PROMATEC®
TECHNOLOGIES, INC.

FINAL REPORT
CTP-2010

DESIGN BASIS ACCIDENT TESTING ON 3M INTERAM™ FLEXIBLE FIRE WRAP

WYLE LABORATORIES REPORT NO. 46979-1

July 27, 1998

P.O. BOX 309 • CYPRESS, TEXAS 77410-0309
(281) 373-4040 • TELEFAX (281) 256-2694

01PRO98008

PROMATEC®
TECHNOLOGIES, INC.

CTP-2010
October 17, 2001

FOREWORD

This forward shall serve as notice of review by the Quality Assurance Manager as stated in QAM20188, Issue E, dated December 31, 1998, Section XI, paragraph 4.5.

The Promatec Quality Assurance Department has approved the applicable procedures, monitored the construction of the test specimens and monitored the application of the fire proofing material. This Department has verified maintenance of complete documentation of the fireproofing material application and hereby verifies that approved procedures were utilized in the application of fire proofing material into various assemblies.

The application installation and inspection procedures referenced herein are considered PROPRIETARY and therefore excluded from the contents of this documentation package. Promatec will provide these procedures to interested parties upon written request.

Copies of the applicable manufacturer's Certificates of Compliance are available from the Promatec Quality Assurance Department upon written request and are therefore excluded from the contents of this documentation package.

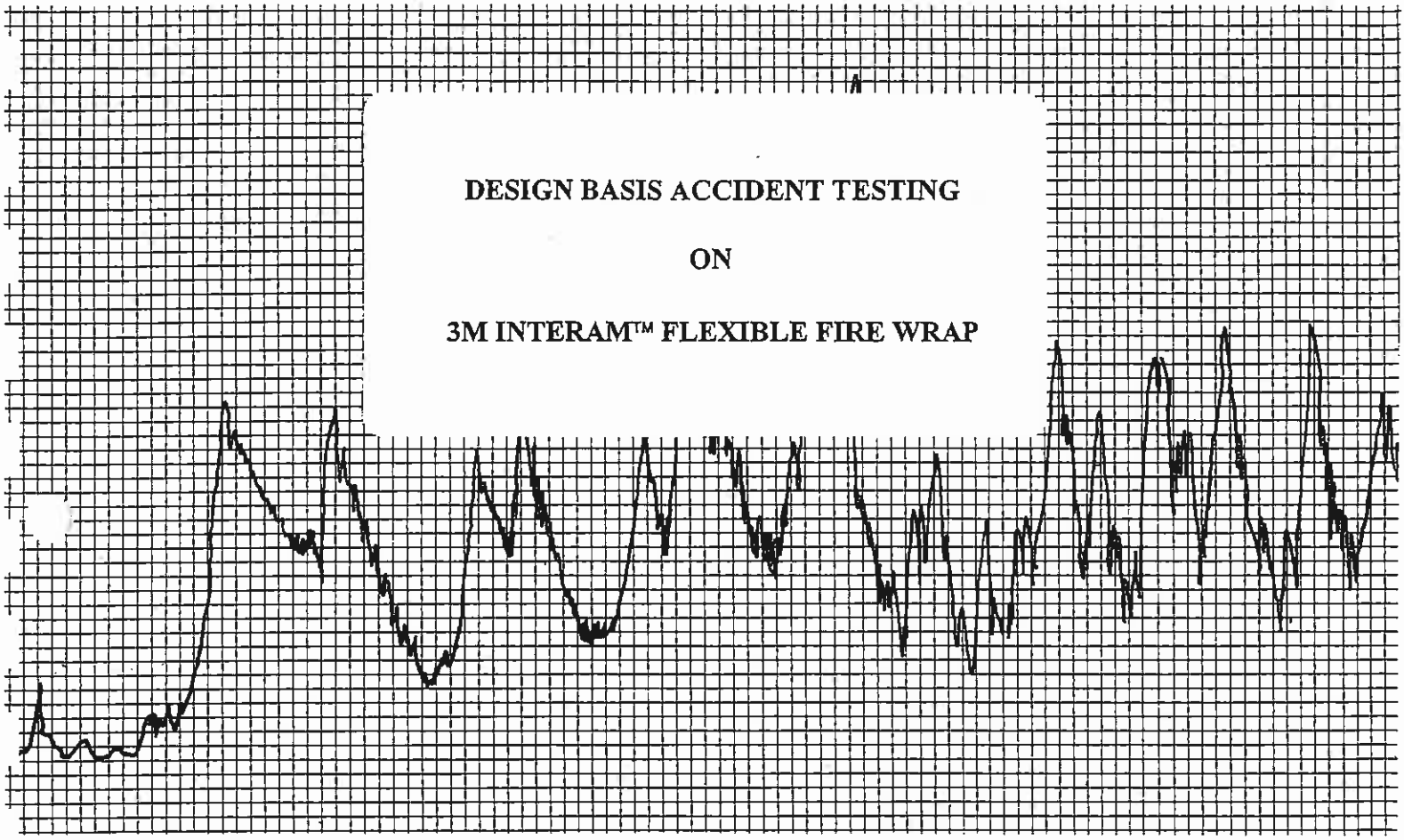
The Quality Assurance/Quality Control functions performed by Promatec personnel are governed within the applicable sections of the Promatec Quality Assurance Program and the applicable Quality Control Procedures.

Dorcas Smithwick
Quality Assurance Manager

P.O. BOX 309 • CYPRESS, TEXAS 77410-0309
(281) 373-4040 • TELEFAX (281) 256-2694

wyle laboratories

Huntsville, Alabama



DESIGN BASIS ACCIDENT TESTING

ON

3M INTERAM™ FLEXIBLE FIRE WRAP

NEQ

NUCLEAR ENVIRONMENTAL QUALIFICATION

REPORT

DESIGN BASIS ACCIDENT TESTING

ON

3M INTERAM™ FLEXIBLE FIRE WRAP

For

Promatec Technologies, Inc.
P. O. Box 309
Cypress, TX 77410

NEQ
Nuclear Environmental Qualification Test Report

wyle laboratories

REPORT NO.	46979-1
WYLE JOB NO.	46979
CUSTOMER P. O. NO.	2252
PAGE 1 OF	68 PAGE REPORT
DATE	July 6, 1998
SPECIFICATION(S)	See References in Paragraph 5.0

1.0 CUSTOMER Promatec Technologies Inc.

ADDRESS P. O. Box 309, Cypress, TX 77410

2.0 TEST SPECIMEN 3M Interam™ Flexible Fire Wrap

3.0 MANUFACTURER See Paragraph 6.0

4.0 SUMMARY

Flexible Fire Wrap, as described in Paragraph 6.0 and hereinafter called the specimens, were subjected to a test program as required by Promatec Technologies, Inc., Purchase Order 2252. This test program was performed on June 19 through July 1, 1998.

The test program consisted of the following:

- Receipt Inspection
- Radiation Exposure
- LOCA Simulation
- Post-Test Inspection

The specimens completed the required test as specified in Promatec Technologies Inc. Purchase Order 2252.

Test requirements, procedures, and results are described in Paragraphs 9.0, 10.0, and 11.0 of this report.

STATE OF ALABAMA
COUNTY OF MADISON } ss. Alabama Professional Engineer Reg. No. 16011

Joseph T. Hazeltine, PE, being duly sworn, deposes and says: The information contained in this report is the result of complete and carefully conducted testing and is to the best of his knowledge true and correct in all respects.

Joseph T. Hazeltine

SUBSCRIBED and sworn to before me this 27th day of July, 1998

Susan A. Bridges SEAL

Notary Public in and for the State of Alabama at Large

My Commission expires September 5, 2001

Wyle shall have no liability for damages of any kind to person or property, including special or consequential damages, resulting from Wyle's providing the services covered by this report.

PREPARED BY Robert Hardy 7/27/98
Robert Hardy, Project Engineer

APPROVED BY Rod Thornberry 7-27-98
Rod Thornberry, Project Manager

WYLE Q. A. R. G. Thomas 7-28-98
R. G. Thomas, Q.A. Manager

wyle laboratories

Huntsville, Alabama

(bds)

5.0 REFERENCES

- Promatec Technologies, Inc., Purchase Order No. 2252
- Wyle Laboratories' Quotation No. 543/6144/DB
- Promatec Technologies, Inc., Test Plan No. CTP-2010, Revision 3, "Design Basis Accident Testing (LOCA) of 3M Interam™ Flexible Fire Wrap"
- ASTM D 3911-95 "Standard Test Method for Evaluating Coatings used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions"
- 10 CFR 21, "Reporting of Defects and Non-Compliance"
- 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants"
- Wyle Laboratories' Quality Assurance Program Manual, Revision 1

6.0 SPECIMEN DESCRIPTION

The specimens for this test program consisted of two 24" wide x 4" deep x 24" long cable trays, each covered with three layers of Interam E54C fire wrap. The Promatec Test Plan contained in Appendix VIII of this report contains a detailed description of the test specimens.

Both specimens were prepared by Promatec and shipped to Wyle Laboratories separately.

One of the specimens was exposed to a gamma radiation source after being received by Wyle while the other was tested as received from Promatec without any radiation exposure.

7.0 QUALITY ASSURANCE

All work on this test program was performed in accordance with Wyle Laboratories' Quality Assurance Program, which complies with the applicable requirements of 10 CFR 50, Appendix B, ANSI N45.2, and the Regulatory Guides.

The Wyle Laboratories, Huntsville Facility, Quality Management System is registered in compliance with the ISO-9001 International Quality Standard. Registration has been completed by Quality Management Institute (QMI), A division of the Canadian Standards Association (CSA).

8.0 TEST EQUIPMENT AND INSTRUMENTATION

All instrumentation, measuring, and test equipment used in the performance of this test program were calibrated in accordance with Wyle Laboratories' Quality Assurance Program which complies with the requirements of ANSI/NCSL Z540-1, ISO 10012-1, and Military Specification MIL-STD-45662A. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

9.0 REQUIREMENTS

The specimens shall be subjected to the following:

- Receipt Inspection
- Radiation Exposure (one specimen only)
- LOCA Simulation
- Post-Test Inspection

10.0 PROCEDURES

10.1 Receipt Inspection

An inspection was performed upon receipt of the specimens at Wyle Laboratories. The specimens were checked to ensure that they were as described in Paragraph 6.0. Additionally, the specimens were visually inspected for any physical damage. Photographs were taken of the specimens during the Receipt Inspection.

10.2 Radiation Exposure

One specimen (designated as the irradiation specimen and marked accordingly) was exposed to gamma radiation using a Cobalt-60 source. The total dose for the exposure was 2.042E8 rads gamma (see Appendix IV for the radiation facility report).

The radiation exposure was measured as air equivalent gamma using a Cobalt-60 source at a dose rate average of 7.906E5 and 2.557E5 rads per hour (two series were performed on the specimen to achieve the total dose). The dose rate was measured at the geometric centerline of the specimen.

10.0 PROCEDURES (Continued)

10.3 LOCA Simulation

10.3.1 Test Setup

10.3.1.1 Specimen Installation

The specimens were installed in a Wyle-provided test chamber by placing them on a steel frame prepared for that purpose. The specimens were in contact only with the steel cable trays, no contact was made with the fire wrap material. The specimens were positioned so that there was no direct impingement of the steam used to heat the test chamber. The specimens were placed in the horizontal orientation as they would be in an installed location. The specimens were placed in such a way that the chemical spray was at the top of the specimens and covered a horizontal plane, which was equal to approximately 0.15 gpm per square foot.

10.3.1.2 Monitoring

Three thermocouples were placed at points along the specimens. Each of the three thermocouples was placed within 2" of a specimen. The average of these three thermocouples was used to control the test chamber temperature. The test chamber temperature, pressure, and chemical spray flow rate were recorded throughout the duration of the test. Temperature, pressure, and flow rate versus time plots are contained in Appendix V.

10.3.2 Accident Test

The test chamber temperature was increased to approximately 120°F and held for a minimum of 30 minutes prior to the start of the accident simulation. The accident profile shown in Figure 1 in Appendix II was used for the application of steam and pressure for the Accident Test with the exception of the initial peak (2.7 hours). The initial peak temperature was 283°F and the initial peak pressure was approximately 38 psig per the requirements of the Promatec Technologies' test plan. After the 2.7-hour point, the profile shown in Figure 1 was followed. The initial transient was performed on a best-effort basis. The transient was continued until the peak conditions were achieved. The duration of the test was 283 hours.

Starting at approximately the 2.7-hour point of the test, chemical spray was initiated inside the test chamber. The chemical spray consisted of deionized water with 2800-ppm boric acid for an initial pH of 5.0 at approximately 80°F at the beginning of the Accident Test. At the 1.5-hour point of the chemical spray, Tri-Sodium Phosphate was added to the chemical spray and the pH was increased to 7.5. The chemical spray was captured, recirculated, and sprayed for the remaining duration of the test.

10.0 PROCEDURES (Continued)

10.3 LOCA Simulation (Continued)

10.3.2 Accident Test (Continued)

The pH of the chemical spray was measured each day and adjusted as necessary to maintain a pH of 7.0 to 7.5. The chemical spray rate was approximately 0.15 gpm/sq. ft. The chemical spray flow rate plot contained in Appendix V shows the flow rates of the chemical spray pump, which equates to 4.2 gpm for 0.15 gpm/sq. ft.

10.4 Post-Test Inspection

The specimens were visually inspected by Wyle personnel and a representative of Sargent & Lundy[LLC] following the completion of the Accident Test.

11.0 RESULTS

Following the radiation exposure, a visual inspection of the irradiated specimen revealed the specimen to be in essentially the same condition as when it was initially received.

