TEST REPORT

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

REPORT NO. 58883
OUR JOB NO. DE 58883
CONTRACT ---
YOUR P. O. NO. B-24403

CAROLINA POWER & LIGHT COMPANY
Brunswick Steam Electric Plant
Southport, North Carolina 28461

91-Page Report

DATE 24 August 1984

ENVIRONMENTAL QUALIFICATION
OF
RAYCHEM-FLAMTROM™-1000V CONTROL 7/C 12AWG 1975 CG12-400 CABLE
FOR
CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANTS 1 AND 2

STATE OF CALIFORNIA }
COUNTY OF RIVERSIDE } ss.

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

Roy C. Sadlier

SUBSCRIBED and sworn to before me this 26th day of September, 19 84

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

My commission expires [illegible] 19 87

OFFICIAL SEAL
CATHERINE C KELTY
NOTARY PUBLIC - CALIFORNIA
RIVERSIDE COUNTY
My comm. expires JUL 14, 1987

W-867A

DEPARTMENT DYNAMICS/ENVIRONMENTAL

DEPT. MGR. J. J. Anderson

TEST ENGINEER L. F. Goad

REGISTERED PROFESSIONAL ENGINEER

DCAS—QAR VERIFICATION

QUALITY ASSURANCE L. Housteau

TABLE OF CONTENTS

LIST OF TABLES, PHOTOGRAPHS, AND FIGURES

1.0 **SUMMARY**

Four Seven-Conductor Cables, Part No. CG12-400, were received for test in accordance with the referenced specifications. The specimens were furnished to Wyle Laboratories by Raychem.

The cable jackets were marked as follows: Raychem-Flamtrol TM -1000V Control 7/C 12AWG 1975 CG12-400.

The specimens were subjected to the following tests:

Irradiation Test*	2 specimens	6.2×10^7 rads
	2 specimens	1.1×10^8 rads
Receiving Inspection	4 specimens	
Thermal Aging	2 specimens	254F
	2 specimens	284F
LOCA	4 specimens	
Voltage Withstand	4 specimens	

* Performed at International Nutronics, Inc., Irvine, California

Functional tests were performed before and after each test, as required.

There was no visible evidence of damage or deterioration of any specimen as a result of the test conditions.

The specimens held voltage at rated current throughout the test and passed the post-LOCA voltage withstand tests.

For additional information, including test equipment used, refer to the test data sheets included in each section of this report.

Carolina Power as referenced in this report means Carolina Power & Light Company Brunswick Steam Electric Plants 1 and 2.

Reference to cable or specimens means Cable CG12-400.

2.0 REFERENCES

2.1 Carolina Power & Light Company Purchase Order No. B-22403, dated 27 October 1983.

2.2 Wyle Laboratories Test Plan No. 566-1674, Revision A, "Test Plan for Demonstration of Raychem Cable for Qualified Use in Class 1E Service, Primary and Secondary Containment, for Carolina Power & Light Company", dated 1 May 1984, included in this report as Appendix I.

2.3 Wyle Laboratories Test Plan No. 566-1674-1, Revision A, "Test Plan for Voltage Withstand Level Testing of Raychem Cable Samples After a LOCA Test for Carolina Power & Light Company", dated 1 May 1984, included in this report as Appendix II.

2.4 Wyle Laboratories Quality Assurance Manual No. 380, Revision D, dated 15 April 1984.

SECTION 1

RECEIVING INSPECTION

1.1 TEST PROCEDURE

Upon receipt at Wyle Laboratories from International Nutronics upon completion of the irradiation test, the test specimens were visually examined for evidence of damage which may have been incurred in shipping. Results of the visual examination, together with specimen identification information, were recorded on the appropriate test data sheets.

The test specimens were received in two boxes, marked "A" and "B". Box "A" contained specimens labeled A.S and A.O, as shown on Page 1-2. Box "B" contained specimens labeled B.S and B.O as shown on Page 1-3. Each conductor was identified by heat shrink tags applied by Raychem prior to shipping.

The test specimens were mounted on 30-inch diameter mandrels. Test specimens labeled A.O. and B.O. were to be tested with the jacket ends open, and specimens labeled A.S and B.S were to be tested with the jacket ends sealed.

The identification of the wire assigned numbers as referenced on Page 1-4 is as follows:

- Carolina-assigned wire numbers taken from test plan
- Carolina-assigned identification numbers were those tagged at Raychem
- Wyle-assigned wire numbers were used for electrical hook-up only.

1.2 TEST RESULTS

There was no visible evidence of damage to the test specimens upon receipt at Wyle Laboratories.

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

58883

1-2

DATA SHEET

Customer CAROLINA POWER Job No. 58883

Date 5-23-84

Specimen WIRE + MANDREL

RECEIVING INSPECTION

No. of Specimens Received: 2 SEVEN CONDUCTOR CABLES

Record identification information exactly as it appears on the tag or specimen:

Manufacturer RAYCHEM

Part Numbers CG12-400

How does identification information appear: (name plate, tag, painted, imprinted, etc.)

TAGS

~~Serial Numbers~~ WIRE ID: *

AS-1	AS-6	AO-1	AO-6
AS-2	AS-7	AO-2	AO-7
AS-3		AO-3	
AS-4		AO-4	
AS-5		AO-5	

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification.

Inspection Results: There was no visible evidence of damage to the specimens unless noted below.

* If additional space is required for serial numbers, use an additional page, or reference first functional test data sheet (if applicable).

Inspected By G.C. ADAIR

Sheet No. _____ of _____

Approved Luther S Grad Date: 7-16-84

W-614

Q.C. Form Approval [signature]

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

58883

1-3

DATA SHEET

Customer CAROLINA POWER Job No. 58883

Date 5-23-84

Specimen WIRE & MANDREL

RECEIVING INSPECTION

No. of Specimens Received: 2 SEVEN CONDUCTOR CABLES

Record identification information exactly as it appears on the tag or specimen:

Manufacturer RAYCHEM

Part Numbers CG12-400

How does identification information appear: (name plate, tag, painted, imprinted, etc.)

TAGS

~~WIRE ED~~ Serial Numbers: *

BS-1	BS-6	BO-1	BO-6
BS-2	BS-7	BO-2	BO-7
BS-3		BO-3	
BS-4		BO-4	
BS-5		BO-5	

Examination: Visual, for evidence of damage, poor workmanship, or other defects, and completeness of identification.

Inspection Results: There was no visible evidence of damage to the specimens unless noted below.

* If additional space is required for serial numbers, use an additional page, or reference first functional test data sheet (if applicable).

Inspected By G C ADAIR

Sheet No. _____ of _____

Approved Luther L Beard Date: 7-16-84

W-614

Q.C. Form Approval _____

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

58883

DATA SHEET

1-4

TEST TITLE WIRE ID & ASSIGNMENT FOR ENERGIZATION CIRCUIT Date 6-5-94

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7 CONDUCTOR CABLES Technician VALFCE

Part No. CG12-400 Serial No. N/A Engineer [signature]

ELECTRICAL PHASING	WIRE COLOR	CAROLINA ASSIGNED WIRE NUMBER	CAROLINA ASSIGNED WIRE ID	WYLE ASSIGNED WIRE NUMBER
A	WHITE	1	AO-1	1
	WHITE / BLACK	6	AO-6	2
	WHITE	1	AS-1	3
	WHITE / BLACK	6	AS-6	4
	WHITE	1	BO-1	5
	WHITE / BLACK	6	BO-6	6
	WHITE	1	BS-1	7
	WHITE / BLACK	6	BS-6	8
B	RED	2	AO-2	9
	BLUE	5	AO-5	10
	RED	2	AS-2	11
	BLUE	5	AS-5	12
	RED	2	BO-2	13
	BLUE	5	BO-5	14
	RED	2	BS-2	15
	BLUE	5	BS-5	16
C	GREEN	3	AO-3	17
	ORANGE	4	AO-4	18
	GREEN	3	AS-3	19
	ORANGE	4	AS-4	20
	GREEN	3	BO-3	21
	ORANGE	4	BO-4	22
	GREEN	3	BS-3	23
	ORANGE	4	BS-4	24
N/A	BLACK	7	AO-7	AO-7
	BLACK	7	AS-7	AS-7
	BLACK	7	BO-7	BO-7
	BLACK	7	BS-7	BS-7

W614B-82 QA Form Approval [signature]

SECTION 2

IRRADIATION TEST

2.1 TEST PROCEDURE

The test specimens were shipped from Raychem to International Nutronics for the irradiation testing in accordance with Reference 2.2, Par. 4.1.1 for Condition A and Par. 4.1.2 for Condition B.

2.2 TEST RESULTS

Data sheets for the baseline functional test prior to the irradiation test were furnished to Wyle Laboratories by Raychem, and are included in this report section.

Irradiation certification data sheets are included in this report section.

The baseline functional and irradiation tests were acceptable and comply with Reference 2.2

C612-400 Butyl 44

58883

RAYCHEM CORPORATION LABORATORY NOTEBOOK
PROPRIETARY INFORMATION

№ 8050 C4
2-2

Subject Pre Irradiation IRs LAP-83-451 Date: 5-9-84 UE&C 9527-01-113-Y5

IR's at 500 volts DC for 1 min
Instrument Gen Rad 1864 Serial No. 1933
Measurements made between each wire and all the other wires and the mandrel
Measurements made at room temperature in air.

Wire	IR
AS-1	3.5×10^{12}
AS-2	3.5×10^{12}
AS-3	3×10^{12}
AS-4	3.5×10^{12}
AS-5	4×10^{12}
AS-6	5×10^{12}
AS-7	5×10^{12}
AO-1	4×10^{12}
AO-2	4×10^{12}
AO-3	3×10^{12}
AO-4	3.5×10^{12}
AO-5	5×10^{12}
AO-6	4.5×10^{12}
AO-7	4.5×10^{12}
BS-1	4.5×10^{12}
BS-2	5×10^{12}
BS-3	4.5×10^{12}
BS-4	4×10^{12}
BS-5	7.1×10^{12}
BS-6	6.8×10^{12}
BS-7	6.6×10^{12}
BO-1	8.4×10^{12}
BO-2	5.8×10^{12}
BO-3	4.5×10^{12}
BO-4	5.5×10^{12}
BO-5	8.2×10^{12}
BO-6	9.4×10^{12}
BO-7	7.8×10^{12}

Work Directed By:

Signature	Date	Read and Understood By:	Date
[signature]	5-9-84	M.L.N.D	5-9-84

INTERNATIONAL NUTRONICS, INC. 58883 2-3

CERTIFICATION

CUSTOMER NAME:	WYLE LABORATORIES
CUST. PROD. NO.	58883
I.N.I. RUN NO.	WL-012
DATE RUN:	May 11, 1984
DOSE RECEIVED:	6.2×10^7 rads Air Equivalent
SOURCE TYPE:	Cobalt 60

BY R. R. Baldwin

TITLE PLANT MANAGER

DATE 5/28/84

1962 Barranca Road/Irvine, California 92714 (714) 863-9381

WYLE LABORATORIES

IRRADIATION DATA SHEET

58883

(To be returned to Wyle Laboratories)

2-4

REQUEST (To be completed by Wyle Laboratories)

Date: 5-8-84 Wyle Job No. 58883 Wyle P.O. No. 3-8936

Specimen: Raychem-Flamtrol TM unshielded jacketed Cab Part No. UE&C 9527-01-113-4B

Air Equivalent Required Dose: Min. 6.2×10^7 Max. 6.82×10^7 Rate not to exceed 1×10^6 rads/hr

Source Type: Cobalt-60/gamma Specimen rotation required: Yes ☑ No ☐ 1 times

Sketch required: Yes ☐ No ☑

Post irradiation contamination check required: Yes ☐ No ☑

Dosimeter Locations: ☑ Standard (min. and max. expected locations) ☐ Other (sketch attached)

Comments Condition A. Shipping Box Marked "A"

The required dose shall be measured at the Geometric centerline of the standard.

DATA (To be completed by performing lab)

RUN NO. WL012

Facility: INTERNATIONAL NUTRONICS, INC (IRVINE) Technician: JOHN P O'SULLIVAN

Total Dose (air): Min. 6.2×10^7 (rads); Max. _____ (rads)
Rate: 0.9×10^6 rads/hr

Number of dosimeters used: 6

Dosimetry: A.E.R.E. HARWELL RED PERSPEX TO READ ABSORBED DOSE IN MD. CONVERTED TO AIR DOSE BY MASS ENERGY ABSORBTION COEFFICIENTS. SOURCE - N.B.S. HANDBOOK 85

Contamination Check Results (if required): NR

Specimen rotation description: ITEM ROTATED 180° AT HALFWAY POINT

Comments:

SEE ATTACHED SHEETS FOR DATES AND TIMES IN AND OUT

Date and Time In: N/A Out: N/A

Sketch (if required): Please show source size, curies; distances, specimen, and dosimeter placement.

Robert Baldwin hereby certifies that the above information is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Date 5/28/84 Sup'r Signature R. R. Baldwin Title PLANT MGR.

Form No. W908 QA Form Approval AQA

DATE: 5-11-84

LOCATION DETERMINATION WORKSHEET
for
10 CFR 50 App. B Work

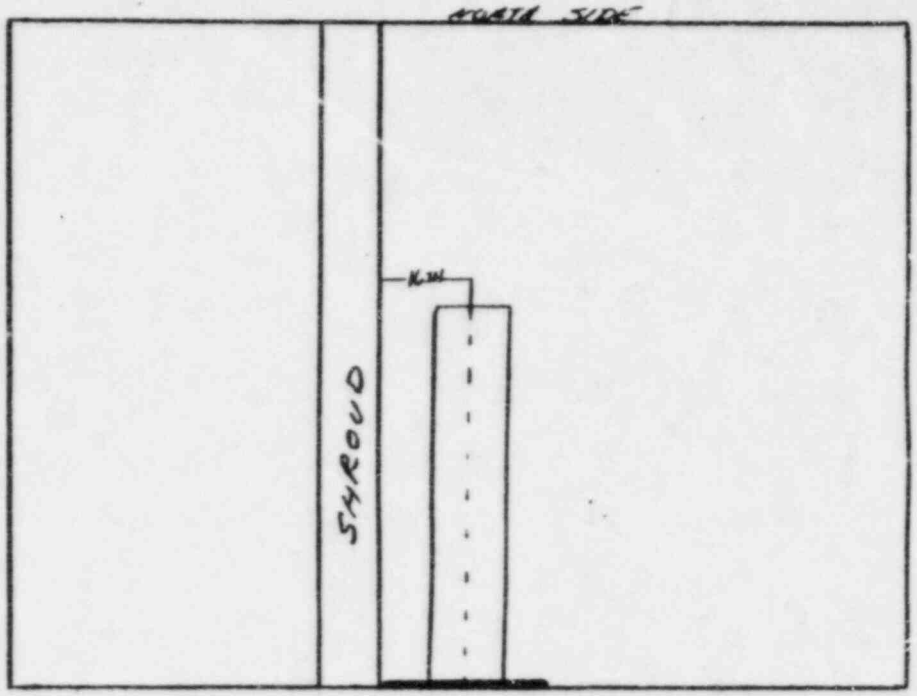
Cust. Name: WYLE Cust. Job No.: 58883 I.N.I. Run No.: WL 012

Max. Dose: 6.82×10^7 Rads Min. Dose: 6.2×10^7 Rads Max. Dose Rate: 1.0×10^6 Rads/hr. Dose Equiv.: 62 Rads(R.

I.D. No.: A Dimensions: H x W x D Weight: Physical Char.: KAYCHEM-ELECTRICAL TAN UNSHIELDED JACKETED CABLE

Comments: THE REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE CABLE BUNDLE

LOC.	RDNG.	ABSORB.	THCK. (cm.)	SPEC. ABSORB.	DOSE IN H_2O x 10^6	DOSE EQUIV. x 10^6
6"	.399	.344	.280	1.22	1.44	1.30
12"	.385	.330	.314	1.05	1.19	1.07
18"	.286	.231	.271	.85	.94	.84
24"	.267	.212	.304	.69	.76	.68
30"	.241	.186	.295	.63	.70	.63
36"	.175	.120	.287	.41	TLTM	TLTM



LOCATION SKETCH--DIMENSIONAL

Dosimetry Run Information: RTM Start: 4716.3 RTM End: 4717.3 Net Time: 1.0 HRS

Dosimeters Placed By: DAA Date: 5-11-84 Dosimeters Read By: JPD Date: 5-11-84

Q.C. Approval (Yes) No RRB Location: 16 inches Date: 5/24/84

Dose Rate Max.: DA Rads/hr. Dose Rate Min.: 0.9×10^6 Rads/hr.

58883

CUSTOMER NAME WYLE LABORATORIES 58883

CUSTOMER JOB NO. 58883 2-6

I.N.I. RUN NO. WL012

DATE 5/11/84

TEST SPECIFICATION: REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE MANDREL

ROTATION REQUIRED: ✓ YES _____ NO

TIME/DOSE INFORMATION: ITEM WAS PLACED IN A FIELD OF 0.9 x 10^6 RADS PER HOUR AIR EQUIVALENT

RUNNING TIME METER (RTM) BOX A

DATE 5/11/84 RTM IN 4717.3 DOSE RATE MIN 0.9x10^6 DOSE MIN 27.x 10^6

DATE 5/13/84 RTM OUT 4748.3 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 31

DATE 5/21/84 RTM IN 4915.9 DOSE RATE MIN 0.9x10^6 DOSE MIN 2.79x10^6

DATE 5/21/84 RTM OUT 4919.0 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 3.1

DATE 5/24/84 RTM IN 4975.7 DOSE RATE MIN 0.9x10^6 DOSE MIN 0.36x10^6

DATE 5/24/84 RTM OUT 4976.1 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS .4

DATE _____ RTM IN _____ DOSE RATE MIN _____ DOSE MIN _____

DATE _____ RTM OUT _____ SIDE _____ DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS _____

DATE 5/24/84 TOTAL HRS 34.5 SIDE 1 DOSE RATE MIN .9x10^6 DOSE MIN 31.05x10^6

DOSE RATE MAX _____ DOSE MAX _____

BY John P. O'Sullivan

APPROVED BY R.R. Ballentine

CUSTOMER NAME WYLE LABORATORIES

58883

CUSTOMER JOB NO. 58883

2-7

I.N.I. RUN NO. W24 017

DATE 5/11/84

TEST SPECIFICATION: REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE MANDREL

ROTATION REQUIRED: ✓ YES _____ NO

TIME/DOSE INFORMATION: ITEM WAS PLACED IN A FIELD OF 0.9×10^6 RADS PER HOUR AIR EQUIVALENT

RUNNING TIME METER (RTM) Box A

DATE 5/13/84 RTM IN 47483 DOSE RATE MIN 0.9×10^6 DOSE MIN 27.9×10^6

DATE 5/14/84 RTM OUT 47793 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 31

DATE 5/21/84 RTM IN 49190 DOSE RATE MIN 0.9×10^6 DOSE MIN 2.79×10^6

DATE 5/21/84 RTM OUT 49221 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 3.1

DATE 5/24/84 RTM IN 49761 DOSE RATE MIN 0.9×10^6 DOSE MIN 0.36×10^6

DATE 5/24/84 RTM OUT 49765 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS .4

DATE _____ RTM IN _____ DOSE RATE MIN _____ DOSE MIN _____

DATE _____ RTM OUT _____ SIDE _____ DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS _____

DATE 5/24/84 TOTAL HRS 34.5 SIDE 2 DOSE RATE MIN $.9 \times 10^6$ DOSE MIN 31.05×10^6

DOSE RATE MAX _____ DOSE MAX _____

BY John P. O'Sullivan

APPROVED BY R.R. Baldwin

INTERNATIONAL NUTRONICS, INC. 58883

CERTIFICATION

CUSTOMER NAME:	WYLE LABORATORIES
CUST. PROD. NO.	58883
I.N.I. RUN NO.	WL-011
DATE RUN:	May 11, 1984
DOSE RECEIVED:	1.1×10^8 rads Air Equivalent
SOURCE TYPE:	Cobalt 60

BY R. R. Baldwin

TITLE PLANT MANAGER

DATE 5/28/84

1962 Barranca Road/Irvine, California 92714 (714) 863-9361

WYLE LABORATORIES

IRRADIATION DATA SHEET

58883

(To be returned to Wyle Laboratories)

2-9

REQUEST (To be completed by Wyle Laboratories)

Date: 5-8-84 Wyle Job No. 58883 Wyle P.O. No. 3-8936

Specimen: Raychem-Elamtrol TM unshielded jacketed Cables Part No. WE&C 9527-01-113-48

Air Equivalent Required Dose: Min. 1.1×10^8 Max. 1.21×10^8 Rate not to exceed 1×10^6 rads/hr

Source Type: Cobalt-60/gamma Specimen rotation required: Yes ☑ No ☐ 1 times

Sketch required: Yes ☐ No ☑

Post irradiation contamination check required: Yes ☐ No ☑

Dosimeter Locations: ☑ Standard (min. and max. expected locations) ☐ Other (sketch attached)

Comments Condition B Shipping Box Marked "B"

The required dose shall be measured at the Geometric centerline of the Mandrel

DATA (To be completed by performing lab) RUN NO. WL011

Facility: INTERNATIONAL MICROWAVES, INC. (IRVINE) Technician: JOHN P. O'SULLIVAN

Total Dose (air): Min. 1.1×10^8 (rads); Max. _____ (rads)
Rate: 0.9×10^6 rads/hr

Number of dosimeters used: 6

Dosimetry: A.E.R.E. HARWELL RED PERSPEX TO READ ABSORBED DOSE IN H$_2$O. CONVERTED TO AIR DOSE BY MASS ENERGY ABSORBTION CO-EFFICIENTS. SOURCE - N.B.S. HAND BOOK 85

Contamination Check Results (if required): NR

Specimen rotation description: ITEM ROTATED 180° AT HALFWAY POINT

Comments:

SEE ATTACHED SHEETS FOR DATES AND TIMES (A) RAID OUT

Date and Time In: N/A Out: N/A

Sketch (if required): Please show source size, curies; distances, specimen, and dosimeter placement.

Robert Baldwin hereby certifies that the above information is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

Date 5/28/84 Sup'r Signature R. R. Baldwin Title PLANT MGR.

Form No. W908 QA Form Approval A04

DATE: 5-11-84

LOCATION DETERMINATION WORKSHEET
for
10 CFR 50 App. B Work

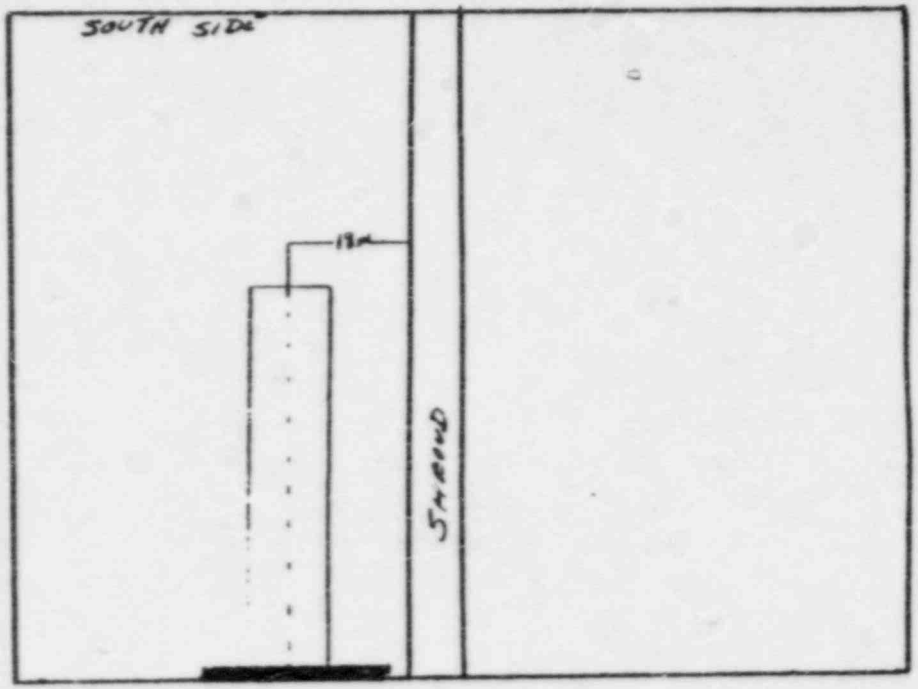
Cust. Name: WYLE Cust. Job No.: 58883 I.N.I. Run No.: 426011

Max. Dose: 6.21×10^8 Rads Min. Dose: 6.1×10^8 Rads Max. Dose Rate: 1.0×10^6 Rads/hr. Dose Equiv.: 110 MR (AIR

I.D. No.: B Dimensions: H x W x D Weight: Physical Char.: RAYCHEM-FLUROTEL TM UNSHIELDED JACKETED CAL

Comments: THE REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE MANDREL

LOC.	RDNG.	ABSORB.	THCK. (cm.)	SPEC. ABSORB.	DOSE IN H_2O x 10^6	DOSE EQUIV. x 10^6
6"	.469	.414	.323	1.28	1.54	1.38
12"	.390	.335	.311	1.07	1.22	1.09
18"	.341	.286	.315	.90	1.00	.90
24"	.275	.220	.301	.73	.80	.72
30"	.224	.169	.281	.60	.67	.60
36"	.207	.152	.304	.50	.57	.51



Dosimetry Run Information: RTM Start: 4716.3 RTM End: 4717.3 Net Time: 1.0 HRS.

