Southern California Edison

San Onofre Nuclear Generating Station Units 2 & 3

ENVIRONMENTAL QUALIFICATION (EQ)
REPORT M85114
REVISION 0

Loss of Coolant Accident (LOCA) Test of "Moisture Dam" Modified Rockbestos RSS-6-104/LE Coaxial Cable, ABB/CE Mineral Insulated Triaxial Cable, and CONAX Coaxial Penetration Feedthroughs for the Regulatory Guide 1.97 High Range Radiation Monitoring (HRRM) System

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1.0 PURPOSE

The purpose of this report is to document the evaluation of Loss of Coolant Accident (LOCA) test results on Rockbestos "Moisture Dam" modified coaxial cable, ABB/CE Mineral Insulated (MI) coaxial cable, and CONAX coaxial penetration feedthroughs performed at WYLE Laboratories in Huntsville, Alabama from September 21 through September 26, 1996.

The LOCA test program was not intended to be a complete IEEE-323-1974 test sequence. Instead, the purpose of the test was twofold: 1) To determine the LOCA steam and chemical spray induced signals on the test specimens pico ampere signal carrying capabilities and; 2) Confirm the moisture dam modified cable will prevent moisture from migrating into the penetration coaxial connectors.

2.0 BACKGROUND

After startup from Unit 2 Cycle 8 Refueling Outage, the Regulatory Guide (R.G.) 1.97 High Radiation Range Monitor (HRRM), Equipment ID 2RI-7820-2 developed periodic instrument failure alarms. Non Conformance Report (NCR) 950800177 (Reference 6.3) was written to report this problem. Subsequently, this monitor experienced the same symptoms during train B ESF Sub-Group testing which included starting of containment Emergency Cooler 2ME400. This problem initiated Southern California Edison (SCE) to start an investigation and perform additional environmental testing of the containment HRRM coaxial cable configuration.

On June 11, 1996, SCE completed an environmental qualification (EQ) reassessment of the coaxial cables and connectors associated with the HRRM and concluded that during a Loss of Coolant Accident (LOCA), moisture could permeate the cable jacket, migrate along the coaxial cable shield, collect in the electrical connector, causing a loss of the HRRM signal. NCR 960600430 (Reference 6.4) was then written to report this conclusion and to declare the HRRMs inoperable. Since the failure mechanism was determined to have existed from initial installation, SCE issued an Licensee Event Report (LER), 96-005 (Reference 6.2) to the Nuclear Regulatory Commission (NRC).

Previous investigations into the induced signal issue are documented in two SCE Memorandum For Files (References 6.8 and 6.9). These memorandums document the results of various literature searches and test methods, including steam and chemical spray testing, related to the temperature induced signal phenomena. Steam and chemical spray testing documented in References 6.8 and 6.9 included coaxial cables manufactured by Brand Rex and Rockbestos. In addition, pressurized submergence testing of "moisture dam" cable configurations is documented in SCE Commercial Grade Item (CGI) Dedication Laboratory Report 96-3415 (Reference 6.15, provided as Attachment G). The pressurized submergence testing was performed to verify moisture dam design capability, and to recognize the effects of moisture intrusion on signal continuity.

3.0 RESULTS/CONCLUSION/RECOMMENDATION

3.1 ABB/CE Mineral Insulated Cable connected to Conax 75 ohm Coaxial Feedthroughs

ABB/CE Mineral Insulated (MI) cable is not significantly sensitive to thermal transients, moisture intrusion, or sudden air flow across the cable. The projected transient induced signal during peak LOCA environmental conditions is expected to be on the order of tens of Rads/hour, returning to normal within hours. Under a steady state temperature of 200F, the MI cable produced an induced signal equivalent to only one Rad/hour. The stainless steel jacketed MI cable is a more robust design, and will provide a significantly more stable signal than the installed Rockbestos RSS-6-104/LE coaxial cable during LOCA environmental conditions.

3.2 Rockbestos RSS-6-104/LE "Moisture Dam" Modified Cable connected to Conax 75 ohm Coaxial Feedthroughs

Throughout the 5 day LOCA test, signal continuity was maintained on the "moisture dam" modified Rockbestos RSS-6-104/LE coaxial cable. It was demonstrated that the "moisture dam" modification prevented moisture intrusion into the coaxial cable connectors. However, transient induced signals on the order of thousands of Rads/hour can be expected during peak LOCA environmental conditions. At detector signal currents equivalent to greater than thousands of Rads/ hour, the modified coaxial cable provides satisfactory performance. Under a steady state temperature of 200F, the Rockbestos cable produced an induced signal equivalent to hundreds of Rads/hour.

4.0 TEST SPECIMEN and WYLE LABORATORY TEST SETUP

4.1 Test Specimen Description

The specimens for this test program consisted of the following:

- **Rockbestos RSS-6-104/LE Coaxial Cables**

Cable Specimen #1 -	250' length with "moisture dam" and Amphenol 82-816 HN connectors on both ends. See Section 4.2 below for a description of the "moisture dam" design.
Cable Specimen #2 -	Same as cable specimen # 1
Cable Specimen #3 -	Same as cable specimen # 1

- **ABB/CE Mineral Insulated (MI) Cable Specimen**

  A single 30' length triaxial cable with HN connectors. This cable is completely constructed from inorganic materials. The MI cable is a double stainless steel sheathed, single copper conductor cable. The dielectric is silicone dioxide (SiO_2). The HN connector plugs are hermetically sealed to the cable jacket through an all welded construction technique. The gasket material used for the HN connector is grafoil. The post fabrication insulation resistance and capacitance measurements were taken at room and elevated temperatures and provided as Attachment E. The cable was fabricated by Whittaker Corporation in Simi, California for ABB/CE. The cable specimen was fabricated and shipped directly from Whittaker to Wyle Laboratories.

- **Conax Coaxial Penetration Feedthroughs**

  Four (4) 75-ohm coaxial penetration feedthroughs 24 inches long with 6 inch pigtails. These penetration feedthroughs were fabricated and supplied by Conax Corporation. The pigtails came mated with an Amphenol type 82-321 jack connector (Certificate of Conformance is provided as Attachment D). The penetration feedthroughs were shipped directly after fabrication from Conax to Wyle Laboratories.

  The electrical connections at the penetration feedthrough were covered with Raychem WCSF-N heat shrink sleeves. The construction details of these sleeves are described in Section 10.4.1.1 of the Wyle Test Report (Reference 6.1).

4.2 Rockbestos "Moisture Dam" Cable Description

Rockbestos RSS-6-104/LE cable was obtained from the warehouse (Material Code 027-75377) and three (3) 250' length cable specimens were cut. The "moisture dam" was installed by SCE personnel in accordance with the "Moisture Dam" Installation Instruction (provided as Attachment B). Amphenol plug connectors (Part No. 82-816, Conax Part No. N44079-03) were supplied by Conax (Certificate of Conformance provided as Attachment D) to SCE under SCE purchase order 8H066002. Once the Rockbestos "moisture dam" cable specimens were assembled, they were shipped to WYLE Laboratories in Huntsville, Alabama to be thermal and radiation aged.

From the same Rockbestos cable reel, four lengths of approximately 25 feet each were cut and used as part of the test setup. Standard BNC and Amphenol 82-816 connectors were installed on the ends of the cables. These connectors were made by SCE personnel and shipped to WYLE Laboratories. These cables were used as test lead hookups from the outboard of the Conax penetration feedthrough specimens to the test measuring equipment and thus were not thermally nor radiation aged. An electrical schematic of the test monitoring equipment is presented in Figure 1 of the SCE test monitoring procedure (Reference 6.5, provided as Attachment C).

4.3 Test Specimen Thermal and Radiation Aging Summary

Upon receipt of the Rockbestos cable specimens, WYLE Laboratories aged the specimens in their thermal aging ovens. After thermal aging was complete, WYLE coordinated the radiation aging portion with ISOMEDIX in Whippany, New Jersey.

The following table summarizes the thermal and radiation aging parameters:

Table 4.1 - Rockbestos Test Specimen Thermal and Radiation Aging

Rockbestos Cable	Thermal Aging	Radiation Aging (Rads)	Notes
Specimen #1	102.5 hrs @ 239 °F (+5/-0 °F)	1.55 E-8	1
Specimen #2	135 hrs @ 248 °F (+5/-0 °F)	1.55 E-8	1
Specimen #3	135 hrs @ 257 °F (+5/-0 °F)	1.55 E-8	1

Note: 1) Radiation dose rate was a minimum of 0.75 megarads/hour and not exceeding a maximum of 0.84 megarads/hour.

A review of all of the age-sensitive materials associated with the Rockbestos moisture dam modified cable sample was performed (References 6.7, 6.12, 6.13 and 6.14). These materials included the Rockbestos coaxial cable insulation and jacket, Amphenol coaxial cable connector insulator and gasket, and Raychem WCSF-N heat shrink material. The limiting activation energy of 1.1eV for the silicone gasket of the Amphenol connector was used to establish aging temperatures and durations for the three cable samples simulating 30, 20 and 10 years of normal operation at 120 °F ambient. Thermal aging to simulate 40 years wasn't considered since SONGS has already been in operation in excess of 10 years with the remaining plant life less than 30 years. The 20 and 10 year samples were established as backups to the 30 year sample in case it became unavailable for testing.

Conax has established thermal and radiation qualification well in excess of 40 years at 120 °F ambient and over 200 megarads with IR measurements in excess of 1E12 ohms post thermal and radiation aging (Reference 6.11). Since the organic materials and design of the coaxial feedthrough samples are the same as the feedthroughs tested in Conax's qualification program, this formed the basis for not aging the four Conax coaxial feedthrough samples.

The ABB/CE MI cable was not thermal or radiation aged because all of the critical components associated with this cable assembly is from inorganic materials and is not susceptible to significant environmental aging mechanisms. The only organic material used is "Sylgaurd 170" which is an epoxy material used only as an alignment aide during triaxial splice manufacturing process only and is not credited for any electrical insulation nor any sealing function.

4.4 LOCA Simulation Test Specimen Setup

Originally, Rockbestos cable specimen #3 was to be used for the LOCA test, with specimens #1 and #2 held as spares. Based on an extremely sharp bend at the "moisture dam" (Reference 6.1, Photograph 6), and subsequent IR measurement at 500 VDC indicated a short circuit condition (Reference 6.1, Notice of Anomaly No.2). The decision was made to proceed with the test using specimen #2.

The individual Conax penetration feedthroughs were meggard at 500VDC (see Table 4.2). The penetration feedthroughs were then inserted through the four 1 inch diameter holes of the WYLE LOCA test chamber's header plate. Once the penetration feedthroughs were centered, they were tightened down with swagelok fittings. The Rockbestos cable specimen #2 was carefully connected onto penetration feedthroughs 1 and 4. An IR measurement was taken of the entire penetration feedthrough and cable circuit (See Table 4.3). The MI cable specimen was connected to penetration feedthroughs 2 and 3. The MI cable and penetration feedthrough connection was torqued to 126 inch-pound (Reference 6.1, Section 10.4.1). Subsequently, an IR measurement was taken of the entire penetration feedthrough and MI cable circuit (See Table 4.3). After the IR measurement was taken, the connections between the penetration feedthrough and cable plug connector were covered with Raychem WCSF-N heat shrink material.

The Rockbestos cable specimen was coiled in the cable tray section and secured to the tray using TEFZEL tie wraps. The coil has a radius of 5 inches and is approximately 48 inches long. The MI cable was secured inside the Rockbestos coil loop. A total of five thermocouples were mounted inside the test chamber. Three thermocouple were mounted onto the cable tray to determine the average LOCA ambient temperature. One thermocouple was mounted at the back of the tray, the second in the middle of the tray, and the third was placed at the front, near Conax penetration feedthroughs. These thermocouples were used to establish the average chamber temperature. The fourth and the fifth thermocouples were placed within one or two inches of the Rockbestos and MI cable respectively.

The chamber door was lifted using a forklift and placed into position and then bolted down. After all test monitoring leads were connected to the outboard side of the penetration feedthroughs, the LOCA test was considered ready to begin.

4.5 IR Measurement Summary

Many factors play a role in insulation resistance measurement values such as ambient humidity levels, dust materials on contact surfaces, or how solid the connection is between the meggaring device and the IR sample. Sometimes lower IR values may improve by cleaning the conducting surfaces and performing another IR measurement. This is evident by comparing the IR measurement taken for Conax feedthrough #4 (Table 4.2) which is lower than when IR measurements were taken for pre the LOCA circuit which consisted of Conax feedthroughs #1 and #4 connected to 250 feet of Rockbestos cable (Table 4.3). Tables 4.2 and 4.3 summarizes the pre LOCA, mid LOCA and post LOCA insulation resistance data.

Table 4.2 - Pre LOCA IR Values on Conax Penetration Feedthroughs

Conax Coaxial Penetration Feedthrough	IR - Center to Shield @ 500 VDC (Measure @ Temp °F)	Date&Time
1	7.8 E-12 ohms (Ambient)	09/20/96 & 0830
2	8.0 E-12 ohms (Ambient)	09/20/96 & 0840
3	8.0 E-12 ohms (Ambient)	09/20/96 & 0850
4	1.9 E-10 ohms (Ambient)	09/20/96 & 0900

Table 4.3 - Cable and Penetration Feedthrough Specimen Summary

LOCA Stage	Rockbestos Cable Specimen #2 Connected to Penetration Feedthroughs 1 & 4 (Channel 1)		MI Cable Connected to Penetration Feedthroughs 2 & 3 (Channel 2)	
	IR Center to Shield	Date@ Time	IR Center to Shield	Date@ Time
Pre LOCA (Note 1)	2.7 E10 ohms	09/20/96@1115	7.8 E10 ohms	09/20/96@ 1150
Mid LOCA (Note 2)	2 E9 ohms	09/23/96@ 1115	1.8 E10 ohms	09/20/96@1118
	2.4E8 ohms	09/24/96@ 1340	5.0E10 ohms	09/24/96@1330
	1.85E8 ohms	09/25/96@ 0907	5.5E9 ohms	09/25/96@0912
POST LOCA (Notes 3,4 and 5)	2.7E9 ohms	09/26/96@1315	4.5E9 ohms	09/26/96@1318

Notes:

1. IR measured at Ambient Temperature.
2. IR measurement includes 25' cable test lead and measured at steady state temperature of 200 °F.
3. IR Shield to Ground for Rockbestos (4E9 ohms).
4. IR Shield to Ground for MI (4.5E9 ohms).
5. IR measured as chamber was cooling down (<200 °F).

4.6 Test Monitoring Equipment Traceability

The majority of the test equipment was supplied by WYLE Labratories and calibration is covered under the WYLE Laboratories Quality Assurance Program as documented in WYLE Labratories Test Report 45662-1, Appendix VIII (Reference 6.1).