The non-irradiated specimen was damaged when it was being placed in the LOCA test chamber. The specimen was bumped into a protrusion, which resulted in a one-inch tear in one side. The penetration depth of the tear was estimated to be 1/32 of an inch. Wyle was directed by Promatec to repair the damage by applying a single wrap of Promatec-supplied tape completely around the specimen in such a way that the tear was covered with one layer. Additionally, the tape was banded along both edges with steel banding strap. See Notice of Anomaly No. 1.

At the 45-hour and 10-minute point of the test, a steam solenoid valve on the LOCA test chamber stuck open, which caused the temperature to increase approximately 12°F above the required temperature. At that point, the redundant controller shut off steam to the test chamber. This caused the temperature of the chamber to drop until the steam solenoid valve could be replaced. The temperature of the test chamber dropped to as low as 90°F. Once the valve was replaced, the temperature of the chamber was brought back to the required value. The time below the required temperature (4 hours and 37 minutes) was added to that point of the temperature profile and testing was continued. See Notice of Anomaly No. 2.

11.0 RESULTS (Continued)

The specimens successfully completed the test program as specified in Paragraph 9.0. A post-test visual inspection revealed that the specimens were in good condition with no apparent damage and little change from the Receipt Inspection except to the non-irradiated specimen which had two edges of tape which came unstuck. Each of the two edges that came unstuck were approximately 12" in length; however, they were still securely attached to the specimen. It appeared that the tape becoming unstuck had no detrimental effects on the ability of the specimen to perform its intended function. No disintegration or dislodgment of the mat material or associated components was observed. Additionally, although no baseline weights were taken, the specimens were noticeably heavier due to water absorption. Water was found to be draining from the specimens, particularly the non-irradiated specimen where the tape had become unstuck and the blue material underneath the stainless wrap was visible.

The following appendices are included in this report:

Appendix	Contents
I	Notices of Anomaly
II	Figure
III	Photographs
IV	Radiation Facility Report
V	Accident Test Plots
VI	Instrumentation Equipment Sheet
VII	Chemical Spray pH Data Sheet
VIII	Promatec Technologies Inc. Test Plan No. CTP-2010, Revision 3

APPENDIX I

NOTICES OF ANOMALY

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wyle laboratories

ORIGINAL

NOTICE OF ANOMALY

DATE: June 18, 1998

NOTICE NO.: 1 P.O. NUMBER: 2252 CONTRACT NO.: N/A

CUSTOMER: Promatec Technologies WYLE JOB NO.: 46979

NOTIFICATION MADE TO: Mike Murphy NOTIFICATION DATE: 6/17/98

NOTIFICATION MADE BY: Bobby Hardy VIA: phone

CATEGORY: ☒ SPECIMEN ☐ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 6/17/98

PART NAME: 3M Interam flexible Fire Wrap (non-irradiated specimen) PART NO. N/A

TEST: LOCA I.D. NO. N/A

SPECIFICATION: Promatec Test Plan CTP-2010, Revision 2B PARA. NO. 10

REQUIREMENTS:

The specimen shall be subjected to a Design Basis Accident Condition (LOCA) Test per the requirements of the above referenced specification.

DESCRIPTION OF ANOMALY:

The non-irradiated specimen was damaged during the test setup.

DISPOSITION - COMMENTS - RECOMMENDATIONS:

The specimen was bumped into part of the environmental test chamber while it was being placed. The specimen was taken back out of the chamber and examined for damage. A one-inch long tear was found in the side of the specimen. The tear appeared to be just through the stainless-steel outer layer. The penetration depth of the tear was estimated to be 1/32 of an inch. Wyle was directed by Promatec to apply a single wrap of Promatec supplied stainless-steel adhesive tape completely around the specimen such that the tear was covered. Additionally, the tape was banded along both edges with steel banding strap. Attached to this Notice of Anomaly is a sketch of the repair. The customer will make the decision as to the final disposition.

RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21: ■ CUSTOMER ☐ WYLE

VERIFICATION:

PROJECT ENGINEER: Robert Hardy 6/18/98
Robert Hardy

TEST WITNESS: N/A

PROJECT MANAGER: Rod Thornberry 6-18-98
Rod Thornberry

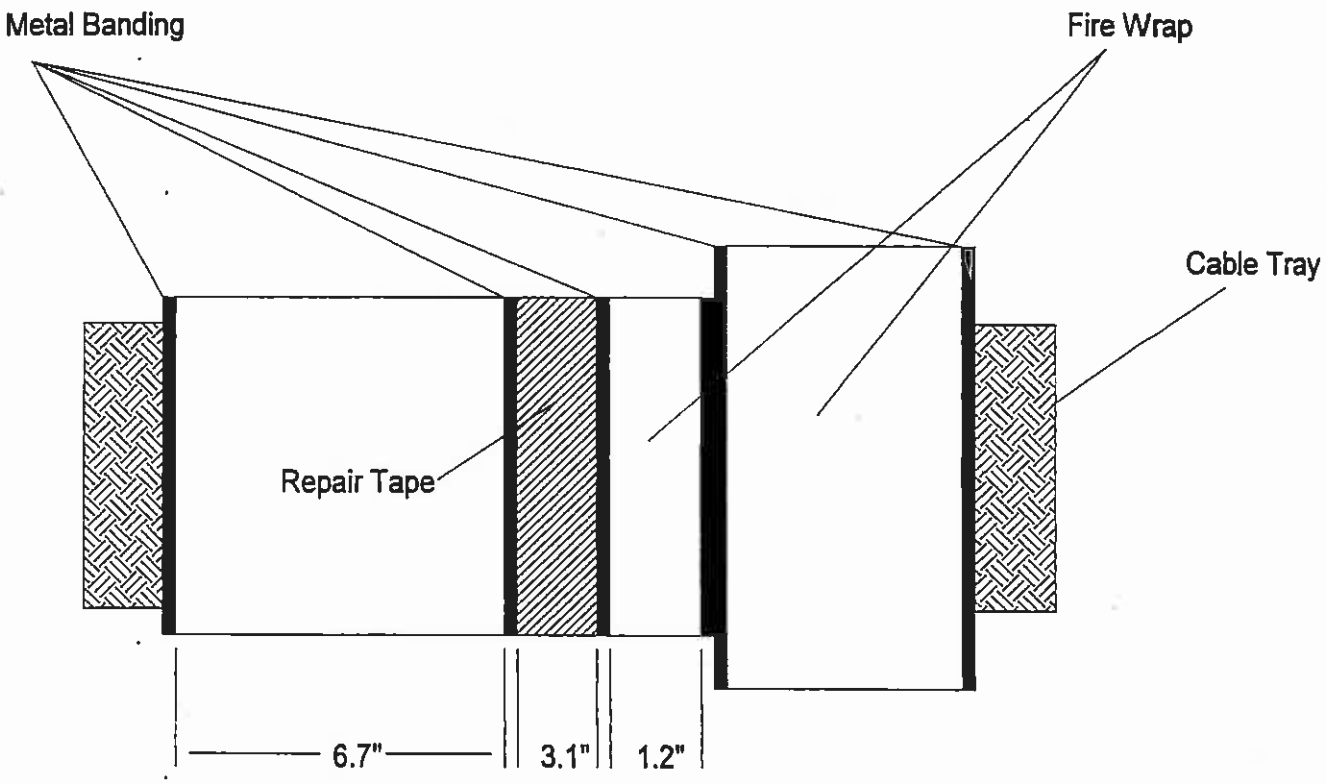
REPRESENTING: N/A

INTERDEPARTMENTAL COORDINATION:

QUALITY ASSURANCE: 6-19-98

Wyle Laboratories
Notice of Anomaly No. 1
Job No. 46979
June 18, 1998
Page 2 of 2

SIDE VIEW



wyle laboratories

ORIGINAL

NOTICE OF ANOMALY

DATE: June 23, 1998

NOTICE NO.: 2 P.O. NUMBER: 2252 CONTRACT NO.: N/A

CUSTOMER: Promatec Technologies Inc. WYLE JOB NO.: 46979

NOTIFICATION MADE TO: Mike Murphy NOTIFICATION DATE: 6/22/98

NOTIFICATION MADE BY: Bobby Hardy VIA: phone

CATEGORY: ☐ SPECIMEN ☐ PROCEDURE ☒ TEST EQUIPMENT DATE OF ANOMALY: 6/21/98

PART NAME: Flexible Fire Wrap PART NO. N/A

TEST: LOCA I.D. NO. N/A

SPECIFICATION: Promatec Test Plan No. CTP02010, Rev. 2 PARA. NO. 10.1

REQUIREMENTS:

The specimens shall be subjected to a Design Basis Accident Condition (LOCA) Test per the requirements of the above referenced test plan.

DESCRIPTION OF ANOMALY:

At 06:40 on 6/21/98 (45-hour, 10-minute point of the test), a valve on the test chamber stuck open which caused the temperature to increase approximately 12°F above the required temperature causing the redundant controller to shut down the steam to the chamber. The temperature of the chamber then dropped to as low as 90°F.

DISPOSITION - COMMENTS - RECOMMENDATIONS:

The malfunctioning valve was replaced and the temperature of the chamber was slowly brought back to the requirement of 250°F and stabilized. The total time the temperature was not within the requirement was 4 hours and 37 minutes. This amount of time will be added to the 250°F temperature plateau so that all required time at temperature is accounted for. The customer will make the decision as to the final disposition.

RESPONSIBILITY TO ANALYZE ANOMALIES AND COMPLY WITH 10 CFR PART 21: ■ CUSTOMER ☐ WYLE

VERIFICATION:

PROJECT ENGINEER: Robert Hardy 6/23/98
Robert Hardy

TEST WITNESS: N/A

PROJECT MANAGER: Rod Thornberry 6-23-98
Rod Thornberry

REPRESENTING: N/A

INTERDEPARTMENTAL COORDINATION:

QUALITY ASSURANCE: Brenda Bannister 6-24-98

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APPENDIX II

FIGURE

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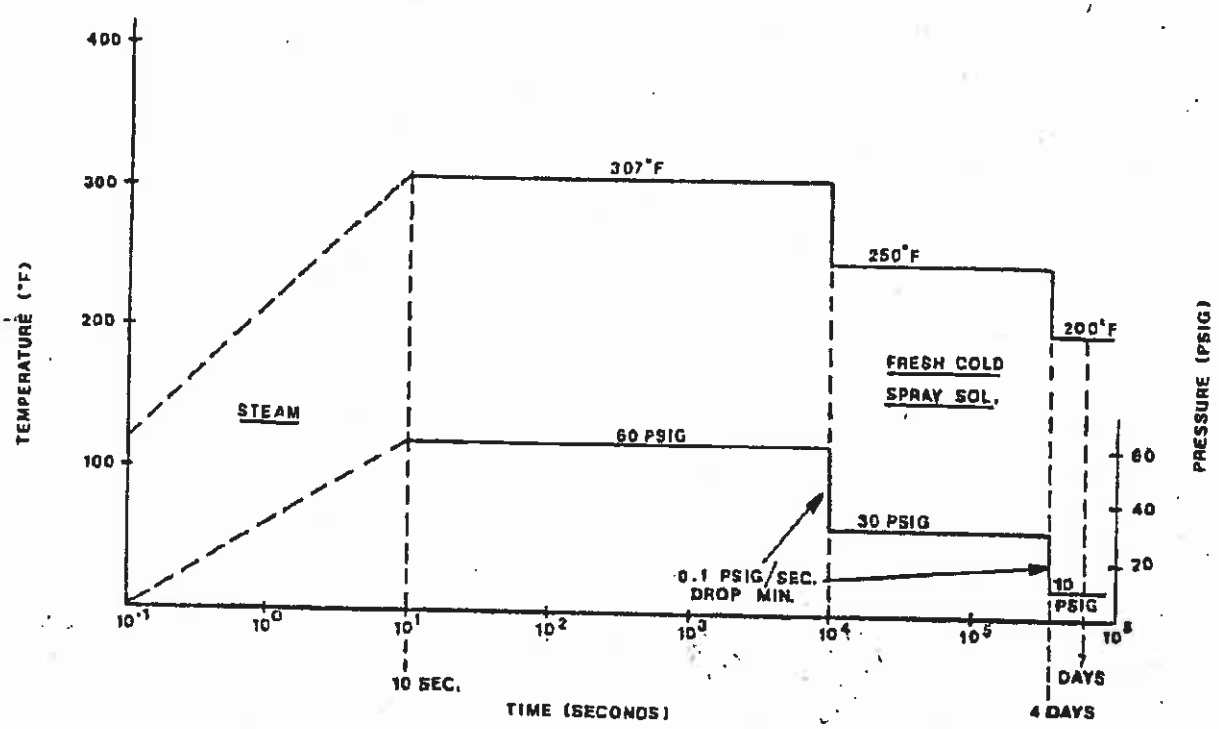
D 3911



Typical Design Basis (DBA) Testing Parameters (Temperature-Time-Pressure)—PWR Containment