Dosimeters Placed By: DAA Date: 5-11-84 Dosimeters Read By: [illegible] Date: 5-11-84

Q.C. Approval (Yes) No [illegible] Location: 18 INCHES Date: 5/29/84

Dose Rate Max.: 29 Rads/hr. Dose Rate Min.: $.9 \times 10^6$ Rads/hr.

CUSTOMER NAME WYLE LABORATORIES

CUSTOMER JOB NO. 58883

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2-11

I.N.I. RUN NO. ~~WYLE~~ WYLE 11

DATE 5/11/84

TEST SPECIFICATION: REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE MANDREL

ROTATION REQUIRED: ✓ YES _____ NO

TIME/DOSE INFORMATION: DOSE: ITEM WAS PLACED IN A FIELD OF 9×10^5 RADS PER HOUR AIR EQUIVALENT

RUNNING TIME METER (RTM) BOX B

DATE 5/11/84 RTM IN 4717.3 DOSE RATE MIN 9×10^5 DOSE MIN 49.5×10^6

DATE 5/14/84 RTM OUT 4772.3 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 55

DATE 5/21/84 RTM IN 4915.9 DOSE RATE MIN 9×10^5 DOSE MIN 4.95×10^6

DATE 5/21/84 RTM OUT 4921.4 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 5.5

DATE 5/24/84 RTM IN 4975.7 DOSE RATE MIN 9×10^5 DOSE MIN 6.3×10^5

DATE 5/24/84 RTM OUT 4976.4 SIDE 1 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS .7

DATE _____ RTM IN _____ DOSE RATE MIN _____ DOSE MIN _____

DATE _____ RTM OUT _____ SIDE _____ DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS _____

DATE 5/24/84 TOTAL HRS 61.2 SIDE 1 DOSE RATE MIN 9×10^5 DOSE MIN 55.08×10^6

DOSE RATE MAX _____ DOSE MAX _____

BY John P. Dinsmore

APPROVED BY R.R. Brown

CUSTOMER NAME WYLE LABORATORIES 58883

CUSTOMER JOB NO. 58883 2-12

I.N.I. RUN NO. ~~58883~~ W1011 #6

DATE 5/11/84

TEST SPECIFICATION: REQUIRED DOSE SHALL BE MEASURED AT THE GEOMETRIC CENTERLINE OF THE MANDREL

ROTATION REQUIRED: ✓ YES _____ NO

TIME/DOSE INFORMATION: ITEM WAS PLACED IN A FIELD OF 9×10^5 RADS PER HOUR AIR EQUIVALENT

RUNNING TIME METER (RTM) BOX B

DATE 5/14/84 RTM IN 4772.3 DOSE RATE MIN 9×10^5 DOSE MIN 6.3×10^6

DATE 5/14/84 RTM OUT 4779.3 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 7

DATE 5/18/84 RTM IN 4858.3 DOSE RATE MIN 9×10^5 DOSE MIN 43.2×10^6

DATE 5/20/84 RTM OUT 4906.3 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 48

DATE 5/21/84 RTM IN 4921.4 DOSE RATE MIN 9×10^5 DOSE MIN 49.5×10^6

DATE 5/21/84 RTM OUT 4926.9 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS 5.5

DATE 5/24/84 RTM IN 4976.4 DOSE RATE MIN 9×10^5 DOSE MIN 6.3×10^5

DATE 5/24/84 RTM OUT 4977.1 SIDE 2 DOSE RATE MAX _____ DOSE MAX _____

TOTAL HRS .7

DATE 5/24/84 TOTAL HRS 61.2 SIDE 2 DOSE RATE MIN 9×10^5 DOSE MIN 55.08×10^6

DOSE RATE MAX _____ DOSE MAX _____

BY John P. Sibilia

APPROVED BY R.R. Brem

SECTION 3

FUNCTIONAL TEST

3.1 EST PROCEDURE

Insulation resistance measurements were made between each conductor and all other conductors in the cable at 500 vdc after one minute or electrification.

These measurements were made before radiation exposure by Raychem. Following radiation, before and after thermal aging, after installation in the pressure vessel*, and at the times shown in test profile, (see Figure 5-4) the measurements were made and recorded by Wyle Laboratories personnel.

* The IR test after installation in the pressure vessel as shown on Page 5-17 included all penetrations and lead wires

3.2 TEST RESULTS

Results of the pre-radiation functional tests are presented in Section 2 of this report; results of post-radiation functionals are included in this report section. Results of subsequent functionals are presented in the appropriate sections of this report.

Test equipment used for the functional test is listed on Page 5-42 of this report.

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

TEST TITLE POST RADIATION FUNCTIONAL Date 5-23-84

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM SEVEN CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer

WIRE ID	VALUE [OHMS]	WIRE ID	VALUE [OHMS]
AS-1	7.0 x 10"	BS-1	3.0 x 10"
AS-2	7.8 x 10"	BS-2	4.0 x 10"
AS-3	6.4 x 10"	BS-3	2.8 x 10"
AS-4	7.8 x 10"	BS-4	3.8 x 10"
AS-5	4.5 x 10"	BS-5	2.1 x 10"
AS-6	5.2 x 10"	BS-6	3.5 x 10"
AS-7	5.3 x 10"	BS-7	2.4 x 10"
AO-1	6.4 x 10"	BO-1	3.0 x 10"
AO-2	7.2 x 10"	BO-2	4.0 x 10"
AO-3	6.4 x 10"	BO-3	3.0 x 10"
AO-4	7.8 x 10"	BO-4	3.8 x 10"
AO-5	5.3 x 10"	BO-5	1.9 x 10"
AO-6	4.5 x 10"	BO-6	2.4 x 10"
AO-7	4.8 x 10"	BO-7	2.4 x 10"

SECTION 4

THERMAL AGING TEST

4.1 TEST PROCEDURE

The test specimens were installed in two temperature test chambers. The specimens on Mandrel "A" were installed in the first chamber, and were subjected to a stabilized temperature of 254F for a period of 100 hours. The specimens on Mandrel "B" were installed in the second chamber, and were subjected to a stabilized temperature of 284F for a period of 100 hours.

The thermal aging test was performed in accordance with Par. 4.2 of Reference 2.2

At the conclusion of the test period, the specimens were removed from the test chambers, were visually examined for evidence of damage or deterioration, and were subjected to the functional tests of Section 2.

4.2 TEST RESULTS

There was no visible evidence of damage to the specimens as a result of the test conditions.

Data as shown on Page 4-5 is incorrect due to the test leads being reversed. Refer to Page 5-16 for the correct data.

For additional information, refer to the test data sheets included in this report section. Test equipment used for the thermal aging and functional tests is recorded on Pages 4-6 and 5-42, respectively.

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

Test Title: THERMAL AGING SIMULATION

Customer CAROLINA POWER
Part No "A" CG12-400
S/N See Rec. Insp
Spec. Wyle T.P. 56167 Rev. A
Para. 4.2.2
Specimen WIRE

Job No. 58503
Date Test Started 5-25-84
Date Test Completed 5-29-84
Amb. Temp. 72°F ± 18°F
Photo NO
Test Med. AIR
Specimen Temp. 284°F

PROCEDURE

The specimen* was installed in a suitable temperature test chamber. The specimen was subjected to the stabilized "accelerated" aging temperature** environment for the periods required** (as shown on Page 4-4).

At the conclusion of the test the specimen was visually examined for evidence of physical damage or deterioration.

TEST RESULTS

Results of the post-test visual inspections are listed on Page 4.4.

* Or specimens
** Values calculated in the aging analysis

Specimen Meets Spec. Requirements YES ☑ NO ☐

Q.C. Form Approval [signature]

Tested By C. C ADAIR
Witness N/A Date: N/A
Sheet No. N/A of N/A
Approved [signature] Date: 7-16-84

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

Test Title: THERMAL AGING SIMULATION

Customer CAROLINA POWER

Part No. CG12-400

S/N See Rec Insp.

Spec. Wyle TP 576-1624 Rev A

Para. 4.2.1

Specimen WIRE

Job. No. 58883

Date Test Started 5-25-84

Date Test Completed 5-29-84

Amb. Temp. 72°F ± 10°F

Photo NO

Test Med. AIR

Specimen Temp. 254°F

PROCEDURE

The specimen* was installed in a suitable temperature test chamber. The specimen was subjected to the stabilized "accelerated" aging temperature** environment for the periods required** (as shown on the following page).

At the conclusion of the test the specimen was visually examined for evidence of physical damage or deterioration.

TEST RESULTS

Results of the post-test visual inspections are listed on Page 4-4.

* Or specimens

** Values calculated in the aging analysis

Specimen Meets Spec. Requirements YES ☑ NO ☐

Q. C. Form Approval

Tested By G. C. ROAIR

Witness N/A Date: N/A

Sheet No. N/A of N/A

Approved G Roair Date: 7-16-84

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4-4

WYLE LABORATORIES

DATA SHEET

CUSTOMER CAROLINA POWER

Test Title: THERMAL AGING SIMULATION

Specimen WIRE

Part No. RAYCHEM "A + B"

Job No. 59953

S/N See Rec Insp

Date 5-25-94

DATE/TIME IN TEMP.	DATE/TIME OUT OF TEMP	ELAPSED TIME	TEMPERATURE DEGREES F	NAME OF TEST ITEM: / POST TEST RESULTS:
1900 5-25-84	1800 5-29-84	100 HOURS	354	"A" RAYCHEK NO VISIBLE DAMAGE
1700 5-25-84	1600 5-29-84	100 HOURS	384	"B" RAYCHEK NO VISIBLE DAMAGE

W 614 B

QC Form Approval

SHEET ____ OF ____

58883

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

DATA SHEET

4-5

TEST TITLE POST THERMAL AGING FUNCTIONAL Date 5-31-84

Customer CAROLINA POWER Job No. 58893

Specimen RAYCHEM SEVEN CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer J Good

WIRE ID	VALUE [OHMS]	WIRE ID	VALUE [OHMS]
AS-1	4.5×10^{10}	BS-1	8.2×10^{8}
AS-2	4.8×10^{10}	BS-2	6.4×10^{8}
AS-3	4.6×10^{10}	BS-3	6.3×10^{8}
AS-4	5.0×10^{10}	BS-4	9.8×10^{8}
AS-5	5.0×10^{10}	BS-5	1.0×10^{9}
AS-6	4.8×10^{10}	BS-6	1.0×10^{9}
AS-7	4.4×10^{10}	BS-7	1.0×10^{9}
AO-1	3.8×10^{10}	BO-1	9.2×10^{8}
AO-2	3.2×10^{10}	BO-2	8.9×10^{8}
AO-3	3.0×10^{10}	BO-3	8.7×10^{8}
AO-4	3.4×10^{10}	BO-4	8.6×10^{8}
AO-5	3.8×10^{10}	BO-5	8.3×10^{8}
AO-6	4.2×10^{10}	BO-6	8.8×10^{8}
AO-7	4.4×10^{10}	BO-7	9.0×10^{8}

NOTE: LEAD WIRE IN WERE CONNECTED REVERSE. 6-4-84 VOR.

W614B-82 QA Form Approval

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

TEST TITLE THERMAL AGING & LOCA

CUSTOMER CAROLINA POWER Job No. 58883 Date 5-23-84

Specimen CAYCHEM 7-CONDUCTOR CABLES Technician ADAIR

Part No. C612-400 Serial No. N/A Engineer J Ladd

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
RECORDER	KAYE	DR-2B	0 TO 300°F 0 TO 50 PSIG	8574	12-29-83	7-1-84	±.005%
AGING CHAMBER	WYLE	N/A	AMB. TO 350°F	3	—	—	—
AGING CHAMBER	WYLE	N/A	AMB. TO 350°F	10	—	—	—
DIGITAL THERMOMETER	FLUKE	2160A	-350 TO 750°F	8290	3-13-84	7-15-84	±2.0°F
DIGITAL THERMOMETER	FLUKE	2160A	-350 TO 750°F	8401	3-13-84	7-15-84	±2.0°F
DIGITAL THERMOMETER	ANALOGIC	2572	-350 TO 750°F	8577	3-13-84	7-15-84	±2.0°F
RECORDER	HEWLETT PACKARD	7132-A	0-100 AS 0-500°F	8672	SYSTEM	CALIBRATIO	N
RECORDER	HEWLETT PACKARD	7132-A	0-500°F	8674	SYSTEM	CALIBRATIO	N
LOCA CHAMBER	WYLE	LOCA	0 TO 75 PSI AMB. TO 475°F	1	—	—	—
FLOW METER	F&P	V2-35	0.26 TO 1.53 GPM	7704A0BSV -A7-12	6-6-84	6-6-85	±2% FS
DMM	KEITHLEY	177	0-20 VDC	9097	12-6-83	12-9-84	±.1%

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4-6

QA Form Approval LH
W614D-82

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.

SECTION 5

LOCA TEST

5.1 TEST PROCEDURE

5.1.1 TEST SETUP

The basic elements of the Wyle LOCA test system are shown in Figure 5-1. Photographs 5-1 through 5-3 are photos of the test specimens being installed into the LOCA chamber.

The relevant systems in the Wyle LOCA test facility are as follows:

- Temperature: Initially generated with a boiler, a superheater (rock bed) and finally with submerged electrical heaters. It is controlled via very low mass thermocouples interfaced to a Wyle-designed electronically controlled three-way valve (mixes superheated and cooler saturated steam) or with standard electrical immersion heater controls.

- Pressure: Initially generated with a boiler. Steam is then valved off and pressure is generated with immersion heaters in the spray solution and compressed air for pressures above the saturation pressure.

- Spray: Initially pre-heated in a separate chamber; the solution is heated in the bottom of the LOCA chamber and circulated to the spray nozzles at the top.

- Data: Data are generated via temperature and pressure transducers and recorded via standard chart or digital recorders.

5.1.2 CABLE INSTALLATION

All the cables were tested simultaneously. They were left on the mandrels after irradiation and were installed in the test chamber as shown in Figures 5-2 and 5-3. Control and data thermocouples were distributed and mounted closely (3 inches) to the coiled samples.

The ends were routed to Raychem-designed penetration assemblies and spliced to the penetrator leads with Raychem WCSFN. All splicing was performed by Raychem personnel. Views of the cables are shown in Photographs 5-2, 5-3 and 5-4. (Note Mandrel B is on top and A is on the bottom, as shown in the photographs.)

5.1.3 ELECTRICAL POWER AND MONITORING

The external penetrator leads were connected to the circuits shown in Figures 5-2 and 5-3.

All the power current circuits were isolated. Each conductor voltage was separately fused such that insulation failures would not directly interact. The required power currents were individually trimmed to +/-10% by adjustment of the lead length (load resistance). Inductive interactions prevented closer adjustment of these values.

All voltage and power current values were measured via accurate DMM's and precision shunts and were monitored daily.

5.1.4 LOCA TESTING

Steam, superheated steam, demineralized water spray, and air pressure were utilized to envelop the required LOCA test profile shown in Figure 2 of Reference 2.2. Figure 5-4 is the actual test profile, including all down times as shown in test summary on Page 5-33.

5.1.4 (continued)

After the specimens were mounted in the chamber and the chamber was sealed, a controlled steam/superheated steam blowdown of the LOCA chamber was performed for six hours and 45 minutes. The test was interrupted at three hours and 15 minutes due to the loss of superheated steam. During the down time (approximately nine hours) the LOCA chamber was maintained at 200F and ambient pressure via the immersion heaters. The superheater was recharged and testing continued.

The steam was then terminated and the pre-heated (pressurized) de-mineralized water spray was initiated. Temperature control via the LOCA chamber immersion heaters was initiated as rapidly as possible. This was possible, since in operation the spray is circulated from the bottom of the LOCA chamber to the top nozzles, leaving the external spray reservoir empty. During the transition from superheated steam to de-mineralized water spray (320F to 250F) the test specimens were subjected to an additional 45 minutes at the elevated temperature.

The spray was continuously circulated for a 24-hour period at a rate of 1.44 gpm. This is equal to 0.15 gallons per minute per square foot of horizontal cross-sectional area of the LOCA chamber. An air partial pressure was added to the saturated water vapor pressure to maintain the total pressure at the specified level.

The spray was then terminated and the temperature was maintained for the duration of the test via the immersion heaters. Air was added to the chamber to maintain the pressure at the specified level. The relative humidity was maintained at 100% after the spray was terminated. Reference "Technical Opinion", Page 5-6.

At the conclusion of the test, the specimens were subjected to the functional tests described in Section 2, and were visually examined for evidence of damage or deterioration. Photograph 5-5 shows the specimens following LOCA test.

5.2 TEST RESULTS

No anomalies were noted during the test. There was no visible evidence of damage or deterioration of the specimens as a result of the test conditions. The test specimens were subjected to the elevated temperature and humidity for a longer duration than required due to the down times.

The test specimens maintained rated voltage and current throughout the test program.

After approximately 13 hours lapsed time, one of the fail-safe thermocouples opened up, shutting off the immersion heaters in the chamber. The test temperature dropped out of specification from 250F down to 230F for one hour and 15 minutes. The test time at 250F was extended to make up this lost time.

When the spray was terminated and the temperature was maintained via the immersion heaters, the relative humidity was maintained at 100% by keeping the water temperature higher than the air temperature in the chamber. Wyle Laboratories was unable to record the humidity inside the chamber, so the technical opinion presented on Page 5-6 is included to assure Carolina Power & Light that the 100% humidity requirement was maintained.

For additional information, refer to the test data sheets included in this report section. Test equipment used in the performance of the LOCA test are listed on Pages 4-6 and 5-42.

Page 5-34 is a typical temperature and pressure recording during the first ramp.

5.2 (continued)

Pages 5-35 through 5-41 are typical daily recordings of temperature and pressure.

The original data (temperature and pressure recordings) will be maintained by Wyle Laboratories unless otherwise instructed by Carolina Power, and will be available for inspection by authorized personnel.

TECHNICAL OPINION

A closed adiabatic system containing dry air and liquid water will eventually reach an equilibrium state where the water and air temperature is the same, and the total presure is equal to the sum of the partial pressures of the air and water vapor at this temperature. The partial pressure of the water vapor will be the saturation pressure of the water at this equilibrium temperature.

By definition, the relative humidity of an air-water mixture is the ratio of the partial pressure of the water vapor to the saturation pressure of water at the mixture temperature, which in this equilibrium condition is one or 100%.

In this ideal state you can argue that the time required to reach total equilibrium will approach infinity since the rate of heat transfer is a function of the temperature differential within the system. In the test case in question, however, the system is not adiabatic and the effect will move the system to equilibrium rather quickly.

By putting energy into the system, via the water in the bottom of the chamber, to maintain the desired vapor temperature, a temperature differential is maintained between the water and vapor. In our case the differential runs from four to 11 degrees (208°-204° to 215°-204°). This differential temperature does two things. First, it ensures a continuous free convection circulation of the air-vapor mixture within the system which continuously passes over the heated water, and secondly, keeps the vapor pressure at the water surface higher than the partial pressure of the water vapor in the air.

For the above reasons, I see no way the air-vapor mixture in the chamber can be anything but saturated, or at a relative humidity of one.

Prepared by:

Robert Wheelock
Technical Staff Engineer
Fluid Systems Specialist

Robert L. Wheelock

FIGURE 5-1

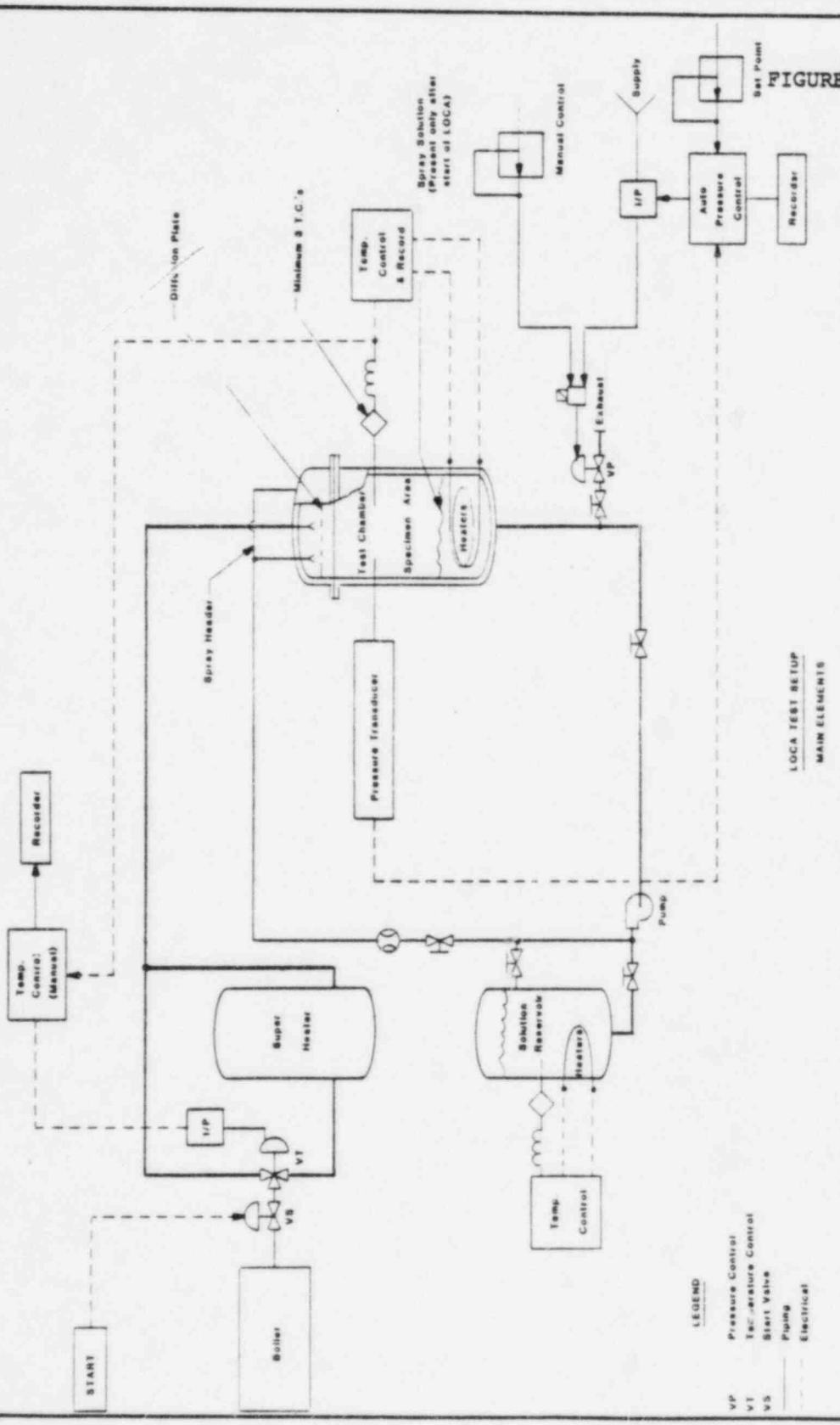
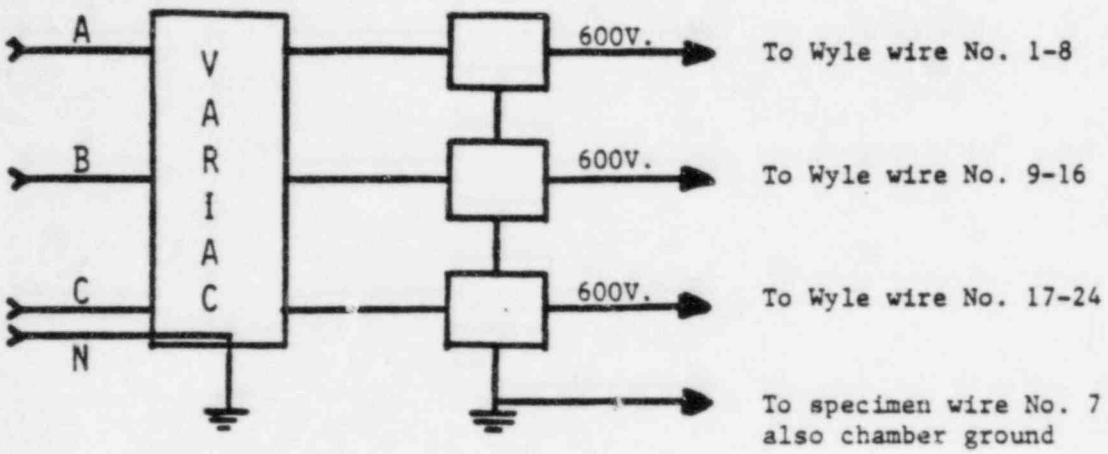
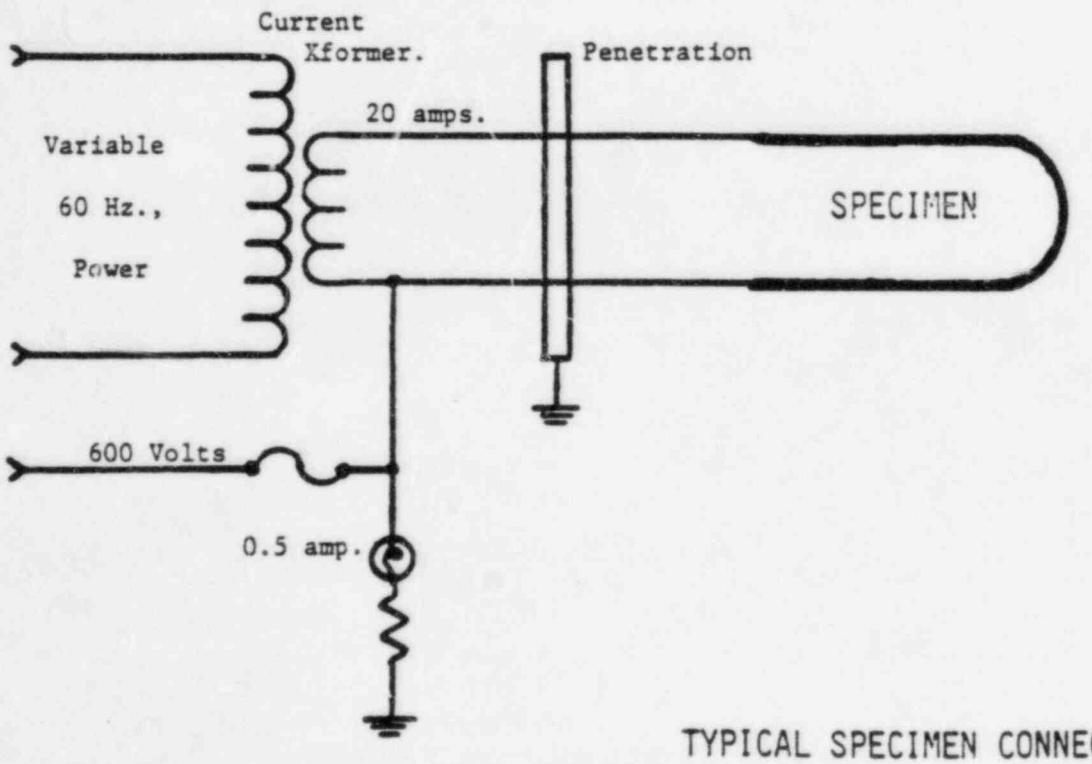