The only test equipment supplied by SCE were two Keithly 261 pico ampere signal generators. The calibration of this equipment is bounded by SCE's Measurement and Test Equipment (M&TE) program. A summary of the SCE Keithly 261s used are provided below:

- ID No. M3-2881
  Calibrated Date: 08/24/96
- ID No. I2-8529
  Calibrated Date: 08/26/96

5.0 TEST RESULTS and EVALUATION

The LOCA test was performed at WYLE Laboratories in Huntsville, Alabama, as documented in Wyle Test Report 45662-1 (Reference 6.1, included as Attachment F). The WYLE test report provides additional details regarding the test set up and environmental parameters. The following discussion provides information on the electrical signal monitoring performed by SCE personnel during steam and chemical spray testing.

The LOCA chamber was pre-heated to 120 °F and held steady for approximately 30 minutes. Throughout the pre-heat period, pico ampere signals were injected through both cable specimens. Within this 30 minute period, current input was varied from 10, 100, 1,000 to 10,000 pico amps with measurements of the corresponding output (see Table 5.2). See Table 5.1 for summary of HPRM signal current versus equivalent dose rate.

Table 5.1- HRRM Signal Current and Equivalent Dose Rate

Signal Current (Amps)	Dose Rate (Rads/Hr)
1E-3	1E8
1E-4	1E7
1E-5	1E6
1E-6	1E5
1E-7	1E4
1E-8	1E3
1E-9	1E2
1E-10	1E1
1E-11	1

A summary of the input versus the output for both cable specimens during the 30 minute preheat prior to LOCA simulation is summarized below:

Table 5.2 Preheat Signal Current Comparison

Input (A)	Rockbestos Cable Output (A)	MI Cable Output (A)
1E-11	5E-10	1.25E-11
1E-10	1E-9	1.1E-10
1E-9	3E-10	1.1E-9
1E-8	1.1E-8	1.1E-8

It should be noted that an output signal with a negative polarity will drive the General Atomic HRRM RP2C readout to alarm "fail." After 30 minutes at 120 °F, the LOCA simulation was initiated (at 0947 on September 21, 1996), and continued for 5 days (Reference 6.1, Figure 1).

5.1 Rockbestos "Moisture Dam" Cable Performance

Refer to Figures 3 and 4 for the following discussion. The input current through the Rockbestos cable specimen was 10 pico amps which is equivalent to a 1 Rad/Hour signal. At the start of the LOCA test, the output current from the Rockbestos cable specimen responded by going negative within the first second. After approximately 5 seconds, the output current recovered and started to increase in the positive direction. Approximately 30 seconds into the LOCA transient, a peak reading of about 6E-8 amps (equivalent to 6000 rads/hour) was measured during the peak test temperature of 315 °F (See Figure 3). Once the peak output of 6000 rads/hour was reached, the signal output began to go back down and eventually crossed into the negative region at approximately 13-14 minutes into the LOCA test.

Approximately 2 hours into the LOCA transient the chamber temperature drifted 15 °F below the desired test profile at which time WYLE personnel injected steam into the test chamber, driving the Rockbestos cable signal negative, where it remained through most of the transient portion (27.8 hours) of the LOCA test.

When steady state of the LOCA test was reached (200F), the input signal was increased to 1E-9 amps (100 rads/hour) and the output reading became positive. On September 24, 1996 around 1340, the Rockbestos cable specimen was disconnected from the test measuring equipment and an IR measurement was taken. Subsequent to the measurement, the Rockbestos cable was reconnected to the test monitoring equipment and the input signal was changed to 1E-10 amps (10 rads/hour). The output reading was driven negative for approximately one hour until the output became positive.

5.2 ABB/CE Mineral Insulated Cable Performance

Refer to Figures 1 and 2 for the following discussion. The input current tnrough the mineral insulated cable specimen was 1E-11 amps which is equivalent to a 1 rad/hour signal. At the start of the LOCA test, the output current from the MI cable specimen responded by going negative (polarity) within approximately 3 seconds. After approximately 7 seconds, the output current started to recover. In approximately 15 seconds, the output of the MI cable was greater than 1E-11 amps.

Five minutes into the test, the input current was raised to 1E-10 amps (equivalent to 10 rads/hour). Approximately 20 minutes into the test, the peak output current was measured to be 1.85E-10 amps or 18.5 rads/hour. Given the input is equivalent to 10 rads/hour and the output was 18.5 rads/hour, the net induced rads/hour is 8.5. Since this induced rads/hour is based on a 30 foot MI cable sample, linear extrapolation to an equivalent 250 foot length is 71 rads/hour (See Figure 1). After the peak induced error stabilized at 71 rads/hour, the induced error started to come back down.

About 3 hours into the test, with the LOCA chamber temperature around 267 °F, the Keithly 261 picoampere signal generator was turned "OFF". The output was measured to be 2.0E-11 amps or equivalent to 2 rads/hr for the 30 foot MI cable. Linear extrapolation for a 250 foot length is equal to about 17 rads/hour of induced error.

About 27.8 hours into the test, a 200 °F steady state condition was reached and the MI cable sample performed steadily with a maximum induced error of no more than 0.6 rads/hour or 5 rads/hour for an equivalent 250' length. Several times during the steady state portion, IR measurements were taken at 500VDC. It was noticed that subsequent to these IR measurements, with the input signal set back to 1E-11 amps, the output was negative (polarity). However, within 5 minutes, the MI cable sample recovered into the positive current region and remained steady.

During the cooldown phase subsequent to the five day LOCA test, air was injected into the test chamber to lower the temperature. The input current during the cooldown period was maintained at 1E-11 amps. The induced rads/hour extrapolated to 250' cable length was no greater than 20 rads/hour.

6.0 REFERENCES

6.1 WYLE Laboratories Test Report 45662-1, Revision 0, Environmental Qualification Test Program on Coaxial Cables, Mineral Insulated Cable and Conax Penetration Feedthroughs. Test Report for LOCA Simulation of Coaxial Cable for Southern California Edison."

6.2 Licensee Event Report 96-005, Subject: Containment High Range Radiation Monitors Not Environmentally Qualified.

6.3 Non Conformance Report 950800177, Subject: 2RI-7820-2 Failed Low For A Short Period of Time.

6.4 Non Conformance Report 960600430, Subject: During LOCA-MSLB Testing of HRRM, Failure Mechanism For Moisture Intrusion Into Penetration Connectors Was Discovered.

6.5 Southern California Edison Document "Coaxial Cable LOCA Simulation Test Procedure and Results for Monitoring Electrical Parameters, Dated September 19, 1996.

6.6 Southern California Edison Document "High Range Radiation Monitor Moisture Dam Installation Instruction, Dated August 6, 1996.

6.7 Southern California Edison, EQDP M37609, "High Range Radiation Monitor Detector", Revision 6.

6.8 Memorandum For File, "High Range Radiation Monitoring (HRRM) Coaxial Cable Test Results and Recommendation," Dated January 24, 1996.

6.9 Memorandum For File, "High Range Radiation Monitoring (HRRM) Coaxial Cable Engineering Analysis - Conclusions and Recommendations," Dated June 4, 1996.

6.10 CHAR Report CSR096, "EMI Testing of SONGS Moisture Dam on High Range Radiation Monitor", Dated June 20, 1996.

6.11 Southern California Edison, EQDP M38381, "Conax Corporation Instrumentation Electrical Penetration Assembly", Revision 1.

6.12 Southern California Edison, EQDP M37600, "Amphenol Coaxial Cable Connectors", Revision 4.

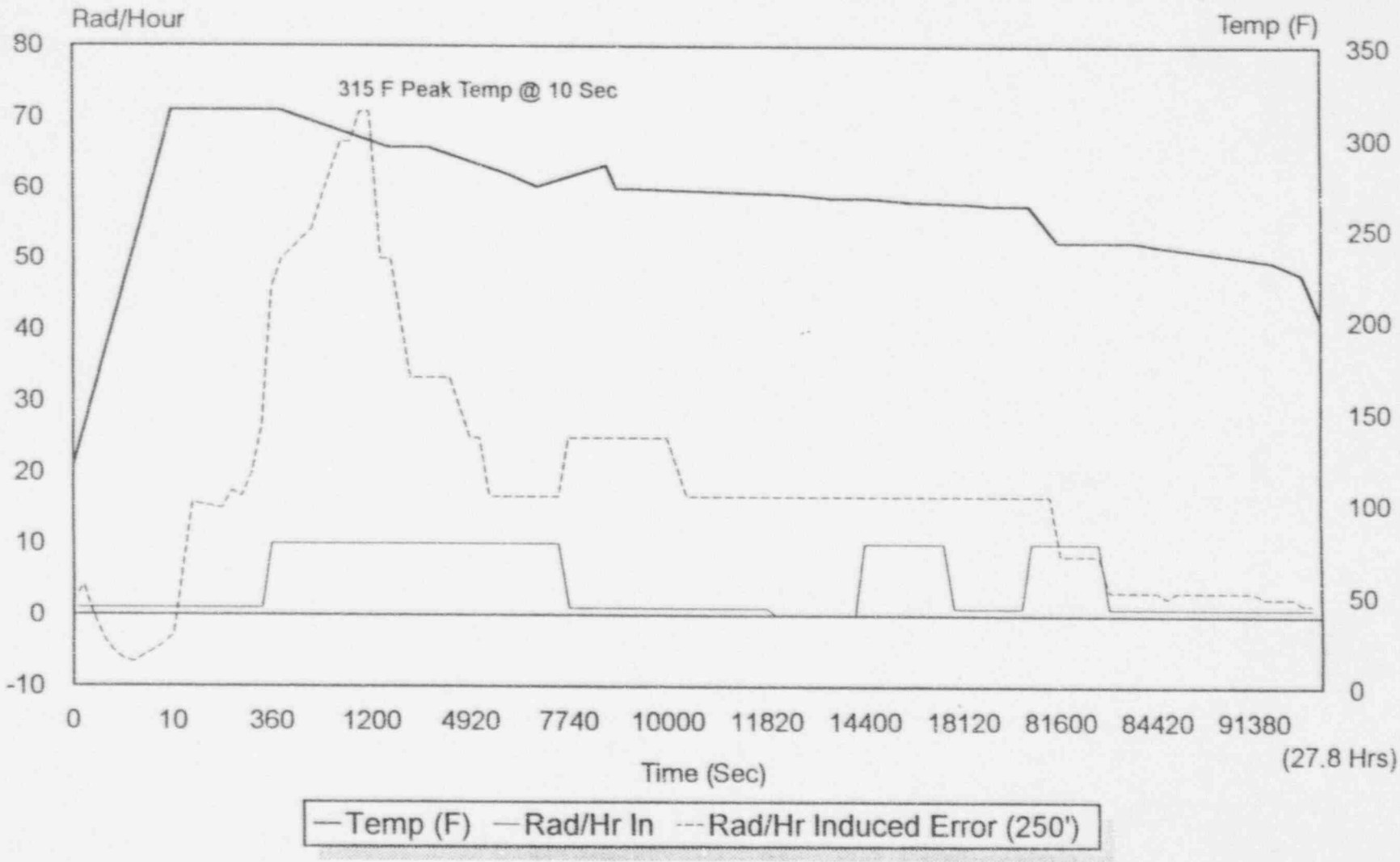
6.13 Southern California Edison, EQDP M37621, "Raychem WCSF-N and WCSF-050-N Shim Stock", Revision 2.

6.14 Southern California Edison, EQDP M85079, "Rockbestos RSS-6-104/LE Coaxial Cable", Revision 3.

6.15 CGI Report 96-3415, "HRRM Connector Moisture Test," Dated June 18, 1996.

Figure 1

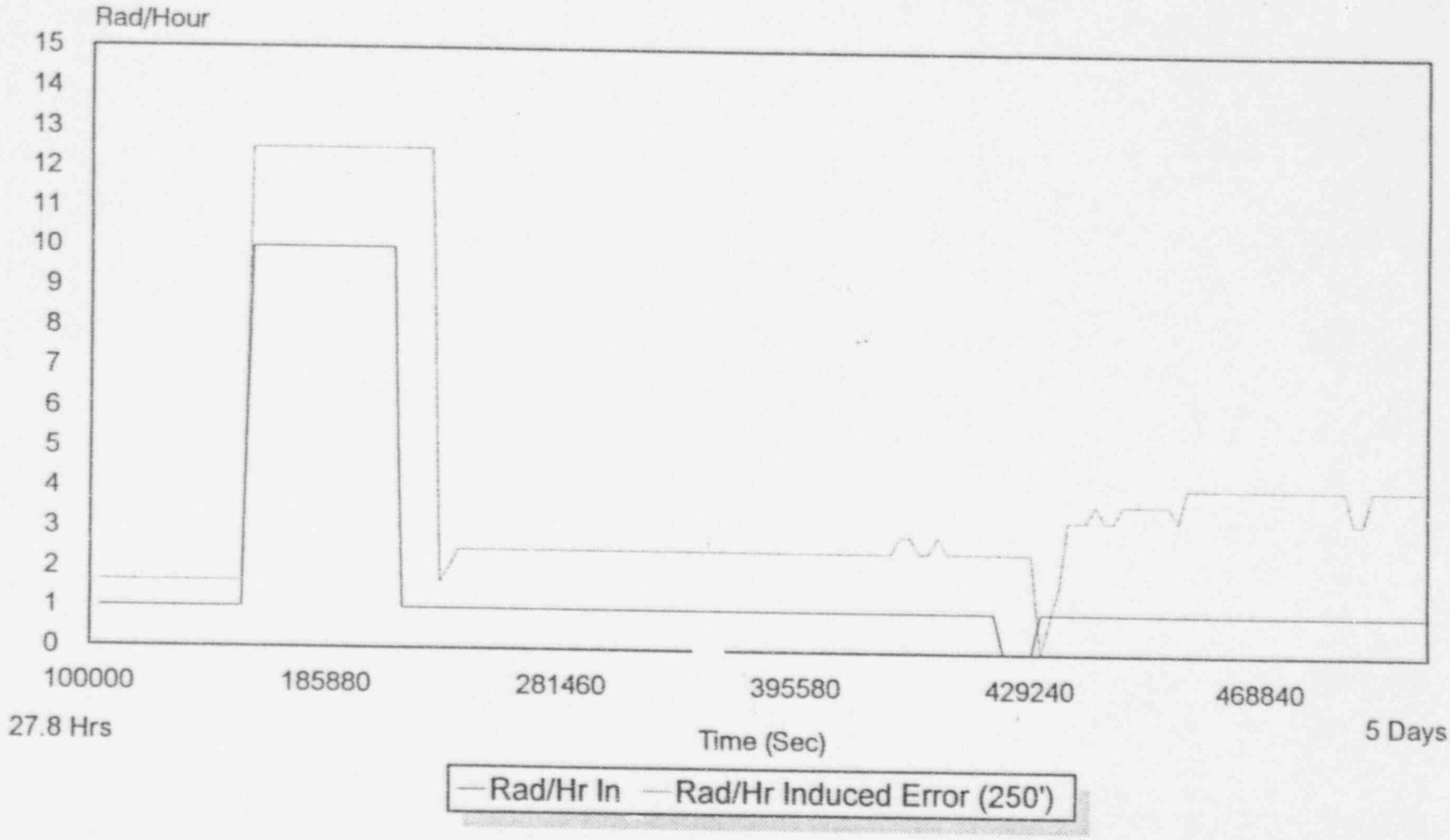
MI Cable - LOCA Transient (0 Sec - 27.8 Hrs)