Figure 1

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APPENDIX III

PHOTOGRAPHS

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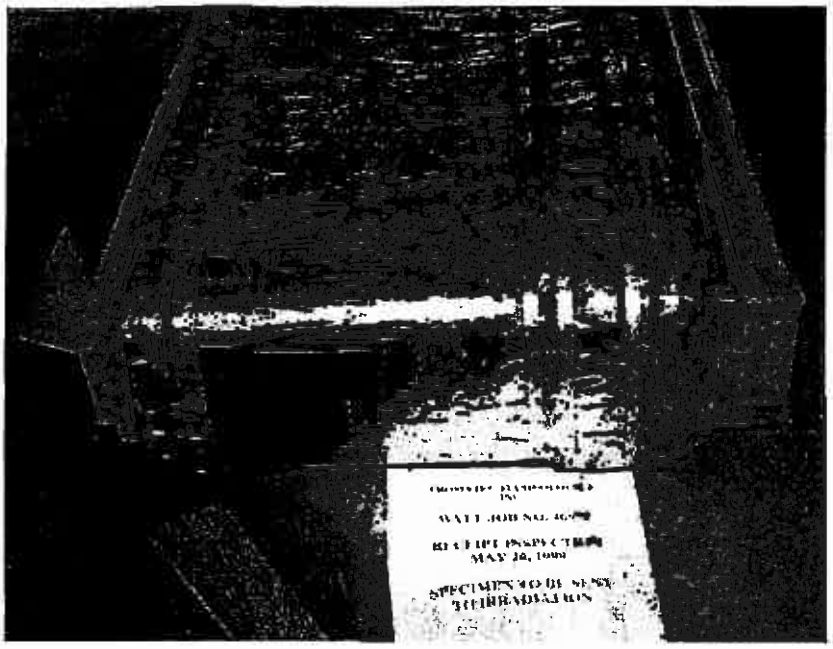
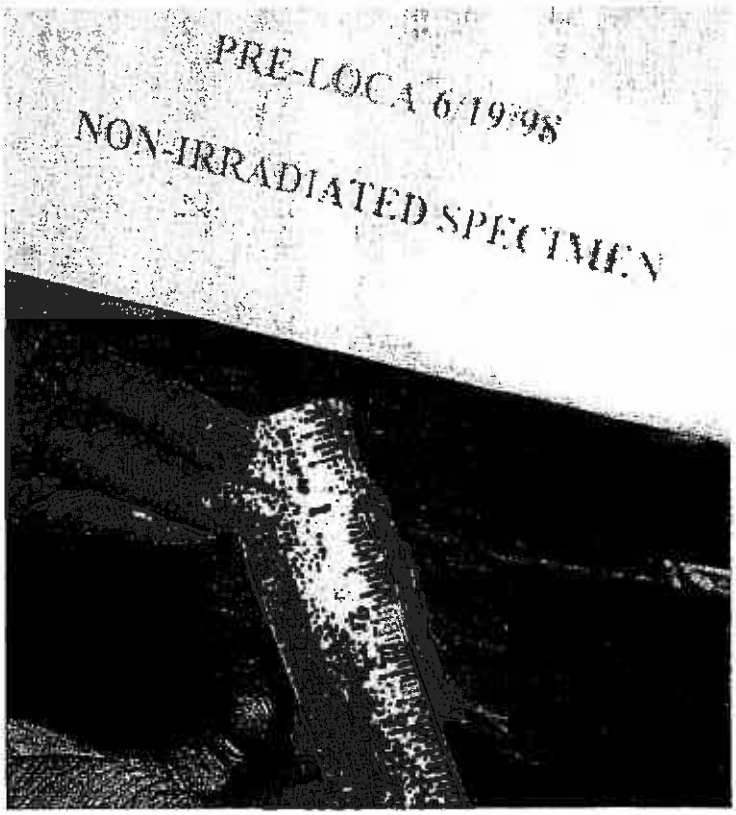
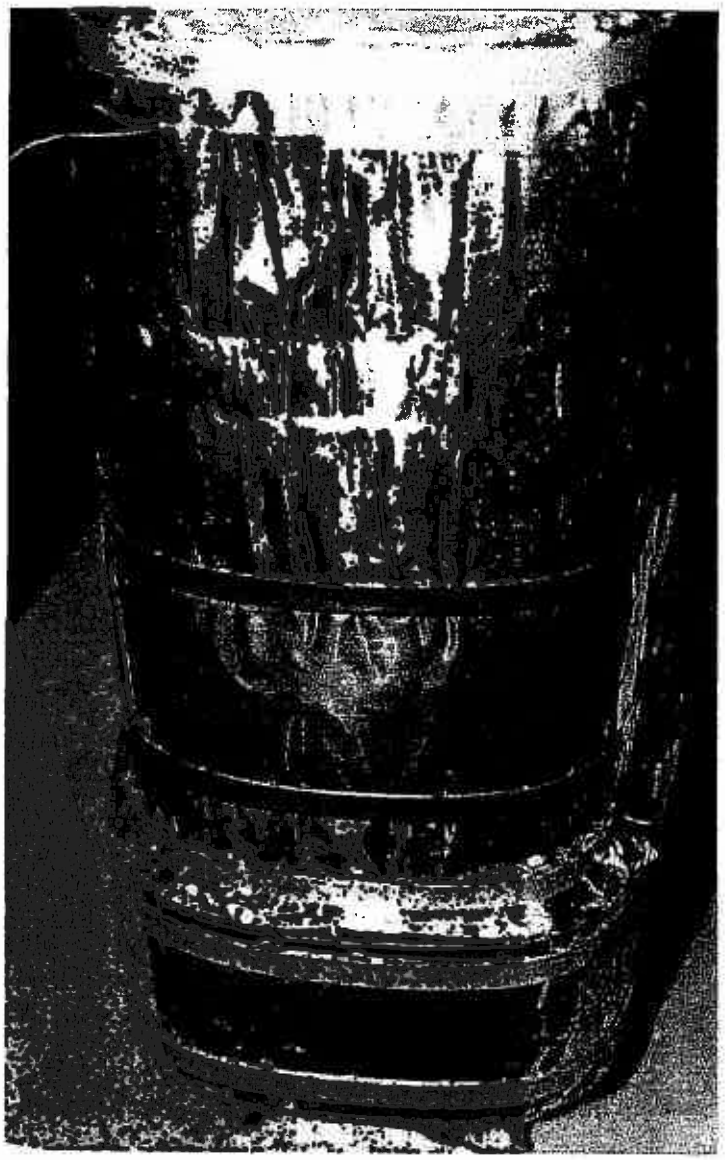


Photograph 1
Receipt Inspection of Specimen Sent to Irradiation
(Photo of Non-Irradiation Specimen Not Available)

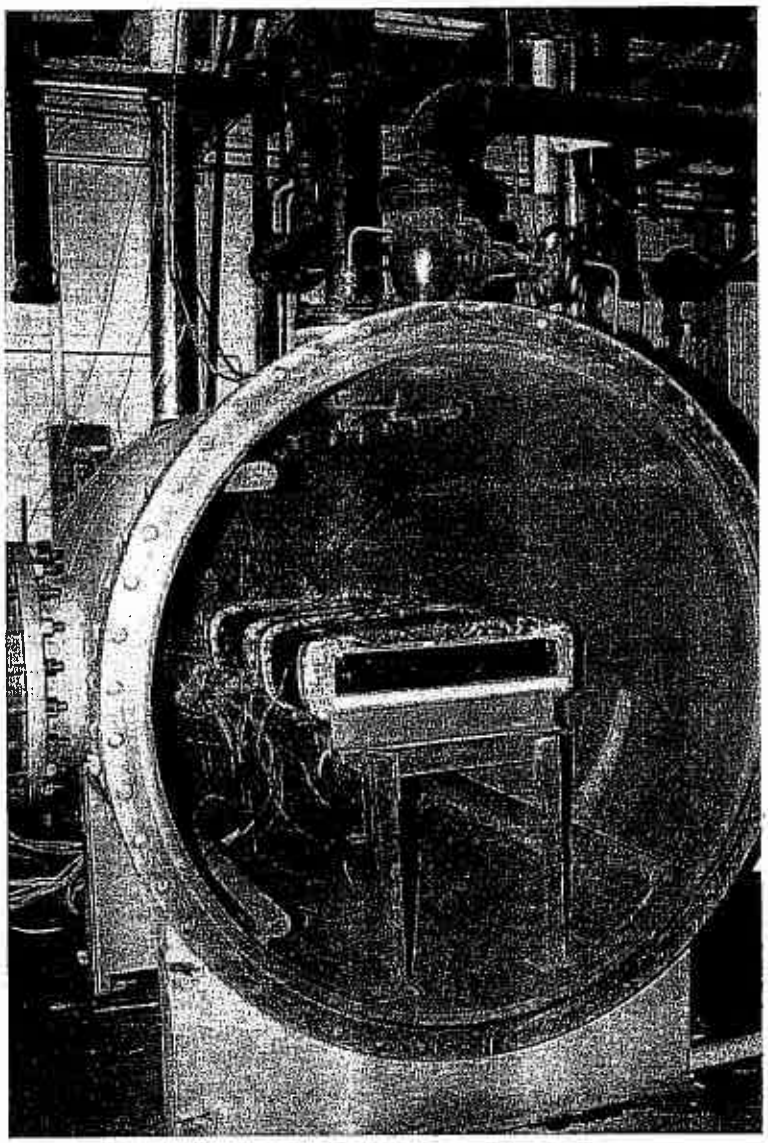
Photograph 2
Post-Irradiation Inspection of Specimen Sent to Irradiation



Photograph 3
Damage to Non-Irradiation Specimen Prior to LOCA Test



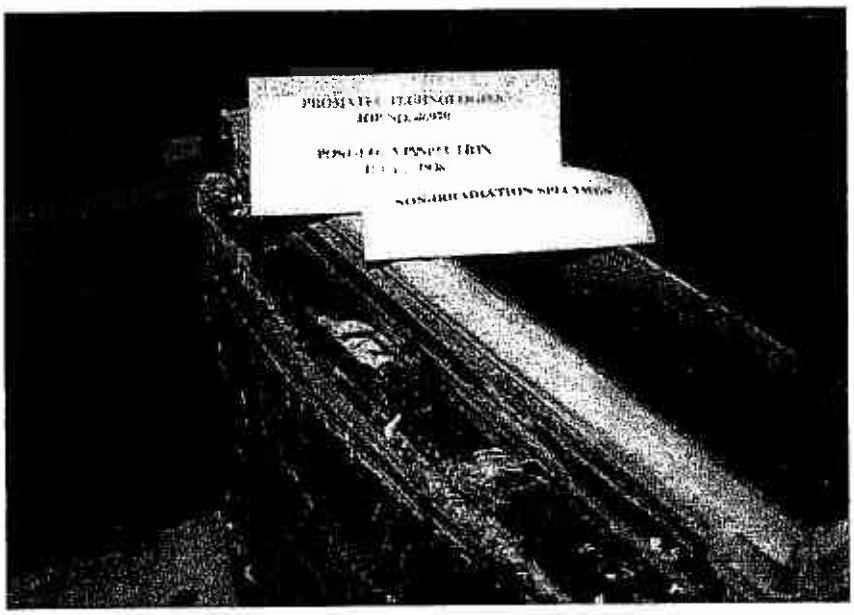
Photograph 4
Repair of Damage to Non-Irradiation Specimen
Prior to LOCA Test



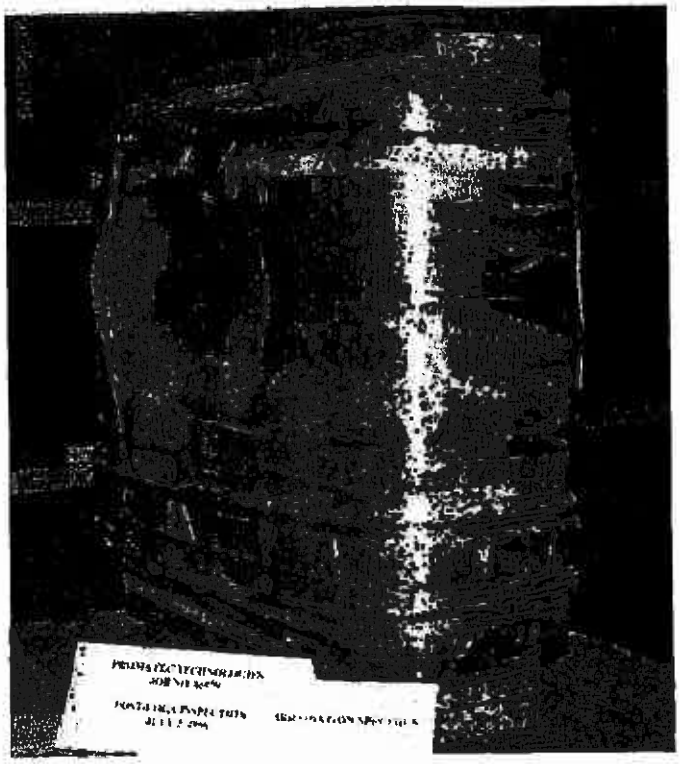
Photograph 5
Specimens Installed in LOCA Chamber Prior to Testing
Non-Irradiation Specimen in Rear, Irradiated Specimen in Front

Photograph 6
Post-LOCA View of Specimens Prior to Removal from Chamber

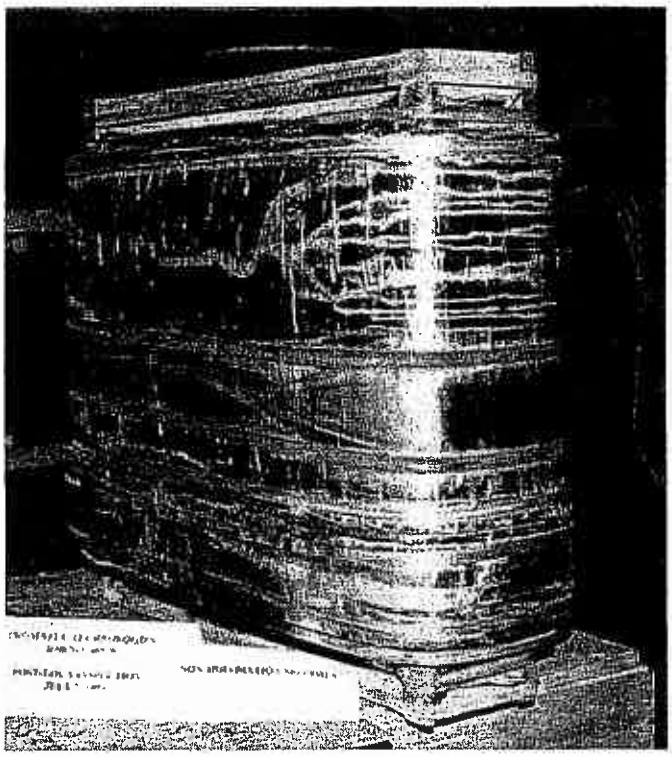
Photograph 7
View of Top of Non-Irradiation Specimen Showing Area on Top of Specimen Where Tape Came Unstuck



Photograph 8
View of Bottom of Non-Irradiation Specimen Showing Area on Top of Specimen Where Tape Came Unstuck



Photograph 9
Post-LOCA View Of Irradiated Specimen



Photograph 10
Post-LOCA View Of Non-Irradiated Specimen

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APPENDIX IV

RADIATION FACILITY REPORT

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Georgia Institute of Technology

Neely Nuclear Research Center
Hot Cell Operations
900 Atlantic Drive
Atlanta, Georgia 30332-0425
(404) 894-3600 FAX: (404) 894-9325
http://www.nnrc.gatech.edu/

June 18, 1998

Wyle Laboratories
7800 Highway 20 West
Huntsville, Al 35806

Attention: Bobby Hardy

Client Reference: 4-8162-P
GT Reference: 9816

The items covered by the above numbers have been irradiated in accordance with quality assurance requirements using Cobalt-60 (gamma energies 1.173 MeV, 1.331 MeV) to the total dose requested.