Set Point
Supply
Manual Control
Spray Solution (Present only after start of LOCA)
Temp. Control & Record
Minimum 3 T.C.'s
Diffusion Plate
I/P
Auto Pressure Control
Recorder
Exhaust
VP
Test Chamber
Specimen Area
Heaters
Spray Header
Pressure Transducer
Pump
Recorder
Temp. Control (Manual)
Super Heater
Solution Reservoir
Heaters
I/P
VT
VS
Temp. Control
START
Boiler
LOCA TEST SETUP
MAIN ELEMENTS
LEGEND
VP Pressure Control
VT Temperature Control
VS Start Valve
Piping
Electrical

FIGURE 5-2
TYPICAL CONNECTIONS



HIGH VOLTAGE CIRCUIT BLOCK DIAGRAM

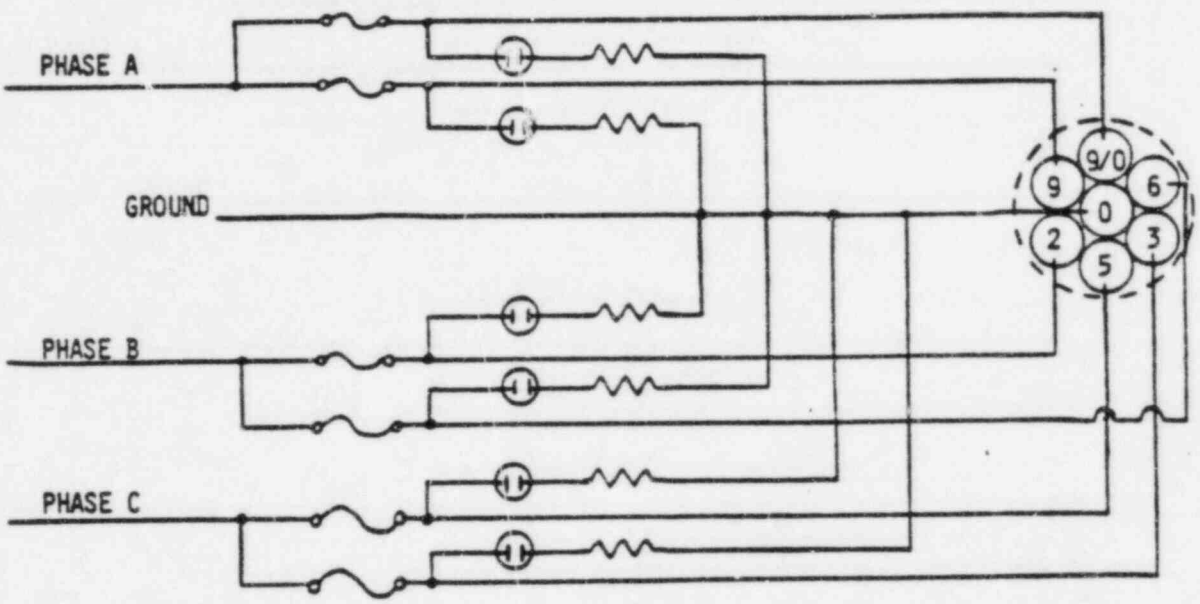


TYPICAL SPECIMEN CONNECTIONS

FIGURE 5-3

SPECIMEN HOOK-UPS

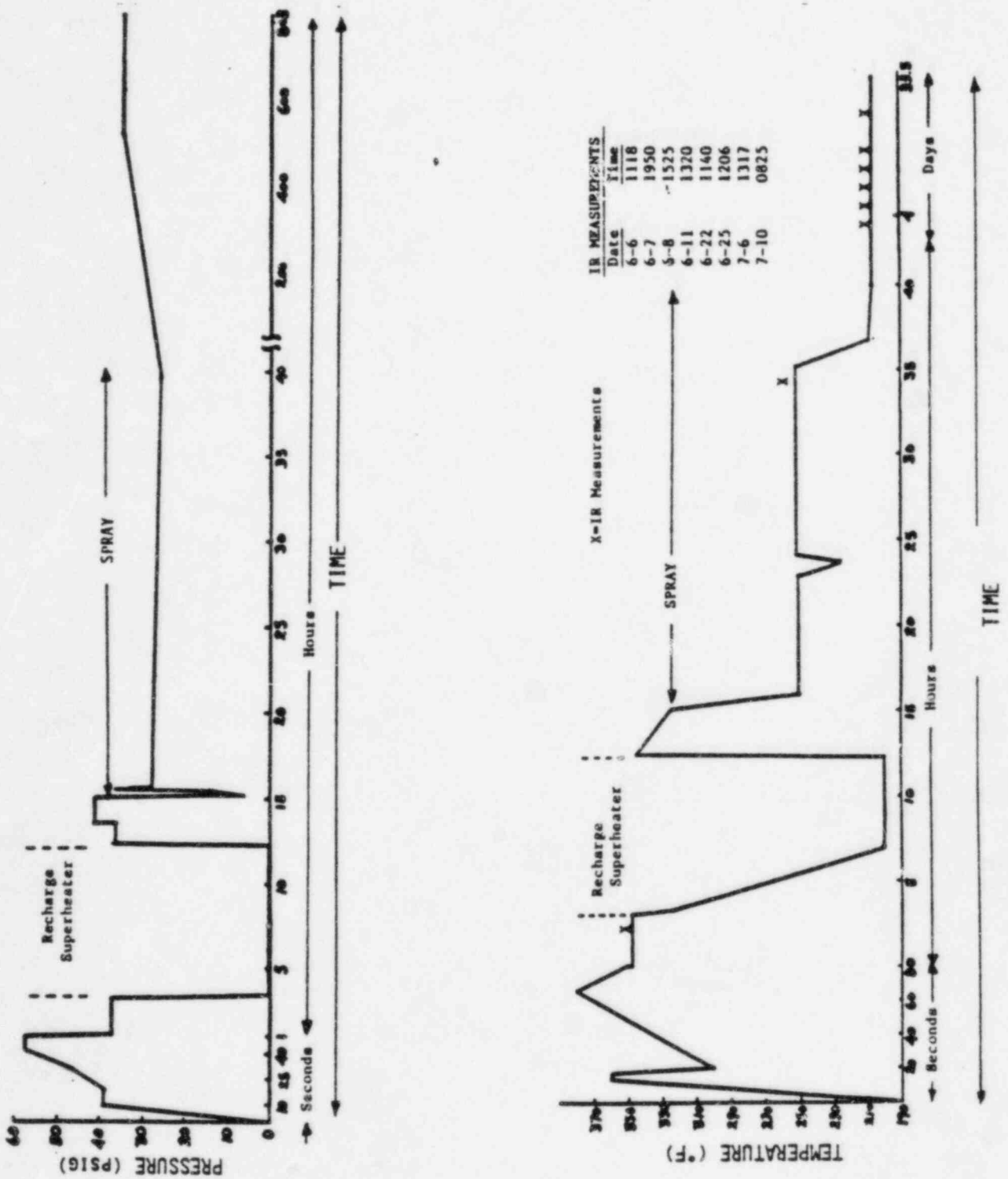
Circuit Energization
Typical One Sample

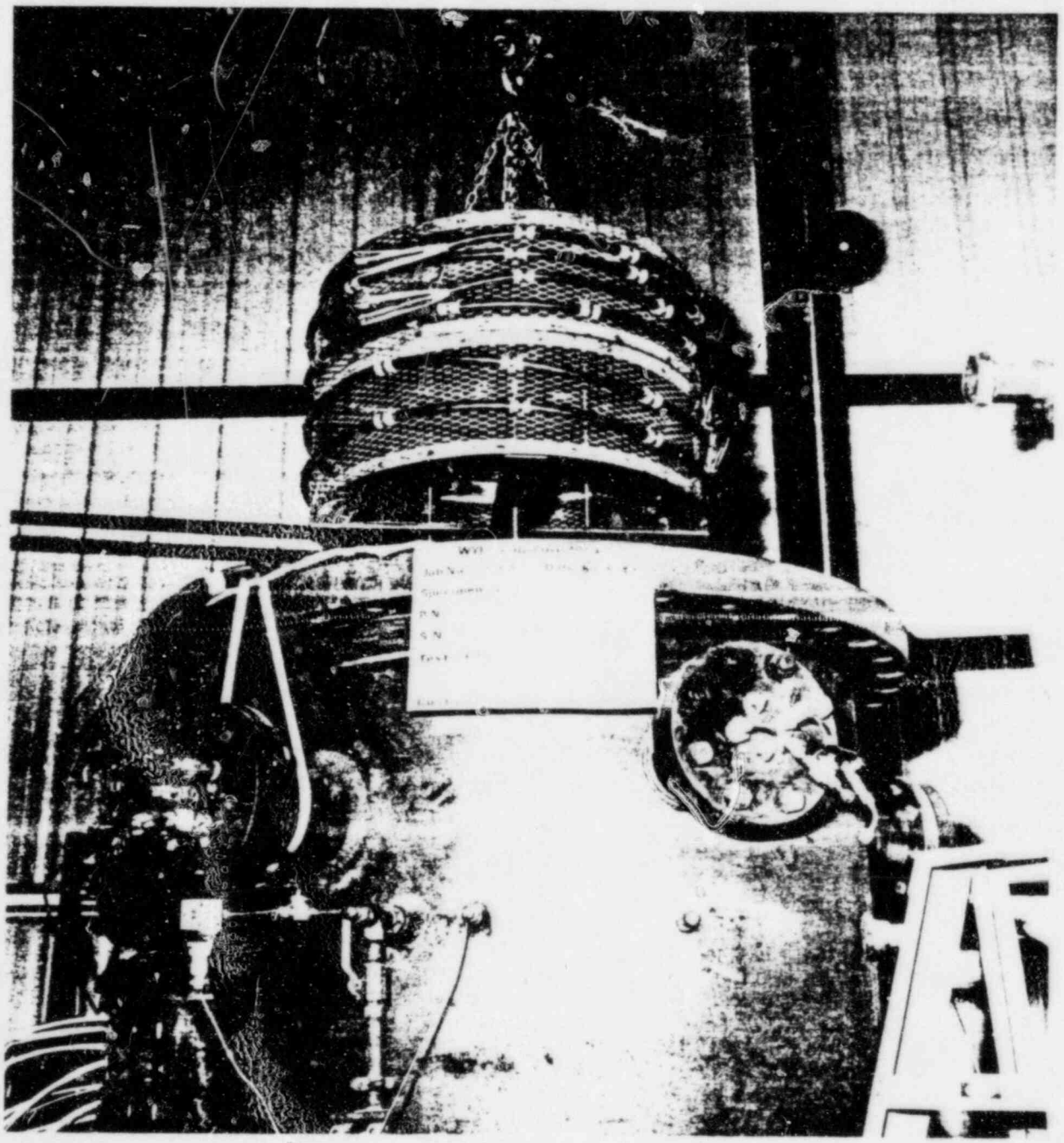


0 = black
2 = red
3 = orange
5 = green
6 = blue
9 = white
9/0 = white/black

Total of 24 fuses
and monitoring circuits

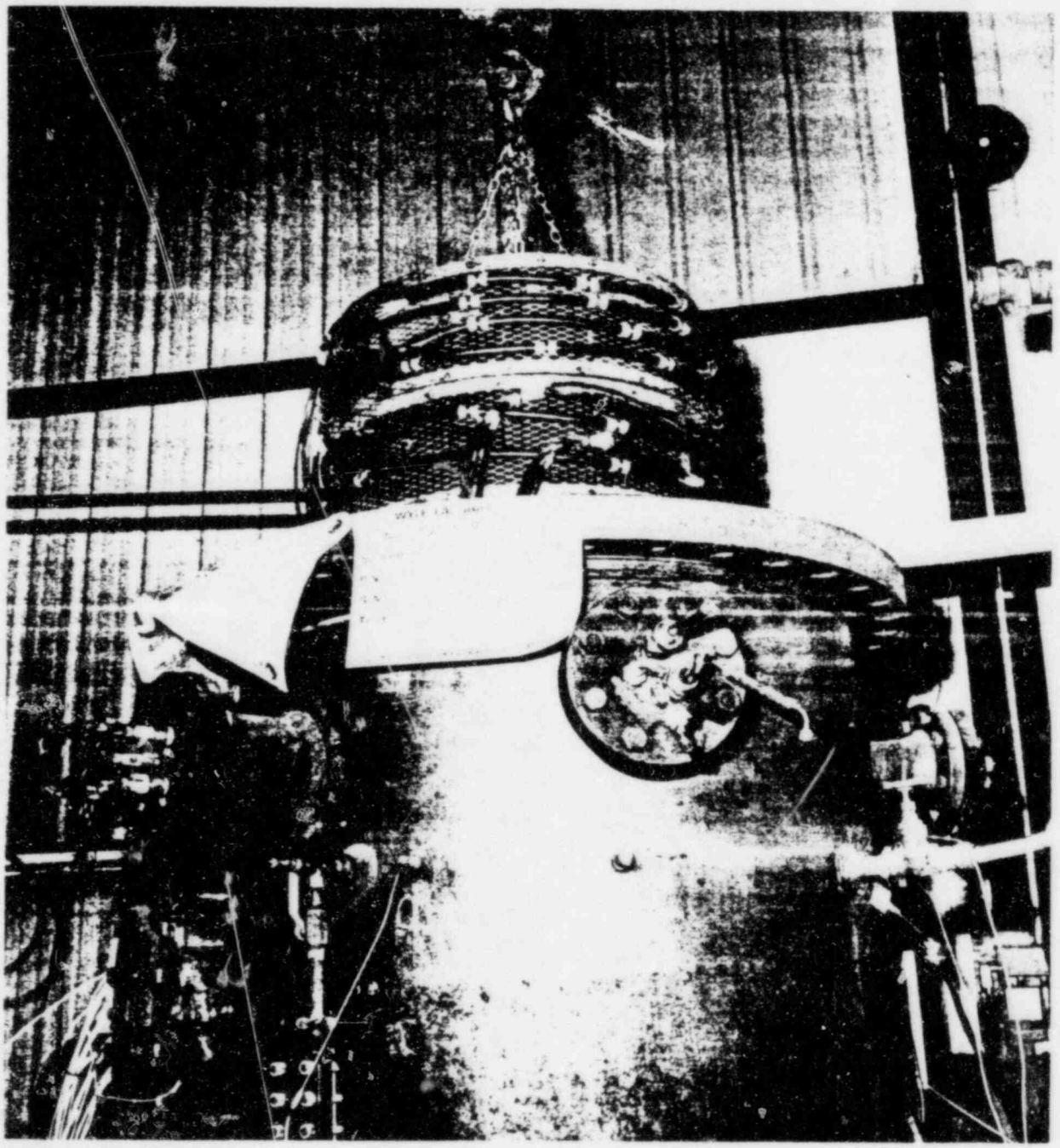
FIGURE 5-4
ACTUAL TEST PROFILE





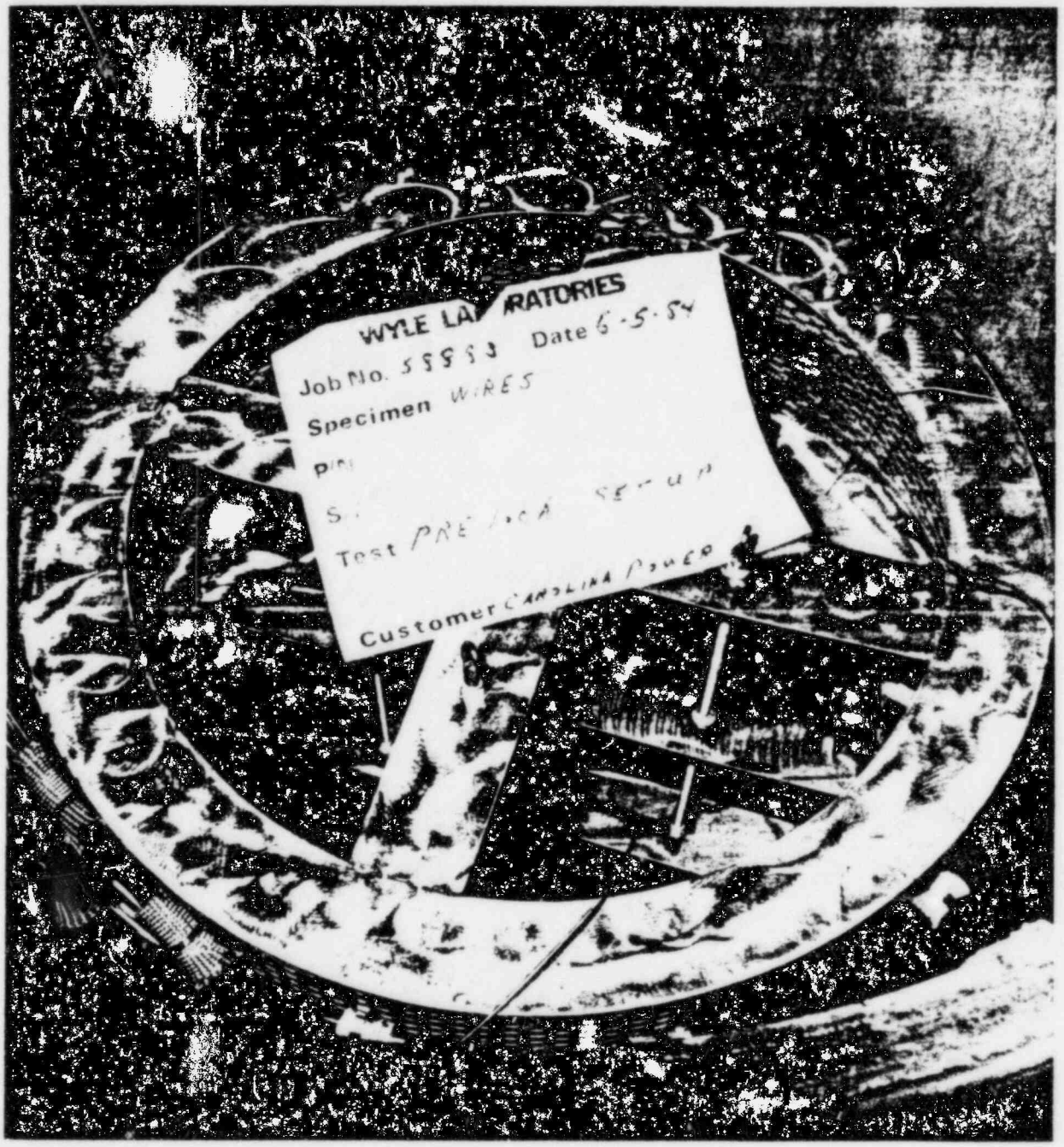
PHOTOGRAPH 5-1

PRE-LOCA TEST



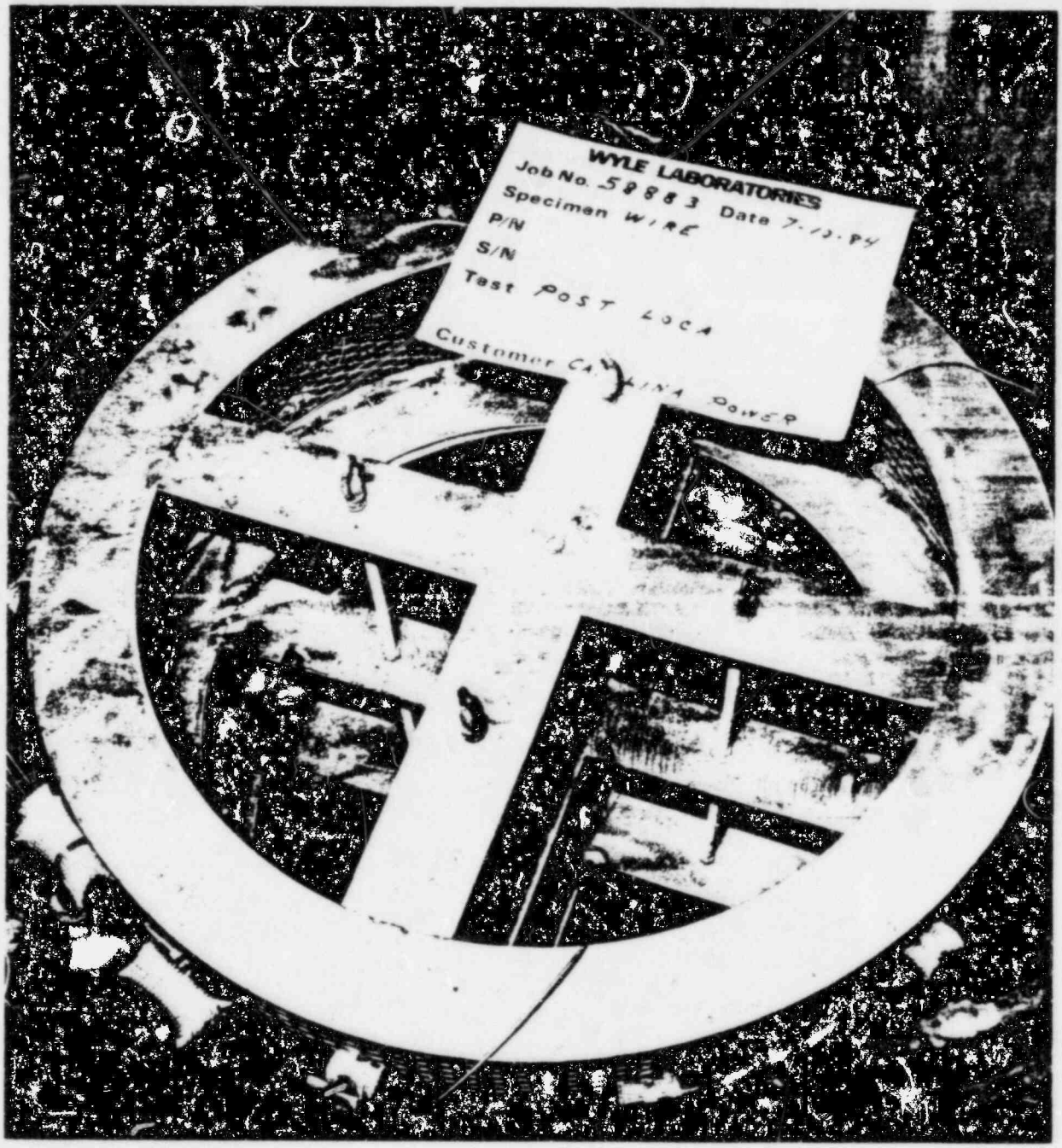
PHOTOGRAPH 5-2

PRE-LOCA TEST



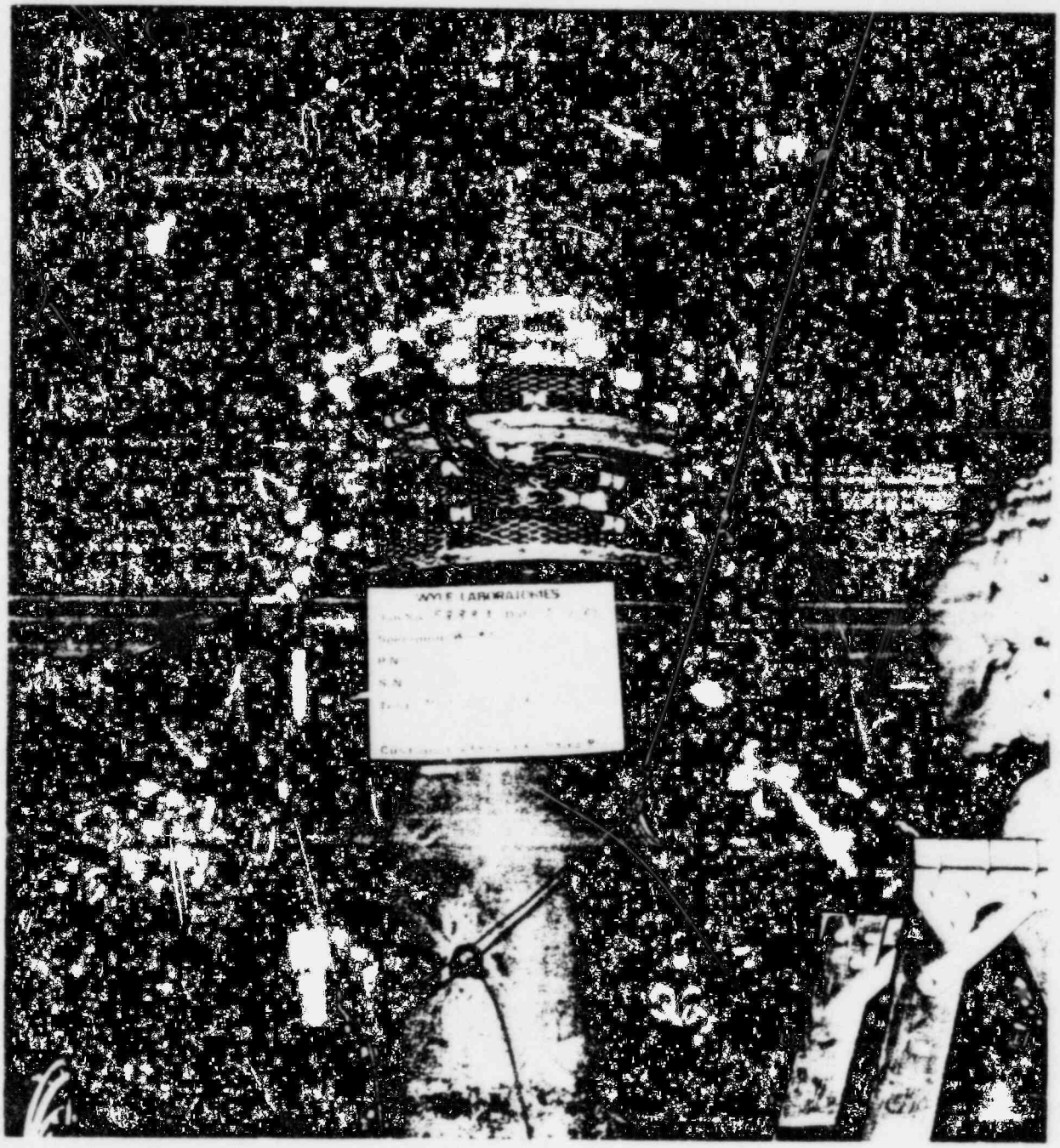
PHOTOGRAPH 5-3

PRE-LOCA TEST



PHOTOGRAPH 5-4

POST-LOCA TEST



PHOTOGRAPH 5-5

POST-LOCA TEST

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

TEST TITLE PRE-LOCA FUNCTIONAL Date 6-4-84

Customer CAROLINA POWER Job No. 58893

Specimen RAYCHEM SEVEN CONDUCTOR CABLES Technician VALFRE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WIRE ID	VALUE [OHMS]	WIRE ID	VALUE [OHMS]
AS-1	3.5×10^{13}	BS-1	2.6×10^{13}
AS-2	2.5×10^{13}	BS-2	3.0×10^{13}
AS-3	2.8×10^{13}	BS-3	2.9×10^{13}
AS-4	1.4×10^{13}	BS-4	2.7×10^{13}
AS-5	1.6×10^{13}	BS-5	3.0×10^{13}
AS-6	2.4×10^{13}	BS-6	~~9.0×10^{11}~~ 2.6×10^{13}
AS-7	2.8×10^{13}	BS-7	4.5×10^{13}
AO-1	2.0×10^{13}	BO-1	1.7×10^{13}
AO-2	1.0×10^{13}	BO-2	3.5×10^{13}
AO-3	1.4×10^{13}	BO-3	8.4×10^{12}
AO-4	2.6×10^{13}	BO-4	2.6×10^{13}
AO-5	1.8×10^{12}	BO-5	2.4×10^{13}
AO-6	1.5×10^{12}	BO-6	2.2×10^{13}
AO-7	7.0×10^{11}	BO-7	4.0×10^{13}

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

DATA SHEET

58883

5-17

TEST TITLE IR FUNCTIONAL - PRE LOCA Date 6-5-84

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7 CONDUCTOR CABLES Technician VALFRE

Part No. CG12-400 Serial No. N/A Engineer L Hood

SPECIMEN	CONFIGURATION [WIRE NUMBERS]	CONVERSION TO WYLE TERMINAL NO.	MEASUREMENTS [OHMS]
A0	"A" = 2,4,6,7 H.V. 1,3,5 GRD	9,18,2,A07 H.V. 1,17,10 GRD	2.4×10^{10}
	"B" = 2,4,6,7 GRD 1,3,5 H.V	9,18,2,A07 GRD 1,17,10 H.V.	3.0×10^{10}
AS	'A' = 2,4,6,7 H.V. 1,3,5 GRD	11,20,4,AS7 H.V. 3,19,12 GRD	2.8×10^{10}
	'B' = 2,4,6,7 GRD 1,3,5 H.V.	11,20,4,AS7 GRD 3,19,12 H.V.	3.0×10^{10}
B0	'A' = 2,4,6,7 H.V 1,3,5 GRD	13,22,6,B07 H.V. 5,21,14 GRD	1.2×10^{10}
	'B' = 2,4,6,7 GRD 1,3,5 H.V	13,22,6,B07 GRD 5,21,14 H.V.	3.5×10^{10}
BS	'A' = 2,4,6,7 H.V. 1,3,5 GRD	15,24,8,BS7 H.V. 7,23,16 GRD	4.0×10^{10}
	'B' = 2,4,6,7 GRD 1,3,5 H.V.	15,24,8,BS7 GRD 7,23,16 H.V	4.0×10^{10}

W614B-82 QA Form Approval LH

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-18

TEST TITLE LOCA IR TEST (PEAK) Date 6-6-84 1118HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer S Goad

WIRE ID	WYLE TERMINL	VALUE [OHMS]	WIRE ID	WYLE TERMINL	VALUE [OHMS]
AS-1	3	3.5×10^{8}	BS-1	7	5.0×10^{8}
AS-2	11	3.5×10^{8}	BS-2	15	4.5×10^{8}
AS-3	19	3.0×10^{8}	BS-3	23	4.0×10^{8}
AS-4	20	3.0×10^{8}	BS-4	24	4.5×10^{8}
AS-5	12	3.0×10^{8}	BS-5	16	4.0×10^{8}
AS-6	4	3.0×10^{8}	BS-6	8	5.0×10^{8}
AS-7	GRD	4.0×10^{8}	BS-7	GRD	5.0×10^{8}
AO-1	1	5.4×10^{8}	BO-1	5	7.6×10^{8}
AO-2	9	5.0×10^{8}	BO-2	13	6.4×10^{8}
AO-3	17	5.0×10^{8}	BO-3	21	5.8×10^{8}
AO-4	18	5.0×10^{8}	BO-4	22	6.8×10^{8}
AO-5	10	5.0×10^{8}	BO-5	14	6.6×10^{8}
AO-6	2	5.0×10^{8}	BO-6	6	8.2×10^{8}
AO-7	GRD	5.0×10^{8}	BO-7	GRD	7.8×10^{8}

W614B-82 QA Form Approval SG

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-19

TEST TITLE CURRENT CHECKS (250° 35PSI PLATEAU) Date 6-6-84 7 SS 0210 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VENTURE

Part No. CG12-400 Serial No. N/A Engineer L. Hood

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	20.9	13	BO-2	22.0
2	AO-6	23.1	14	BO-5	21.7
3	AS-1	23.0	15	BS-2	22.5
4	AS-6	20.6	16	BS-5	21.6
5	BO-1	22.2	17	AO-3	20.5
6	BO-6	22.0	18	AO-4	21.1
7	BS-1	22.0	19	AS-3	22.0
8	BS-6	21.5	20	AS-4	21.3
9	AO-2	20.7	21	BO-3	21.8
10	AO-5	20.9	22	BO-4	22.2
11	AS-2	21.3	23	BS-3	21.3
12	AS-5	20.4	24	BS-4	23.2

W614B-82 QA Form Approval LH

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

DATA SHEET

58883

5-20

TEST TITLE LOCA IR TEST (END 250° PLATEAU) Date 6-7-84 1950 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALACE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WIRE ID	WYLE TERMINAL	VALUE [OHMS]	WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	6.4×10^{8}	BS-1	7	9.6×10^{8}
AS-2	11	8.2×10^{8}	BS-2	15	5.7×10^{8}
AS-3	19	5.3×10^{8}	BS-3	23	5.6×10^{8}
AS-4	20	8.8×10^{8}	BS-4	24	8.8×10^{8}
AS-5	12	7.0×10^{8}	BS-5	16	5.5×10^{8}
AS-6	4	8.4×10^{8}	BS-6	8	1.0×10^{9}
AS-7	GRD	7.6×10^{8}	BS-7	GRD	8.6×10^{8}
AO-1	1	1.6×10^{9}	BO-1	5	1.4×10^{9}
AO-2	9	1.4×10^{9}	BO-2	13	1.2×10^{9}
AO-3	17	8.0×10^{8}	BO-3	21	5.0×10^{8}
AO-4	18	1.3×10^{9}	BO-4	22	1.4×10^{9}
AO-5	10	1.1×10^{9}	BO-5	14	5.0×10^{8}
AO-6	2	1.6×10^{9}	BO-6	6	1.6×10^{9}
AO-7	GRD	1.2×10^{9}	BO-7	GRD	1.2×10^{9}

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WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-21

TEST TITLE CURRENT CHECKS (END 250° PLATEAU) Date 6-7-84 1950 HD

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	21.1	13	BO-2	20.1
2	AO-6	20.1	14	BO-5	20.6
3	AS-1	20.8	15	BS-2	20.4
4	AS-6	21.0	16	BS-5	20.2
5	BO-1	20.3	17	AO-3	21.1
6	BO-6	22.1	18	AO-4	20.2
7	BS-1	~~BS-2~~ 21.1	19	AS-3	21.4
8	BS-6	21.2	20	AS-4	21.9
9	AO-2	20.2	21	BO-3	20.3
10	AO-5	21.1	22	BO-4	20.0
11	AS-2	21.4	23	BS-3	21.2
12	AS-5	20.8	24	BS-4	22.0

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WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-22

TEST TITLE LOCA IR TEST (200°F 25 PSIG Date 6-8-84 1525 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALFRE

Part No. CGL2-400 Serial No. N/A Engineer [illegible]

WIRE ID	WYLE TERMINL	VALUE [OHMS]	WIRE ID	WYLE TERMINL	VALUE [OHMS]
AS-1	3	1.7×10^{9}	BS-1	7	4.5×10^{9}
AS-2	11	4.0×10^{9}	BS-2	15	~~3.0×10^{9}~~ VR 2.8×10^{9}
AS-3	19	2.0×10^{9}	BS-3	23	3.5×10^{9}
AS-4	20	3.5×10^{9}	BS-4	24	5.1×10^{9}
AS-5	12	2.6×10^{9}	BS-5	16	3.5×10^{9}
AS-6	4	3.0×10^{9}	BS-6	8	4.5×10^{9}
AS-7	GRD	3.0×10^{9}	BS-7	GRD	4.5×10^{9}
AO-1	1	1.7×10^{10}	BO-1	5	8.0×10^{9}
AO-2	9	1.1×10^{10}	BO-2	13	6.8×10^{9}
AO-3	17	7.2×10^{9}	BO-3	21	4.0×10^{9}
AO-4	18	1.1×10^{9}	BO-4	22	7.2×10^{9}
AO-5	10	7.4×10^{9}	BO-5	14	4.5×10^{9}
AO-6	2	1.2×10^{10}	BO-6	6	9.0×10^{9}
AO-7	GRD	1.2×10^{10}	BO-7	GRD	8.2×10^{9}

W6148-82 QA Form Approval [illegible]

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-23