Input Signal = 1, 10 Rad/Hour

Figure 2

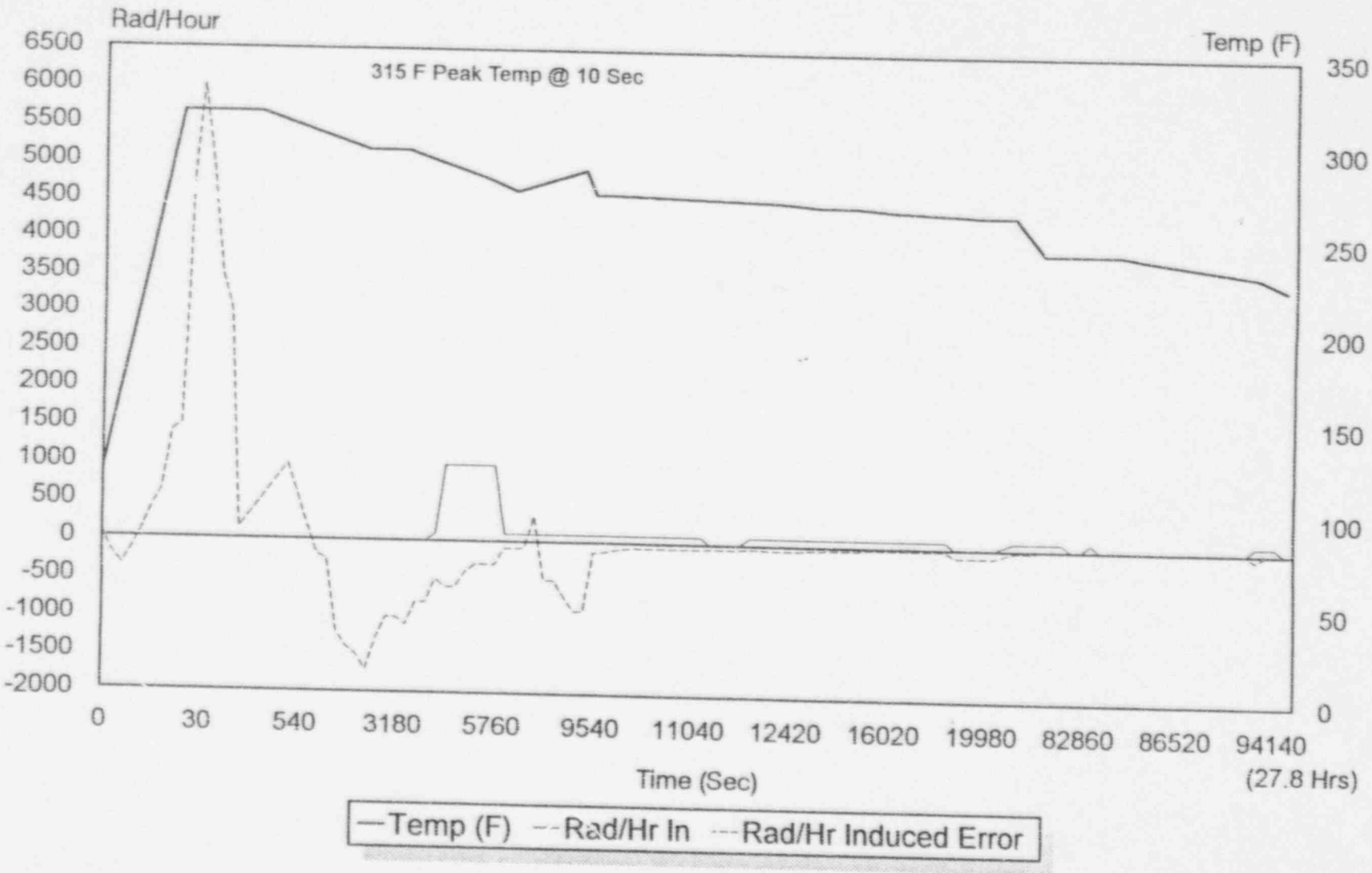
MI Cable - LOCA Steady State @ 200F



Input Signal = 0, 1, 10 Rad/Hour

Figure 3

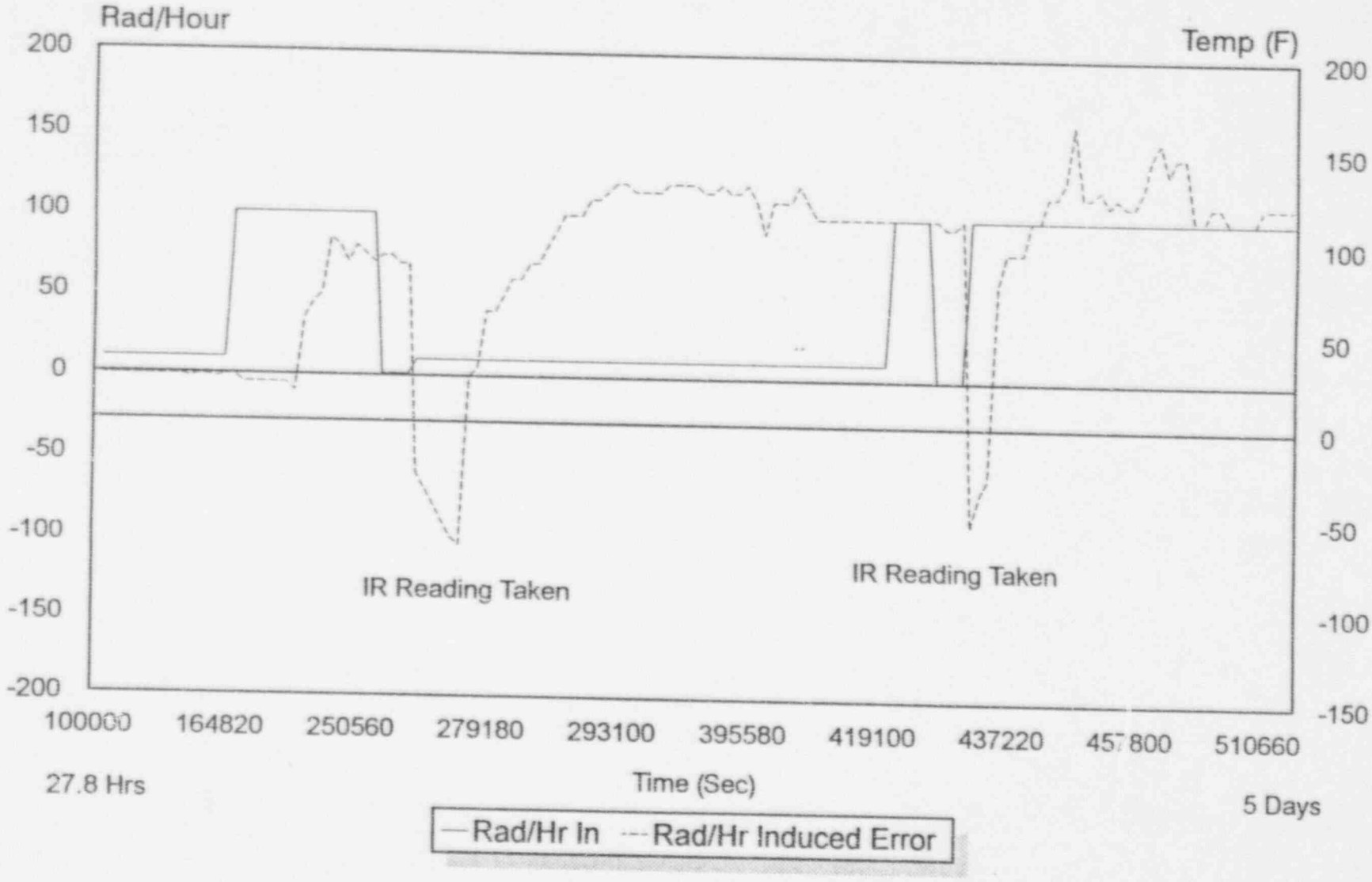
Rockbestos "Moisture Dam" Cable - LOCA Transient (0 Sec - 27.8 Hrs)



Input Signal = 1, 10, 1000 Rad/Hour

Figure 4

Asbestos "Moisture Dam" Cable - LOCA Steady State @ 200F



Input Signal = 0, 1, 10, 100 Rad/Hour

Attachment A

Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Laboratories

(19 Pages)

The following Table 1, "Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs", is a compilation of test monitoring data taken during LOCA testing at WYLE Labs from September 21 through 26, 1996. This testing is documented in reference 6.1. The tabulated data points are a combination of actual data points read from the Keithly 610C electrometers and the Astro-med recorder strip charts. These data points have been independently verified from the Astro-med charts. These tabulated data points form the basis for Figures 1 through 4 documented in the main body of EQ Report M85114.

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Attachment A

Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
Pre heat 09/21/96 @ 920		120	1.00e-11	1.25e-11	1	1.25	2.08	1.00e-11	5.00e-10	1	50.00	49	
			1.00e-10	1.10e-10	10	1.10	8.33	1.00e-10	1.00e-09	10	10.00	90	
			1.00e-09	1.10e-09	100	1.10	83.33	1.00e-09	3.00e-10	100	0.30	-70	
			1.00e-08	1.10e-08	1000	1.10	833.33	1.00e-08	1.10e-10	1000	1.10	100	
LOCA	0	120	1.00e-11	1.25e-11	1	1.25	2.08	1.00e-11	5.00e-10	1	50.00	49	
09/21/96 @ 950	1		1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	-2.00e-09	1	-200.00	-201	
	2		1.00e-11	1.00e-11	1	1.00	0.00	1.00e-11	-3.50e-09	1	-350.00	-351	
	3		1.00e-11	6.00e-12	1	1.40	-3.33	1.00e-11	-1.50e-09	1	-150.00	-151	
	4		1.00e-11	4.00e-12	1	1.60	-5.00	1.00e-11	1.00e-09	1	100.00	99	
	5		1.00e-11	2.50e-12	1	1.75	-6.25	1.00e-11	4.00e-09	1	400.00	399	
	6		1.00e-11	2.00e-12	1	1.80	-6.67	1.00e-11	6.30e-09	1	630.00	629	
	7		1.00e-11	3.00e-12	1	1.70	-5.83						
	8		1.00e-11	4.00e-12	1	1.60	-5.00						
	9		1.00e-11	5.00e-12	1	1.50	-4.17	1.00e-11	1.40e-08	1	1400.00	1399	
	10	315	1.00e-11	6.50e-12	1	1.35	-2.92	1.00e-11	1.50e-08	1	1500	1499	
	20	315						1.00e-11	4.70e-08	1	4700.00	4699	
	30	315	1.00e-11	2.90e-11	1	2.90	15.83	1.00e-11	6.00e-08	1	6000.00	5999	