We certify the specifics of the irradiation as follows:

Irradiation Period	Intervals between 16:25 on 5/26/98 and 12:32 on 6/8/98 as shown on the enclosed Gamma Irradiation Log Sheets.
Dose Rate	Less than 1.0E6 Rads/hr average (Air Equivalent); maximum error plus or minus 2.08%.
Total Dose	Minimum of 2.0E8 Rads (Air Equivalent) as shown on the enclosed Gamma Irradiation Log Sheets; maximum error plus or minus 2.08%.
Dose Measurement	Keithley Autoranging Picoammeter Model 485 with LND Ionization Chamber Probe. Calibration completed by Georgia Institute of Technology traceable to NIST Cobalt-60.

The specific calculations for the irradiation are enclosed. Please let me know if any additional information is required.

Yours truly,

Dwayne P. Blaylock
Manager, Hot Cell Operations
Neely Nuclear Research Center

Enclosures

Georgia Institute of Technology

Neely Nuclear Research Center
Hot Cell Operations
900 Atlantic Drive
Atlanta, Georgia 30332-0425
(404) 894-3600 FAX: (404) 894-9325
http://www.nnrc.gatech.edu/

June 10, 1998

Wyle Laboratories
7800 Highway 20 West
P.O. Box 77777
Huntsville, Al 35807-7777

Attention: Bobby Hardy

Client Reference: 4-8162-P
GT Reference: 9816

The item covered by the above reference numbers was transported to the Georgia Institute of Technology Neely Nuclear Research Center on May 26, 1998 via Airborne Express. Upon removal of the specimen from the packaging, water damage was noted on some of the packaging materials (fig 1). Inspection of the specimen showed no visible signs of damage.

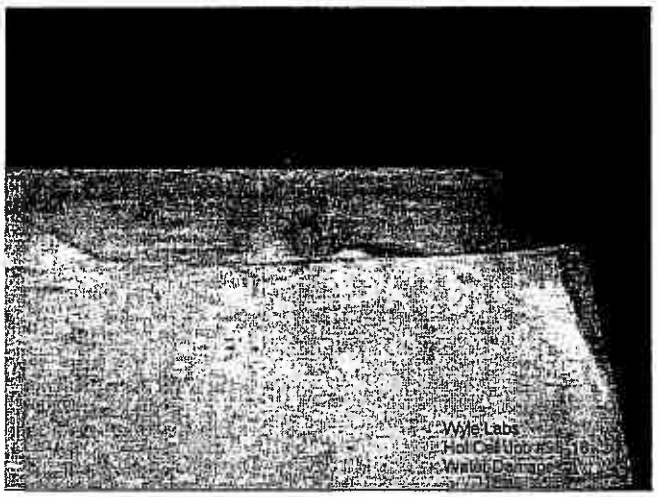


Figure 1: Packaging Materials Water Damage

If you have any further questions or require additional information, please do not hesitate to call me.

Sincerely,

Dwayne P. Blaylock
Manager, Hot Cell Operations
Neely Nuclear Research Center

Georgia Institute of Technology
Neely Nuclear Research Center
900 Atlantic Drive, N.W.
Atlanta, GA 30332-0425

Gamma Irradiation Log and Dose Rate Measurement Sheet

Client:	Wyle Laboratories	**NRC Reference:**	9816a
Reference:	4-8162-P	**Total Dose:**	2.0E8 Rads + Unc.
Item:	1 Cable Tray	**Dose Rate:**	≤1.0E6 Rads/hr

Start Date	Start Time	End Date	End Time	Lapsed Hours	Dose Rate Rads/hr	Total Dose Rads	Cumulative Dose (Rads)
05/26/98	16:25	06/05/98	11:00	234.58	7.906E+05	1.854E+08	1.854E+08

Dose Rate Determination*

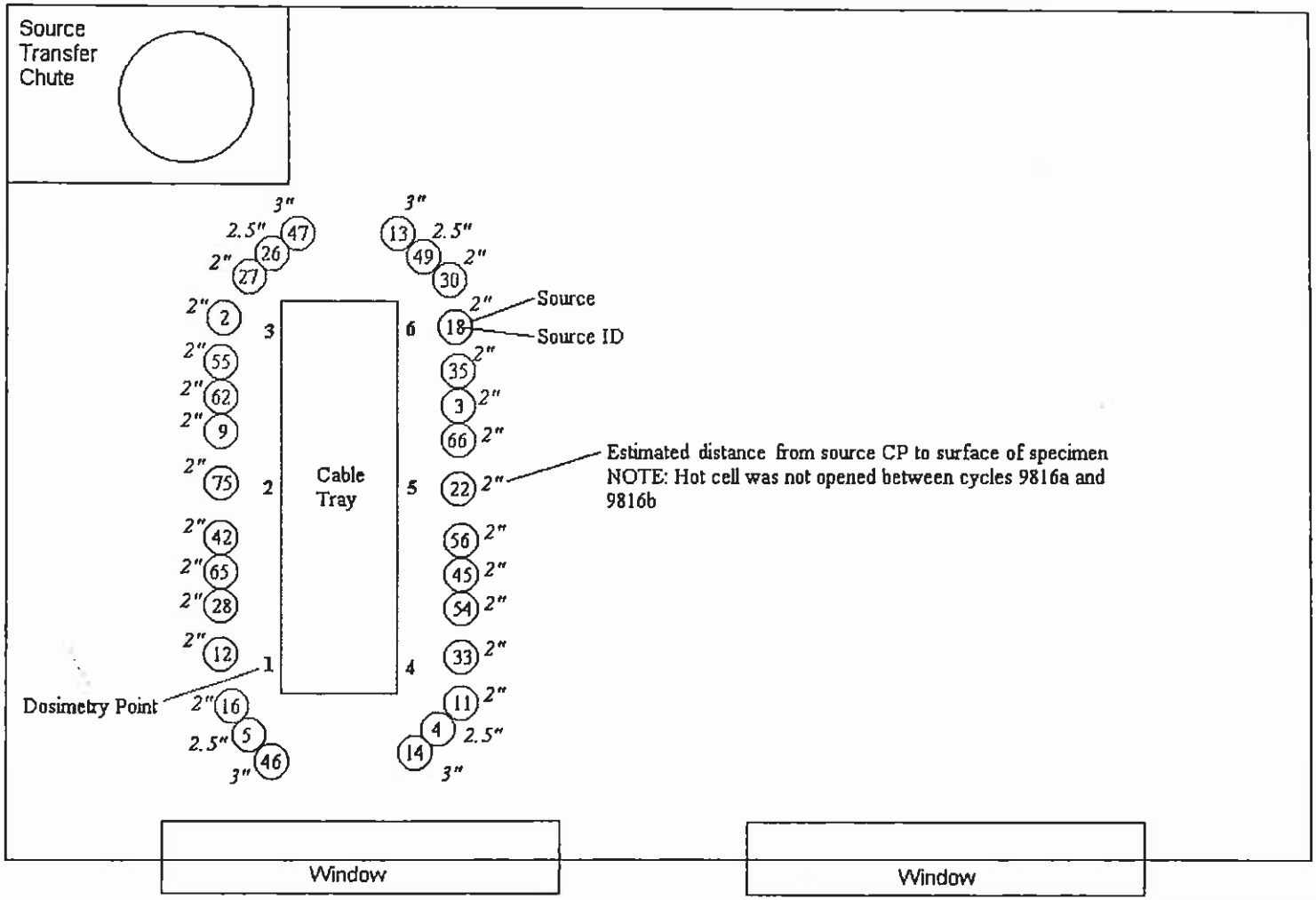
Dosimetry Measurement	Current (Amps)	Dose Rate (Rads/hr)
1	9.576E-07	7.901E+05
2	9.658E-07	7.992E+05
3	9.534E-07	7.854E+05
4	9.541E-07	7.862E+05
5	9.667E-07	8.002E+05
6	9.511E-07	7.829E+05

Average Dose Rate (Rads/hr): 7.906E+05

*Dose Rate determined from ionization probe current using the following formula:
DR(Rads/hr)= 2.989E17 * (Amps)2 + 5.385E11 * (Amps) + 350.792

Completed: _____ Date: 6/8/98

Reviewed: _____ Date: 6/9/98



Georgia Institute of Technology
Neely Nuclear Research Center
Hot Cell Operations/Gamma Irradiation Services

Client: Wyle Laboratories Job Number: 9816a

Not to Scale

Georgia Institute of Technology
Neely Nuclear Research Center
900 Atlantic Drive, N.W.
Atlanta, GA 30332-0425

Gamma Irradiation Log and Dose Rate Measurement Sheet

Client:	Wyle Laboratories	**NRC Reference:**	9816b
Reference:	4-8162-P	**Total Dose:**	2.0E8 Rads + Unc.
Item:	1 Cable Tray	**Dose Rate:**	≤1.0E6 Rads/hr

Start Date	Start Time	End Date	End Time	Lapsed Hours	Dose Rate Rads/hr	Total Dose Rads	Cumulative Dose (Rads)
06/05/98	11:00	06/08/98	12:32	73.53	2.557E+05	1.880E+07	2.042E+08

Dose Rate Determination*

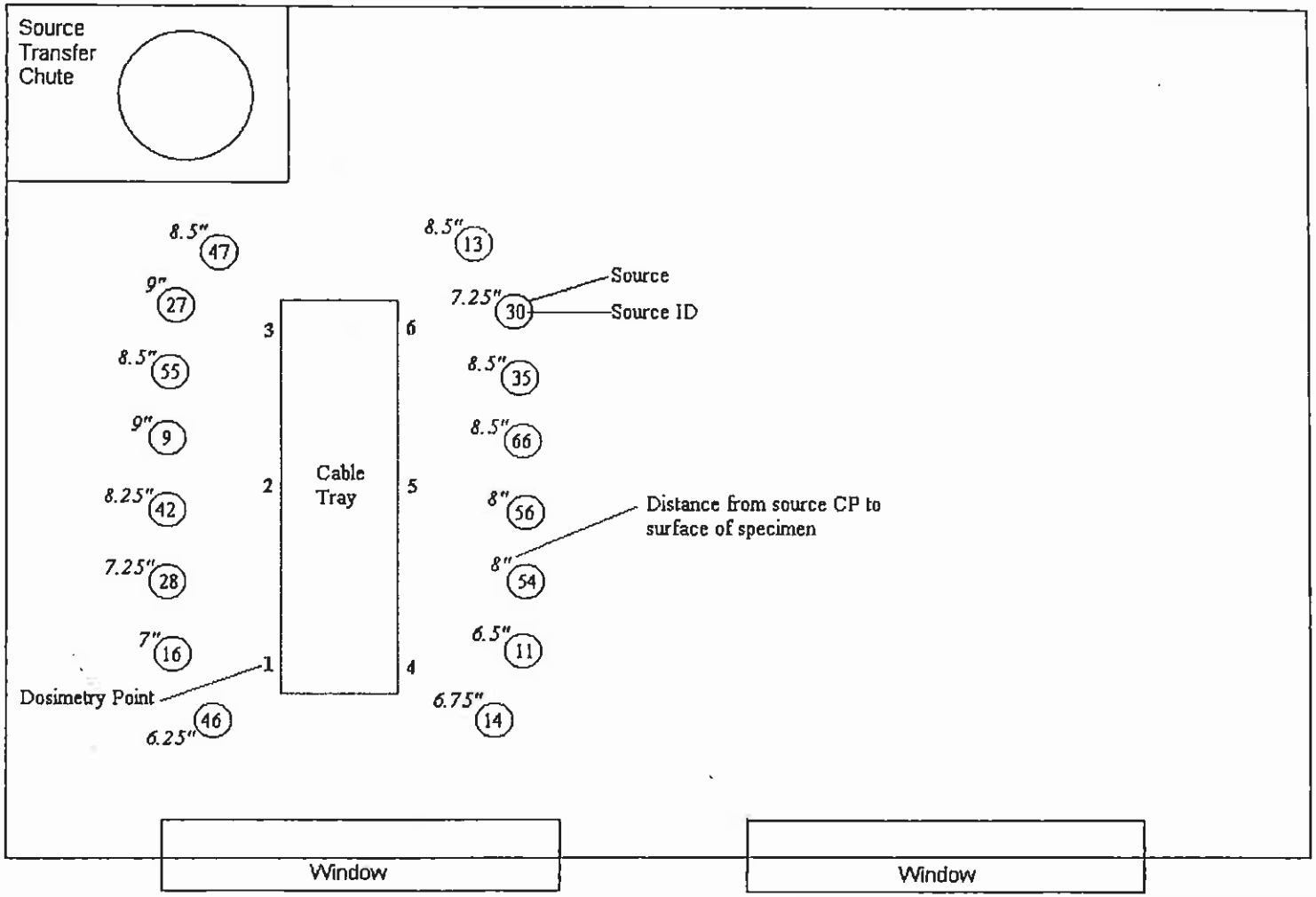
Dosimetry Measurement	Current (Amps)	Dose Rate (Rads/hr)
1	3.979E-07	2.619E+05
2	3.924E-07	2.576E+05
3	3.930E-07	2.581E+05
4	3.847E-07	2.517E+05
5	3.832E-07	2.505E+05
6	3.887E-07	2.548E+05