TEST TITLE CURRENT CHECKS (200°F 25 PSIG) Date 6-8-84 1525 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	20.2	13	BO-2	20.2
2	AO-6	21.7	14	BO-5	20.2
3	AS-1	20.4	15	BS-2	21.0
4	AS-6	21.1	16	BS-5	20.7
5	BO-1	20.1	17	AO-3	21.7
6	BO-6	20.3	18	AO-4	20.7
7	BS-1	20.9	19	AS-3	20.5
8	BS-6	21.3	20	AS-4	20.2
9	AO-2	20.2	21	BO-3	20.2
10	AO-5	21.7	22	BO-4	20.1
11	AS-2	20.1	23	BS-3	21.2
12	AS-5	20.8	24	BS-4	21.5

W614B-82 QA Form Approval [signature]

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-24

TEST TITLE LOCA IR TEST (200° ÷ 27 PSIG) Date 6-11-84 1320 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer J Goad

WIRE ID	WYLE TERMINAL	VALUE [OHMS]	WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	3.0×10^{9}	BS-1	7	5.0×10^{9}
AS-2	11	5.6×10^{9}	BS-2	15	4.0×10^{9}
AS-3	19	3.0×10^{9}	BS-3	23	5.0×10^{9}
AS-4	20	5.0×10^{9}	BS-4	24	6.4×10^{10}
AS-5	12	3.5×10^{9}	BS-5	16	4.5×10^{9}
AS-6	4	4.5×10^{9}	BS-6	8	5.0×10^{9}
AS-7	GRD	4.5×10^{9}	BS-7	GRD	5.8×10^{10}
AO-1	1	1.8×10^{10}	BO-1	5	7.6×10^{9}
AO-2	9	1.3×10^{10}	BO-2	13	5.8×10^{9}
AO-3	17	1.0×10^{10}	BO-3	21	4.0×10^{9}
AO-4	18	1.4×10^{10}	BO-4	22	6.6×10^{9}
AO-5	10	7.9×10^{9}	BO-5	14	5.0×10^{9}
AO-6	2	1.1×10^{10}	BO-6	6	9.0×10^{9}
AO-7	GRD	1.5×10^{10}	BO-7	GRD	6.3×10^{9}

W614B-82 QA Form Approval LH

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-25

TEST TITLE CURRENT CHECKS (200°F 27 PSIG Date 6-11-84 1320 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALFRE

Part No. CG12-400 Serial No. N/A Engineer

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	20.7	13	BO-2	20.1
2	AO-6	21.2	14	BO-5	20.3
3	AS-1	21.0	15	BS-2	20.8
4	AS-6	20.7	16	BS-5	20.7
5	BO-1	20.0	17	AO-3	21.2
6	BO-6	20.4	18	AO-4	21.2
7	BS-1	21.2	19	AS-3	21.0
8	BS-6	21.4	20	AS-4	21.9
9	AO-2	20.0	21	BO-3	20.2
10	AO-5	20.8	22	BO-4	20.0
11	AS-2	21.6	23	BS-3	21.4
12	AS-5	20.9	24	BS-4	21.6

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WYLE SCIENTIFIC SERVICES & SYSTEMS GROUP
LABORATORIES

DATA SHEET

58883

5-26

TEST TITLE LOCA IR TEST (200°F 31 PSIG) Date 5-22-84 1140 Hrs

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician WAFRE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WIRE ID	WYLE TERMINAL	VALUE [OHMS]	WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	2.6×10^{9}	BS-1	7	5.1×10^{9}
AS-2	11	5.6×10^{9}	BS-2	15	5.0×10^{9}
AS-3	19	3.5×10^{9}	BS-3	23	5.2×10^{9}
AS-4	20	5.6×10^{9}	BS-4	24	7.4×10^{9}
AS-5	12	3.5×10^{9}	BS-5	16	5.0×10^{9}
AS-6	4	5.0×10^{9}	BS-6	8	5.1×10^{9}
AS-7	GRD	4.5×10^{9}	BS-7	GRD	5.2×10^{9}
AO-1	1	2.6×10^{10}	BO-1	5	9.0×10^{9}
AO-2	9	1.7×10^{10}	BO-2	13	7.0×10^{9}
AO-3	17	1.5×10^{10}	BO-3	21	5.0×10^{9}
AO-4	18	2.0×10^{10}	BO-4	22	9.6×10^{9}
AO-5	10	1.0×10^{10}	BO-5	14	5.0×10^{9}
AO-6	2	2.2×10^{10}	BO-6	6	1.1×10^{10}
AO-7	GRD	1.8×10^{10}	BO-7	GRD	7.4×10^{9}

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WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-27

TEST TITLE CURRENT CHECKS (200°F 31 PXC) Date 6-22-84 1255 HS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALFRE

Part No. CG12-400 Serial No. N/A Engineer P. Grad

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	21.1	13	BO-2	21.0
2	AO-6	22.3	14	BO-5	21.4
3	AS-1	21.0	15	BS-2	21.2
4	AS-6	20.6	16	BS-5	20.9
5	BO-1	22.0	17	AO-3	22.0
6	BO-6	21.5	18	AO-4	21.1
7	BS-1	20.6	19	AS-3	21.2
8	BS-6	20.9	20	AS-4	22.6
9	AO-2	20.8	21	BO-3	22.2
10	AO-5	21.8	22	BO-4	21.3
11	AS-2	22.4	23	BS-3	21.2
12	AS-5	21.1	24	BS-4	21.2

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WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-28

TEST TITLE LOCA IR TEST (200°F 34 PSIG) Date 6-25-84 1206 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALFRE

Part No. CGL2-400 Serial No. N/A Engineer [illegible]

WIRE ID	WYLE TERMINAL	VALUE [OHMS]	WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	2.0×10^{9}	BS-1	7	5.0×10^{9}
AS-2	11	5.0×10^{9}	BS-2	15	5.0×10^{9}
AS-3	19	2.8×10^{9}	BS-3	23	5.0×10^{9}
AS-4	20	5.0×10^{9}	BS-4	24	6.6×10^{9}
AS-5	12	2.4×10^{9}	BS-5	16	4.5×10^{9}
AS-6	4	3.5×10^{9}	BS-6	8	5.0×10^{9}
AS-7	GRD	3.5×10^{9}	BS-7	GRD	5.0×10^{9}
AO-1	1	2.8×10^{10}	BO-1	5	9.0×10^{9}
AO-2	9	1.8×10^{10}	BO-2	13	7.2×10^{9}
AO-3	17	1.7×10^{10}	BO-3	21	5.0×10^{9}
AO-4	18	2.2×10^{10}	BO-4	22	7.6×10^{9}
AO-5	10	1.1×10^{10}	BO-5	14	5.0×10^{9}
AO-6	2	2.8×10^{10}	BO-6	6	1.1×10^{10}
AO-7	GRD	1.8×10^{10}	BO-7	GRD	7.2×10^{9}

W614B-82 QA Form Approval [illegible]

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

58883

5-29

DATA SHEET

TEST TITLE CURRENT CHECKS (200°F 74 PSIG) Date 6-25-84 1315Hrs

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	A0-1	20.6	13	B0-2	20.2
2	A0-6	20.7	14	B0-5	20.3
3	AS-1	20.6	15	BS-2	20.9
4	AS-6	20.7	16	BS-5	20.3
5	B0-1	20.1	17	A0-3	20.7
6	B0-6	20.3	18	A0-4	20.6
7	BS-1	20.3	19	AS-3	21.0
8	BS-6	20.2	20	AS-4	21.1
9	A0-2	20.3	21	B0-3	21.4
10	A0-5	20.1	22	B0-4	20.2
11	AS-2	21.1	23	BS-3	20.5
12	AS-5	21.0	24	BS-4	20.4

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WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

DATA SHEET

58883

5-30

TEST TITLE LOCA IR TEST (200°F 34 HRS) Date 7-6-84 1317 HRS

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician LEFFLER

Part No. CG12-400 Serial No. N/A Engineer

WIRE ID	WYLE TERMINAL	VALUE [OHMS]	WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	1.6×10^{9}	BS-1	7	3.5×10^{9}
AS-2	11	4.0×10^{9}	BS-2	15	3.5×10^{9}
AS-3	19	2.4×10^{9}	BS-3	23	3.5×10^{9}
AS-4	20	4.0×10^{9}	BS-4	24	5.0×10^{9}
AS-5	12	1.7×10^{9}	BS-5	16	3.0×10^{9}
AS-6	4	2.6×10^{9}	BS-6	8	3.5×10^{9}
AS-7	GRD	3.6×10^{9}	BS-7	GRD	3.0×10^{9}
AO-1	1	2.0×10^{10}	BO-1	5	3.0×10^{9}
AO-2	9	1.3×10^{10}	BO-2	13	6.0×10^{9}
AO-3	17	1.2×10^{10}	BO-3	21	4.0×10^{9}
AO-4	18	1.6×10^{10}	BO-4	22	6.8×10^{9}
AO-5	10	8.4×10^{9}	BO-5	14	4.0×10^{9}
AO-6	2	1.9×10^{10}	BO-6	6	9.4×10^{9}
AO-7	GRD	1.4×10^{10}	BO-7	GRD	6.4×10^{9}

W614B-82 QA Form Approval

WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

58883

DATA SHEET

5-31

TEST TITLE CURRENT CHECKS (200°F 34 PSIG) Date 7-6-84 14:27

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VALERE

Part No. CG12-400 Serial No. N/A Engineer [signature]

WYLE TERMINAL	WIRE ID	CURRENT AC AMPS	WYLE TERMINAL	WIRE ID	CURRENT AC AMPS
1	AO-1	20.2	13	BO-2	21.5
2	AO-6	20.8	14	BO-5	20.8
3	AS-1	20.5	15	BS-2	21.0
4	AS-6	20.4	16	BS-5	21.0
5	BO-1	21.2	17	AO-3	20.6
6	BO-6	21.5	18	AO-4	20.1
7	BS-1	20.1	19	AS-3	20.5
8	BS-6	20.2	20	AS-4	21.0
9	AO-2	20.1	21	BO-3	21.3
10	AO-5	20.2	22	BO-4	21.2
11	AS-2	20.9	23	BS-3	20.1
12	AS-5	20.6	24	BS-4	20.9

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WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

DATA SHEET

58883

5-32

TEST TITLE LOCA IR TEST (Amb Temp) Date 7-10-84 0425H

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7-CONDUCTOR CABLES Technician VAZEKE

Part No. CGL2-400 Serial No. N/A Engineer [illegible]

