ \Omega$ erratic
Q16	$5.0 \times 10^{10}\ \Omega$
D2	$1.1 \times 10^{[illegible]}\ \Omega$
D12	$1.1 \times 10^{11}\ \Omega$
D13	$4.0 \times 10^{[illegible]}\ \Omega$
D14	9/27m ~~1.1xx~~ $1.1 \times 10^{11}\ \Omega$
D15	$1.1 \times 10^{12}\ \Omega$
D2	$1.6 \times 10^{11}\ \Omega$

Tested By: John H. Mag[illegible] Date: 11/26/86

Witness: [illegible] Date: 11/26/86

Sheet No. 2 of 2

Approved: J. Hazlett 11/26/86

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

DATA SHEET

DRAFT

WYLE LABORATORIES

Customer: Commonwealth Edison Company
Specimen: Cables & Splices
Part No.: Various
Spec.: WCP 17559-01
Para.: 3.3
S/N: NO
GSI: NO

Amb. Temp.:
Photo: YES
Test Med.: Steam
Specimen Temp.: 300 °F

Job No.: 17559-01
Report No.: 17554-02
Start Date: 12-5-86

Test Title: Post-LOCA Functional Test (BWR #3)

INSULATION RESISTANCE TEST: INSULATION RESISTANCE SHALL BE MEASURED AT 500 VDC FOR 1 MINUTE FOR INFORMATIONAL PURPOSES ONLY

Specimen	Reading
Q17	<50KΩ @ 10VDC
Q18	<50KΩ @ 10VDC
Q19	<50KΩ @ 10VDC
Q20	<50KΩ @ 10VDC

Tested By: R. Langston Date: 12/5/86
Witness: [illegible] Date: 12/5/86
Sheet No. 2 of 2
Approved: [illegible] 12/5/86

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84