Average Dose Rate (Rads/hr): 2.557E+05

*Dose Rate determined from ionization probe current using the following formula:
DR(Rads/hr)= 2.989E17 * (Amps)2 + 5.385E11 * (Amps) + 350.792

Completed: _____ Date: 6/8/98

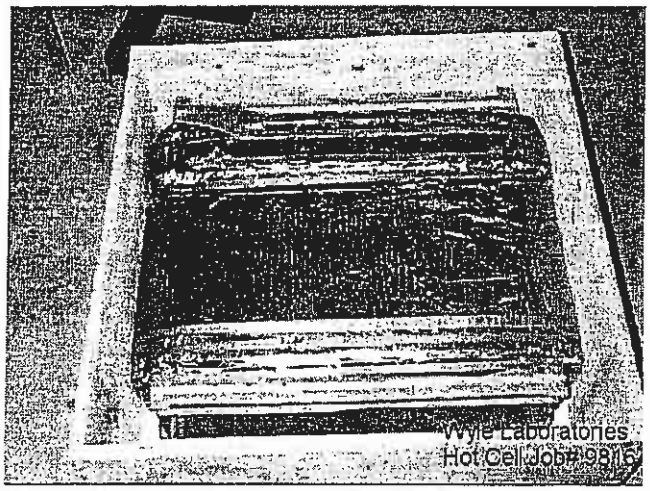
Reviewed: _____ Date: 6/9/98



Georgia Institute of Technology
Neely Nuclear Research Center
Hot Cell Operations/Gamma Irradiation Services

Client: Wyle Laboratories Job Number: 9816b

Not to Scale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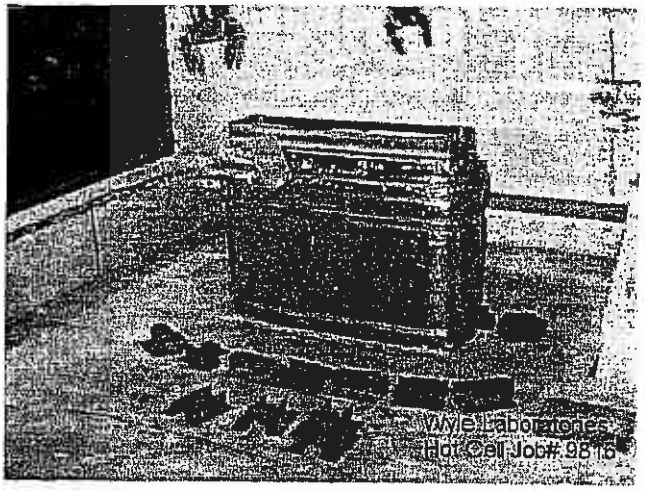
Hot Cell Job# 9816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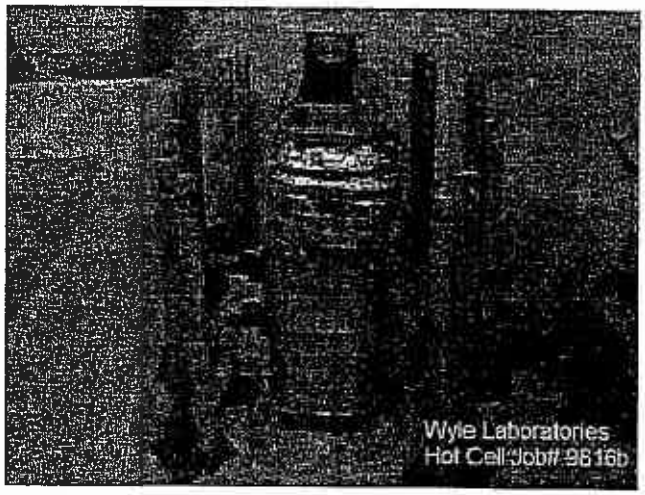
Hot Cell Job# 9816


Wyle Laboratories
Hot Cell Job# 9816b

Georgia Institute of Technology

Neely Nuclear Research Center
Hot Cell Operations
900 Atlantic Drive
Atlanta, Georgia 30332-0425
(404) 894-3600 FAX: (404) 894-9325
http://www.nnrc.gatech.edu

Certificate of Calibration
August 22, 1997

Manufacturer:	LND PROBE
Model:	52120
Description:	Ionization Probe
Serial No.:	NNRC-107
Calibrated by:	Georgia Institute of Technology Neely Nuclear Research Center Atlanta, GA 30332-0425
	Next Calibration Due 7/21/98 ± 25%

This certificate attests that this instrument has been calibrated with standards traceable to the National Institute of Standards and Technology.

NIST Traceability

Reference Test:	846/258170-97 HD9716 NIST DB 932/115

Georgia Institute of Technology

Neely Nuclear Research Center
Hot Cell Operations
900 Atlantic Drive
Atlanta, Georgia 30332-0425
(404) 894-3600 FAX: (404) 894-9325
http://www.nnrc.gatech.edu

Certificate of Calibration

June 20, 1997

Manufacturer:	Keithley
Model:	485
Description:	Autoranging Picoammeter
Serial No.:	472783
Calibrated by:	Georgia Institute of Technology Neely Nuclear Research Center Atlanta, GA 30332-0425

Next Calibration Due 06/17/98 ± 25%

This certificate attests that this instrument has been calibrated with standards traceable to the National Institute of Standards and Technology.

Standards Used in Calibration

Keithley Picoampere Source, Model No. 263, SN 0558088
Calibrated: November 11, 1996 Due 10/17/97 ± 25%
Calibrated by: Simco Electronics
8601 Dunwoody Place
Suite 342
Atlanta, GA 30350

Traceability:

ID#	MFG	MDL#	Description	Due Cal
16588	DATRON	1281	DMM	08/05/97
04534	ESI	SR1010	Resistance Transfer Standard	09/08/97
03070	ESI	SR1010	Res Standard	09/08/97
13015	ESI	SR1010	Std Resistor	09/08/97
15540	ESI	SR1	Std Resistor 10 Megohm	11/05/97
18727X	AEL	HI-MEG	Resistance Box	04/04/97

PARAMETER	NIST NUMBERS
Ratio	Ratio
Resistance	811/255094
DC Volts	Fluke Josephson Array System

Revision 01 (01/98)

RS - 120

Georgia Institute of Technology

Office of Radiological Safety
Neely Nuclear Research Center
900 Atlantic Drive, NW
Atlanta, Georgia 30332-0425
(404) 894-3605 FAX: (404) 894-9325
http://www.ors.gatech.edu/

Radioactive Contamination Clearance

Client: Wyle Laboratories

Client Reference Number: 4-8162-P

Georgia Tech Reference Number: 9816

Item(s): -1-Cable Tray

Direct Radiation Survey: < 100 cpm

Instrument Used: Ludlum II Serial Number: 48835 Cal. Due: 12/19/98

Contamination Survey: < 100 dpm Beta < 20 dpm Alpha

Instrument Used: LB5100 Serial Number: 13795 Cal. Due: 08/01/98

Release for Shipment:

This certifies that the above listed items have been surveyed and are free from radioactive contamination. Authorization is hereby given for release of the items from the Neely Nuclear Research Center.

Office of Radiological Safety — Date: 6-8-98

Neely Nuclear Research Center Operations — Date: 6-8-98

LB5100-W Low Background Counting System -- Smear Analysis

Date: 6/8/98
Counting Unit Id: 1
Data file name: C:\LBXL\UNIT1\SME1A004.XLD
Batch Ended: 6/8/98 12:46
Crosstalk Correction: Not Applied

Alpha activity action level (DPM): 20.00
Beta activity action level (DPM): 100.00
Certainty level for MDA and flags: 95.00%
High Voltage Setting: 1490

Application Revision: 3
Application Version: Standard

Alpha efficiency log file: TH230AB
Alpha Efficiency: 28.04%
Alpha to Beta Crosstalk: 29.37%
Alpha Background (CPM): 0.1
Alpha Correction Factor: 1.000

Beta efficiency log file: SR90AB
Beta Efficiency: 42.86%
Beta into Alpha Crosstalk: 0.40%
Beta Background (CPM): 1.7
Beta Correction Factor: 1.000

Batch ID: HOT CELL JOB

	Alpha Activity				Beta Activity							
Carrier	DPM	σ	flags	MDA	DPM	σ	flags	MDA	Count time (min)	Alpha CPM	Beta CPM	Completion Date - Time
1	-0.357	3.58	<MDA	13.45	3.03	4.10	<MDA	16.57	1.00	-0.100	1.30	6/8/98 12:46

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APPENDIX V

ACCIDENT TEST PLOTS

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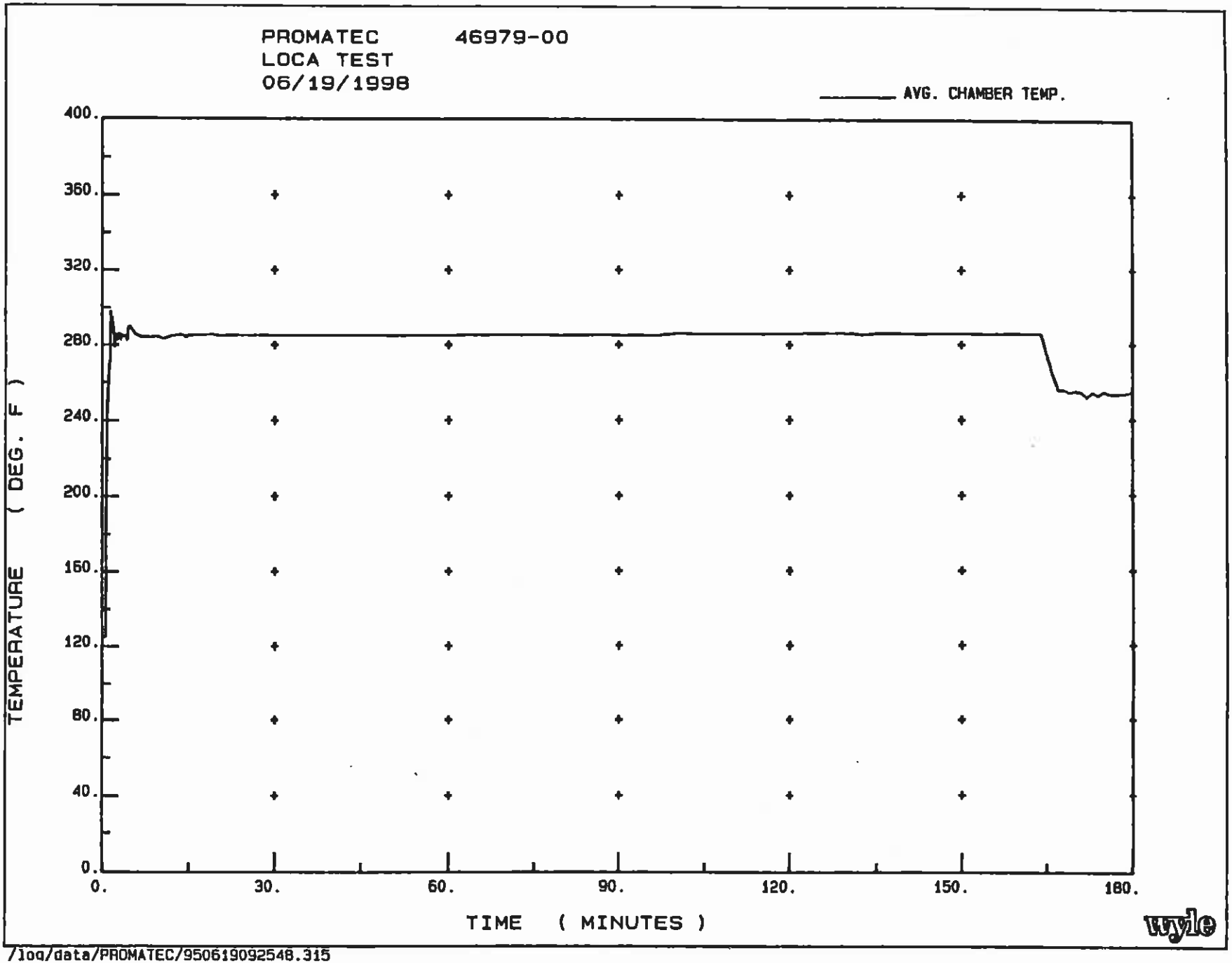