WIRE ID	WYLE TERMINAL	VALUE [OHMS]
AS-1	3	3.5 x 10"
AS-2	11	2.4 x 10"
AS-3	19	2.2 x 10"
AS-4	20	2.2 x 10"
AS-5	12	2.0 x 10"
AS-6	4	2.2 x 10"
AS-7	GRD	3.5 x 10"
AO-1	1	3.5 x 10"
AO-2	9	3.0 x 10"
AO-3	17	3.0 x 10"
AO-4	18	2.8 x 10"
AO-5	10	3.0 x 10"
AO-6	2	2.6 x 10"
AO-7	GRD	6.8 x 10"

WIRE ID	WYLE TERMINAL	VALUE [OHMS]
BS-1	7	3.0 x 10"
BS-2	15	1.4 x 10"
BS-3	23	2.4 x 10"
BS-4	24	2.8 x 10"
BS-5	16	2.4 x 10"
BS-6	8	2.6 x 10"
BS-7	GRD	3.5 x 10"
BO-1	5	3.0 x 10"
BO-2	13	2.8 x 10"
BO-3	21	2.2 x 10"
BO-4	22	2.2 x 10"
BO-5	14	3.5 x 10"
BO-6	6	2.4 x 10"
BO-7	GRD	4.5 x 10"

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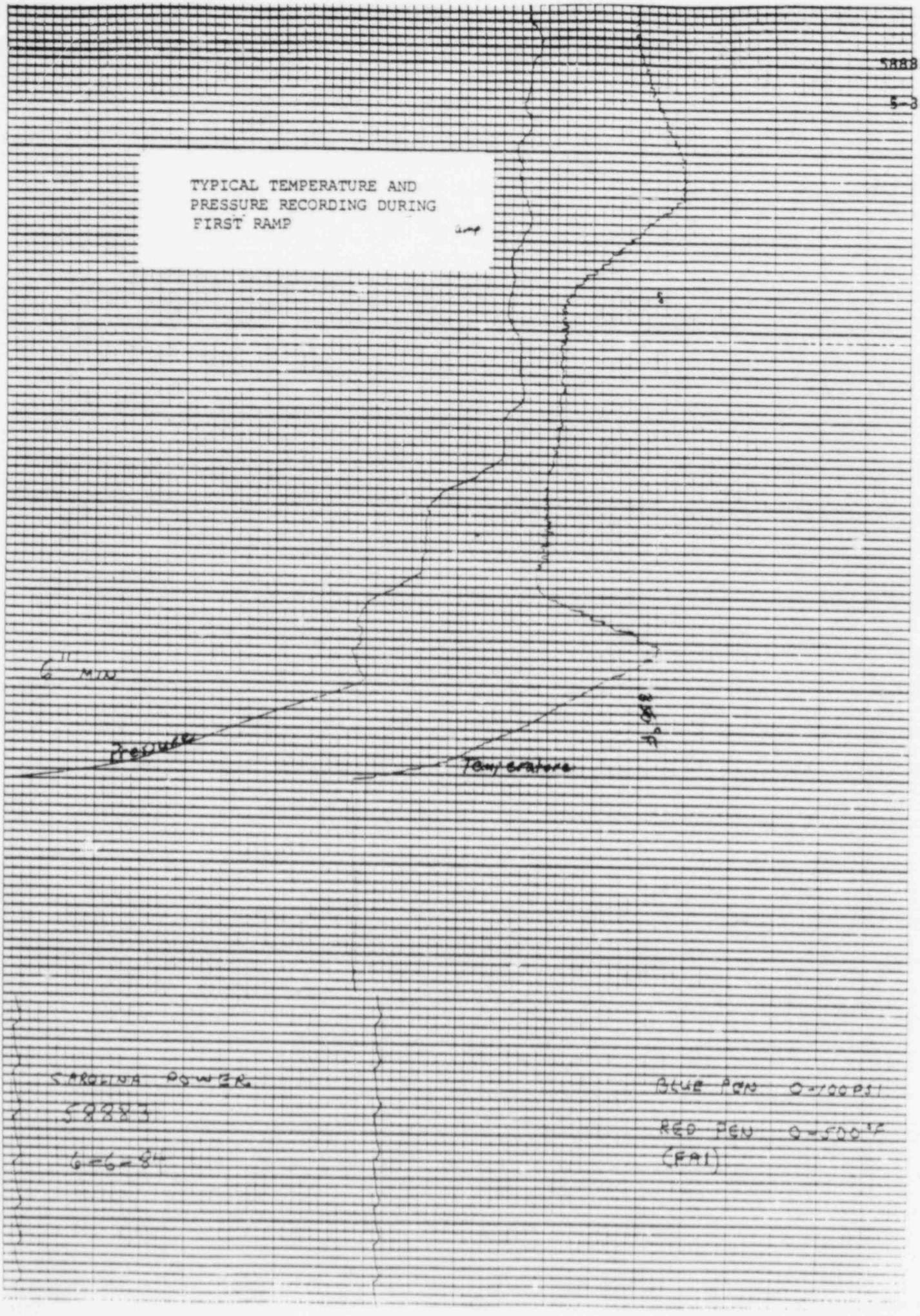
WYLE SCIENTIFIC SERVICES & SYSTEMS LABORATORIES GROUP

TEMPERATURE AND PRESSURE SUMMARY

Date	Time	Elapsed Time	Temperature (°F)	Comments	Elapsed Time	Pressure(psig)
6-6	1015	0 to 14S	195 to 360		0 to 10S	0 to 39
		14 to 16S	360		10 to 19S	39
		16 to 20S	360 to 300		19 to 30S	39 to 46
		20 to 65S	300 to 375		30 to 42S	46 to 57
		65 to 80S	375 to 350		42S to 1h	57
		1.3 to 3.0m	350 to 348		1 to 1.03h	57 to 37
		3.0m to 3.0h	348		1.03 to 3.25h	37
	1332	3.0 to 3.25h	348 to 324	Recharge Superheater	3.25 to 12.28h	37 to 0
		3.25 to 12.25h	324 to 200	Maintain Chamber at 200°F	12.28 to 12.32h	0 to 36
	2234	12.25 to 12.28h	200 to 345		12.32 to 13.52h	36
6-7	0123	12.28 to 15.10h	345 to 324		13.52 to 13.53h	36 to 41
	0208	15.10 to 15.85h	324 to 250	Start spray	13.53 to 15.00h	41
	0908	15.85 to 22.85h	250		15.00 to 15.07h	41 to 6
		22.85 to 23.68	250 to 226	Out of spec,1h.15m.	15.07 to 15.47h	6 to 14
	1023	23.68 to 24.10	226 to 252	Back in spec.	15.47 to 15.50h	14 to 36
		24.10 to 35.13	252		15.50 to 15.53h	36 to 28
	2301	35.13 to 36.73	252 to 208	Reducing temp.	15.53 to 39.77h	28 to 26
6-8	0208	36.73 to 39.85	208 to 204	Stop spray	39.77 to 519.8h	26 to 35
7-9	2125	39.85 to 803.13	204	Completed test	519.8 to 803.13h	35

TYPICAL TEMPERATURE AND PRESSURE RECORDING DURING FIRST RAMP



0607 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11	12	13	14	15	16
13:43:00		249.1F	263.7F						27.3P							
13:48:59		254.8F	269.4F						30.0P							
14:01:00		257.0F	266.5F						30.6P							
15:01:00		253.8F	263.7F						27.0P							
16:01:00		251.7F	259.3F						26.3P							
17:01:00		253.4F	262.9F						26.7P							
18:01:00		253.4F	264.3F						27.1P							
19:01:00		253.3F	262.5F						26.3P							
20:01:00		254.1F	264.6F						27.1P							
21:01:00		253.7F	265.0F						26.4P							
21:05:27		252.5F	261.1F						26.4P							
21:19:22		253.1F	261.8F						26.1P							
21:25:11		253.1F	263.5F						26.0P							
21:35:12		248.3F	248.4F						26.0P							
22:01:00		235.0F	234.7F						25.9P							
22:07:19		231.5F	239.3F						25.7P							
22:12:29		229.8F	229.5F						25.9P							
22:24:28		224.4F	224.4F						26.0P							
22:43:38		215.8F	223.9F						25.7P							
23:01:00		208.1F	217.6F						26.3P							
23:18:29		201.6F	211.2F						26.4P							
00:01:00		202.8F	212.2F						25.9P							

0614 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11	12	13	14	15	16
10:01:00		203.2F	218.8F						27.4P							
11:01:00		203.9F	225.4F						27.8P							
12:01:00		203.4F	217.5F						27.0P							
13:01:00		204.2F	226.3F						27.6P							
14:01:00		204.3F	217.2F						27.5P							
15:01:00		204.2F	223.9F						27.5P							
16:01:00		203.7F	216.5F						27.3P							
17:01:00		204.3F	225.1F						28.0P							
18:01:00		203.7F	216.1F						27.3P							
19:01:00		203.8F	222.0F						27.4P							
20:01:00		203.6F	227.5F						27.8P							
21:01:00		203.1F	226.8F						28.3P							
22:01:00		203.8F	222.3F						27.5P							
23:01:00		203.6F	226.7F						27.8P							
00:01:00		203.5F	228.6F						28.0P							
01:01:00		203.8F	232.0F						28.2P							
02:01:00		203.0F	220.4F						27.5P							
03:01:00		203.8F	222.7F						27.8P							
04:01:00		203.6F	225.4F						27.5P							
05:01:00		203.5F	229.2F						27.9P							
06:01:00		203.1F	222.3F						28.0P							
07:01:00		203.7F	222.7F						27.8P							

0622 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11	12	13	14	15	16
12:52:00		204.5F	231.9F						32.2P							
13:52:00		202.4F	221.0F						32.6P							
14:52:00		204.9F	227.2F						32.8P							
15:52:00		205.0F	228.5F						32.3P							
16:52:00		204.1F	217.5F						32.5P							
17:52:00		204.4F	222.6F						32.2P							
18:52:00		204.7F	229.9F						33.4P							
19:52:00		203.9F	218.5F						32.0P							
20:52:00		203.7F	224.3F						32.3P							
21:52:00		204.1F	229.2F						32.5P							
22:52:00		203.1F	223.7F						32.5P							
23:52:00		203.7F	222.4F						32.0P							
00:52:00		204.3F	227.2F						32.0P							
01:52:00		204.1F	231.2F						33.4P							
02:52:00		204.1F	222.9F						32.3P							
03:52:00		204.1F	227.5F						32.5P							
04:52:00		204.3F	229.3F						32.5P							
05:52:00		204.3F	233.2F						33.3P							
06:52:00		203.6F	221.6F						32.7P							
07:52:00		204.0F	221.5F						32.5P							
08:52:00		204.0F	225.5F						32.3P							
09:52:00		204.3F	227.2F						32.9P							

0630 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11 AIR	12	13	14	15	16
08:47:00		202.2F	220.1F						34.4P		68.0F	68.4F	68.3F			
09:17:00		202.6F	227.0F						34.5P		70.1F	70.7F	70.4F			
09:47:00		202.4F	220.4F						34.1P		72.7F	73.7F	73.1F			
10:17:00		202.4F	218.2F						34.0P		75.0F	76.2F	75.4F			
10:47:00		202.9F	219.1F						34.0P		77.0F	78.1F	77.5F			
11:17:00		203.4F	221.2F						33.9P		80.4F	82.0F	81.0F			
11:47:00		203.9F	225.0F						34.7P		82.9F	84.9F	83.6F			
12:17:00		204.3F	228.9F						35.1P		84.6F	85.7F	85.1F			
12:47:00		204.1F	217.0F						34.1P		87.8F	90.1F	88.9F			
13:17:00		204.1F	219.7F						34.0P		90.4F	92.2F	91.1F			
13:47:00		204.9F	223.6F						33.9P		91.0F	92.1F	91.7F			
14:17:00		205.1F	229.5F						35.2P		91.0F	91.6F	91.4F			
14:47:00		205.6F	217.3F						34.4P		91.5F	91.8F	91.8F			
15:17:00		205.6F	220.8F						34.1P		91.7F	91.8F	91.6F			
15:47:00		204.9F	225.1F						34.7P		90.3F	89.8F	89.8F			
16:17:00		204.9F	228.9F						35.0P		89.7F	89.1F	89.1F			
16:47:00		204.5F	217.0F						34.0P		89.0F	88.5F	88.3F			
17:17:00		205.4F	220.2F						34.5P		88.2F	87.2F	87.3F			
17:47:00		205.4F	222.8F						33.8P		87.5F	86.5F	86.7F			
18:17:00		205.0F	227.9F						34.9P		86.1F	84.7F	84.9F			
18:47:00		204.0F	218.7F						34.0P		85.0F	83.8F	83.9F			
19:17:00		204.5F	221.1F						34.0P		83.7F	82.3F	82.4F			

0707 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11 AIR	12	13	14	15	16
20:10:10		206.8F	217.8F						34.5P		157.0F	156.6F	157.1F			
20:11:00		206.6F	217.7F						34.4P		156.6F	156.6F	156.8F			
20:41:00		206.4F	219.7F						34.3P		158.5F	158.1F	158.1F			
21:11:00		205.9F	223.2F						34.3P		158.9F	158.0F	158.5F			
21:41:00		206.5F	226.9F						34.6P		156.8F	156.4F	156.8F			
22:11:00		205.4F	225.8F						34.6P		157.9F	157.5F	157.8F			
22:41:00		205.2F	215.3F						34.0P		158.2F	158.3F	158.7F			
23:11:00		206.2F	218.5F						34.3P		156.1F	156.0F	155.4F			
23:41:00		206.0F	218.9F						34.3P		157.1F	157.1F	156.3F			
00:11:00		205.6F	220.6F						33.9P		157.9F	158.0F	158.0F			
00:41:00		205.7F	221.9F						34.2P		159.2F	158.1F	158.2F			
01:11:00		205.8F	223.5F						34.3P		157.1F	156.4F	157.0F			
01:41:00		205.8F	224.3F						34.5P		156.4F	156.6F	157.0F			
02:11:00		206.1F	226.0F						34.8P		157.8F	157.4F	157.5F			
02:41:00		206.0F	229.1F						34.7P		158.2F	157.8F	158.0F			
03:11:00		205.6F	215.8F						34.1P		158.5F	158.2F	158.3F			
03:41:00		206.8F	218.5F						34.4P		156.5F	156.4F	156.1F			
04:11:00		206.8F	222.0F						33.8P		156.9F	157.0F	156.7F			
04:41:00		206.1F	225.0F						34.3P		157.8F	158.1F	158.1F			
05:11:00		206.5F	226.6F						34.5P		158.9F	158.4F	158.3F			
05:41:00		205.9F	228.8F						35.1P		156.0F	156.3F	156.5F			
06:11:00		205.7F	216.0F						33.9P		157.0F	156.9F	157.2F			

0709 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11 AIR	12	13	14	15	16
15:41:00		208.3F	218.0F						34.3P		159.8F	159.2F	159.5F			
16:11:00		207.7F	209.2F						34.4P		157.5F	157.4F	156.7F			
16:41:00		208.0F	218.1F						34.6P		159.1F	158.8F	158.8F			
17:11:00		207.2F	209.5F						33.9P		157.3F	157.2F	157.3F			
17:41:00		208.0F	212.8F						33.9P		159.5F	158.9F	159.3F			
18:11:00		207.2F	217.0F						34.1P		157.0F	156.7F	156.8F			
18:41:00		207.1F	218.9F						34.4P		158.5F	158.3F	158.4F			
19:11:00		206.1F	221.2F						34.7P		157.6F	156.8F	157.1F			
19:41:00		207.6F	211.6F						34.0P		157.1F	157.1F	157.1F			
20:11:00		207.0F	215.4F						34.4P		158.4F	157.8F	158.6F			
20:41:00		205.5F	219.8F						34.1P		159.0F	158.4F	158.3F			
21:11:00		205.5F	222.9F						34.5P		156.6F	156.8F	156.8F			
21:41:00		199.2F	204.9F						1.2P		157.8F	158.0F	158.0F			
22:02:36		168.0F	157.7F						0.5P		158.8F	158.2F	158.4F			
22:11:00		160.4F	158.1F						0.5P		159.7F	158.7F	158.4F			
22:41:00		146.1F	144.5F						0.5P		155.9F	156.2F	155.3F			
23:11:00		136.6F	134.9F						0.4P		158.0F	157.6F	157.9F			
23:41:00		128.3F	126.2F						0.4P		158.9F	158.4F	158.0F			
00:11:00		120.7F	118.1F						0.4P		155.9F	156.0F	155.5F			
00:41:00		114.2F	112.2F						0.3P		157.4F	157.1F	157.6F			
01:11:00		108.5F	106.0F						0.3P		158.8F	158.3F	157.9F			
01:41:00		103.7F	101.6F						0.3P		158.6F	158.2F	158.7F			

0710 100	01	02 AIR	03 WATER	04	05	06	07	08	09 PRESS	10	11 AI2	12	13	14	15	16
02:11:00		99.5F	98.3F						0.3P		156.1F	156.4F	155.7F			
02:41:00		95.8F	94.3F						0.3P		157.4F	157.1F	157.4F			
03:11:00		92.6F	91.2F						0.3P		157.9F	157.7F	158.4F			
03:41:00		89.5F	89.0F						0.3P		158.0F	158.0F	158.3F			
04:11:00		86.9F	86.8F						0.3P		156.3F	156.1F	156.0F			
04:41:00		84.6F	84.3F						0.3P		156.0F	156.3F	156.3F			
05:11:00		82.9F	83.2F						0.3P		157.4F	157.5F	157.6F			
05:41:00		81.2F	80.6F						0.2P		158.5F	158.2F	158.3F			
06:11:00		79.8F	80.3F						0.2P		157.2F	156.6F	157.0F			
06:41:00		78.8F	79.5F						0.2P		156.9F	156.7F	156.5F			
07:11:00		78.3F	78.9F						0.2P		157.7F	157.4F	157.5F			
07:41:00		78.3F	78.1F						0.2P		158.6F	158.2F	158.5F			
08:11:00		78.9F	78.9F						0.1P		156.4F	156.3F	155.7F			
08:41:00		79.8F	79.2F						0.1P		158.4F	158.1F	158.4F			
09:11:00		82.2F	79.0F						0.2P		157.1F	156.8F	157.7F			
09:41:00		84.5F	80.6F						0.2P		157.4F	157.1F	157.6F			
10:11:00		86.7F	81.3F						0.2P		157.7F	157.5F	157.6F			
10:41:00		88.3F	82.7F						0.2P		158.8F	157.8F	157.5F			
11:11:00		89.7F	83.5F						0.2P		156.1F	156.8F	155.8F			
11:41:00		91.1F	84.9F						0.3P		157.5F	157.5F	157.1F			
12:11:00		92.8F	86.8F						0.3P		157.7F	157.0F	156.8F			
12:41:00		94.9F	88.0F						0.3P		158.4F	158.1F	158.1F			

WYLE LABORATORIES SCIENTIFIC SERVICES & SYSTEMS GROUP

TEST TITLE Functionals & LOCA

CUSTOMER CAROLINA POWER Job No. 58883 Date 5-23-84

Specimen RAYCHEM 7 CONDUCTOR CABLES Technician VAUGHT

Part No. CGL2-400 Serial No. N/A Engineer Ford

EQUIPMENT	MANUFACTURER	MODEL NO.	RANGE	WYLE NO.	CALIBRATION LAST	CALIBRATION DUE	ACCY.
MEGOHMMETER	GENERAL RADIO	1864	500 V	L30,200	5-8-84	5-8-85	Data Ref P 3-43
DMM	KEITHLEY	179	0-20VDC	9079	12-6-83	12-9-84	±.1%
DMM	BECKMAN	TECH-330	0-1000 VAC 0-200MVAC	8893	2-22-84	2-24-85	±10%
AC CURRENT CLAMP	BECKMAN	CT-231	0-1000 VAC 0-150AMPS	9065	4-19-84	10-21-84	±2%
AC/DC HIPOT	ASSOCIATE RESEARCH	04045A	0-5000 VAC	9124	4-23-84	10-28-84	±3%

58883
5-42

QA Form Approval

W614D-82

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.

= 58883

CALIBRATION DATA CONTINUATION SHEET

VIKING LABORATORIES 5-43

440 Bernardo Avenue
Mountain View, Ca 94043
(415) 969-5500

JOB NO.	CONTROL NO.	CAL DATE	RECALL DATE
05125	0004-12	5-8-84	5-8-85

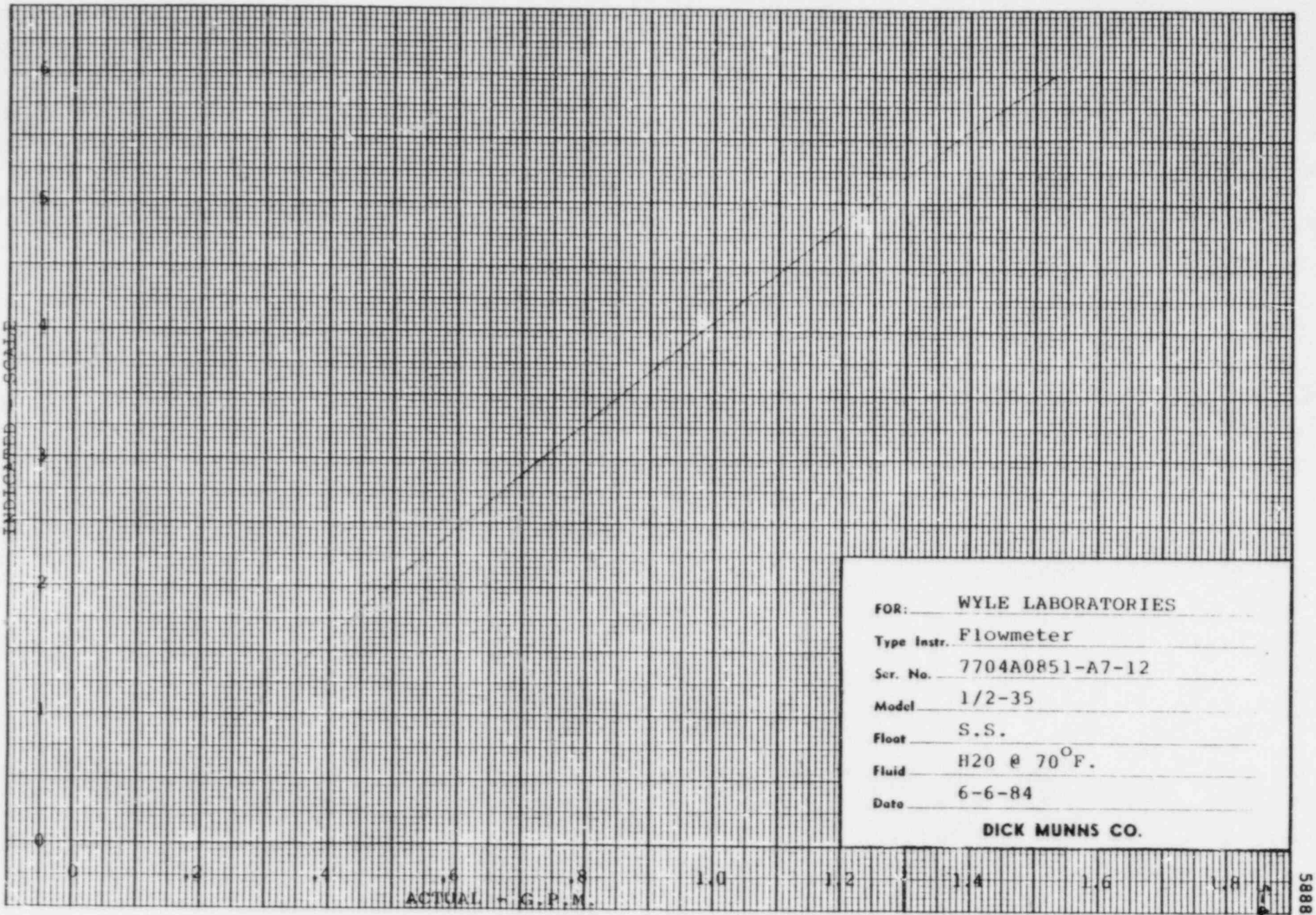
CUSTOMER	DATE	OOS ☐ EST. REQ. ☐ AOC ☐
RAYCHEM	5-8	

INSTRUMENT DESCRIPTION	PURCHASE ORDER	CUSTOMER ☐ VENDOR ☐
TEGOHMMETER		

MANUFACTURER	MODEL NO.	SERIAL NO.	ASSET NO.
GR	1864	1733	C-175-6**

FUNCTIONS TESTED	ACCEPTABLE ERROR	STD/APPLIED	INDICATED	CORRECTED VALUE
RESISTANCE				
HIGH-RANGE 1 MΩ RANGE	± (2? RDG	1 000 MΩ	1 00 MΩ	
10 MΩ	+ 1?)	10 00 MΩ	10 0 MΩ	
100 MΩ		100 0 MΩ	100 MΩ	
1 GΩ		1.000 GΩ	0 99 GΩ	
10 GΩ		10.00 GΩ	9.9 GΩ	
100 GΩ	± (2? RDG	100 0 GΩ	99 GΩ	
	+ 3?)			
1 TΩ	± (2? RDG	1 000 TΩ	0.955 TΩ	
	+ 4?)			
10 TΩ	± (2? RDG	10 00 TΩ	9.55 TΩ	
	+ 6?)			