Attachment A

Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
	40	315						1.00e-11	5.00e-08	1	5000.00	4999	
	50	315						1.00e-11	3.50e-08	1	3500.00	3499	
951	60	315	1.00e-11	2.80e-11	1	2.80	15.00	1.00e-11	3.00e-08	1	3000.00	2999	
952	120	315	1.00e-11	3.10e-11	1	3.10	17.50						
953	180	315	1.00e-11	3.00e-11	1	3.00	16.67						
954	240	315	1.00e-11	3.40e-11	1	3.40	20.00						
955	300	315	1.00e-11	4.20e-11	1	4.20	26.67	1.00e-10	1.60e-09	10	16.00	150	
956	360	315	1.00e-10	1.55e-10	10	1.55	45.83						
957	420	315	1.00e-10	1.60e-10	10	1.60	50.00						
Chemical Spray													
958	480		1.00e-10	1.65e-10	10	1.65	54.17	1.00e-10	1.00e-08	10	100.00	990	
959	540		1.00e-10	1.70e-10	10	1.70	58.33						
1000	600		1.00e-10	1.75e-10	10	1.75	62.50	1.00e-10	2.00e-09	10	20.00	190	
1004	840		1.00e-10	1.80e-10	10	1.80	66.67	1.00e-10	-1.75e-09	10	-0.06	-185	
1006	960		1.00e-10	1.80e-10	10	1.80	66.67	1.00e-10	-2.40e-09	10	-0.04	-250	
1008	1080		1.00e-10	1.85e-10	10	1.85	70.83	1.00e-10	-1.20e-08	10	-0.01	-1210	
1010	1200		1.00e-10	1.85e-10	10	1.85	70.83	1.00e-10	-1.40e-08	10	-0.01	-1410	
1019	1740		1.00e-11	7.00e-11	10	7.00	50.00	1.00e-10	-1.50e-08	10	-0.01	-1510	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1026	2160	295	1.00e-10	1.60e-10	10	1.60	50.00	1.00e-10	-1.70e-08	10	-0.01	-1710	
1030	2400	295	1.00e-10	1.50e-10	10	1.50	41.67	1.00e-10	-1.30e-08	10	-0.01	-1310	
1037	2820	295	1.00e-10	1.40e-10	10	1.40	33.33	1.00e-10	-1.00e-08	10	-0.01	-1010	
1043	3180	295	1.00e-10	1.40e-10	10	1.40	33.33	1.00e-10	-1.00e-08	10	-0.01	-1010	
1046	3360	295	1.00e-10	1.40e-10	10	1.40	33.33	1.00e-10	-1.10e-08	10	-0.01	-1110	
1049	3540		1.00e-10	1.40e-10	10	1.40	33.33	1.00e-10	-8.00e-09	10	-0.01	-810	
1054	3840		1.00e-10	1.40e-10	10	1.40	33.33	1.00e-10	-8.00e-09	10	-0.01	-810	
1111	4860							1.00e-09	-4.00e-09	100	-0.25	-500	
1112	4920		1.00e-10	1.30e-10	10	1.30	25.00	1.00e-08	4.00e-09	1000	2.50	-600	
1114	5040		1.00e-10	1.30e-10	10	1.30	25.00	1.00e-08	4.00e-09	1000	2.50	-600	
1116	5160		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-08	6.00e-09	1000	1.67	-400	
1118	5280		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-08	7.00e-09	1000	1.43	-300	
1123	5580	280	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-08	7.00e-09	1000	1.43	-300	
1126	5760		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-08	7.00e-09	1000	1.43	-300	
1130	6000		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	1.40e-10	100	7.14	-86	
1134	6240	273	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	1.60e-10	100	6.25	-84	
1140	6600		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	2.00e-10	100	5.00	-80	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1149	7140		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	4.40e-09	100	4.40	340	Rockbestos cable started to go positive and then went negative. This anamoly attributed to 15F temperature increasing excursion
1159	7740		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-4.00e-09	100	-0.25	-500	
1200	7800		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-4.00e-09	100	-0.25	-500	
1206	8160		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-6.00e-09	100	-0.17	-700	
1217	8820		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-8.00e-09	100	-0.13	-900	
1225	9300	285	1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-8.00e-09	100	-0.13	-900	
1229	9540	272	1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-2.60e-10	100	-3.85	-126	
1231	9660		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	-1.60e-10	100	-6.25	-116	
1233	9780		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	8.00e-11	100	12.50	-92	
1235	9900		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	2.80e-10	100	3.57	-72	
1236	9960		1.00e-11	4.00e-11	1	4.00	25.00	1.00e-09	3.90e-10	100	2.56	-61	
1241	10260		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	4.00e-10	100	2.50	-60	
1242	10320		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	4.00e-10	100	2.50	-60	
1254	11040		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	4.40e-10	100	2.27	-56	
1256	11160		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	4.40e-10	100	2.27	-56	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1300	11400		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-4.00e-10	10	-0.25	-50	
1303	11580		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-11	-5.00e-10	1	-0.02	-51	
1305	11700		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-12	-5.00e-10	0	-0.00	-50.1	
1306	11760		1.00e-11	3.00e-11	1	3.00	16.67	OFF	-5.00e-10	0	0.00	-50	
1307	11820		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	6.00e-10	100	1.67	-40	
1309	11940		OFF	2.00e-11	0	??	16.67						
1310	12000		OFF	2.00e-11	0	??	16.67	1.00e-09	5.00e-10	100	2.00	-50	
1312	12120	269	OFF	2.00e-11	0	??	16.67	1.00e-09	5.00e-10	100	2.00	-50	
1317	12420		OFF	2.00e-11	0	??	16.67	1.00e-09	5.00e-10	100	2.00	-50	
1318	12480		OFF	2.00e-11	0	??	16.67	1.00e-09	5.00e-10	100	2.00	-50	
1322	12720		OFF	2.00e-11	0	??	16.67	1.00e-09	6.00e-10	100	1.67	-40	
1329	13140	267	OFF	2.00e-11	0	??	16.67	1.00e-09	6.00e-10	100	1.67	-40	
1339	13740	267	OFF	2.00e-11	0	??	16.67	1.00e-09	7.00e-10	100	1.43	-30	
1343	13980	267	OFF	2.00e-11	0	??	16.67	1.00e-09	7.00e-10	100	1.43	-30	
1350	14400	267	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	7.00e-10	100	1.43	-30	
1357	14820	267	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	7.00e-10	100	1.43	-30	
1405	15300		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1408	15480		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1417	16020		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1422	16320	265	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1432	16920	265	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1434	17040		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1442	17520		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1443	17580		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1452	18120	264	1.00e-11	3.00e-11	1	3.00	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1505	18900	264	1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-9.00e-10	10	-0.11	-100	
1511	19260		1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-9.00e-10	10	-0.11	-100	
1518	19680	263	1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-9.00e-10	10	-0.11	-100	
1523	19980	263	1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-9.00e-10	10	-0.11	-100	
1537	20820	263	1.00e-11	3.00e-11	1	3.00	16.67	1.00e-10	-9.00e-10	10	-0.11	-100	
1544	21240	263	1.00e-10	1.20e-10	1	1.20	16.67						
1545	21300	263	1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1554	21840		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
1559	22140		1.00e-10	1.20e-10	10	1.20	16.67	1.00e-09	8.00e-10	100	1.25	-20	
9/22/96@ 0831	81600	243	1.00e-10	1.10e-10	10	1.10	8.33	1.00e-09	1.00e-09	100	1.00	0	
838	82080	243	1.00e-10	1.10e-10	10	1.10	8.33	1.00e-09	1.00e-09	100	1.00	0	
845	82500	243	1.00e-10	1.10e-10	10	1.10	8.33	1.00e-09	1.00e-09	100	1.00	0	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr in	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
847	82620	243	1.00e-10	1.10e-10	10	1.10	8.33	1.00e-10	7.00e-11	10	1.43	-3	
851	82860	243	1.00e-10	1.10e-10	10	1.10	8.33	1.00e-10	6.00e-11	10	1.67	-4	
852	82920	243	1.00e-11	1.40e-11	1	1.40	3.33			100	??	0	
853	82980	243	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	6.00e-11	10	1.67	-4	
856	83160	243	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	6.00e-11	10	1.67	-4	
900	83400	243	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-11	-2.00e-11	1	-0.50	-3	
911	84060		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-11	-2.00e-11	1	-0.50	-3	
917	84420	241	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
926	84960		1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	7.00e-11	10	1.43	-3	
939	85740		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
949	86340		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
952	86520		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
958	86880		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
Chemical Spray Turned Off @ 1017	88020		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
1019	88140		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1 43	-3	
1032	88920		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
1049	89940		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	7.00e-11	10	1.43	-3	
1113	91380		1.00e-11	1.40e-11	1	1.40	3.33	1.00e-10	8.00e-11	10	1.25	-2	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1134	92640		1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	2.00e-10	10	2.00	10	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1141	93060	232	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-10	100	5.00	-80	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1149	93540		1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	1.00e-09	100	1.00	0	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1159	94140		1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	1.00e-09	100	1.00	0	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1213	94980	225	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	8.00e-11	10	1.25	-2	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1249	97140		1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	Rockbestos cable signal output started to fluctuate from 0 - 2 E-10 Amps
1629	110340	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1638	110880	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
1659	112140	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
1717	113220	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
1839	118140	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
1917	120420	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
2048	125880	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
2319	134940	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
9/23/96 @ 0120	142200	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
220	145800	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
312	148920	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	8.00e-11	10	1.25	-2	
451	154860	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
651	162060	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
725	164100	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	8.00e-11	10	1.25	-2	
737	164820	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	9.00e-11	10	1.11	-1	
918	170880	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-09	1.00e-09	100	1.00	0	
922	171120	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	
940	172200	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	
953	172980	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1001	173460	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	
1023	174780	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	
1053	176580	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.50e-10	100	1.05	-5	
1141	179460	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	9.00e-10	100	1.11	-10	
1311	184860	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.35e-09	100	1.35	35	
1328	185880	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.45e-09	100	1.45	45	
1420	189000	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.50e-09	100	1.50	50	
1853	205380	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.85e-09	100	1.85	85	
9/24/96@ 0331	236460	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.80e-09	100	1.80	80	
722	250320	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.70e-09	100	1.70	70	
726	250560	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.80e-09	100	1.80	80	
744	251640	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.75e-09	100	1.75	75	
752	252120	200	1.00e-10	1.15e-10	10	1.15	12.50	1.00e-09	1.70e-09	100	1.70	70	
801	252660	200	1.00e-11	2.50e-11	1	2.50	12.50	1.00e-11	7.50e-10	1	75.00	74	
814	253440	200	1.00e-11	2.50e-11	1	2.50	12.50	1.00e-11	7.50e-10	1	75.00	74	
844	255240	200	1.00e-11	2.50e-11	1	2.50	12.50	1.00e-11	7.00e-10	1	70.00	69	
901	256260	200	1.00e-11	2.50e-11	1	2.50	12.50	1.00e-11	7.00e-10	1	70.00	69	

Attachment A

Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1414	275040	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-10	-5.00e-10	10	-0.20	-60	Cable was meggared and readings are negative
1418	275280	200	1.00e-11	1.25e-11	1	1.25	2.08	1.00e-10	-6.00e-10	10	-0.17	-70	
1422	275520	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	-7.00e-10	10	-0.14	-80	
1435	276300	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	-8.00e-10	10	-0.13	-90	
1439	276540	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	-9.00e-10	10	-0.11	-100	
1444	276840	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	-9.50e-10	10	-0.11	-105	
1448	277080	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.00e-10	10	1.00	0	
1452	277320	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.50e-10	10	1.50	5	
1523	279180	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	5.00e-10	10	5.00	40	
1536	279960	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	5.00e-10	10	5.00	40	
1544	280440	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	6.00e-10	10	6.00	50	
1550	280800	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	7.00e-10	10	7.00	60	
1553	280980	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	7.00e-10	10	7.00	60	
1601	281460	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	8.00e-10	10	8.00	70	
1614	282240	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	8.00e-10	10	8.00	70	
1632	283320	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	9.00e-10	10	9.00	80	
1653	284580	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.00e-09	10	10.00	90	
1702	285120	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	

Attachment A

Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr-250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1715	285900	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
1732	286920	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
1802	288720	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
1824	290040	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
1845	291300	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
1915	293100	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
1924	293640	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
1933	294180	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
1946	294960	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
1954	295440	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
2003	317580	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
2024	383640	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2033	384180	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2055	385500	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2116	386760	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2146	388560	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
2203	389580	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
2234	391440	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2255	392700	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
2317	394020	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.25e-09	10	12.50	115	
2343	395580	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
2356	396360	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
09/25/96 @ 113	400980	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.00e-09	10	10.00	90	
143	402780	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
205	404100	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
226	405360	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
305	407700	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.30e-09	10	13.00	120	
327	409020	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.20e-09	10	12.00	110	
406	411360	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
427	412620	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
444	413640	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
506	414960	200	1.00e-11	1.35e-11	1	1.35	2.92	1.00e-10	1.10e-09	10	11.00	100	
515	415500	200	1.00e-11	1.35e-11	1	1.35	2.92	1.00e-10	1.10e-09	10	11.00	100	
536	416760	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
553	417780	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	
615	419100	200	1.00e-11	1.35e-11	1	1.35	2.92	1.00e-10	1.10e-09	10	11.00	100	
645	420900	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-10	1.10e-09	10	11.00	100	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
715	422700	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-09	100	2.00	100	
737	424020	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-09	100	2.00	100	
749	424740	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-09	100	2.00	100	
807	425820	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-09	100	2.00	100	
823	426780	200	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-09	2.00e-09	100	2.00	100	
841	427860	200	OFF	3.00e-12	0	??	2.50	OFF	1.00e-09	0	??	100	
846	428160	200	OFF	3.00e-12	0	??	2.50	OFF	9.50e-10	0	??	95	
854	428640	200	OFF	3.00e-12	0	??	2.50	OFF	9.50e-10	0	??	95	
904	429240	200	OFF	3.00e-12	0	??	2.50	OFF	1.00e-09	0	??	100	
942	431520	200	1.00e-11	1.00e-11	1	1.00	0.00	1.00e-09	1.00e-10	100	10.00	-90	MI & Rockbestos Cable was meggared
949	431940	200	1.00e-11	1.10e-11	1	1.10	0.83	1.00e-09	3.00e-10	100	3.33	-70	
951	432060	200	1.00e-11	1.20e-11	1	1.20	1.67	1.00e-09	4.00e-10	100	2.50	-60	
1055	435900	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	1.60e-09	100	1.60	60	
1117	437220	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	1.80e-09	100	1.80	80	
1138	438480	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	1.80e-09	100	1.80	80	
1204	440040	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	1.80e-09	100	1.80	80	
1226	441360	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	2.00e-09	100	2.00	100	
1256	443160	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	2.00e-09	100	2.00	100	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250°	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1317	444420	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.15e-09	100	2.15	115	
1348	446280	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.15e-09	100	2.15	115	
1418	448080	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.25e-09	100	2.25	125	
1426	448560	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.60e-09	100	2.60	160	
1448	449880	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.15e-09	100	2.15	115	
1518	451680	200	1.00e-11	1.45e-11	1	1.45	3.75	1.00e-09	2.15e-09	100	2.15	115	
1526	452160	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	2.20e-09	100	2.20	120	
1552	453720	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
1610	454800	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.15e-09	100	2.15	115	
1620	455400	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
1700	457800	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
1751	460860	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.20e-09	100	2.20	120	
1818	462480	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.40e-09	100	2.40	140	
1854	464640	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.50e-09	100	2.50	150	
1926	466560	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.30e-09	100	2.30	130	
2004	466840	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.40e-09	100	2.40	140	
2022	469920	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.40e-09	100	2.40	140	
2052	471840	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	
2105	472500	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr in	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
2129	473940	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
2155	475500	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
2207	476220	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	
2217	476820	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	
2223	477180	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	
9/26/96@ 0713	508980	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.00e-09	100	2.00	100	
741	510660	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	2.10e-09	100	2.10	110	
830	513600	200	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-09	2.10e-09	100	2.10	110	
850	514800	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
908	515880	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
913	516180	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-09	2.10e-09	100	2.10	110	
914	516240	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-08	1.10e-08	1000	1.10	100	
932	517320	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-08	1.10e-08	1000	1.10	100	
1048	521880	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-08	1.10e-08	1000	1.10	100	
1129	524340	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-08	1.10e-08	1000	1.10	100	
Post LOCA Temperature Spike From 200 to 250F	0	200	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	1.00e-09	1	100.00	99	

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Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
1 min	60	250	1.00e-11	1.60e-11	1	1.60	5.00	1.00e-11	1.00e-09	1	100.00	99	Rockbestos vary sporadic.
2 min	120	250	1.00e-11	1.40e-11	1	1.40	3.33	1.00e-11	-1.00e-09	1	-0.01	-101	Signal trace fluctuating both + and - direction
3 min	180	250	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	-5.00e-10	1	-0.02	-51	
4 min	240	250	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	1.00e-09	1	100.00	99	
5 min	300	250	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	-7.00e-09	1	-0.00	-701	
Post LOCA Temperature Spike From 250 to 300F	420	250	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	-7.00e-09	1	-0.00	-701	Rockbestos vary sporadic.
1 min	480	300	1.00e-11	1.30e-11	1	1.30	2.50	1.00e-11	5.00e-10	1	50.00	49	Signal trace fluctuating both + and - direction
2 min	540	300	1.00e-11	1.70e-11	1	1.70	5.83	1.00e-11	-4.90e-09	1	-0.00	-491	
3 min	600	300	1.00e-11	1.70e-11	1	1.70	5.83	1.00e-11	-3.40e-08	1	-0.00	-3401	
4 min	660	300	1.00e-11	2.90e-11	1	2.90	15.83	1.00e-11	-1.10e-07	1	-0.00	-11001	
5 min	720	300	1.00e-11	3.30e-11	1	3.30	19.17	1.00e-11	-1.20e-07	1	-0.00	-12001	

Attachment A

Table 1 - Rockbestos and ABB/CE Coaxial Cable LOCA Test @ WYLE Labs

September 21 - 26, 1996

Clock Hour	Time (Sec)	Temp (F)	MI Cable (Channel 2)					Rockbestos (Channel 1)					Comments
			I_{in} (A)	I_{out} (A)	Rad/ Hr In	Error Factor	Induced Rad/Hr- 250'	I_{in} (A)	I_{out} (A)	Rad/Hr In	Error Factor	Induced Rad/Hr	
Injecting Air to Cool Chamber from 300F	780	<300	1.00e-11	3.40e-11	1	3.40	20.00	1.00e-11	-1.00e-08	1	-0.00	-1001	As temp cooled, MI and Rockbestos started to recover
	840	<300	1.00e-11	3.30e-11	1	3.30	19.17	1.00e-11	1.00e-07	1	10000.00	9999	
	1020	<300	1.00e-11	2.80e-11	1	2.80	15.00	1.00e-11	1.00e-07	1	10000.00	9999	
	3060	???	1.00e-11	1.50e-11	1	1.50	4.17	1.00e-11	1.00e-09	1	100.00	99	

Attachment B

SCE High Range Radiation Monitor Moisture Dam Installation Instruction

(6 Pages)

Southern California Edison Company
San Onofre Nuclear Generating Station Units 2&3

High Range Radiation Monitor
Moisture Dam Installation Instruction

Prepared By: _____ Date 8-6-96
Wayne Nakamoto

Reviewed By: _____ Date 08/06/96
Bob Greene

TABLE OF CONTENTS

1 INTRODUCTION

This procedure provides general instructions for moisture barrier preparation on Rockbestos RSS-6-104/LE coaxial cable used for the SONGS 2 & 3 High Range Radiation Monitor (HRRM) system.