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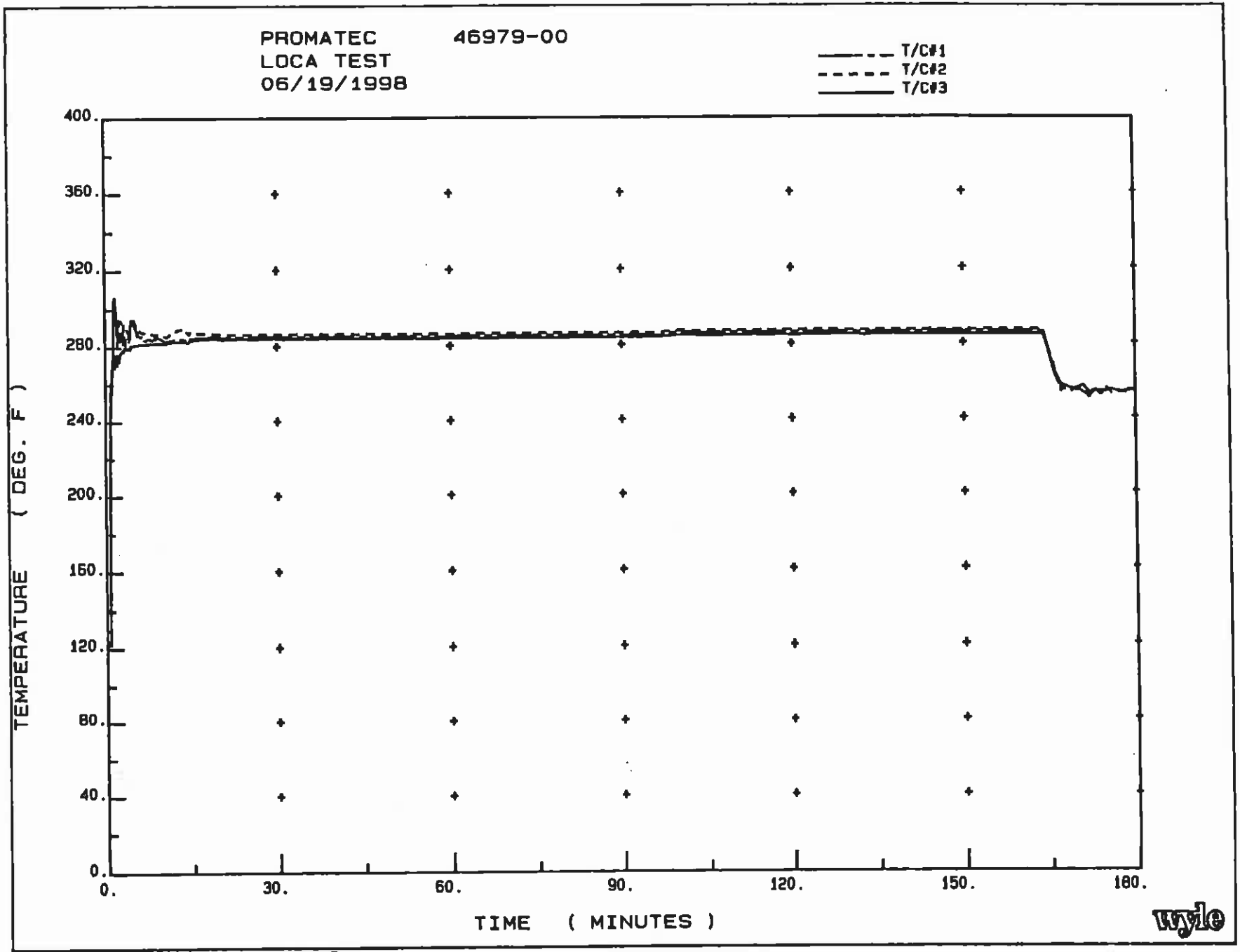

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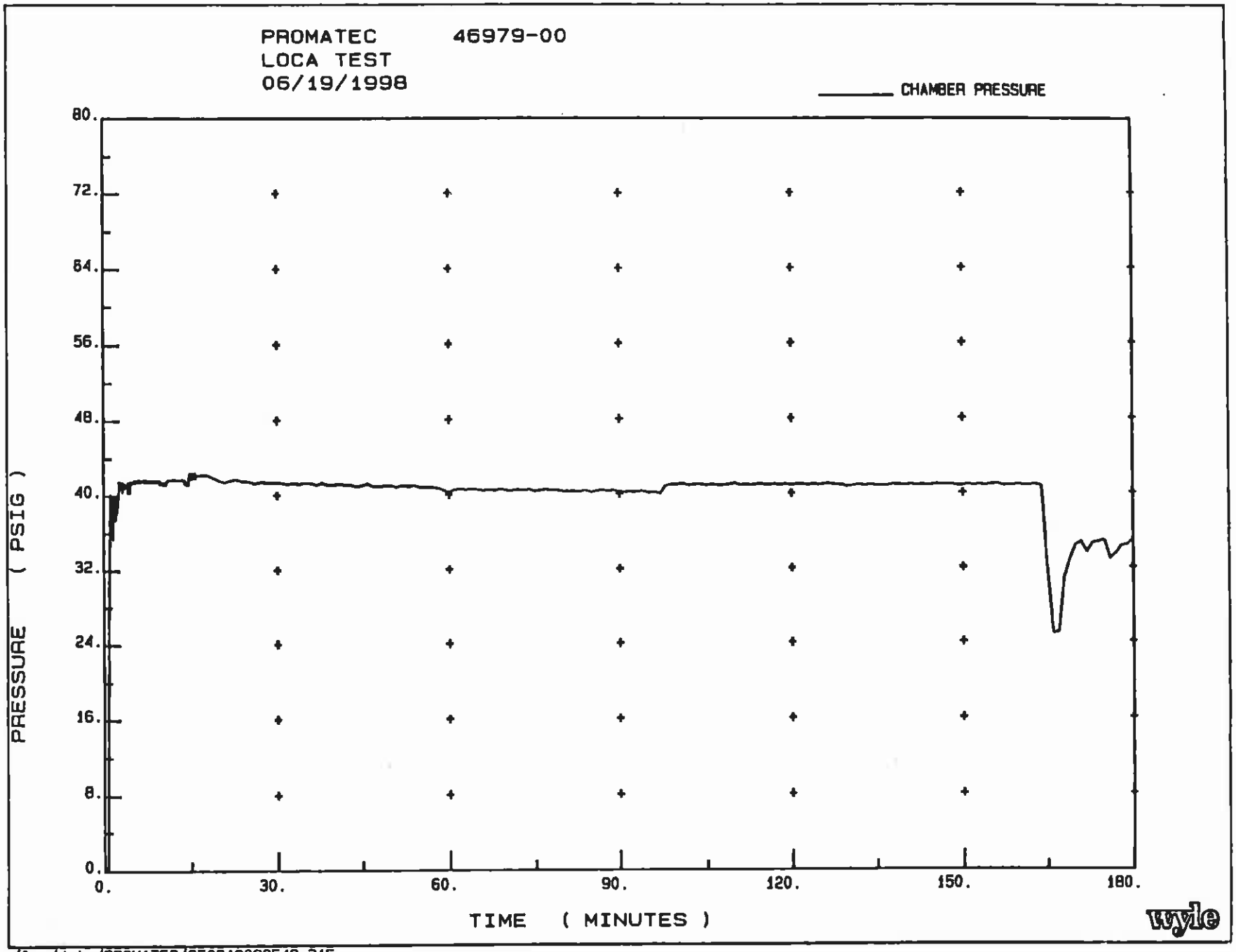

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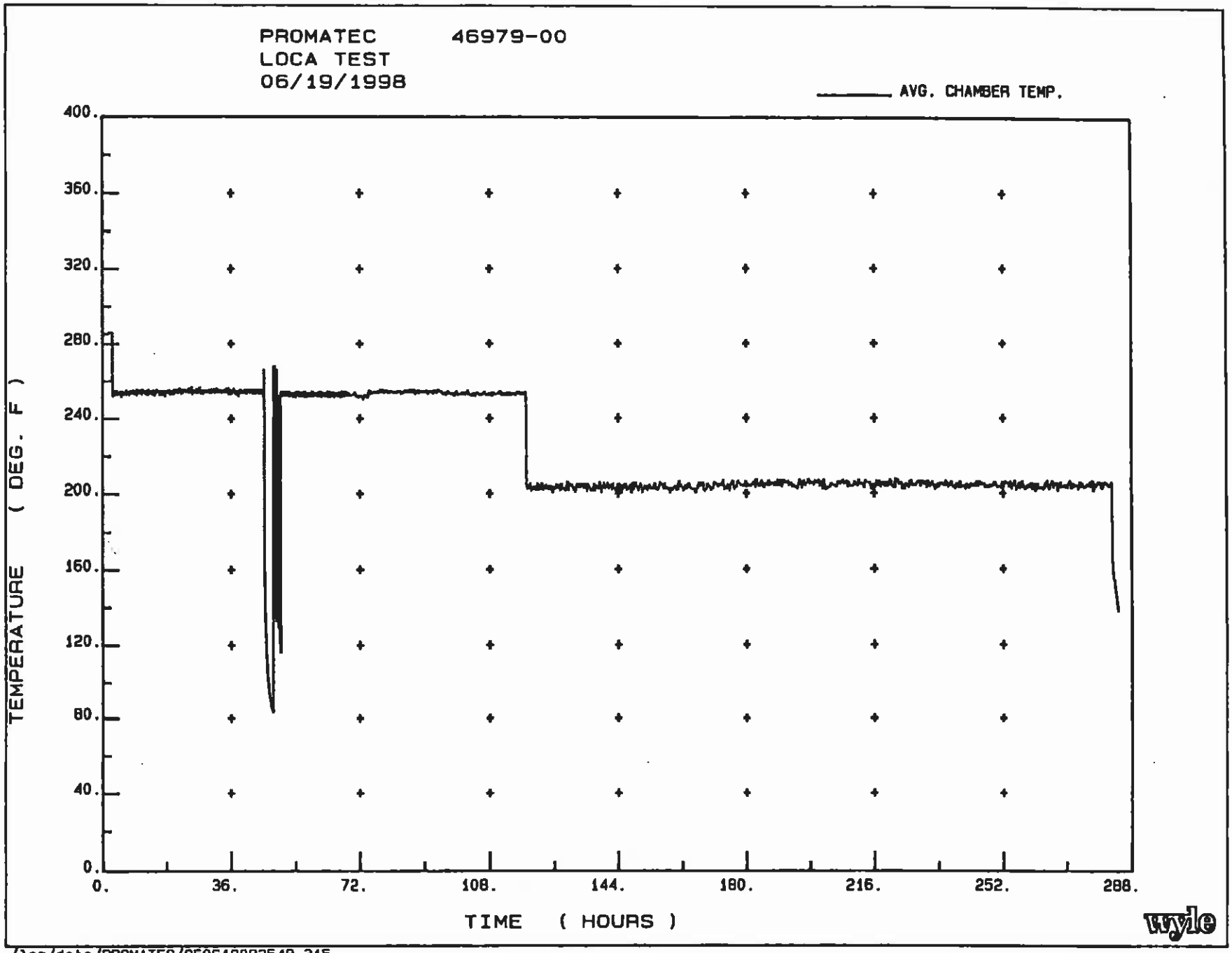

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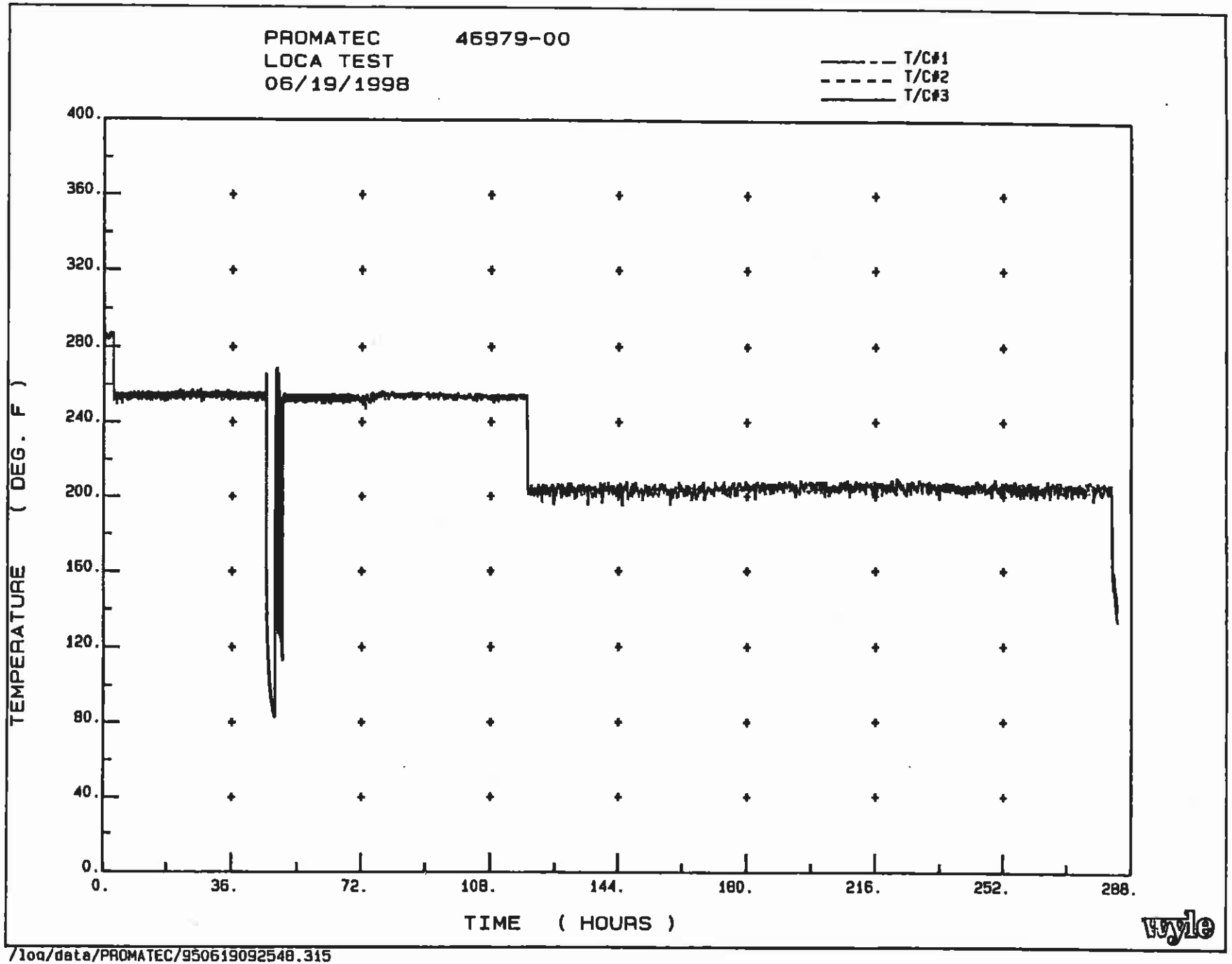