LIST ALL EQUIPMENT USED IN THIS CALIBRATION.				REMARKS
MANUFACTURER	MODEL NO.	ASSET NO.	RECALL DATE	


INDICATED SCALE
0
1
2
3
4
5
6
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
ACTUAL - G.P.M.
FOR: WYLE LABORATORIES
Type Instr. Flowmeter
Ser. No. 7704A0851-A7-12
Model 1/2-35
Float S.S.
Fluid H20 @ 70°F.
Date 6-6-84
DICK MUNNS CO.
58883

58883

5-45

Dick Munns Company

LIQUID AND GAS - FLOWMETER CALIBRATION SERVICE

Phone 596-1559 3335 Cerritos Avenue Los Alamitos, Calif. 90720

RENTAL METER

Certificate

DATE 6-6-84

SUBMITTED FOR CALIBRATION BY Wyle Laboratories

TYPE OF INSTRUMENT Flowmeter

SERIAL NO. 7704A0851-A7-12

MODEL NO. 1/2-35

MFGR. F & P

RATED ACCURACY ± 2% F.S.

CALIBRATION INTERVAL 12 months

INDICATED	ACTUAL	REMARKS
SCALE	G.P.M.	
1	.26	H20 @ 70°F.
2	.49	
3	.731	
4	.978	
5	1.243	
6	1.530	

CALIBRATED BY COMPARISON WITH THE FOLLOWING STANDARDS

Test units A-6 & A-7. N.B.S. Traceability #M-2055.

As per MIL-STD-45662.

ALL INSTRUMENTS USED TO ACCOMPLISH ABOVE CALIBRATION HAVE DIRECT TRACEABILITY TO THE NATIONAL BUREAU OF STANDARDS, WASHINGTON, D.C.

CALIBRATION BY RM APPROVED BY

SECTION 6

VOLTAGE WITHSTAND LEVEL TEST

6.1 TEST PROCEDURE

At the conclusion of the LOCA test described in Section 5, the cable ends of the specimens were cut inside the pressure vessel, and the mandrels, with the cables still attached, were removed from the vessel. The cables were then removed from the mandrels without uncoiling. The ends of each specimen were prepared by cutting the lead wires between the penetration and test specimen. The lead wire connected to each conductor of each test specimen was stripped to facilitate the electrical hook-up.

The center portion of each cable was immersed in tap water at room temperature.

With the water bath grounded, the conductors were connected as shown in Figure 1, (Reference 2.3, Appendix II) Configuration A.

A withstand voltage of 1200 ac volts was applied by uniformly increasing the applied voltage from zero to maximum at a rate not exceeding 500 volts per second, holding 1200 volts for five minutes, and decreasing the voltage to zero in not less than three seconds.

The connections were then changed to conform with Figure 1, Configuration B, and a second voltage withstand test performed in accordance with Par. 5.6 of Reference 2.3, except that at the end of the five-minute period, the voltage was increased at a uniform rate, not exceeding 500 volts AC per second, to a value of 3600 AC volts, held for five minutes, and then reduced to zero in not less than five seconds.

The connections were then changed to conform to Figure 1, Configuration A. A withstand voltage of 3600 volts AC was applied by increasing the applied voltage from zero to maximum at a rate not exceeding 500 volts AC per second, holding for five minutes, and then decreasing the voltage to zero in not less than five seconds.

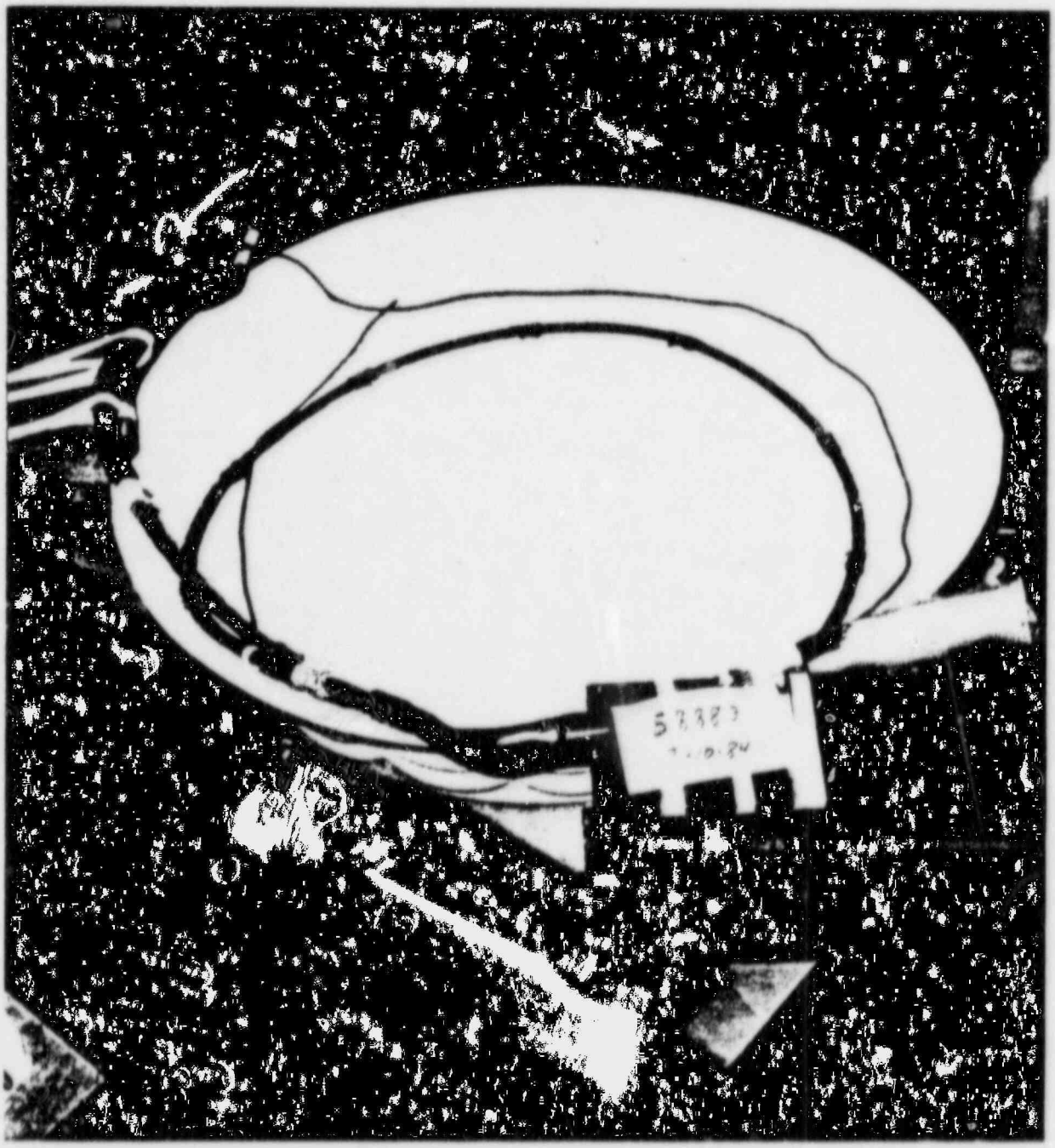
6.1 (continued)

The voltage applied to the test specimens was measured and recorded on data sheets.

6.2 TEST RESULTS

No electrical breakdown was noted as a result of this test.

Test results are recorded on the test data sheet included in this report section. Photograph 6-1 shows the test specimens installed in the test setup. Test equipment used in the performance of this test is listed on Page 5-42.



PHOTOGRAPH 6-1

TEST SETUP: VOLTAGE WITHSTAND LEVEL

WYLE SCIENTIFIC SERVICES & SYSTEMS GROUP LABORATORIES

58883

6-4

DATA SHEET

TEST TITLE VOLTAGE WITHSTAND Date 7-10-84 1230 Hr

Customer CAROLINA POWER Job No. 58883

Specimen RAYCHEM 7 CONDUCTOR CABLES Technician VALERIE

Part No. CGI2-400 Serial No. N/A Engineer PDad

SPECIMEN	CONFIGURATION [WIRE NO]	1200 VAC RESULTS (5 min)	3600 VAC RESULTS (5 min)
AC	'A' = 2, 4, 6, 7 HV 1, 3, 5 GRD	NO BREAKDOWN	NO BREAKDOWN
	'B' = 2, 4, 6, 7 GRD 1, 3, 5 HV	NO BREAKDOWN	NO BREAKDOWN
AS	'A' = 2, 4, 6, 7 H.V 1, 3, 5 GRD	NO BREAKDOWN	NO BREAKDOWN
	'B' = 2, 4, 6, 7 GRD 1, 3, 5 H.V	NO BREAKDOWN	NO BREAKDOWN
BC	'A' = 2, 4, 6, 7 HV 1, 3, 5 GRD	NO BREAKDOWN	NO BREAKDOWN
	'B' = 2, 4, 6, 7 GRD 1, 3, 5 H.V	NO BREAKDOWN	NO BREAKDOWN
BS	'A' = 2, 4, 6, 7 H.V 1, 3, 5 GRD	NO BREAKDOWN	NO BREAKDOWN
	'B' = 2, 4, 6, 7 GRD 1, 3, 5 H.V	NO BREAKDOWN	NO BREAKDOWN

W614B-82 QA Form Approval

APPENDIX I

TEST PLAN
FOR
DEMONSTRATION OF RAYCHEM CABLE FOR
QUALIFIED USE IN CLASS 1E SERVIDE
PRIMARY AND SECONDARY CONTAINMENT
FOR
CAROLINA POWER & LIGHT COMPANY

REVISION A, 1 May 1984

(7 Pages)

REVISION A
1 May 1984

22 September 1983

TEST PLAN
FOR
DEMONSTRATION OF RAYCHEM CABLE FOR
QUALIFIED USE IN CLASS 1E SERVICE
PRIMARY AND SECONDARY CONTAINMENT
FOR
CAROLINA POWER & LIGHT COMPANY

APPROVALS:

WYLE LABORATORIES:

Test Engineer Gustave L Good Date 9-22-83

Manager,
Dynamics Dept. J J Lindeman Date 9/23/83

Quality Assurance G Hilmas Date 9-23-83

CAROLINA POWER & LIGHT COMPANY David R Phipps Date 6-5-84

1.0 OBJECTIVE

To perform qualification testing of Raychem-Flamtrol unshielded, jacketed cables having combined conductor insulation and jacket wall thickness equal to or greater than 0.120 inch to determine qualification for Class 1-E service inside primary containment under loss of coolant accident (LOCA) or high energy line break (HELB) conditions specific to Brunswick Steam Electric Plant (BSEP). Testing will be performed on two sets of pre-aged cable specimens. One set will be pre-aged to simulate eight years of in-plant service (Condition A). The other set will be pre-aged to simulate 40 years of in-plant service (Condition B). Testing to be performed on these specimens shall determine ability to perform intended functions under LOCA or HELB conditions during the remaining plant life.

2.0 MATERIALS

2.1 CABLE DESCRIPTION

Cables to be tested shall be Raychem-Flamtrol unshielded, jacketed cables whose combined conductor insulation and jacket wall thickness is greater than 0.120 inch and whose jackets were radiation crosslinked with a 2.0Mev beam.

2.2 CABLE SAMPLE

Test specimens are to be fabricated from 7-conductor, 12 AWG, unused cable available at BSEP. Primary insulation thickess is 0.045 inch and the jacket thickness is nominally 0.09 inch.

3.0 TEST SPECIMENS

3.1 Two specimens each of cables aged at Condition A and Condition B will be configured and tested as follows:

a. Cable jackets will be left intact and will exit the pressure vessel through suitable penetrations.

b. Cable jackets will be stripped in such a way that their ends will be inside the pressure vessel. Individual components will be spliced to individual penetration leads inside the pressure vessel. Thus, the open ends of the cable specimens will be exposed to the simulated adverse environment inside the vessel.

3.1 (continued)

c. Each specimen will be of sufficient length to be wound for one complete turn on a 30-inch diameter mandrel, which will be used to hold the specimens in place during preconditioning and environmental exposure.

4.0 SPECIMEN PRE-CONDITIONING

4.1 RADIATION AGING

4.1.1 Condition A

One specimen of each configuration (3.1.a and 3.1.b) will be exposed to an air equivalent dose of 6.2×10^7 rads of gamma radiation from a cobalt-60 source. The dose rate shall not exceed 1.0×10^6 rads per hour. This exposure simulates eight years of in-plant service (1.2×10^7 rads) plus the postulated LOCA radiation (5.0×10^7 rads).

4.1.2 Condition B

One specimen of each configuration (3.1.a and 3.1.b) will be exposed to an air equivalent dose of 1.1×10^8 rads of gamma radiation from a cobalt-60 source. The dose rate shall not exceed 1.0×10^6 rads per hour. This exposure simulates 40 years of in-plant service 6.0×10^7 rads) plus the postulated LOCA radiation (5.0×10^7 rads).

4.2 THERMAL AGING

4.2.1 Condition A

One specimen of each configuration (3.1.a and 3.1.b), while on the mandrel, will be aged at 123C for 100 hours to simulate eight years of life at 66C, based on Arrhenius analysis of long-term thermal life data.

4.2.2 Condition B

One specimen of each configuration (3.1.a and 3.1.b), while on the mandrel, will be aged at 140C for 100 hours to simulate 40 years of life at 66C, based on Arrhenius analysis of long-term thermal life data.

5.0 LOCA TEST PROCEDURE

5.1 SPECIMEN INSTALLATION

The mandrels on which the pre-conditioned specimens are mounted shall be installed in the pressure vessel in such a way that they will be restrained from moving during the test.

Jacket ends of one specimen on each mandres will be stripped to expose the primary insulation to the environment inside the pressure vessel. Individual components will be spliced to individual penetration leads inside the pressure vessel.

Cable ends of the remaining specimen on each specimen on each mandrel shall be sealed. Suitable penetrations shall be made as specified in 3.1.a and 3.1.b.

5.2 ELECTRICAL CONNECTIONS

The specimens shall be continuously energized as shown in Figure 1, where terminals A, B, and C are connected to a 4-wire, 3-phase, Y-connected transformer, with a grounded neutral, whose line voltage is adjusted to 600 volts. Each transformer lead is fused at 0.5 amperes to facilitate failure detection.

Each energized conductor shall be connected as shown in Figure 1 and the current transformer shall be adjusted to provide a simulated load current of 20 amperes in each conductor. This adjustment is made at room temperature and the current will vary during the test as the conductor temperature varies.

5.3 ENVIRONMENTAL EXPOSURE

The specimens shall be exposed to the simultaneous temperature and pressure profiles shown in Figure 2.

The specimens shall be exposed continuously to a demineralized water spray beginning six hours after the start of the environmental exposure. The spray shall be directed vertically downward at a minimum rate of 1.44 gallons per minute per square foot of horizontal cross-sectional area of the pressure vessel and shall continue for 24 hours. After 24 hours, the relative humidity will be maintained at 100% for the duration of the test.

5.4 MEASUREMENTS

5.4.1 The following parameters will be monitored during the test:

a. Voltage
b. Voltage circuit continuity
c. Load Current
d. Pressure
e. Temperature
f. Humidity
g. Insulation resistance values

5.4.2 Insulation resistance measurements will be made between each conductor and all other conductors in the cable at 500 vdc after one minute of electrification. Such measurements shall be made before and after radiation exposure, before and after thermal aging, after installation in the pressure vessel, and at the times shown in Figure 2.

6.0 ACCEPTANCE CRITERIA

Ability to carry the simulated load current of 20 amps at 600 vac will demonstrate qualification of the cables for Class 1-E service in primary containment at BSEP.

7.0 REPORT

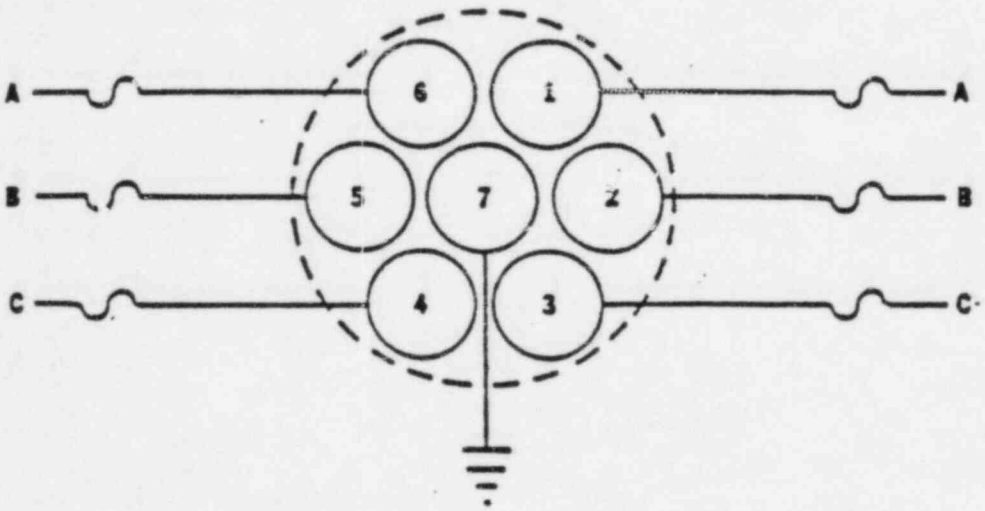
At the conclusion of the test program a report will be issued which will include the following:

a. Description of test specimens
b. Description of the test program
c. Detailed test data in tabular or chart form, as appropriate
d. Test conclusions
e. Calibration records of test data acquisition instruments

Unless otherwise specified, two bound, and one unbound, photo-ready copies of the report will be furnished.

FIGURE 1

TEST ENERGIZATION CIRCUIT (TYPICAL)



CONDUCTOR DETAIL

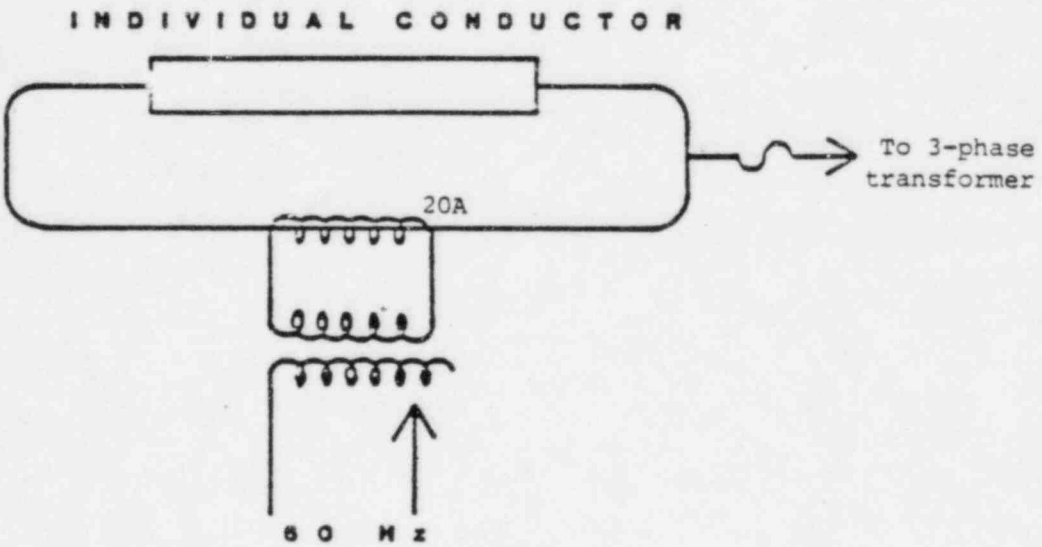
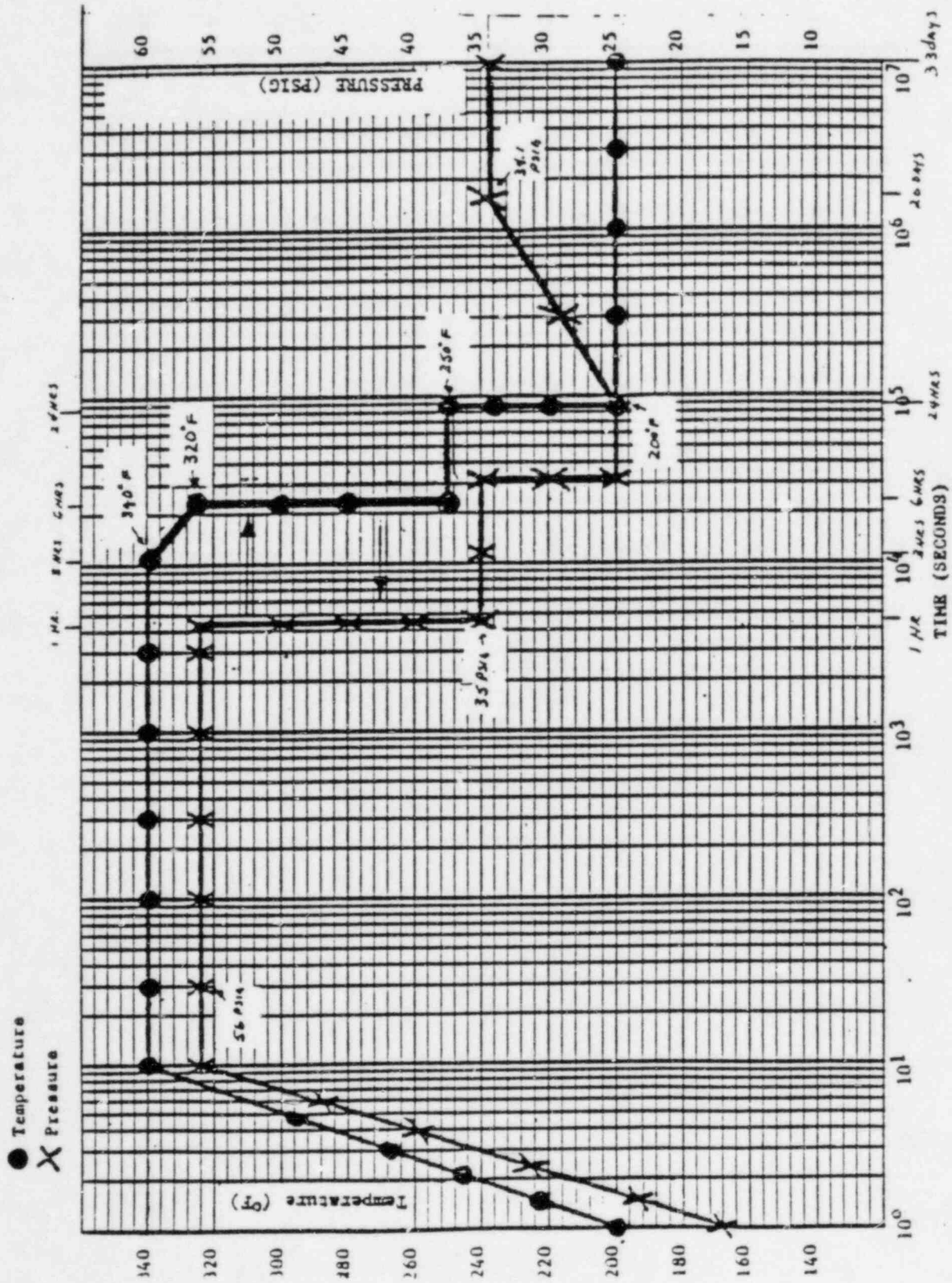


FIGURE 2



ENVIRONMENTAL PROFILE INCLUDING IEEE 323-74 MARGINS FOR PRIMARY CONTAINMENT

APPENDIX II

TEST PLAN
FOR
VOLTAGE WITHSTAND LEVEL TESTING
OF
RAYCHEM CABLE SAMPLES
AFTER A LOCA TEST
FOR
CAROLINA POWER & LIGHT COMPANY

REVISION A, 1 May 1984

(4 Pages)

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

REVISION A
1 May 1984

23 September 1983

TEST PLAN
FOR
VOLTAGE WITHSTAND LEVEL TESTING
OF
RAYCHEM CABLE SAMPLES
AFTER A LOCA TEST
FOR
CAROLINA POWER & LIGHT COMPANY

APPROVALS:

WYLE LABORATORIES:

Test Engineer Luther L Gwaltney Date 9-23-83

Manager, Dynamics Dept. J. J. Anderson Date 9/23/83

Quality Assurance B Hickman Date 9-23-83

CAROLINA POWER & LIGHT COMPANY David R. Phyfe Date 6-5-84

1.0 OBJECTIVE

To determine the extent to which the cables may exhibit residual margin upon completion of the aging and harsh environment exposure described in Reference 3.1.