2 SCOPE

The scope of this moisture dam installation procedure is limited to the SONGS 2 & 3 HRRMs. The plant Ids are 2(3) RE-7820-1 and 2(3) RE-7820-2.

3 MOISTURE DAM INSTALLATION INSTRUCTIONS

3.1 Materials

3.1.1 Amphenol HN connectors (Part Number 82-816)

3.1.2 Raychem WCSF-200N

3.1.3 Raychem S1119 Adhesive Tape

3.1.4 22 AWG Solid Strand Copper Conductor

3.2 Installation Details

3.2.1 Install the Amphenol HN connector on the field cable per appropriate procedure

3.2.2 Locate the point on the cable 2 - 2.5 inches away from field end of Amphenol connector.

3.2.3 Remove 3 inches of the coaxial cable jacket.

3.2.4 CAREFULLY remove 2 inches of the coaxial cable shield leaving half inch of shield on both ends.

CAUTION:	When removing the shield, be careful not to damage/gouge the coaxial cable insulation

3.2.5 Apply S1119 adhesive tape under the #22 AWG wire to build up (one or two layers).

3.2.6 Solder four #22 AWG solid strand copper conductor across the shield (90 ° apart)

3.2.7 Wrap S1119 adhesive tape over the #22 AWG wire with one layer.

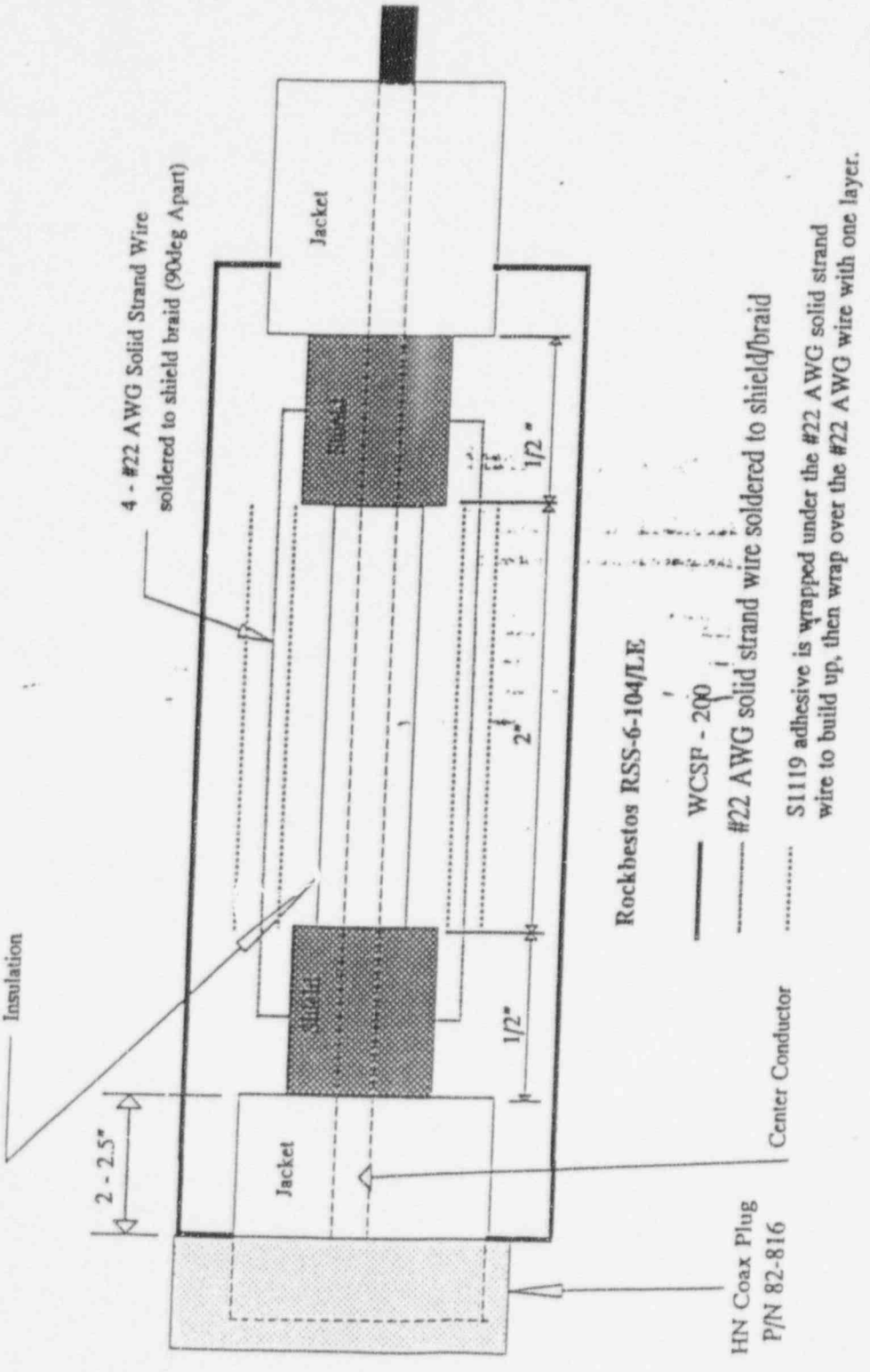
3.2.8 Apply minimum of 8 inches in length of the WCSF-200N over the moisture dam construction

3.3 Cable samples 1, 2 and 3 have completed in accordance with steps 3.2.1 thru 3.2.8

Prepared by: Rad Monitor Tech Date: 8-8-96

Prepared by: Bruce Hopper Rad Monitor Tech Date: 8-8-96

FIGURE 1
MOISTURE DAM DESIGN



Attachment C

SCE Coaxial Cable LOCA Simulation Test Procedure and Results for Monitoring Electrical Parameters

(33 Pages)

Southern California Edison Company
San Onofre Nuclear Generating Station Units 2&3

Coaxial Cable LOCA Simulation Test Procedure and Results for Monitoring Electrical Parameters

Third Test, September 16 through 30, 1996

Prepared By: Wayne Nakamoto Date 9/19/96
Wayne Nakamoto

Reviewed By: Bob Greene Date 09/19/96
Bob Greene

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LIST OF FIGURES

LIST OF ATTACHMENTS

1.0 INTRODUCTION

This procedure establishes the requirements and instructions for demonstrating the performance of coaxial cable test specimens before, during, and after simulated LOCA environment. The test specimens are comprised of one Rockbestos RSS-6-104/LE coaxial cable with "Moisture Dam" modification and one Mineral Insulated (MI) coaxial cable. Both of the cable specimens will be connected to Conax coaxial penetration feedthroughs. The simulated LOCA conditions are identified in the WYLE Laboratories Test Procedure 45662 (Reference 1).

Note: This procedure applies to the second LOCA test sequence performed on the cable specimens and coaxial penetrations. The cable specimens and coaxial penetrations are identified in Table 1.

2.0 SCOPE/PURPOSE

The scope of this test procedure is limited to the Southern California Edison supplied coaxial cable and coaxial feedthrough test specimens as identified in Table 1.

The purpose of this test is to establish and/or quantify the capability of coaxial cable "Moisture Dam" configuration from preventing moisture intrusion and migration through the coaxial cable jacket and down the shield to the coaxial connectors and thus leading to failure of maintaining signal continuity. Also, this test will establish the capability both the Rockbestos cable and Mineral Insulated (MI) cable of maintaining picoamp range signal continuity under a simulated LOCA. Both cable samples will be connected to Conax coaxial feedthroughs and tested as an integrated system simulating the High Range Radiation Monitor system.

2.1 Continuity and Static Insulation Resistance Verification

Continuity and insulation resistance (IR) between the test specimen center conductor and shield, and shield to ground, shall be verified prior to, during, and following the LOCA simulation. Additional IR data may be taken as required.

This test will be performed using a megger with suitable test leads. Test data shall be recorded in the format shown in Table 2.

2.2 Dynamic Cable Performance

Figure 1 shows schematically the test specimens and measuring equipment configuration. The Keithly 261 will be used to simulate the "keep alive" source

within the Sorrento Electronics (General Atomic) RD-23 detector. The Keithly 610 will be used to monitor the signal "noise" effects of LOCA conditions on the coaxial cable. Coaxial cable current levels during LOCA simulation will be monitored and recorded as described in Section 6.2.

3.0 TEST EQUIPMENT

All test measuring equipment used in this procedure is calibrated in accordance with the Wyle Laboratories Quality Assurance Program and is identified in the Wyle Test Report (Reference 4.2).

3.1 Static Insulation Resistance Test

(4) Two 75 Ohm Conax Feedthroughs, 24" Long with 6.0" Pigtails at end w/ HN-Coax Jack Connectors (w/ Ampehnol 82-321 interface) and Raychem WCSF-N Shims at each end.

(4) Control Test Vessel Penetration

(1) Megger, 500V

3.2 Dynamic Cable Performance Test

(1) One Coaxial cable test specimen with Ampehnol connectors on each end.

(1) One Mineral Insulated cable test specimen with HN connectors on each end.

(2) Control Test Vessel Penetration

(2) Keithly 610C or 610CR Electrometers

(2) Keithly 261 Current Source

(1) Astromed MT95K2 Mainframe including the following subcomponents:

(1) AWP1 analog input card

(1) VOP1 video module

(1) SVGA compatible video monitor

(2) PL-259 connectors for 610C input

(2) Cables to go from Keithly 610C to Astromed recorder

(3) Pack of 400 sheet Z fold paper for Astromed

(1) Configuration disk for Astromed recorder

4.0 REFERENCES

4.1 WYLE Laboratories Test Procedure 45662, "Test Procedure for LOCA Simulation of Coaxial Cable for Southern California Edison".

4.2 WYLE Laboratories Test Report 45662-1, "Test Report for LOCA Simulation of Coaxial Cable for Southern California Edison".

5.0 ACCEPTANCE CRITERIA

5.1 Continuity and Static Insulation Resistance Test

Pre, Mid and Post LOCA Rockbestos and MI coaxial cable test specimens must maintain center conductor continuity. Shield to ground resistance measurements maybe taken for information only.

5.2 Dynamic Cable Performance Test

As discussed in Section 2.2, the purpose of this test is to verify the prevention of moisture propagation down the coaxial cable shield down to the cable specimen connectors by the "Moisture Dam" modification under simulated LOCA environmental conditions. In addition, MI cable will also be monitored under the simulated LOCA environment.

Picoamp signals will be be applied to both test circuits and will be monitored during the LOCA testing. Signal continuity in the picoamp range should be maintained throughout the LOCA testing in order to consider the testing successfull.

6.0 PROCEDURE

6.1 **Pre LOCA Continuity and Static Insulation Resistance Test**

Prior to exposure to the simulated LOCA environmental conditions, the following steps shall be performed on each test specimen (and coaxial penetration).

6.1.1 Connect the megger to the test specimen using the megger test lead.

6.1.2 Verify continuity. Apply megger voltage(500VDC) and derive conductor to shield insulation resistance. Record in the applicable Table.

6.1.3 Turn megger off and disconnect test specimen.

6.2 Dynamic Cable Performance Test

6.2.1 Preliminary Checks

6.2.1.1 Ensure test equipment is present as per Section 3.2.

6.2.1.2 Ensure test cables on the outside of chamber are wrapped with thermal insulating material.

6.2.2 Setting up and configuring the Astromed recorder.

6.2.2.1 Install connectors on analog module cards (AWP1).

6.2.2.2 Install cables from Keithly 610C into appropriate channels on AWP1 amplifier per Figure 1.

6.2.2.3 Connect Astromed recorder to a power source.

6.2.2.4 Turn Astromed to the ON position (1).

6.2.2.5 Set recorder internal date and time by performing the following.

6.2.2.5.1 Depress the front panel SYS key.

6.2.2.5.2 Depress the soft key above SYSTEM CLOCK.

6.2.2.5.3 Use selection arrows to select each component date and time.

6.2.2.5.4 Depress EXIT

6.2.2.6 Downloading of the configuration program.

6.2.2.6.1 Insert the disk labeled Wyle Labs Cable Testing Astromed setup in disk drive.

6.2.2.6.2 Press the MODE key

6.2.2.6.3 Press the soft key above FROM DISK

6.2.2.6.4 Use the encoder wheel to select file you want to download.

6.2.2.6.5 Press the soft key above RUN. This should download the entire recorder

configuration and labels.

6.2.2.6.6 Depress SAVE.

6.2.2.6.7 Depress the soft key above ENTIRE MODE in the left display.

6.2.2.6.8 Use INC or DEC to select one of four soft keys into which the mode will be saved.

6.2.2.6.9 Use the keypad to type a label for the grid.

6.2.2.6.10 Press the soft key above ACCEPT to store the chart into the selected soft key. This will be displayed whenever the MODE key is depressed.

NOTE: If any labels need to be changes depress EDIT and edit buffers 1-9 as required.

6.2.3 **To activate recorder to begin recording**

6.2.3.1 Ensure that inputs are approximately in the middle of each chart. If not, the zero suppression may need to be used to center the channel.

6.2.3.2 Ensure there is enough paper in the recorder to last the duration of the test to be performed. This can be done by checking the printed number on the paper. The paper goes from 400 downward to 1. The lower the number, the less paper you have.

6.2.3.3 Verify chart speed is correct for application.

6.2.3.4 Start recording by depressing the RUN/HALT button.

6.2.4 **Stopping the recorder.**

6.2.4.1 Depress the RUN/HALT button

6.2.4.2 Remove, label and store the trace.

6.2.5 **Setting up and configuring the Keithly 610C Electrometer (set up and checkouts).**

6.2.5.1 Set METER SWITCH to POWER OFF

6.2.5.2 Lock ZERO CHECK

6.2.5.3 Set RANGE SWITCH to VOLTS and MULTIPLIER SWITCH to 1.0

6.2.5.4 Turn METER SWITCH to CENTER ZERO. Meter should read the center zero. If not, adjust as required.

6.2.5.5 Set FEEDBACK switch to FAST

6.2.6 **Setting up and configuring the Keithly 261 Pico Ammeter (set up and checkouts).**

6.2.6.1 Connect test specimen input cable to front input connection.

6.2.6.2 Set POLARITY SWITCH to "OFF." Warm up 15 minutes.

6.2.6.3 Set mantissa to 1E-11.

6.2.6.4 Set polarity to "+."

6.2.6.5 Ensure that both Astromed and Keithly 610 respond to input signals. Run through the listed range of -5E-11 to +5E-11 amps.