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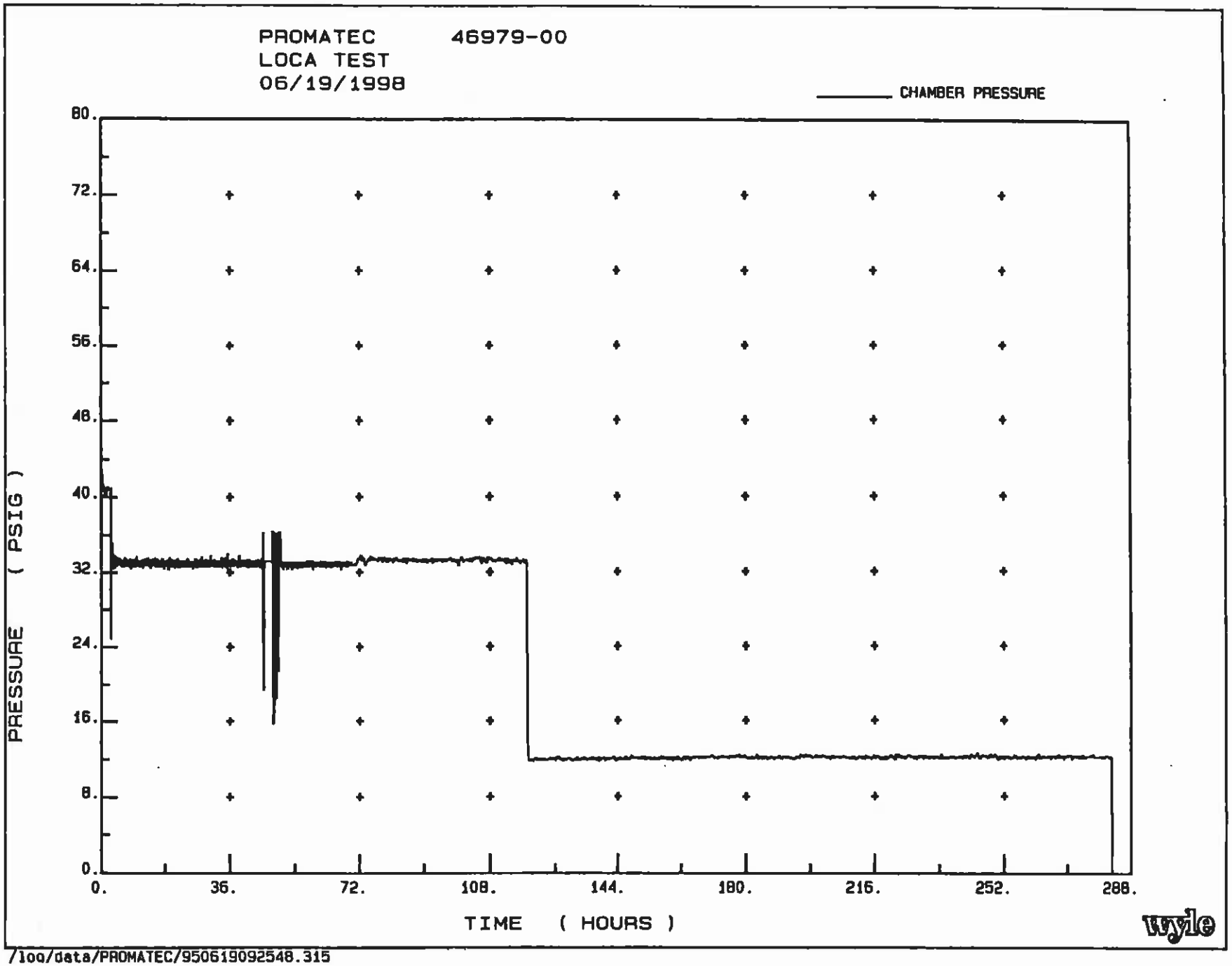

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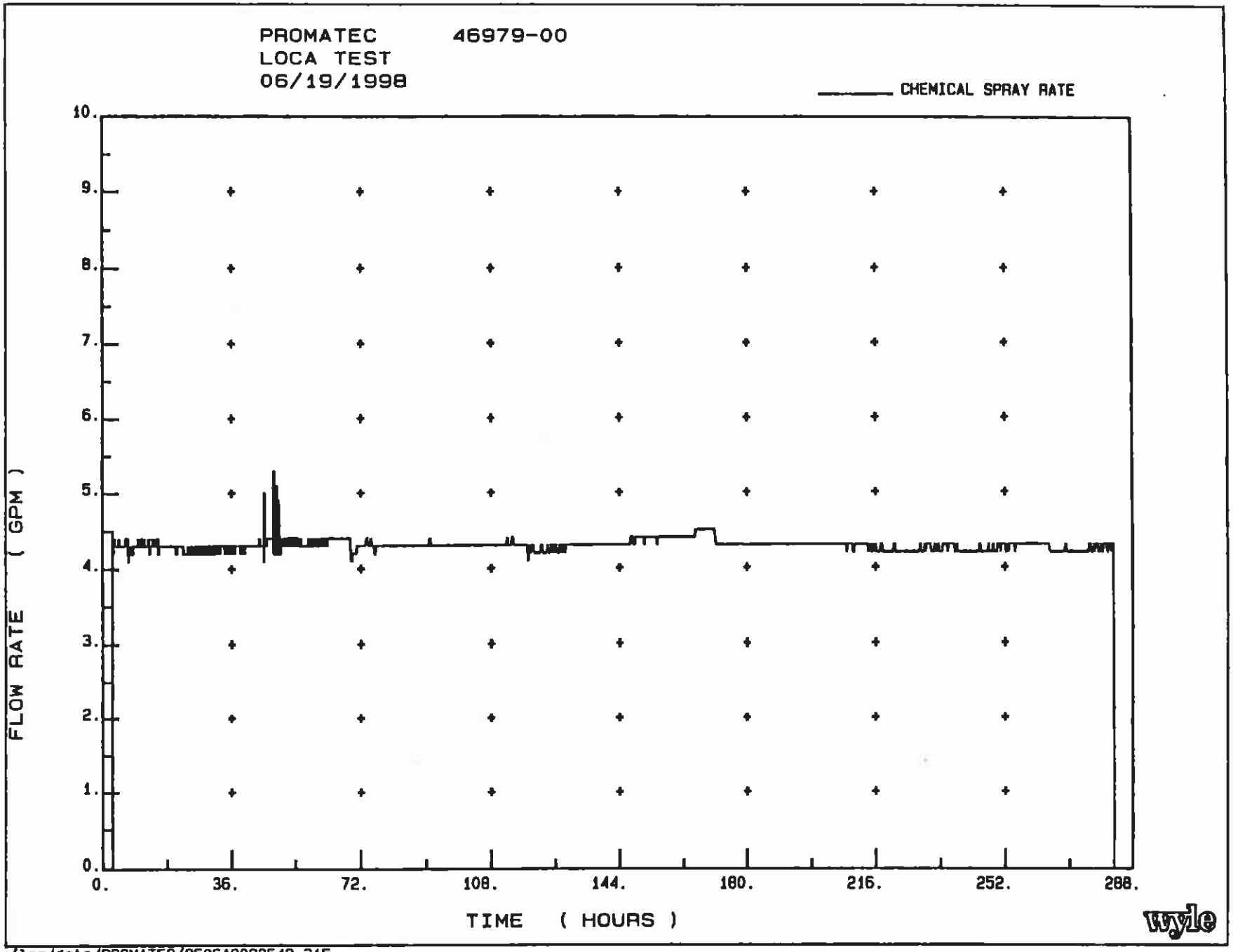

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APPENDIX VI

INSTRUMENTATION EQUIPMENT SHEET

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INSTRUMENTATION EQUIPMENT SHEET

F 1

DATE: 06/19/98 JOB NUMBER: 46979-00 TEST AREA: LOCA
TECHNICIAN: P. WADSWORTH CUSTOMER: ~~PERMATEC~~ PROMETEC TYPE TEST: LOCA

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	DATA SYS	DAYTRONIC	10K6	N/A	101936	MULTI	MFG	06/02/98	06/02/99
2	STRAIN PWR	VISHAY	2110	N/A	011516	15 VDC	1% REG	01/22/98	07/21/98
3	COND STRAIN	VISHAY	2120	72084	104105	GAIN	2%	01/22/98	07/21/98
4	TEMP ALARM	RESEARCH	61034	102515	100310	-175 TO 375*F	.5%	02/19/98	08/18/98
5	CONTR TEMP	RESEARCH	61011	060155	094531	-175 TO 375*F	.5%	02/19/98	08/18/98
6	RECORD TEMP	HONEYWELL	452X1-B	7710879928003	108367	400*F	.5%	06/03/98	09/01/98
7	CONTR TEMP	RESEARCH	61011	25-061	000735	1500*F	.5%	02/19/98	08/18/98
8	CONTR TEMP	RESEARCH	61011	825061	000721	1500*F	.5%	02/19/98	08/18/98
9	CONTR TEMP	RESEARCH	61011	32-033	100163	1500*F	.5%	02/19/98	08/18/98
10	CONTR TEMP	RESEARCH	61011	32-032	100162	1500*F	.5%	02/19/98	08/18/98
11	TEMP ALARM	RESEARCH	61034	401-90	100160	2000*F	.5%	02/19/98	08/18/98
12	TEMP ALARM	RESEARCH	61034	401-81	100158	1000*F	.5%	02/19/98	08/18/98
13	TEMP ALARM	RESEARCH	61034	401-78	100161	2000*F	.5%	02/19/98	08/18/98
14	TEMP ALARM	RESEARCH	61034	31524	094515	2000*F	.5%	02/19/98	08/18/98
15	TEMP ALARM	RESEARCH	639LLP	312910	011796	1000*F	.5%	02/19/98	08/18/98
16	TEMP ALARM	RESEARCH	61031	1-0154	000707	2000*F	.5%	02/19/98	08/18/98
17	TEMP ALARM	RESEARCH	61031	101-55	000704	2000*F	.5%	02/19/98	08/18/98
18	TEMP ALARM	RESEARCH	639LLP	31291-01-24	011807	-125+375*F T	.5%	02/19/98	08/18/98
19	TEMP ALARM	RESEARCH	61031	101-56	000708	2000*F	.5%	02/19/98	08/18/98
20	AMPL TEMP MV	AGM ELECTRONICS	EA4002	648	092917	1000*F	1%	02/19/98	08/18/98
21	AMPL TEMP MV	AGM ELECTRONICS	EA4002	650	092919	1000*F	1%	02/19/98	08/18/98
22	AMPL TEMP MV	AGM ELECTRONICS	EA4002	410	092920	1000*F	1%	02/19/98	08/18/98
23	THERMOMETER DIG	FLUKE	2190A	208	094906	MULTI	.03%	05/04/98	07/31/98
24	FLOW MTR	RAMAPO	MARK V	6404	092471	1 - 10 GPM	+-.5%	07/09/97	07/09/98
25	FLOW MTR	RAMAPO	MARK V	6404	092470	1 - 10 GPM	+-.5%	07/09/97	07/09/98
26	PRESS GAUGE	ASHCROFT	1082	N/A	106730	100 PSI	.5% FS	06/09/98	09/07/98
27	PRESS XDUCER	MB ELECT	151HAC	41021	100600	100 PSIS	1% FS	02/27/98	08/26/98

This is to certify that the above instruments were calibrated using state-of-the-art techniques with standards whose calibration is traceable to the National Institute of Standards and Technology.

INSTRUMENTATION P. Wadsworth 6-19-98

CHECKED & RECEIVED BY R. Hart 6/19/98

Q.A. Bianca Bowington 6/19/98

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APPENDIX VII

CHEMICAL SPRAY pH DATA SHEET

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DATA SHEET

Page No. VII-3

Test Report No. 46979-1

WYLE LABORATORIES

Customer: Promatec

Specimen: Fire Wrap Material

Part No.: N/A

Spec.: Promatec Test Plan CTP-2010, Rev 3

Para.: 10.1

S/N: N/A

GSI: N/A

Amb. Temp.: N/A

Photo: no

Test Med.: LOCA

Specimen Temp.: see below

Job No.: 46979

Report No.: 46979-1

Start Date: 6/19/98

Test Title: LOCA Test Chemical Spray pH

DATE	INITIAL pH	ADJUSTED pH	CHAMBER TEMPERATURE
6/19/98 12:15	5.0	N/A	254.2°F
6/19/98 14:00	5.0	7.5	253.5°F
6/20/98	6.8	7.5	254.9°F
6/21/98	6.7	7.4	106.0°F *
6/22/98	6.9	7.5	252.6°F
6/23/98	6.9	7.5	254.6°F
6/24/98	7.0	7.6	254.0°F
6/25/98	6.6	7.9	204.7°F
6/26/98	6.7	7.5	202.4°F
6/27/98	6.6	7.7	203.4°F
6/28/98	6.5	7.5	205.6°F
6/29/98	6.4	7.5	203.3°F
6/30/98	6.5	7.6	203.3°F
7/1/98 04:00	6.7	N/A	203.0°F

* SEE NOTICE OF ANOMALY NO. 2

Tested By: [signature] Date: 7/6/98

Witness: N/A Date: —

Sheet No. 1 of 1

Approved: R. [signature] 7/6/98

Notice of Anomaly: None

Wyle Form WH 614A, Rev. APR '84

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APPENDIX VIII

PROMATEC TECHNOLOGIES, INC.,
TEST PLAN NO. CTP-2010, REVISION 3

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PROMATEC TECHNOLOGIES INC.