2.0 SCOPE

The testing described herein will be performed on cable specimens used in the program described in Reference 3.1. That program is intended to demonstrate qualification of the cable for use in Class 1E service in primary and secondary containment at Brunswick Steam Electric Plant (BSEP). Similarly, the post-LOCA testing described herein is intended to determine residual margin in addition to those margins of time, temperature, pressure, voltage, and current accounted for in Reference 3.1. Because neither of these programs is concerned with generic qualification of the cable, there is no residual margin requirement once the cable specimens have met the performance requirements specific to BSEP, as described in Reference 3.1.

3.0 REFERENCES

3.1 "Demonstration of Raychem Cable for Qualified Use in Class 1E Service at BSEP - Primary and Secondary Containment", Revision 2.

4.0 CABLE DESCRIPTION

The cable to be subjected to the high voltage withstand test described below will be the identical specimens used in LOCA tests described in Reference 3.1.

5.0 PROCEDURE

5.1 At the conclusion of the LOCA testing, the cable ends will be cut inside the pressure vessel and the mandrels, with the cables still attached, will be removed from the vessel.

5.2 The cables will then be removed from the mandrels without uncoiling.

5.0 (continued)

5.3 The ends of each specimen will be prepared by removing a short length of the jacket and stripping the primary insulation from each conductor to facilitate electrical connections.

5.4 The center portion of each cable will be immersed in tap water at room temperature.

5.5 With the water bath grounded, the conductors will be connected as shown in Figure 1, Configuration A.

5.6 A withstand voltage of 1200 volts will be applied by uniformly increasing the applied voltage from zero to maximum at a rate not exceeding 500 volts per second, holding 1200 volts for five minutes, and decreasing the voltage to zero in not less than three seconds.

5.7 The connections will then be changed to conform with Figure 1, Configuration B, and a second voltage withstand test performed in accordance with 5.6 above, except that at the end of the five-minute period, the voltage will be increased at a uniform rate, not exceeding 500 volts AC per second, to a value of 3600 AC volts, held for five minutes, and then reduced to zero in not less than five seconds.

5.8 The connections will then be changed to conform to Figure 1, Configuration A. A withstand voltage of 3600 volts AC will then be applied by increasing the applied voltage from zero to maximum at a rate not exceeding 500 volts AC per second, holding for five minutes, and then decreasing the voltage to zero in not less than five seconds.

5.9 The 3600 volts AC is based on80 volts AC/Mil of primary insulation thickness.

6.0 MEASUREMENTS

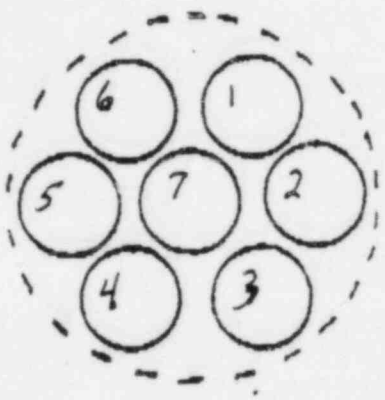
The voltage applied to the test specimens will be measured and recorded on data sheets.

7.0 DOCUMENTATION

An information report will be furnished by Wyle Laboratories.

FIGURE 1

CONNECTIONS FOR VOLTAGE WITHSTAND TEST



Configuration A:	2, 4, 6 and 7 connected to high voltage terminal; 1, 3, and 5 grounded
Configuration B:	2, 4, 6, and 7 grounded; 1, 3, and 5 connected to high voltage terminal

ATTACHMENT 2

TO BESU 842466

RAYCHEM REPORT NO. EM2923

Raychem

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025

Telephone 415) 361 3333
TWX 910 373 1728
Telex 34 8316

Test Report EM #2923

Date **May 7, 1984**

xc: L. J. Frisco

Memo to **Information File**

ATTACHMENT (2).

From **E. J. McGowan**

File

Subject **RAYCHEM-FLAMTROL CABLE, PRE-LOCA TEST INSPECTION**

OBJECT

Insulation resistance and breakdown voltage tests were performed on components taken from a Raychem-Flamtrol insulated, unshielded, jacketed, multiconductor cable to determine if they had been affected by space charge effects during jacket irradiation. The cable specimen was taken from a lot of unused cable provided by Carolina Power and Light Company, which had been shipped from their Brunswick Steam Electric Plant to Raychem. The purpose of the tests was to determine if this particular lot of cable is a suitable sample to be used in subsequent adverse environment testing.

MATERIAL

The test specimen was cut from a length of cable identified by the following marking on the cable jacket:

RAYCHEM-FLAMTROL^{TM}-1000V CONTROL-7/c-12AWG-1973-CG12 400

TEST PROCEDURE

The jacket was removed from a 15-foot length of cable and the components were disassembled. The central 10-foot section of each component was immersed in water for a period of about 22 hours. The insulation resistance of each component was then measured with a G.R. Megohmmeter at 500 V d-c. The a-c breakdown voltage of each component was then measured with a Beckman High Voltage Power Supply, using a rate of rise of 500 volts per second.

The disassembly of the cable and the measurements described above were witnessed by D. R. Rhyne of CP & L.

DETAILED RESULTS

The test results are summarized in Table 1 below.

TABLE 1.

Component Color	Insulation Resistance (ohms)	Breakdown Voltage (kV)
Red	2.8×10^{12}	3.2
Green	4.0×10^{12}	3.1
White	6.0×10^{12}	1.7
Black	1.5×10^{13}	28.7
Blue	4.0×10^{10}	2.2
Orange	5.0×10^{12}	3.3
White/Black	1.0×10^{13}	25.1

COMMENTS

The insulation resistance values were in the expected range, although the value for the blue component was slightly below average.

The breakdown voltage values clearly demonstrate that five of the components were affected by space charge effects during jacket irradiation, as evidenced by decreased electric strength. Therefore, this particular lot of cable (CG12-400) is a suitable sample for use in adverse environment testing to be conducted by CP & L.

E. J. McGowan

EJMcGowan-5/7/84

ATTACHMENT 3

TO BESU 842466

SELECTION OF TEST SAMPLES FOR ADVERSE ENVIRONMENT TESTING

SELECTION OF TEST SAMPLES FOR ADVERSE ENVIRONMENT TESTING

BRUNSWICK STEAM ELECTRIC PLANT

Cable samples to be used in adverse environment testing will be taken from the inventory of unused cable available at BSEP. Constructions on hand include 7-, 10- and 12-conductor unshielded, jacketed cable. For reasons described below, testing of the 7-conductor construction will yield results that are applicable to the other constructions.

The conditions necessary for space charge effects to occur during jacket irradiation of unshielded jacketed cables with a high-energy electron beam are not dependent on the number of conductors in the cable. If the electrons cannot penetrate the jacket and component insulation walls so that a highly ionized path to at least one grounded conductor is formed, space charge will develop and the phenomenon will occur.

In a 7-conductor cable, six component wires are helically wrapped around a center component wire to form a full and uniform outer layer, as shown in Figure 1. This regular configuration ensures that each component wire in the outer layer is in intimate contact with three other component wires and with the inner surface of the jacket. Therefore, among the constructions available, the 7-conductor configuration presents a geometrical arrangement with the greatest potential for space charge effects to occur in a way that reduces the distances between affected components to a minimum, which results in a worst case situation from an electrical breakdown point of view.

If the required adverse environment testing is performed on 7-conductor cables which have been shown by pre-test inspection to contain components affected by space charge, the conclusions drawn from such testing will be applicable to 10- and 12-conductor cables as well. If the affected components in a 7-conductor cable perform their intended function during adverse

environment testing, there is no reason to believe that a 10- or 12-conductor cable would not yield the same result.

For the following reasons, it is more practical to test the 7-conductor configuration:

(a) It has the smallest outside diameter (.765 inch max) which permits the use of a 30-inch diameter (40X) mandrel, whereas the 10- and 12-conductor cables would require 39- and 40-inch diameter mandrels respectively. The larger diameter mandrels are more difficult to handle and require larger ovens and pressure vessels for testing. At Wylie Norco, a 42-inch diameter pressure vessel is available which can accomodate a 30-inch diameter mandrel with specimens mounted (approximately 32-inch diameter overall), but could not accomodate the larger mandrels. Their next larger vessel is 72 inches in diameter and has a volume too large to permit the required supersaturated steam conditions to be maintained in accordance with the proposed LOCA profile.

(b) Pressure vessel penetrations are much more complicated and require more space as the number of conductors is increased.

(c) The amount of instrumentation and auxilary electrical equipment required increases as the number of conductors is increased.

(d) If it was necessary to test 10- or 12-conductor cables, dealing with the disadvantages mentioned in (a), (b) and (c) above would increase the cost and, perhaps, delay the start of testing.

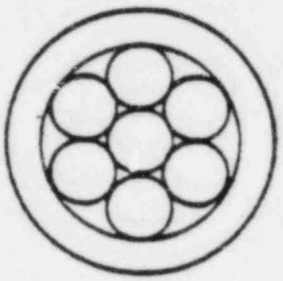


Figure 1. 7-Conductor cable.

ATTACHMENT 4

TO BESU 842466

CP&L P. O. B18696

CAROLINA POWER & LIGHT COMPANY

NUCLEAR PLANT CONSTRUCTION DEPARTMENT
Brunswick Steam Electric Plant
P. O. Box 11060
Southport, N. C. 28461

PURCHASE ORDER
ATTACHMENT (1).

PURCHASE ORDER NUMBER
B-18696

NOTE: ORDER NUMBER **MUST** APPEAR ON ALL INVOICES, CORRESPONDENCE, SHIPPING PAPERS AND CARTONS

ORDER DATE	SHIPMENT PROMISED BY	SHIP VIA	FOB	TERMS	REQ. NO	BUYER CODE
1/10/83	ASAP	BW	SP	N/30	18696	TE/jc

SUPPLIER

Raychem Corp.
Wire & Cable Receiving
2971 Spring St.
Redwood City, CA 94063

Attention: Glen Barcellos

IMPORTANT INSTRUCTIONS

1. ADDRESS ORIGINAL & (2) COPIES OF YOUR ITEMIZED INVOICE TO THE ABOVE ADDRESS ATTENTION ACCOUNTS PAYABLE DEPARTMENT
2. ATTACH ORIGINAL BILL OF LADING OR SHIPPING RECEIPT TO INVOICE
3. INVOICE MUST SHOW ITEM NUMBER SHOWN ON PURCHASE ORDER
4. WHEN PREPAID ATTACH ORIGINAL TRANSPORTATION RECEIPT
5. EACH DISCOUNT PERIOD WILL DATE FROM RECEIPT OF INVOICE CORRECTLY EXECUTED

ITEM	DESCRIPTION	QUANTITY	UNIT	NET UNIT PRICE	TOTAL PRICE
	ORIGINAL NOTIFICATION				
1	Cable/Reel CG12233	110	ft	Price per Invoice	
2	Cable/Reel CG12256	114	ft	Price per Invoice	
3	Cable/Reel CG12338	160	ft	Price per Invoice	
4	Cable/Reel CG12348	146	ft	Price per Invoice	
5	Cable/Reel CG12382 (See Note)	138	ft	Price per Invoice	
6	Cable/Reel CG12400	214	ft	Price per Invoice	

("Q" List / 79-01B Program)

Note - Cable CG12382 two pieces, one @ 124', one @ 14', 138' Total

Cable being shipped to Raychem to Determine if defect (space change) is present.

PURCHASE ORDER NUMBER MUST BE SHOWN ON ALL SHIPMENTS, INVOICES, AND CORRESPONDENCE.

INVOICE SHOULD BE SENT TO:
CAROLINA POWER & LIGHT COMPANY
ACCOUNTS PAYABLE UNIT
P.O. BOX 11060
SOUTHPORT, N.C. 28461

SHIP TO:
CAROLINA POWER & LIGHT COMPANY
CONSTRUCTION DEPT.
BRUNSWICK STEAM ELECTRIC PLANT
SOUTHPORT, N.C. 28461
ATTENTION: MR. R. J. GROOVER, JR.

W. Guarino

N.C. SALES TAX CERTIFICATION REGISTRATION NO. 7

SE & CHARGE
79-01B
H21H3-53199-0A18

JRL 1-10-83

The above order is subject to all instructions, terms and conditions set forth on the face and reverse side hereof. This Order expressly limits acceptance to the terms stated herein, and any additional or different terms proposed by the Seller are rejected unless assented to in writing.

CAROLINA POWER & LIGHT COMPANY

BY T. Ellis

T. Ellis

DATE 1-10-83

NOTE: Attached Acceptance of this Order must be returned to attention of the Purchasing Dept. Only when required as stipulated in Condition 1 on the reverse.

ORIGINAL

LJF JAN 26 '83

CAROLINA POWER & LIGHT COMPANY
NUCLEAR PLANT CONSTRUCTION DEPARTMENT
Brunswick Steam Electric Plant
P. O. Box 11060
Southport, N. C.28461

PURCHASE ORDER CONTINUATION SHEET

PURCHASE ORDER NUMBER
B-18696

ITEM	DESCRIPTION	QUANTITY	UNIT	NET UNIT PRICE	TOTAL PRICE
	Please acknowledge receipt and acceptance of this purchase order by return mail.				
	W. Guarino				

ALL TERMS AND CONDITIONS ON THE FACE AND REVERSE SIDE OF THE SIGNED SHEET ARE EFFECTIVE COVERING THE ABOVE ITEMS AS THOUGH REPEATED HEREON.

ORIGINAL

ATTACHMENT 5

TO BESU 842466

METHOD OF DETERMINING ACCELERATED AGING PARAMETER TO SIMULATE SERVICE AGING OF RAYCHEM FLAMETROL™ CABLES INSTALLED AT BSEP

Raychem

METHOD OF DETERMINING ACCELERATED AGING PARAMETERS TO SIMULATE SERVICE AGING OF RAYCHEM-FLAMTROL™ CABLES INSTALLED AT BRUNSWICK STEAM ELECTRIC PLANT

February 1983

Raychem Corporation
300 Constitution Drive
Menlo Park California 94025

INTRODUCTION

Certain qualification test procedures are intended to determine if components will perform satisfactorily during transient adverse environmental conditions that may occur at any time during the design life of the component. To satisfy such test requirements, it is necessary to pre-condition some of the test specimens in a way that produces degradation equivalent to that which would occur over the service period of interest. To accomplish such pre-conditioning in a reasonable time, accelerated aging techniques are used where specimens are aged at a temperature above the applicable service temperature for a relatively short period.[1] The purpose of this discussion is to describe the analysis used to determine the appropriate accelerated aging condition (time and temperature) for simulating thermal aging of Raychem-Flamtrol™ cables at 66°C for 8 years and 40 years.

GENERAL BACKGROUND

In accordance with chemical reaction rate theory, the relationship between time to failure (L), as defined by a specified test end point, and absolute exposure temperature (K) is given by the Arrhenius equation: $\log (L) = A - BE(1/K)$, where A and B are constants and E is the activation energy of the rate controlling mechanism. Therefore, a typical plot of thermal aging data, where logarithmic average life is plotted against the reciprocal absolute temperature, results in a straight line, as shown in Figure 1, over the temperature range where E is constant. Because B, which is the reciprocal of the gas constant, is the same for all materials, the slope of the thermal life curve is determined by E, the activation energy. Therefore, in the temperature range where the straight line relationship is applicable (constant slope), the activation energy is constant, so each point on the curve represents a condition (time and temperature) which results in the same degree of degradation. In Figure 2, for example, the effect of thermal aging over a period L_1 at a temperature

GENERAL BACKGROUND (Cont'd)

T_1 can be duplicated by aging for a much shorter period L_2 at a higher temperature T_2.

In the present case, it is necessary to determine the accelerated aging conditions that will produce the same degree of degradation that will be caused by thermal aging at service temperature for prescribed periods. In Figure 3, the point (L_3, T_3) represents the service aging condition, which lies below the thermal life curve. This means that the component will not have reached end of life, as defined above, during its service life L_3 at a temperature T_3. To simulate the amount of thermal degradation that it would experience during its service life, an accelerated aging test can be performed at condition (L_4, T_4) which lies on a straight line parallel to the thermal life curve and passing through the point (L_3, T_3), as shown in Figure 4. This process is merely an application of the Arrhenius equation, keeping activation energy constant, but defining the end point as the amount of thermal degradation occurring in service (L_3, T_3) rather than the end of life criterion used in developing the thermal life curve. Although any point on the service aging curve can be used in selecting the accelerated aging test parameters, some standards require that the temperature be chosen so as to make the aging time no less than 100 hours.[2]

DETAILED ANALYSIS

The following analysis was used to determine the appropriate aging temperature to be used in a 100-hour accelerated aging period to simulate service aging at 66°C for 8 and 40 years respectively. It consists of applying the procedure described above to the actual thermal life data for Raychem-Flamtrol.[3] The applicable portion of the Arrhenius plot

DETAILED ANALYSIS (Cont'd)

is shown in Figure 5.*

The coordinates of points A and B in Figure 5 were determined by a regression line analysis of the thermal aging data. Point C represents the service condition of 40 years at 66°C. The service aging curve passes through point C and is parallel to the thermal life curve. The point at which the service aging curve intersects the 100-hour line represents the aging temperature required to produce the same degree of thermal degradation in 100 hours that would occur in 40 years at a service temperature of 66°C. It can be seen that the required temperature is about 140°C.

It is more rigorous to calculate the temperature by applying analytical geometry to the following known information:

	Point A	Point B	Point C	Point D
time	215 days	1850 days	40 years	100 hours
temperature	150°C	127°C	66°C	—

Converting time to hours and degrees Celsius to Kelvin, gives

	Point A	Point B	Point C	Point D
log (hrs)	3.713	4.647	5.545	2.000
$10^5/K$	236	250	295	x

At temperatures higher than 150°C, the rate controlling mechanism is oxygen diffusion, rather than thermal oxidation, and the slope of the curve changes to reflect the lower activation energy of the diffusion process. However, this phenomenon does not enter into the present analysis.

DETAILED ANALYSIS (Cont'd)

Therefore, the slope, m, of the thermal life curve, which passes through A and B, is given by

$$m = \frac{3.713 - 4.647}{236 - 250} = .0667$$

Because the service life curve, which passes through the points C and D, must have the same slope, it follows that

$$.0667 = \frac{5.545 - 2.000}{295 - X}$$

and

$$X = 241.85$$

Substituting $10^5/K$ for X, and solving for K gives

$$10^5/K = 241.85$$
$$K = 413.4$$
$$^{o}C = K - 273 = 140.4$$

Therefore, the appropriate accelerated aging condition corresponding to 40 years at 66°C is 100 hours at 140°C.

A similar calculation to determine the appropriate temperature required to simulate 8 years at 66°C yields

$$.0667 = \frac{4.846 - 2.000}{295 - X}$$

where 4.846 is the log (hrs) corresponding to 8 years. Solving for X gives

DETAILED ANALYSIS (Cont'd)

$$X = 252.3$$
$$10^5/K = 252.3$$
$$K = 396.4$$
$$^{o}C = 123.4$$

so the appropriate accelerated aging condition is 100 hours at 123°C.

REFERENCES

1. IEEE Std 383-1974, IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations.

2. IEE Std 323-1974, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

3. Raychem-Flamtrol Thermal Aging Study, Final Report, Raychem Laboratory Report No. 5160, April 1980.

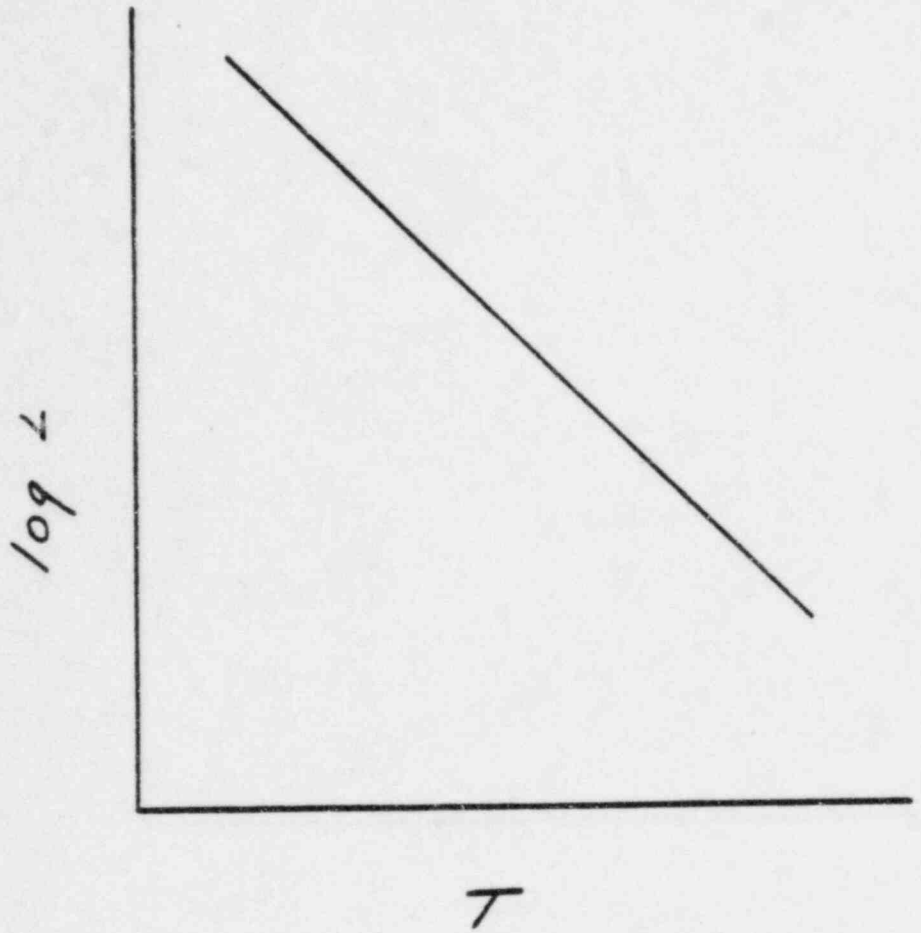


Figure 1. Model Arrhenius plot. Logarithmic average life vs. temperature. (Inverse, absolute, reciprocal seale)

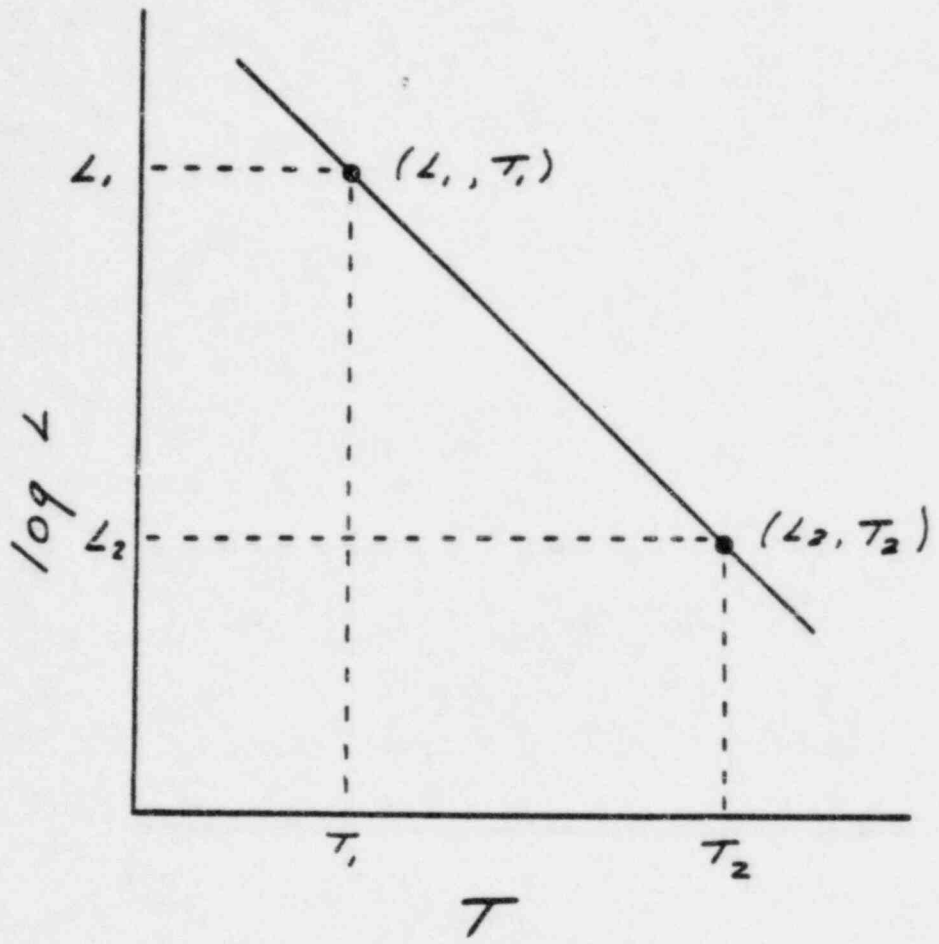


Figure 2. Model Arrhenius plot. Aging conditions (L_1, T_1) and (L_2, T_2) produce the same degree of thermal degradation.