6.2.7 **Testing procedure checklist.**

6.2.7.1 Ensure all cables are connected to test equipment. This includes verifying that cables are installed per Figure 1.

6.2.7.1.1 Test specimen to Keithly 610.

6.2.7.1.2 Keithly 610 recorder output to Astromed.

6.2.7.1.3 Keithly 261 output to test specimen.

6.2.7.2 Ensure all test equipment is powered up, functional and on the correct range.

6.2.7.2.1 Astromed

6.2.7.2.2 Keithly 610C

6.2.7.2.3 Keithly 261

6.2.7.3 Ensure the Astromed recorder is selected to desired chart speed for testing. For the first 60 seconds or so, set recorder speed to 5 mm/sec.

6.2.7.4 Start the Astromed recorder.

6.2.7.5 Start steam testing.

6.2.7.6 Adjust Keithly 610 range as necessary to avoid bottoming out on Astromed recorder. Annotate recorder trace with any range changes.

6.2.7.7 Adjust Keithly 261 range as necessary to avoid bottoming out on Astromed recorder. Annotate recorder trace with any range changes.

6.2.7.8 After readings stabilize somewhat, reduce chart speed to 1 mm/sec for balance of test.

6.3 **Mid LOCA Continuity and Static Insulation Resistance Test**

At some time during exposure to the simulated LOCA environmental conditions, the following steps shall be performed on each test specimen.

6.3.1 Connect the megger to the test specimen using the megger test lead.

6.3.2 Verify continuity

6.3.3 Apply megger voltage (500VDC) and derive conductor to shield insulation resistance. Record in the appropriate Table.

6.3.4 Turn megger off and disconnect test specimen.

6.4 **Post LOCA Continuity and Static Insulation Resistance Test**

Following exposure to the simulated LOCA environmental conditions, the following steps shall be performed on each test specimen.

6.4.1 Connect the megger to the test specimen using the megger test lead.

6.4.2 Verify continuity

6.4.3 Apply megger voltage (500VDC) and derive conductor to shield insulation resistance. Record in the appropriate Table.

6.4.4 Turn megger off and disconnect test specimen.

6.5 **Use Attachment 3 "LOCA Cable Test Procedure" to document procedure execution.**

TABLE 1

TEST SPECIMEN IDENTIFICATION

Specimen Number	Description	Comments
1	250' Rockbestos RSS-6-104/LE	Aged @ 257F for 135 hrs
N/A	250' Rockbestos RSS-6-104/LE	Spare - Aged @ 248F for 135 hrs
N/A	250' Rockbestos RSS-6-104/LE	Spare - Aged @ 239F for 102.5 hrs
2	30' ABB Mineral Insulated	Inorganic including connector
Feedthrough 1	75 ohm Coax Feedthrough, 24" long w/ 6" Pigtails w/ HN-Coax Jack Connectors	
Feedthrough 2	75 ohm Coax Feedthrough, 24" long w/ 6" Pigtails w/ HN-Coax Jack Connectors	
Feedthrough 3	75 ohm Coax Feedthrough, 24" long w/ 6" Pigtails w/ HN-Coax Jack Connectors	
Feedthrough 4	75 ohm Coax Feedthrough, 24" long w/ 6" Pigtails w/ HN-Coax Jack Connectors	

TABLE 2

PRE-LOCA TEST

CONTINUITY AND STATIC INSULATION RESISTANCE TEST

Time/Date:

Specimen Number	Continuity (Y/N)	Conductor to Shield Resistance @500 VDC	Date/Time	
Feedthrough 1	Y	7.8 E 12 ohms	9/20/96	0830
Feedthrough 2	Y	8.0E 12 ohms	9/20/96	0840
Feedthrough 3	Y	8.0 E 12 Ohms	9/20/96	0850
Feedthrough 4	Y	1.9 E 10 ohms	9/20/96	0900

Notes:

TABLE 3

PRE-LOCA TEST with Conax Feedthroughs

CONTINUITY AND STATIC INSULATION RESISTANCE TEST

Cable Specimen Number	Continuity (Y/N)	Conductor to Shield Resistance @500 VDC	Date/Time
1	Y	2.7E10 ohms	9/20/96 1115
2	Y	7.8 E10 ohms	9/20/96 1150

Notes:

TABLE 4

MID-LOCA TEST with Conax Feedthroughs

CONTINUITY AND STATIC INSULATION RESISTANCE TEST

Time/Date:

Cable Specimen Number	Continuity (Y/N)	Conductor to Shield Resistance @500 VDC	Date/Time
1	Y	2E9 ohms	9/23/96 1115
2	Y	1.8E10 ohms	9/23/96 1110

Cable Specimen Number	Continuity (Y/N)	Conductor to Shield Resistance @500 VDC	Date/Time
1	Y	2.4E8 ohms	9/24/96 1340
2	Y	5.0E10 Ohms	9/24/96 1330
1	Y	1.85E8 Ohms	9/25/96 0707
2	Y	5.5E9 ohms	9/25/96 0912

Notes: INCLUDES APPROXIMATELY 20' CABLE TEST LEAD

TABLE 5

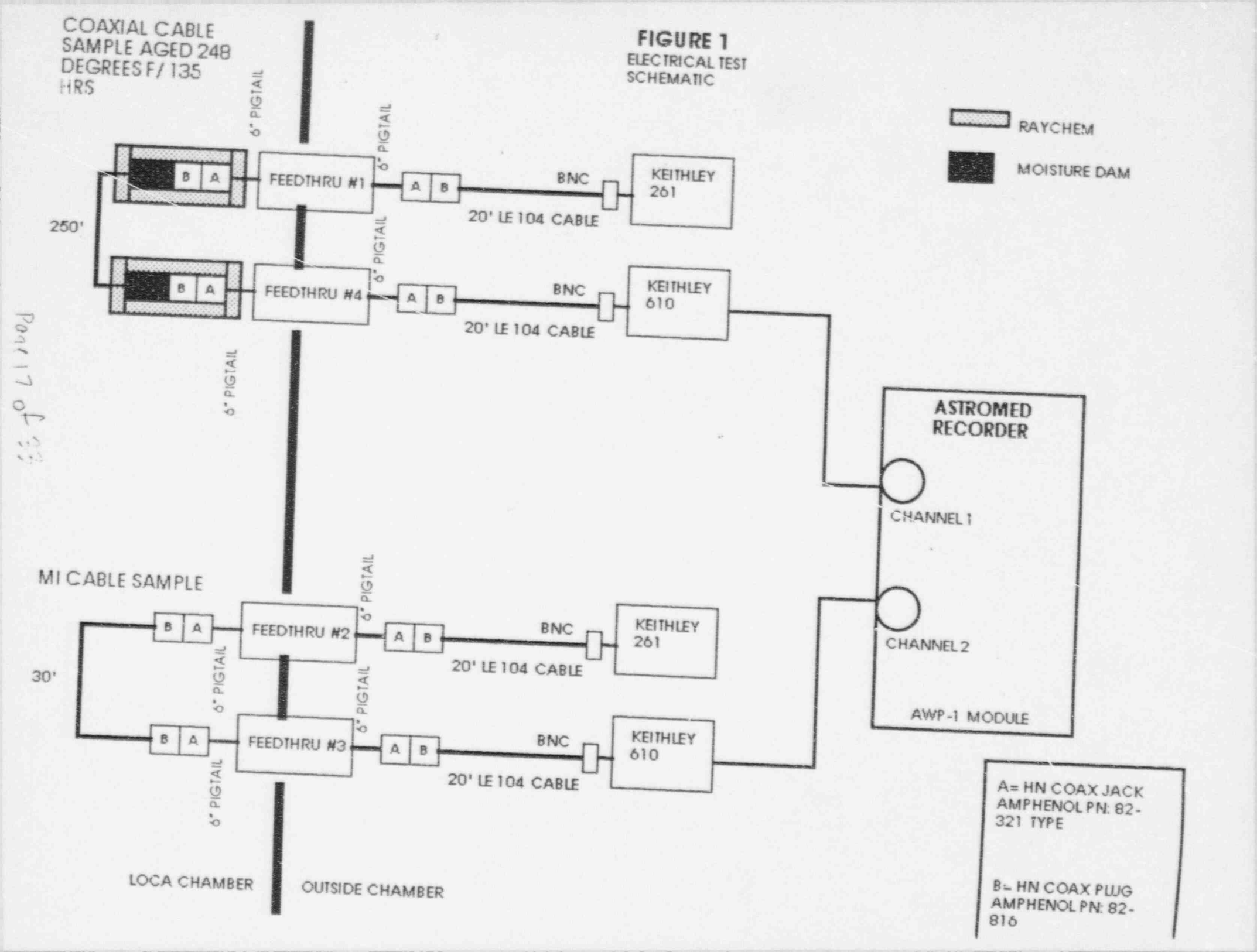
POST-LOCA TEST with Conax Feedthroughs

CONTINUITY AND STATIC INSULATION RESISTANCE TEST

Time/Date:

Cable Specimen Number	Continuity (Y/N)	Conductor to Shield Resistance @500 VDC	Shield to Ground Resistance @500 VDC	Date/Time
1	Y	2.7E9ohms	4E9 Ohms	1315
2	Y	4.5E9ohms	4.5E9ohms	1318

Notes: INCLUDES APPROXIMATELY 20' CABLE TEST LEAD


COAXIAL CABLE
SAMPLE AGED 248
DEGREES F/ 135
HRS
FIGURE 1
ELECTRICAL TEST
SCHEMATIC
RAYCHEM
MOISTURE DAM
6" PIGTAIL
FEEDTHRU #1
FEEDTHRU #4
FEEDTHRU #2
FEEDTHRU #3
B
A
A
B
BNC
KEITHLEY
261
KEITHLEY
610
20' LE 104 CABLE
250'
30'
MI CABLE SAMPLE
ASTROMED
RECORDER
CHANNEL 1
CHANNEL 2
AWP-1 MODULE
LOCA CHAMBER
OUTSIDE CHAMBER
A= HN COAX JACK
AMPHENOL PN: 82-
321 TYPE
B= HN COAX PLUG
AMPHENOL PN: 82-
816

ATTACHMENT 1 - TEST SAMPLE TRACEABILITY

Cable samples:

Material Code: 027-75377, Manufacturer: Rockbestos
Model:RSS-6-104/LE

Connectors: Amphenol connectors P/N 82-816 supplied from CONAX BUFFALO (CONAX P/N N44079-03), CONAX Order No. 7NG700. SCE PO 8H066002.

Raychem: WCSF-200, PO No 6A010903/425I, Req No L6603

S1119 Adhesive tape, PO No 6E2T4015, Mat Code 025-14404

MI Cable: Supplied by ABB Combustion Engineering

Conax: Feedthroughs Supplied by Conax Corporation

ATTACHMENT 2 - PRE AGING ECAD RESULTS

ECAD SYSTEM 1000 Version 5.32

CALIBRATION and DIAGNOSTICS RESULTS

DATE: 09/06/95
TIME: 13:18

	COMMUNICATIONS	HARDWARE CHECK	HARDWARE CAL
Controller Card	: PASSED	N/A	N/A
ECAD Switch	: PASSED	PASSED	N/A
Multimeter	: PASSED	PASSED	N/A
Impedance Meter	: PASSED	PASSED	N/A
Megohmmeter	: PASSED	PASSED	N/A
Oscilloscope	: PASSED	PASSED	PASSED

PULSER MEASUREMENTS

Pulser Amplitude	:	453.25 m Volts
Pulser Frequency	:	20.32 k Hz

TEST LEAD MEASUREMENTS

Avg. DC Resistance	:	945.67 m Ohms
Time Base Check	:	COMPLETED
1 kHz Inductance	:	7.48 u Henry
1 M Ohm Resistor	:	966.40 k Ohms
1 kHz Capacitance	:	1.24 n Farad
Insulation Resistance	:	15.25 G Ohms

COMMUNICATIONS	: PASSED
HARDWARE CHECK	: PASSED
HARDWARE CALIBRATION	: PASSED
PULSER MEASUREMENTS	: PASSED
TEST LEAD MEASUREMENTS	: PASSED

File Set: C:\ECROSS\BP3LC

CIRCUIT IDENTIFICATION
DEVICE : BDC : CABLE 1
DESCRIPTION : 250' BSS-6-104/LE
DEVICE TYPE :
CONFIGURATION : B

TEST AREA : K-20
TERMINATION : SHORTED
HIGH TEST POINT :
LOW TEST POINT :
COMMENTS : CENTR TO SHIELD

ID CODE :
ID CODE :
ID CODE :

PIN : CENT
PIN : SHLD

OPERATOR IDENTIFICATION
1ST LAST NAME : HOPPER
AI LAST NAME : DAHNER
MI :

FIRST NAME : BRUCE
FIRST NAME : REID

U MEASUREMENT UNDEFINED
L INDUCTANCE/QUALITY (H/UNITY)
C CAPACITANCE/DISSIPATION (F/UNITY)

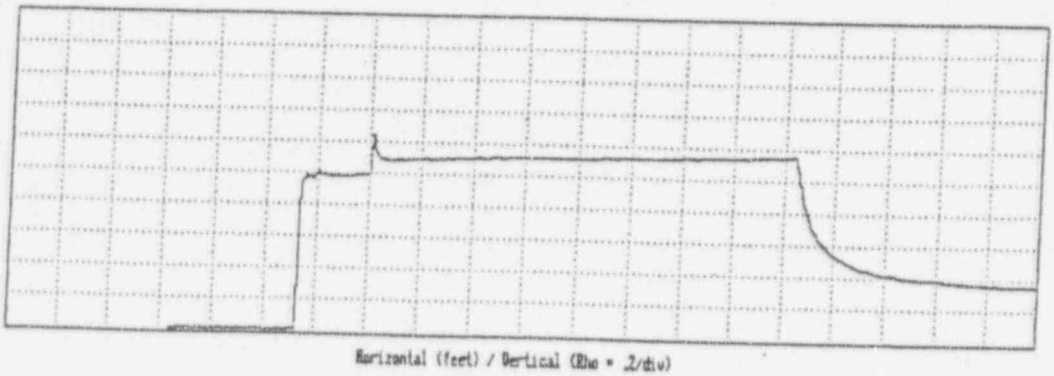
	TEST DATE	TEST TIME	AC + DC VOLTAGE	DC RESISTANCE (OHMS)	AC RESISTANCE 1 kHz (OHMS)	REACTANCE 1 kHz (OHMS)		1kHz
(R)								
(T)	08/05/96	13:47	2.05 n	6.02	6.07	192.00 n	L	30.56 u / 31.64 n