TEST PLAN NO. CTP-2010

DESIGN BASIS ACCIDENT TESTING (LOCA) OF 3M INTERAM™ FLEXIBLE FIRE WRAP

Rev	Date	By	Approved	Issue Date	Comments
3	5/19/98	M. Murphy	C. Spriggs	5/19/98	Revised as Noted

TEST PLAN NO. CTP-2010
DESIGN BASIS ACCIDENT TESTING (LOCA) OF 3M INTERAM™ FLEXIBLE FIRE WRAP

1.0 PURPOSE

1.1 The purpose of this test is to determine that the fire barrier material ingredients of 3M Interam™ E 50 Series E 54C Flexible Fire Wrap will not disintegrate or become dislodged when exposed to a Design Basis Accident condition with the following parameters: 283°F peak temperature, 52 psia peak pressure, 100% humidity, using a material sample which has been irradiated to 2×10^8 Rads and using a chemical spray composition for the first 1-1/2 hours with the pH equal to 4.5-5.0 (By 2800 PPM Boron in the form of Boric Acid) and thereafter with a pH equal to 7.0 - 7.5 (By $Na_3 PO_4$)

2.0 SCOPE

2.1 Test outline, including specimen configuration, sizes, applicable test standards, acceptance criteria, barrier wrap configuration and reporting requirements.

2.2 Procedures for layout and installation of 3M Interam™ material.

2.3 Procedures for quality verification of wrap installation, including material receipt and traceability, in-process inspection and final inspection.

2.4 Reporting and final test report acceptance requirements.

3.0 REFERENCES

3.1 ASTM D-3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions as applicable and as modified herein.

3.3 Promatec Quality Assurance Program Manual, Revision D, Dated June 28, 1995.

4.0 DEFINITIONS

4.1 Raceway: Any channel that is designed and used expressly for supporting or enclosing wires, cable or bus bars. Raceways consist primarily of, but not limited to cable trays and conduit.

4.2 Interam™ E50 Series Mat: Flexible endothermic wrap system manufactured by 3M Company for the separation and protection of redundant cables and equipment in nuclear power facilities (individual component and composite system descriptions are detailed in the body of this test plan).

4.3 Third-Party Testing Laboratory: An independent testing organization capable of performing DBA (Design Basis Accident) testing for the purpose of qualifying systems and designs in accordance with the requirements of this test plan and applicable governing codes and standards.

4.4 Preliminary Test Report: A synopsis of the test issued by the third-party test laboratory. Information reported includes raceway descriptions, observances made during the course of the test, condition of the sample after testing, basic drawings or sketches of the test assembly and preliminary conclusions.

4.5 Final Test Report: A detailed report issued by the third-party test laboratory that includes all relevant information applicable to the test including, but not limited to:

4.5.1 Detailed discussion on test purpose and scope.

4.5.2 Written description and drawings of raceway components used, configurations of the raceways, and material applied and test apparatus.

4.5.3 Written description of the temperature and pressure profiles, spray solution composition including pH, duration, frequency, and rate of spray solutions, and any other pertinent test conditions.

4.5.4 Complete quality assurance documentation of the overall test process, including material certifications, inspection reports and color photographs depicting, as close as possible, the actual size of the test specimens, and test surfaces.

4.5.5 Detailed discussion on the results and conclusions drawn from the test.

4.6 Wrap system definitions:

4.6.1 Longitudinal joint: A joint (or seam) which runs parallel to the item being protected.

4.6.2 Perimeter joint: A joint (or seam) which runs perpendicular to the item being protected

4.6.3 Butt Joint: A joint (or seam) where the edges of two adjacent pieces of the same layer meet with no overlap.

4.6.4 Through Joint: A joint (or seam) where each layer terminates at the same location at a given butt joint

4.6.5 Overlap Joint: A joint (or seam) where a piece of a given layer overlaps onto the same layer piece adjacent to it.

4.6.6 Offset Joint: A butt joint (or seam) that is staggered in its location from the butt joint occurring in the layer *above* or *below* it. (See also Through Joint).

4.6.7 Circumference Wrap Method: An installation method whereby each layer of the mat is installed around the circumference or perimeter of the protected item in a continuous piece. At the longitudinal joint formed where the two edges of the mat meet an overlap is normally incorporated.

4.6.8 Collar: A strip of material of a minimum width which is utilized to cover final layer perimeter butt joints.

4.6.9 Caulk: 3M Fire Dam-150 or Dow Corning 732 Multi-Purpose Adhesive/Sealant.

4.6.10 Tape: 3M T-65 Stainless Steel Tape

5.0 RESPONSIBILITIES

5.1 **Promatec Technologies** shall be responsible for the following:

5.1.1 Supply of wrap system components, craft labor for wrap installation, and quality inspection of wrap installation activities.

5.1.2 Developing and issuing test plans that provide detailed information on the test purpose, items to be tested, wrap system designs to be used, installation procedures and quality control requirements.

5.1.3 Installation of fire barrier wrap systems in accordance with procedures provided in this test plan.

5.1.4 Inspection and documentation of material receipt, in-process installation and final verification in accordance with procedures provided with this test plan.

5.2 **The third-party test laboratory** shall be responsible for the following:

5.2.1 Performance of irradiation of test samples (2×10^8 Rad./200 Mega Rad with 10% margin).

5.2.2 Conformance to the requirements, including test duration, of ASTM D-3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions as applicable and as modified by this test plan under test conditions, raceway configurations and acceptance criteria.

5.2.3 Supply of facilities, test apparatus, instrumentation, measuring equipment and technicians for test activities.

5.2.4 Documenting, reporting, and certifying of all tests.

5.2.5 Written description of the temperature and pressure profiles, spray solution composition including pH, duration, frequency, and rate of spray solutions, and any other pertinent test conditions.

5.2.6 Quality Assurance monitoring and documentation during and after specimen exposure.

5.2.7 Actual performance of test.

5.2.8 Preparation and issuance of preliminary and final test reports.

6.0 WRAP MATERIALS

Component	*Application*
Interam™ E54C Mat	Primary wrap for raceway.
FireDam™ FD-150 Caulk	Filling gaps at seams.
732 Adhesive Sealant	Filling gaps at seams and coverage of outer face of firestop.
T-65 Stainless Steel Foil Tape	Securing overlap joints, covering exposed

	mat and caulk at edges and seams.
1/2" Stainless Banding and Clips	Securement of final mat layer.

7.0 TEST ASSEMBLY

7.1 TEST CONDITIONS:

The following parameters shall be used: a 283°F peak temperature, a 52 psia peak pressure, 100% humidity and an exposure using a chemical spray composition for the first 1-1/2 hours with the pH equal to 4.5-5.0 (By 2800 PPM Boron in the form of Boric Acid) and thereafter with a pH equal to 7.0 - 7.5 (By Na_3 PO_4). This test will be performed on two test samples; one which has been irradiated to 2 x 10^8 Rads (with 10% margin) and one which has not been irradiated.

7.2 RACEWAY CONFIGURATIONS

7.2.1 *Article 1:* A 24" wide X 6" deep X 24" long, commercially available, solid bottom galvanized steel cable tray with solid galvanized steel cover.

Article 2: Same as article 1.

7.3 WRAP SYSTEM ATTRIBUTES

7.3.1 Article 1 - 24" wide X 6" deep X 24" long cable tray.

- Three (3) layers of Interam E54C, each layer having a nominal thickness of 0.4", install as shown on Attachment A.

7.3.2 Article 2 - Same as article 1.

- Same as article 1.

8.0 INTERAM™ INSTALLATION PARAMETERS

8.1 Installers shall be indoctrinated and trained in accordance with the Peak Seals training program for Interam™. Training shall be documented in accordance with the Promatec Quality Assurance Program.

8.2 Install the wrap systems in accordance with guidelines established by the 3M "Installation Booklet Including Quality Assurance Guidelines and Typical Drawings", Issue No. 5500-005, Dated 6/19/87. The following specific requirements apply regardless of options that may be allowed in the installation guide:

Note:

- Butt joints are reasonably tight, with gaps not exceeding 1/4".
- Gaps greater than 1/8" and up to 1/4" shall be caulked with 3M FD-150 or DC 732 Multi-Purpose Adhesive Sealant.

- Exposed mat such as edges of collars and cover strips, longitudinal joints, and perimeter joints shall be covered with tape.
- 1/2" x 0.020 stainless steel banding shall be installed minimum one band per piece and within 1" of the edge of all collars. (Min. two bands required per collar.). Both edges of the T-65 tape applied to the collar will be secured with the banding to the extent practical.

8.5 **24" X 6" CABLE TRAY**

8.5.1 See notes at the beginning of this section.

8.5.2 3 layers of E-54C shall be used, and shall cover a nominal 18" portion of the cable tray centered along the length of the cable tray. The mat shall be installed with a nominal 3" wide collar applied over the final layer, located to provide a nominal 12" wide span between stainless steel bands.

8.5.3 The material shall be applied in accordance with Peak Seals, Inc. Installation Procedure IP-2003, as applicable and as modified herein.

8.5.4 See notes at the beginning of this section.

9.0 INTERAM™ SYSTEM INSPECTION CRITERIA

9.1 Prior to use, receipt inspect all materials in accordance with procedure no. QCP-0055, "Receiving, Handling, and Storage Inspection".

9.2 During wrap installation, verify the following attributes, system is installed in accordance to IP-2003, and following the criteria established in Peak Seals, Inc. Quality Control Procedure QCP-2003, as modified herein.

9.2.1 The gap between the pieces applied around the raceway are filled with FD 150 (1/2 the circumference) and DC 732 Multi-Purpose Adhesive Sealant (the remaining 1/2 circumference).

9.2.2 Exposed mat, such as edges of collars, and longitudinal joints, have been covered with tape.

9.2.3 1/2" x 0.020 stainless steel banding has been installed minimum one band per piece and with in 1" of the edge of all collars. (Min. two bands required per collar.). Both edges of the T-65 tape applied to the collar has been secured with the banding.

9.3 Upon completion of all wrap installation perform a final visual inspection of the system. Verify that wrap is securely installed and all bands are tight.

10.0 TEST PERFORMANCE

10.1 Design Basis Accident Condition (LOCA) Test:

The prepared test assembly shall be subjected to the following conditions: A 283°F peak temperature, a 52 psia peak pressure, 100% humidity and using a chemical spray composition for the first 1-1/2 hours with the pH equal to 4.5-5.0 (By 2800 PPM Boron in the form of Boric Acid) and thereafter with a pH equal to 7.0 - 7.5 (By Na_3 PO_4).

This test will be performed on two test samples; one which has been irradiated to 2 x 10^8 Rads (with 10% margin) and one which has not been irradiated in accordance with ASTM D-3911 Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions as applicable, using an appropriate apparatus.

10.2 Acceptance Criteria

10.2.1 The fire barrier material ingredients of 3M Interam™ E 50 Series E 54C Flexible Fire Wrap or associated components have not disintegrated nor dislodged from the cable tray substrate.

10.2.2 Results shall be documented in a Final Test Report. This Final Report shall contain:

a) Applicable Corporate Test Procedure.

b) Quality Control documentation, as applicable.

c) Summation of Test Results, by the Third Party Testing Organization including a statement as to the likelihood of this material causing the strainers of a nuclear ECCS to become plugged, based on the outcome of this test.

d) Test report as supplied by Third Party Testing organization.

11.0 ATTACHMENTS

11.1 Attachment A, Promatec Technologies Drawing PSI-3065, Revision 1.

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HONEYWELL
MIDNIGHT
NOON
6 AM
6 PM
0 TO 400 °F

HONEYWELL
NOON
MIDNIGHT
6 AM
6 PM

HONEYWELL
MIDNIGHT
6 PM
NO. 16209

HONEYWELL
NOON
MIDNIGHT
6 PM
MY
0 TO 400 °F

HONEYWELL
MIDNIGHT
6 PM
6 AM
NOON
J/NR
CUSTOMER
TYPE TEST
DRY BULB
WET BULB
CHAMBER
START DATE
TECHNICIAN
DATE
CHECKED BY
0 TO 400 °F

HONEYWELL
MIDNIGHT
NOON
6 AM
6 PM
0 TO 400 °F.

HONEYWELL
MIDNIGHT
NOON
6 AM
6 PM
0 TO 400 °F

HONEYWELL
NOON
1
2
3
4
5
6 PM
7
8
9
10
11
MIDNIGHT
1
2
3
4
5
0 TO 400 °F
J/NR
CUSTOMER
DEF TEST
DUMMER
TECHNICIAN
LABS

HONEYWELL
MIDNIGHT
NOON
6 AM
6 PM
0 10 400 °F
0 10 400 °C

HONEYWELL
MIDNIGHT
6 PM
NOON
6 AM
0 TO 400 °F

HONEYWELL
MIDNIGHT
NOON
6 AM
6 PM
0 TO 400 °F