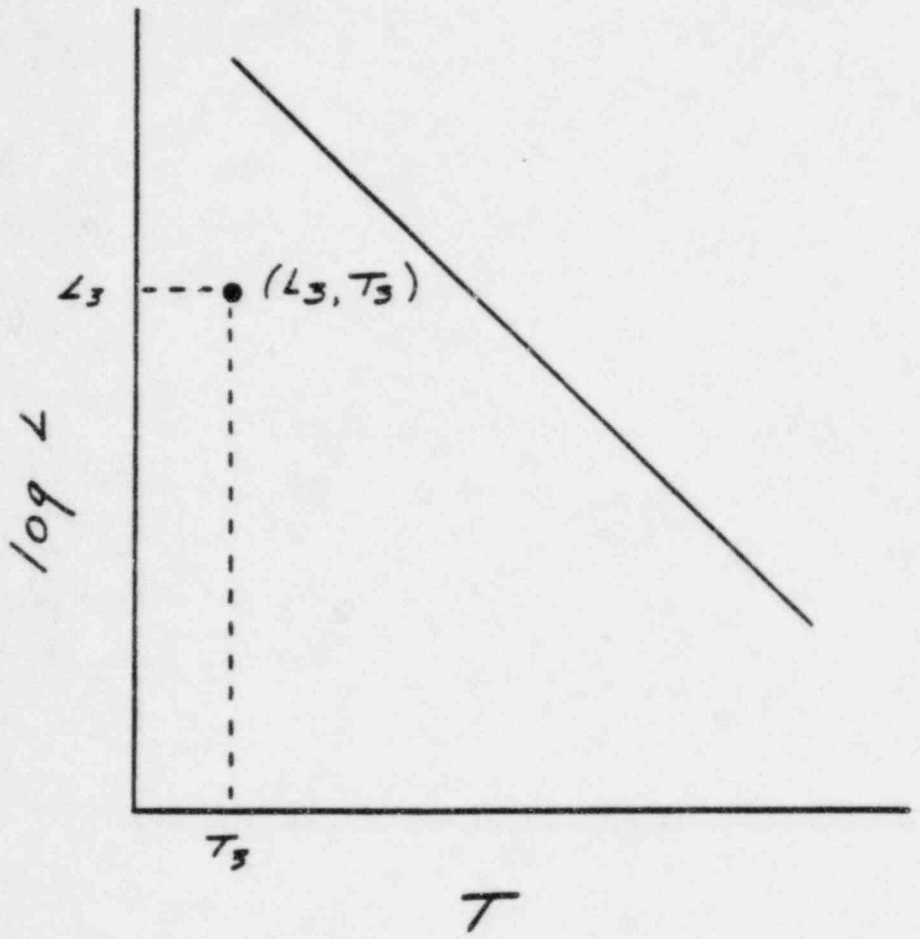


Figure 3. Model Arrhenius plot. Point (L_3,T_3) represents service aging condition.

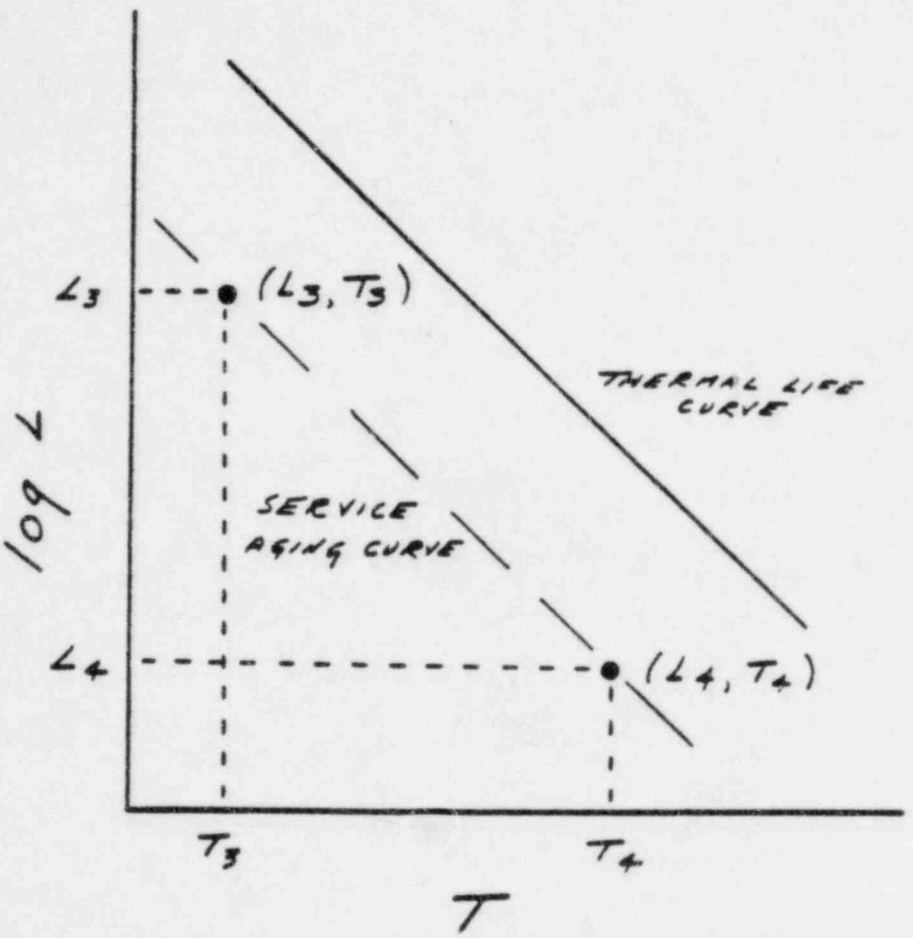


Figure 4. Accelerated aging condition (L_4, T_4) lies on service aging curve which is drawn through service aging condition (L_3, T_3) and parallel to thermal life curve.

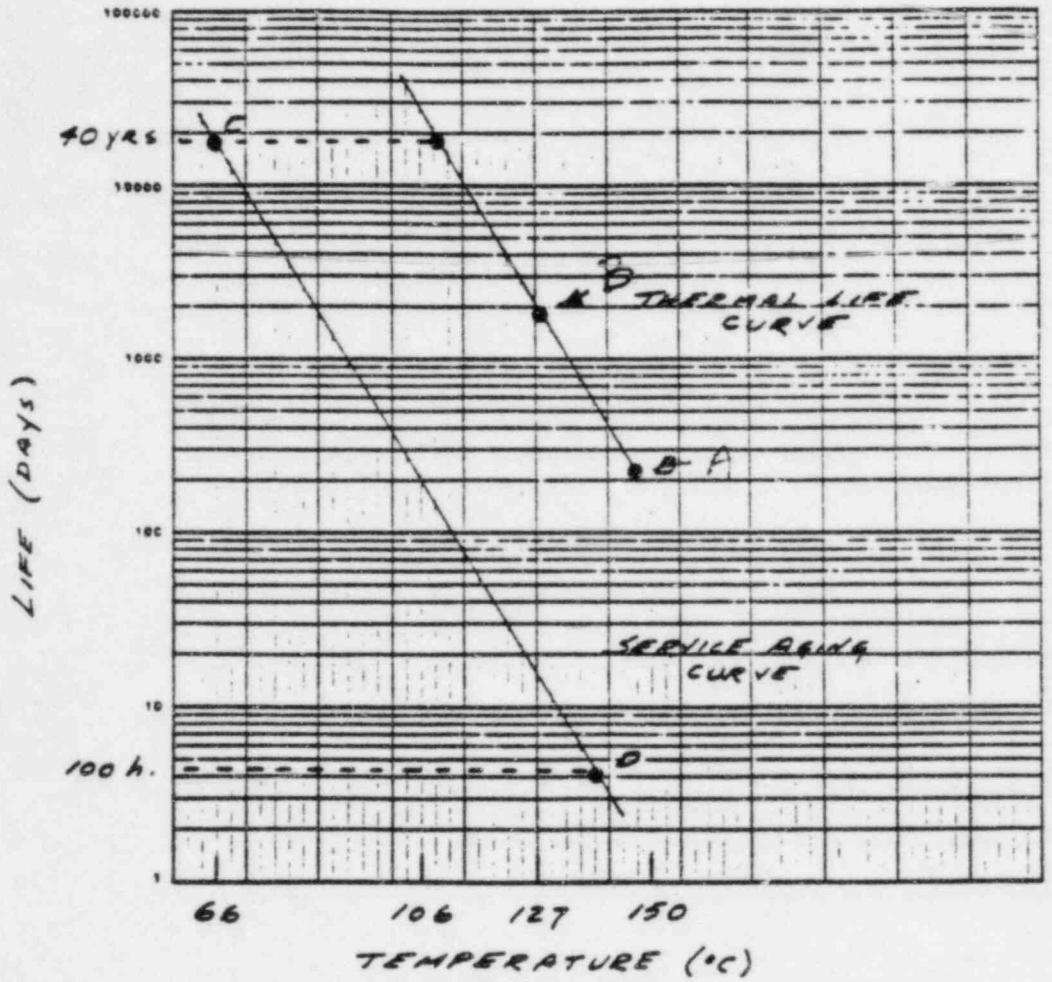


Figure 5. Accelerated aging condition (Point D) to simulate service aging at 66°C for 40 years (Point C) based on thermal life curve for Raychem-Flamtrol.

ENCLOSURE 1

TO BESU 842466

RAYCHEM LETTER TO CP&L DATED OCTOBER 16, 1984 WITH

ATTACHMENTS 1, 2, AND 3

Raychem

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025

Telephone 415) 361 3333
TWX 910 373 1728
Telex 34 8316

October 16, 1984

Mr. David Rhyne
Carolina Power & Light Company
Brunswick Steam Electric Plant
P. O. Box 11060
Southport, NC 28461

Dear Dave:

The purpose of this letter is to provide the information that you requested concerning the cable specimens used in the test program described in Wyle Laboratories Test Report No. 58883, dated 24 August 1984. The following attachments should satisfy your requirements:

Attachment (1). CP&L Purchase Order Number 18696, which describes cable lengths shipped to Raychem from BSEP for the purpose of determining if component wires had been affected by space charge phenomena during jacket irradiation.

Attachment (2). Test Report EM #2923, Raychem-Flamtrol™ Cable, Pre-LOCA Test Inspection, E. J. McGowan, dated May 7, 1984. This report was submitted to you on May 25, 1984. It summarizes results of tests witnessed by you that demonstrate that the component wires of cable CG12-400 were affected by space charge phenomena during jacket irradiation.

Attachment (3). Letter from E. J. McGowan to Luther Goad, Wyle Laboratories, dated August 9, 1984, which describes how the cables specimens were mounted on the test mandrels, provides insulation resistance values measured on the mounted specimens, and includes a copy of the shipping authorization showing that the mandrels were shipped to International Nutronics on May 9, 1984, via Crescent Truck Lines (B/L Number 48779).

In summary, the attached documents were generated during the following sequence of events:

(a) Cable samples were shipped to Raychem by CP&L, BSEP.

(b) The lot with the largest quantity (CG 12-400) was selected for use in the test program.

(c) A length of this cable was disassembled in your presence and electrical tests were performed which showed that some of the

Raychem

components of this cable had been affected by space charge phenomena during jacket irradiation. These tests were also witnessed by you.

(d) Specimens taken from this same lot were mounted on mandrels, insulation resistance measurements were made, and the mandrels were then secured in shipping crates.

(e) The crates were shipped to International Nutronics where they were subjected to prescribed radiation doses and then transferred to Wyle Laboratories, Norco, CA.

As you know, the original jacket marking, which provides product and reel identification, was legible, so there was no chance of confusion regarding the identification of the material tested.

I hope that the information provided herein satisfies your requirements, but do not hesitate to call me if I can be of further assistance.

Sincerely,

Louis J. Frisco

Louis J. Frisco
General Manager
Wire & Cable Division

cc: E. J. McGowan

ATTACHMENTS

PAGE 1 OF 2

CAROLINA POWER & LIGHT COMPANY

NUCLEAR PLANT CONSTRUCTION DEPARTMENT
Brunswick Steam Electric Plant
P. O. Box 11060
Southport, N. C. 28461

PURCHASE ORDER
ATTACHMENT (1).

PURCHASE ORDER NUMBER
B-18696

NOTE: ORDER NUMBER **MUST** APPEAR ON ALL INVOICES, CORRESPONDENCE, SHIPPING PAPERS AND CARTONS

ORDER DATE	SHIPMENT PROMISED BY	SHIP VIA	FOB	TERMS	REQ. NO	BUYER CODE
1/10/83	ASAP	BW	SP	N/30	18696	TE/jc

SUPPLIER

Raychem Corp.
Wire & Cable Receiving
2971 Spring St.
Redwood City, CA 94063

Attention: Glen Barcellos

IMPORTANT INSTRUCTIONS

1. ADDRESS ORIGINAL & (2) COPIES OF YOUR ITEMIZED INVOICE TO THE ABOVE ADDRESS ATTENTION ACCOUNTS PAYABLE DEPARTMENT
2. ATTACH ORIGINAL BILL OF LADING OR SHIPPING RECEIPT TO INVOICE
3. INVOICE MUST SHOW ITEM NUMBER SHOWN ON PURCHASE ORDER
4. WHEN PREPAID ATTACH ORIGINAL TRANSPORTATION RECEIPT
5. EACH DISCOUNT PERIOD WILL DATE FROM RECEIPT OF INVOICE CORRECTLY EXECUTED

ITEM	DESCRIPTION	QUANTITY	UNIT	NET UNIT PRICE	TOTAL PRICE
	ORIGINAL NOTIFICATION				
1	Cable/Reel CG12233	110	ft	Price per Invoice	
2	Cable/Reel CG12256	114	ft	Price per Invoice	
3	Cable/Reel CG12338	160	ft	Price per Invoice	
4	Cable/Reel CG12348	146	ft	Price per Invoice	
5	Cable/Reel CG12382 (See Note)	138	ft	Price per Invoice	
6	Cable/Reel CG12400	214	ft	Price per Invoice	

("Q" List / 79-01B Program)

Note - Cable CG12382 two pieces, one @ 124', one @ 14', 138' Total

Cable being shipped to Raychem to Determine if defect (space change) is present.

PURCHASE ORDER NUMBER MUST BE SHOWN ON ALL SHIPMENTS, INVOICES, AND CORRESPONDENCE.

INVOICE SHOULD BE SENT TO:
CAROLINA POWER & LIGHT COMPANY
ACCOUNTS PAYABLE UNIT
P.O. BOX 11060
SOUTHPORT, N.C. 28461

SHIP TO:
CAROLINA POWER & LIGHT COMPANY
CONSTRUCTION DEPT.
BRUNSWICK STEAM ELECTRIC PLANT
SOUTHPORT, N.C. 28461
ATTENTION: MR. R. J. GROOVER, JR.

W. Guarino

N.C. SALES TAX CERTIFICATION REGISTRATION NO. 7

USE & CHARGE
79-01B
H21H3-53199-0A18

JRL 1-10-83

The above order is subject to all instructions, terms and conditions set forth on the face and reverse side hereof. This Order expressly limits acceptance to the terms stated herein, and any additional or different terms proposed by the Seller are rejected unless assented to in writing.

CAROLINA POWER & LIGHT COMPANY

BY T. Ellis

T. Ellis

DATE 1-10-83

NOTE: Attached Acceptance of this Order must be returned to attention of the Purchasing Dept. Only when required as stipulated in Condition 1 on the reverse.

ORIGINAL

CAROLINA POWER & LIGHT COMPANY
NUCLEAR PLANT CONSTRUCTION DEPARTMENT
Brunswick Steam Electric Plant
P. O. Box 11060
Southport, N. C.28461

PURCHASE ORDER
CONTINUATION SHEET

PURCHASE ORDER NUMBER
B-18696

ITEM	DESCRIPTION	QUANTITY	UNIT	NET UNIT PRICE	TOTAL PRICE
	Please acknowledge receipt and acceptance of this purchase order by return mail.				
	W. Guarino				

ALL TERMS AND CONDITIONS ON THE FACE AND REVERSE SIDE OF THE SIGNED SHEET ARE EFFECTIVE COVERING THE ABOVE ITEMS AS THOUGH REPEATED HEREON

ORIGINAL

Raychem

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025

Telephone 415) 361 3333
TWX 910 373 1728
Telex 34 8316

Test Report EM #2923

Date **May 7, 1984**

xc: L. J. Frisco

Memo to **Information File**

ATTACHMENT (2).

From **E. J. McGowan**

File

Subject **RAYCHEM-FLAMTROL CABLE, PRE-LOCA TEST INSPECTION**

OBJECT

Insulation resistance and breakdown voltage tests were performed on components taken from a Raychem-Flamtrol insulated, unshielded, jacketed, multiconductor cable to determine if they had been affected by space charge effects during jacket irradiation. The cable specimen was taken from a lot of unused cable provided by Carolina Power and Light Company, which had been shipped from their Brunswick Steam Electric Plant to Raychem. The purpose of the tests was to determine if this particular lot of cable is a suitable sample to be used in subsequent adverse environment testing.

MATERIAL

The test specimen was cut from a length of cable identified by the following marking on the cable jacket:

RAYCHEM-FLAMTROL™-1000V CONTROL-7/c-12AWG-1973-CG12 400

TEST PROCEDURE

The jacket was removed from a 15-foot length of cable and the components were disassembled. The central 10-foot section of each component was immersed in water for a period of about 22 hours. The insulation resistance of each component was then measured with a G.R. Megohmmeter at 500 V d-c. The a-c breakdown voltage of each component was then measured with a Beckman High Voltage Power Supply, using a rate of rise of 500 volts per second.

The disassembly of the cable and the measurements described above were witnessed by D. R. Rhyne of CP & L.

DETAILED RESULTS

The test results are summarized in Table 1 below.

TABLE 1.

Component Color	Insulation Resistance (ohms)	Breakdown Voltage (kV)
Red	2.8×10^{12}	3.2
Green	4.0×10^{12}	3.1
White	6.0×10^{12}	1.7
Black	1.5×10^{13}	28.7
Blue	4.0×10^{10}	2.2
Orange	5.0×10^{12}	3.3
White/Black	1.0×10^{13}	25.1

COMMENTS

The insulation resistance values were in the expected range, although the value for the blue component was slightly below average.

The breakdown voltage values clearly demonstrate that five of the components were affected by space charge effects during jacket irradiation, as evidenced by decreased electric strength. Therefore, this particular lot of cable (CG12-400) is a suitable sample for use in adverse environment testing to be conducted by CP & L.

E. J. McGowan

EJMcGowan-5/7/84

Raychem

ATTACHMENT (3).

August 9, 1984

Mr. Luther Goad
Wyle Laboratories
1841 Hillside Avenue
Norce, CA 91760

Dear Luther,

The accompanying data sheet lists the insulation resistance values measured on the Raychem-Flamtrol cables provided by CP&L before the cables were shipped to International Nutronics for irradiation. The number in the upper righthand corner (UE&C9527-01-113-4B) is the number used by CP&L in the program outline under cable description. This number was also used on the shipping boxes containing the cable specimens mounted on the test mandrels.

The cable is further identified on the laboratory notebook pages preceeding the insulation resistance data. A description of how the cables were attached to the mandrels before the measurements were made is included on these pages which are also attached.

To further trace these cables, a copy of the shipping paper when the boxed cables were sent International Nutronics is enclosed.

Sincerely,

E.J. McGowan
Mgr. Technical Services
GSD.

EJM/ts

Enclosures

Subject: 120 MIL WIRE LOCA Date: 5-8-84

CABLE RECIEVED FROM ED McGowan on 5-7-84

CABLE:
RAYCHEM FLAMTROL™
100 V CONTROL
7/c #12 AWG
1975-C612 400

2 EA TWELVE FOOT SECTIONS OF CABLE WERE CUT FROM EACH END OF CABLE SUPPLIED

THE (4) FOUR TEST SAMPLES WERE THEN CLEANED WIPED DOWN USING 1,1,1 TRICHLOROETHANE ON A PAPER TOWEL

(6) SIX INCHES OF THE CABLE JACKET WAS REMOVED FROM EACH END OF THE (4) FOUR SAMPLES

SINGLE CONDUCTOR INSULATION WAS STRIPPED BACK APPROX 1/4 IN.

BENTLEY-HARRIS GLASS SLEEVING LOT# RE-3457 WAS CUT TO APPROX 1.5" LENGTHS / TWO LAYERS WERE PLACED APPROX EVERY 12 INCHES

PANDUIT STAINLESS STEEL TIES IN CONJUNCTION WITH THE GLASS SLEEVING WAS USED TO SECURE SAMPLES TO THE STAINLESS STEEL MANDRELS SUPPLIED BY ED McGOWAN

1/4" X 1.75 (CUT IN HALF LENGTH WISE) MTMS WAS USE TO IDENTIFY INDIVIDUAL SAMPLE WIRES RCN: 502462-0
MO #: 35706-09
M278

Work Directed By:

Signature	Date	Read and Understood By:	Date
[signature]	5-9-84	[signature]	8-8-84

CG12-400 fw 4-4-7

RAYCHEM CORPORATION LABORATORY NOTEBOOK
PROPRIETARY INFORMATION

№ 8050 03

Subject 120 mil Wire LOCA Date: 5-9-84

SEE PAGE 47 FOR COLOR-NUMBER SEQUENCE

IRS WERE TAKEN @ 500 V DC AFTER 1 min.
5 FOR RESULTS SEE PAGE #

(CARBOYS)
SAMPLES WERE PLACED IN THE INSIDE OF A
SHIPPING CRATE PROVIDED BY

SAMPLES TAKEN TO SHIPPING & REC. AT
5:00 5/9/84 FOR APPROPRIATE SHIPMENT
TO INTERNATIONAL NUTRONICS.
1962 BARANCA RD
IRVINE CA 92714

SAMPLE #
(R93201)

Work Directed By:

Signature	Date	Read and Understood By:	Date
[signature]	5-9-84	[signature]	8-8-84

Subject: Pre Irradiation IRs LAP-82-458 Date: 5-9-84 UEC 9527-01-113-Y1

IR's at 500 volts DC for 1 min
Instrument Gen Rad 1864 Serial No. 1733
Measurements made between each wire and all the other wires and the mandrel
Measurements made at room temperature in air.

Wire	IR
AS-1	3.5×10^{12}
AS-2	3.5×10^{12}
AS-3	3×10^{12}
AS-4	3.5×10^{12}
AS-5	4×10^{12}
AS-6	5×10^{12}
AS-7	5×10^{12}
AO-1	4×10^{12}
AO-2	4×10^{12}
AO-3	3×10^{12}
AO-4	3.5×10^{12}
AO-5	5×10^{12}
AO-6	4.5×10^{12}
AO-7	4.5×10^{12}
BS-1	4.5×10^{12}
BS-2	5×10^{12}
BS-3	4.5×10^{12}
BS-4	4×10^{12}
BS-5	7.1×10^{12}
BS-6	6.8×10^{12}
BS-7	6.6×10^{12}
BO-1	8.4×10^{12}
BO-2	5.8×10^{12}
BO-3	4.5×10^{12}
BO-4	5.5×10^{12}
BO-5	8.2×10^{12}
BO-6	9.4×10^{12}
BO-7	7.8×10^{12}

Work Directed By:

Signature	Date	Read and Understood By:	Date
[signature]	5-9-84	[signature] 5-9-84	5-9-84

Raychem

Literature Requisition

Raychem Corporation
300 Constitution Drive
Menlo Park, California 94025

To International Nutronics
1962 Baranca Road
Irvine, CA 92714

ATTENTION:
Bob Baldwin

R 93201

Requester	Date	Ship To Arrive By
Milo Anderson	5-9-84	5-10-84

Ship Prepaid Via: ☐ Charge ☐ Air Mail ☐ 1st Class Mail UPS ☐ Truck ☐ Air Other Crescent Truck Lines

Item No.	Qty. Ordered	Qty. Shipped	Description
1.	2ea		Test Samples LAP-83-450 U.E.&C Spec. 9527-01-113-48

RECEIVED
MAY 14 1984

Energy 8115

Field Sales Office Copy To:
M. Anderson
E. McGowan

Remarks:
CRATES

The Section To Be Completed By Shipping Department Only

Date Shipped	B/L Number	Number of Pieces	Weight	Prepaid Charges	Shipped By
5-9-84	45779	2	245		

CUSTOMER SERVICE

HO1344 (Rev. 4/83)