INSULATION RESISTANCE DATA

	IR TEST VOLTAGE	IR (OHMS) FIRST	FINAL	DURATION (SECONDS)	POLARIZATION RATIO
(R)					
(T)	0	0	0	0	0

LEGEND
(T) = TEST
(R) = REFERENCE
T = tera G = giga M = mega k = kilo
m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Rho = .2/div)

TEST (SOLID)
TIME BASE : 100 nS
FT/DIVISION : Approx 30.0

ECAD SYSTEM 1000 Version 5.32 DATA CHART

File Set: C:\ECROSS\BP3LC

ECAD SYSTEM 1000 Version 5.32 DATA CHART

File Set: C:\ECAD5\JP0L0

CIRCUIT IDENTIFICATION

DEVICE CODE : CABLE 1
DESCRIPTION : 250' RSS-6-104/CI
DEVICE TYPE :
CONFIGURATION : 0

TEST AREA : 6-20
TERMINATION : OPEN
HIGH TEST POINT :
LOW TEST POINT :
COMMENTS : CONN TO SHIELD

HI CODE :
IO CODE :
IO CODE :

PIN : CONN
PIN : SHLD

OPERATOR IDENTIFICATION

OP LAST NAME : HOPPER
RS LAST NAME : SHAFER
MOD :

FIRST NAME : BRUCE
FIRST NAME : REED

U MEASUREMENT UNDEFINED
L INDUCTANCE/QUALITY (H/UNITY)
C CAPACITANCE/DISSIPATION (F/UNITY)

TEST	TEST	AC + DC	DC RESISTANCE	AC RESISTANCE	REACTANCE		
DATE	TIME	VOLTAGE	(OHMS)	1 kHz (OHMS)	1 kHz (OHMS)		1kHz
(E)							
(T) 08/08/96	13:49	1.46	) 500.00 k	5.44	-23.33 k	C	6.82 n / 0.33 n

INSULATION RESISTANCE DATA

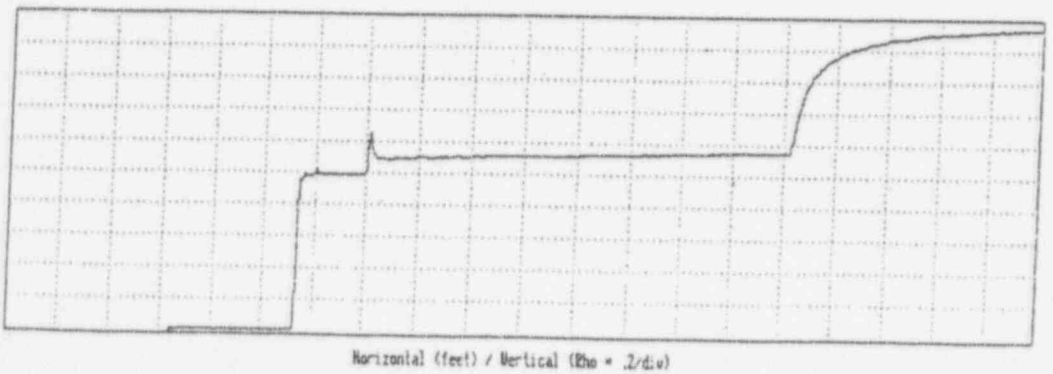
IR TEST	IR (OHMS)		DURATION	POLARIZATION
VOLTAGE	FIRST	FINAL	(SECONDS)	RATIO
(E)				
(T) 1000	13.98 G	20.03 G	180	1.43

LEGEND

(T) = TEST
(R) = REFERENCE

T = tera G = giga M = mega k = kilo
m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Rho = .2/div)

TEST (SOLID)
TIME BASE : 120 nS
FI[illegible]DIVISION : Approx 20.0

CIRCUIT IDENTIFICATION

DEVICE CODE	: CABLE 2	TEST AREA	: K-20		
DESCRIPTION	: 250' RSS-6-104 LC	TERMINATION	: SHORTED	ID CODE :	
DEVICE TYPE	:	HIGH TEST POINT	:	ID CODE :	PIN : CENT
CONFIGURATION	: 0	LOW TEST POINT	:	ID CODE :	PIN : SHLD
		COMMENTS	: CENTR TO SHIELD		

OPERATOR IDENTIFICATION

QP LAST NAME	: HOPPER	FIRST NAME	: BRUCE
AI LAST NAME	: DAHLER	FIRST NAME	: REED
MOS	:		

U MEASUREMENT UNDEFINED
L INDUCTANCE/QUALITY (H/UNITY)
C CAPACITANCE/DISSIPATION (F/UNITY)

TEST	TEST	AC + DC	DC RESISTANCE	AC RESISTANCE	REACTANCE		
BASIC	TIME	VOLTAGE	(OHMS)	1 kHz (OHMS)	1 kHz (OHMS)		1kHz
(R)							
(T) 08/08/96	13:38	0.39 n	5.74	5.74	189.00 n	L	30.08 u / 31.92 n

INSULATION RESISTANCE DATA

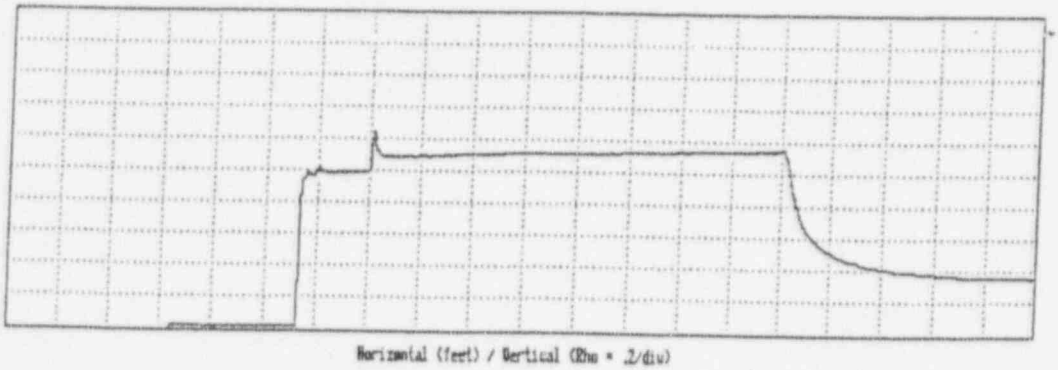
IR TEST	IR (OHMS)		DURATION	POLARIZATION
VOLTAGE	FIRST	FINAL	(SECONDS)	RATIO
(R)				
(T) 0	0	0	0	0

LEGEND

(T) = TEST (R) = REFERENCE

T = tera G = giga M = mega k = kilo
m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Ohm = .2/div)

TEST (SOLID)
TIME BASE : 100 nS
FT/DIVISION : Approx 30.0

ECAD SYSTEM 1000 Version 5.32 DATA CHART

CIRCUIT IDENTIFICATION

DEVICE CODE : CABLE 2
DESCRIPTION : 250' RSS-6-104/LC
DEVICE TYPE :
CONFIGURATION : C

TEST AREA : 6-20
TERMINATION : OPEN
HIGH TEST POINT :
LOW TEST POINT :
COMMENTS : CENTR TO SHIELD

IO CODE :
IO CODE : PIN : CENT
IO CODE : PIN : SHLD

OPERATOR IDENTIFICATION

OP LAST NAME : HOPPER
RS LAST NAME : DHAHER
MOA :

FIRST NAME : BRUCE
FIRST NAME : REED

U MEASUREMENT UNDEFINED
L INDUCTANCE/QUALITY (H/UNITY)
C CAPACITANCE/DISSIPATION (F/UNITY)

	TEST DATE	TEST TIME	AC + DC VOLTAGE	DC RESISTANCE (OHMS)	AC RESISTANCE 1 kHz (OHMS)	REACTANCE 1 kHz (OHMS)		1kHz
(R)								
(T)	08/08/96	13:41	1.29	> 500.00 k	11.25	-23.72 k	C	6.71 n / 0.47 m

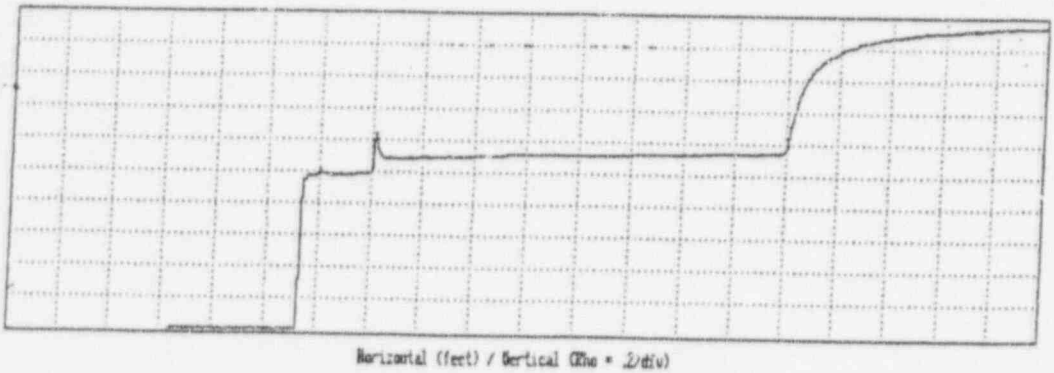
INSULATION RESISTANCE DATA

	IR TEST VOLTAGE	IR (OHMS) FIRST	IR (OHMS) FINAL	DURATION (SECONDS)	POLARIZATION RATIO
(R)					
(T)	1000	8.44 G	9.65 G	180	1.14

LEGEND

(T) = TEST T = tera G = giga M = mega k = kilo
(R) = REFERENCE m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Ohms = 2/div)

TEST (SOLID)
TIME BASE : 100 nS
FT/DIVISION : Approx 50.0

ECAD SYSTEM 1000 Version 5.32 DATA CHART

ECAD SYSTEM 1000 Version 5.32 DATA CHART

File Set: C:\ECAD53\AP0L0

CIRCUIT IDENTIFICATION

DEVICE CODE	: CABLE 3	TEST AREA	: R-20		
DESCRIPTION	: 250' RSS-6-104/LC	TERMINATION	: SHORTED	ID CODE :	
DEVICE TYPE	:	HIGH TEST POINT	:	ID CODE :	PIN : CENT
CONFIGURATION	: F	LOW TEST POINT	:	ID CODE :	PIN : SHLD
		COMMENTS	: CENTR TO SHIELD		

OPERATOR IDENTIFICATION

OP LAST NAME	: HOPPER	FIRST NAME	: BRUCE
RS LAST NAME	: DRAKER	FIRST NAME	: KEED
MOA	:		

Q MEASUREMENT UNCERTAINED
L INDUCTANCE/QUALITY (R/UNCITY)
C CAPACITANCE/DISSIPATION (F/UNCITY)

TEST DATE	TEST TIME	AC + DC VOLTAGE	DC RESISTANCE (OHMS)	AC RESISTANCE 1 kHz (OHMS)	REACTANCE 1 kHz (OHMS)		1kHz
(R)							
(T) 08/08/96	13:26	0.42 n	5.71	5.72	193.00 n	L	30.72 u / 33.73 n

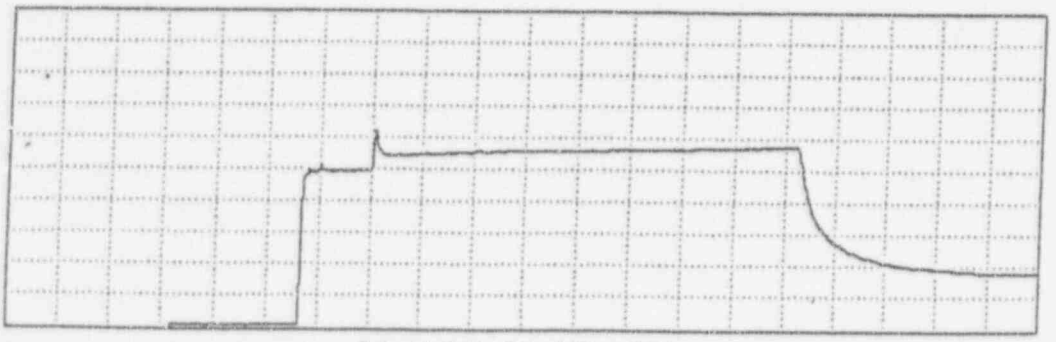
INSULATION RESISTANCE DATA

IR TEST VOLTAGE	IR (OHMS) FIRST	FINAL	DURATION (SECONDS)	POLARIZATION RATIO
(R)				
(T) 0	0	0	0	0

LEGEND

(T) = TEST T = tera G = giga M = mega k = kilo
(R) = REFERENCE m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Rho = Z/div)

TEST (SOLID)
TIME BASE : 100 nS
FT/DIVISION : Approx 30.0

ECAD SYSTEM 1000 Version 5.32 DATA CHART

CIRCUIT IDENTIFICATION

DEVICE CODE	: CABLE 3	TEST AREA	: K-20		
DESCRIPTION	: 350' RG3-6-104/LI	TERMINATION	: OPEN	IO CODE :	
DEVICE TYPE	:	HIGH TEST POINT	:	IO CODE :	PIN : CONN
CONFIGURATION	: C	LOW TEST POINT	:	IO CODE :	PIN : SHLD
		COMMENTS	: CONN TO SHIELD		

OPERATOR IDENTIFICATION

OP LAST NAME	: HOPPER	FIRST NAME	: BRUCE
AS LAST NAME	: DRAHER	FIRST NAME	: REED
MO#	:		

U MEASUREMENT UNDEFINED
L INDUCTANCE/QUALITY (H/UNITY)
C CAPACITANCE/DISSIPATION (F/UNITY)

TEST DATE	TEST TIME	AC + DC VOLTAGE	DC RESISTANCE (OHMS)	AC RESISTANCE 1 kHz (OHMS)	REACTANCE 1 kHz (OHMS)		1kHz
(R)							
(T) 08/28/96	13:29	+14.46 n	> 500.00 k	-1.01 n	-23.20 k	C	6.86 n / 13.71 n

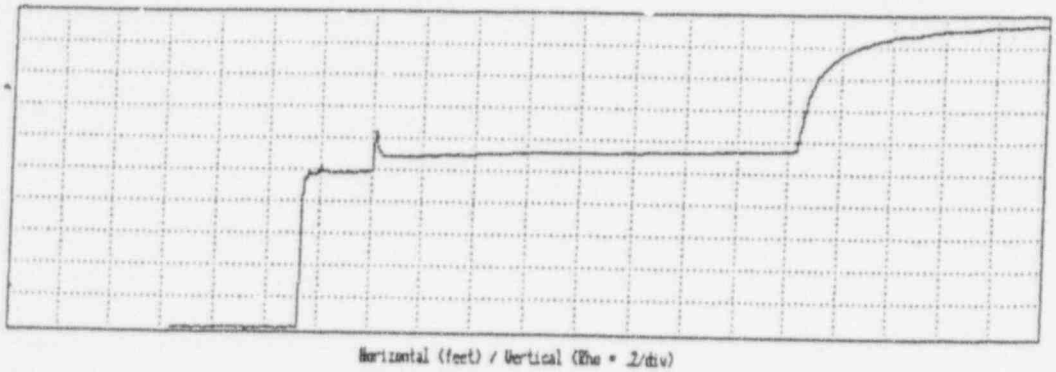
INSULATION RESISTANCE DATA

IR TEST VOLTAGE	IR (OHMS) FIRST	IR (OHMS) FINAL	DURATION (SECOND)	POLARIZATION RATIO
(R)				
(T) 1000	4.30 G	4.69 G	180	1.09

LEGEND

(T) = TEST (R) = REFERENCE
T = tera G = giga M = mega k = kilo
m = milli u = micro n = nano p = pico

TDR Signature(s)



Horizontal (feet) / Vertical (Rho = Ω/div)

TEST (SOLID)
TIME BASE : 100 nS
FT/DIVISION : Approx 30.0

ECAD SYSTEM 1000 Version 5.32 DATA CHART

ATTACHMENT 3 - LOCA TEST PROCEDURE CHECKLIST

PRE LOCA TEST

[✓] Perform Instrument and test equipment inspection per Appendix 1

[✓] Perform Configuration of Astro-Med Recorder by performing steps in Appendix 2, "Installation and Clock Set"

[✓] Download Wyle test program from the disk labeled WYLE LAB CABLE TEST using Appendix 3.

[✓] Configure Keithley 610 by performing steps in Appendix 4

[✓] Configure Keithley 261 by performing Appendix 5

[✓] Perform Pre Test Continuity and Megger check for each sample of cable and record on Table 3.

[✓] Perform Pre Test Checklist per Appendix 6.

LOCA TESTING

[✓] Start the Astro-med recorder with chart speed set to 5mm/sec.

[✓] Start LOCA testing

[✓] Adjust Keithley 610 as required to keep trace on chart

[✓] Adjust Astro-med chart speed to 1mm/sec when required

[✓] Perform Mid test cable meggering and continuity testing. Record results in Table 4.

[✓] At the end of LOCA testing, perform post LOCA megger and continuity checks recording values on Table 5.

POST LOCA TEST

[✓] Disconnect all cable samples from test equipment

[✓] Power down all test equipment

[✓] Store test equipment and make provisions for shipping back to SCE

[ ] ~~Remove video tape from video camera and make provisions for sending to SCE~~ WN 9/19/9

[✓] Remove recorder traces from Astro-med recorder and make provisions to take to SCE

[✓] Make provisons for sending cables, penetrations and anything else deemed required to SCE

Appendix 1 - WYLE Lab Cable Test

Preliminary Checks

A) Ensure test cables are properly connected and wrapped with no strain on the cable specimens

B) Perform Inspection of test equipment

1) 2 Keithley 610C electrometers
2) Astro-med MT95K2 Mainframe Recorder (with proper card configuration)
3) 2 Keithley 261 current sources
4) "D" Submini with BNC female connectors
5) PL259 (RCA) connectors for 610 Input
6) 2 cables that go from Keithley 610 to Astro-med
7) 3 packs of Z fold paper for Astro-med recorder
8) Configuration disk for the Astro-med recorder

Appendix 2 - Astro-med Recorder Configuration

Installation and Clock Set

1. Ensure all input cards are installed and in the required
2. Ensure connectors are installed on AWP 1 card
3. Install cables from Keithley 610 to proper channel of the Astro-med recorder.
4. Tape the connectors with Scotch 33 electrical tape
5. Connect Astro-med to power source
6. Turn the Astro-med to the **"ON"** position
7. Set the recorder's internal **date and clock** by performing the following:
   - A) Depress the fron panel **SYS** key
   - B) Depress the soft key above **"SYSTEM CLOCK"**
   - C) Use the selection arrows to select each component of the date and time
   - D) Use the encoder wheel to set each desired value.
   - E) Depress **EXIT**

Appendix 3 - Astro-med Recorder Configuration

Downloading of Disk

1. Insert disk labeled WYLE LAB CABLE TEST into disk drive on the front of the Astro-med recorder
2. Press the MODE key
3. Press the soft key above "FROM DISK"
4. Use the encoder wheel as required to select the file that you want to download.
5. Depress the soft key above RUN.
6. Depress SAVE
7. Press the soft key above "ENTIRE MODE" in the left display.
8. Use INC or DEC to select one of the four soft keys into which the program will be save.
9. As required use the keypad to type a label for the grid
10. Check the scaling of the recorder channels and ensure that the program has been downloaded properly. Ensure that the inputs are approximmately in the center of the chart's input.
11. Press the soft key above ACCEPT to store the chart into the selected soft key. The label will apprear under the assigned key. This will be displayed whenever the MODE key is depressed.

Appendix 4 - Configuration of Keithley 610 Electrometer

1. Set meter switch to power off position.
2. Lock zero check
3. On the back of the Keithly 610, ensure that the selector switch is set to the 3 Volt postion.
4. Set range switch to Volts and the multiplier switch to 1.0
5. Turn meter switch to Center Zero. Meter should read zero. If not, adjust as required.
6. Return meter switch to the power off position.
7. Set range switch to E-10 and multiplier to 1.
8. Unlock zero check
9. Ensure feedback is in FAST

Appendix 5 - Configuration and Setup of Keithly 261

[✓] Connect test cable to input

[✓] Select current output to 1E-11A

[✓] Place POLARITY switch to "+"

[✓] Let Keithley warm up for 15 minutes

Appendix 6 - Pre Test Checklist

1. Ensure all cables are installed properly per electrical diagram

   [✓] Test cable to Keithley 610

   [✓] Keithley 610 cable to Astro-med recorder

   [✓] Keithly 261 to test cable input

2. Ensure all test equipment is powered up and functional

   A) Keithly 610

      [✓] Powered up

      [✓] Selected to 3 volt range, Mult set to 1 and Mantissa set E-10

      [✓] Zero Lock has been removed

   B) Astro-med recorder

      [✓] Powered Up

      [✓] Inputs functional

      [✓] Chart drive spped is set to desired value

      [✓] Plenty of chart paper to last the duration of the test

      [✓] Scaling is correct

   C) Keithly 261

      [✓] Powered Up

      [✓] Instrument set to 1E-11A

Attachment D

Conax Buffalo Certificate of Conformance for 75 Ohm Coaxial Feedthroughs, Amphenol Connectors and Raychem Heat Shrink Tubing

(3 Pages)

CONAX BUFFALO CORPORATION • 2300 WALDEN AVENUE, BUFFALO, NEW YORK 14225
716-684-4500 • 1-800-223-2389 • FAX: 716-684-7433

IMI

Certificate of Conformance

To: Southern California Edison
San Onofre Nuclear Generating Station
San Clemente, CA 92672

Customer Purchase Order: 8H066002 Sales Order: 7NG700

Item	Part Number	Conax Buffalo Identification	Qty
1	7LK3-21000-01	Feedthrough Assembly, 75 ohm Coax	4
5	N45183-096	Heat Shrink Tubing	8

We Certify:

1. *Items supplied were produced in confor.nance with all contractually applicable specifications as referenced in the subject Purchase Order.*
2. *Items supplied were produced from materials for which Conax Buffalo has available for examination, chemical and/or physical test reports, or other evidence of conformance to applicable specifications.*
3. *All inspections, tests, and calibrations utilized equipment calibrated in accordance with the requirements of MIL-STD-45662A and traceable to the National Institute of Standards and Technology.*
4. *Items supplied were produced in accordance with onax Buffalo Quality Program Manual, Revision R, dated 6/21/95. The requirements of 10CFR21 apply to this order.*
5. *Items supplied are new manufacture.*

Certified By Curt Pratt
Curt Pratt, Quality Engineer

8/22/96
Date

"Excellence By Choice.....Not By Chance"

Conax Buffalo
2300 WALDEN AVENUE, BUFFALO, NY 14225-0273

Data Sheet B

Customer: Southern California Edison Co.
Project: Wyle Laboratories
Customer P.O.: SH066002
Item No.: 1

Conax Sales Order: 7NG700
Conax Feedthrough P/N: 7LK3-21000-01
Feedthrough Type: 75 Ohm Coax
Quantity: 4

Ref. Section IPS-4	Type of Test (Requirements)	Test Acceptance (Stamp)
9.1	Visual Inspection *(Drawing Conformance and Cleanliness)*	CONAX INSP
9.2	Helium Leak Test	He. T.
9.3	Conductor/Shield Continuity	N.P. 14
Per Drawing 7LK3-21000 & IPS-1886 9.1	Dielectric Strength Test *(1 minute , All Values @ +.3/-.0* kvac) Center Conductor to Shield 2.2 kvac Shield to Ground: 0.5 kvac	N.P. 14
Per Drawing 7LK3-21000 & IPS-1886 10.1	Insulation Resistance (Ohms min. @500 vdc) Conductor to Shield: 10^{12} ohms Shield to Ground: 10^{8} ohms	N.P. 14

Conax Quality Control: [signature] Date: 8-22-96

Conax Buffalo

CONAX BUFFALO CORPORATION • 2300 WALDEN AVENUE. BUFFALO. NEW YORK 14225
716-684-4500 • 1-800-223-2389 • FAX. 716-684-7433

IMI

CERTIFICATE OF CONFORMANCE

CUSTOMER: SOUTHERN CALIFORNIA EDISON CO.

NUCLEAR PLANT: SAN ONOFRE

CUSTOMER ORDER NO.: 8H066002

CONAX BUFFALO ORDER NO.: 7NG700

CONAX BUFFALO PART NOS: 7LK3-21000-01
N44079-03
N45181-024
N45182-019
N45183-096

CONAX BUFFALO CERTIFIES THAT THE EQUIPMENT SUPPLIED ON THIS ORDER IS QUALIFIED IN ACCORDANCE WITH IEEE STD. 317-1976 AND IS THE SAME AS, OR EQUAL TO, THAT WHICH WAS QUALIFIED AND TESTED UNDER CONAX BUFFALO REPORT IPS-1054 AND THAT THE USE OF THIS EQUIPMENT DOES NOT EFFECT THE ORIGINAL QUALIFICATION.

CONAX BUFFALO CORPORATION
2300 WALDEN AVENUE
BUFFALO, NY 14225

R. L. NIKANDER DATE 7/2/94
PROJECT ENGINEER
NUCLEAR PRODUCTS DIVISION

Attachment E

Whittaker Corporation Acceptance Test Data Sheets for MI Cable

(4 Pages)

Whittaker

Electronic Resources Division
Whittaker Corporation
1955 North Surveyor Avenue
Simi Valley, California 93063
805/584-4100

FACSIMILE (FAX) TRANSMITTAL

DATE: 9-14-96 FAX NUMBER: (860) 285-3971

PAGE 1 OF 4

ATTENTION: R. MORRIS

COMPANY: ABB-CE

SUBJECT: PO 9606893

MESSAGE: Here is the test data for item 1. The cable is 30 feet long.

FROM: G. GRIFFIS

FAX NUMBER: (805) 583-1381

WHITTAKER CORPORATION
ELECTRONIC RESOURCES DIVISION

ACCEPTANCE TEST DATA SHEET

FOR
FIRST ARTICLE
TRIAXIAL MI CABLE

PART NUMBER: 16-28-00290-5 ~~16-24-00120-004~~ 9-11-96 SERIAL NUMBER: FA 00001

TEST PROGRAM NUMBER: 4772A, REV A JOB TITLE: SONGS 2+3

PURCHASE ORDER NUMBER: 9606893

1.0 Insulation Resistance at room temperature per STP 2190, Revision C.

1.1 Conductor to Shield 4.5 x 10^{10} ohms AFTER ELEVATED TEMP TESTS > 1×10^{13} Ω

Conductor to Ground 5 x 10^{10} ohms > 1×10^{13} Ω

(Limit = 1 x 10^{10} ohms minimum @ 500 VDC)

1.2 Shield to Ground 3 x 10^{10} ohms 7.4×10^{10} Ω

(Limit = 1 x 10^{8} ohms minimum @ 500 VDC)

(Pass)/Fail ERI QA TEST 2 9-14-96
Tech Stamp/Date

2.1 1000 VDC conductor to sheath, sheath to ground and conductor to ground for 10 seconds, 150 uAmps maximum.

Conductor to Shield < .1 uAmps

Shield to Ground .1 uAmps

Conductor to Ground < .1 uAmps

(Pass)/Fail ERI QA TEST 2 9-14-96
Tech Stamp/Date

PART NUMBER: 16-28-00290 ~~16-34-00120~~

SERIAL NUMBER: EA 00001

3.0 Insulation Resistance at 385°F (+15°/-0°F): 391°F per STP 2190, Revision C.

3.1 Conductor to Shield 4.2 x 10^9 ohms 350° 5.4×10^9 Ω 300 3×10^{10}

Conductor to Ground 5.9 x 10^9 ohms 6×10^9 Ω 6.1×10^{10}

(Limit = 1 x 10^9 ohms minimum @ 500 VDC) MM 9-14-96

3.2 Shield to Ground 2.5 x 10^8 ohms 9×10^8 Ω 5.6×10^9

(Limit = 1 x 10^7 ohms minimum @ 500 VDC) MM 9-14-96

(Pass)/Fail ERI QA TEST 2 9-14-96
Tech Stamp/Date

4.0 Dielectric Strength at +385°F (+15°/-0°F): 391°F per STP 2191, Revision C.

4.1 1000 VDC conductor to shield, shield to ground and conductor to ground for 10 seconds, 150 uAmps maximum.

Conductor to Shield .2 uAmps

Shield to Ground 7 uAmps

Conductor to Ground .2 uAmps

(Pass)/Fail ERI QA TEST 2 9-14-96
Tech Stamp/Date

5.0 Capacitance per STP 4745, Revision N/C.

5.1 At 385°F (+15°F/-0°F): 389 °F, Pin to Pin 516 picofarads

5.2 At room temperature: Pin to Pin 530 picofarads

(Limit = ~~1250~~ 660 picofarads maximum) MM 9-11-96

(Pass)/Fail ERI QA TEST 2 9-14-96
Tech Stamp/Date

FILE 5258-1

PAGE 3 OF 3

PART NUMBER: ~~15-36-00120~~ 16-26-00270-5 /40

SERIAL NUMBER: EA 00001

6.0 DC Continuity per STP 2207, Revision A.

6.1 Record pin to pin continuity.

Center Conductor .5 ohms

Shield .3 ohms

Ground .6 ohms

ERI QA TEST 2 9-14-96

Tech Stamp/Date

7.0 Helium Leak Test per STP 2189, Revision D.

7.1 Connector Item 1 to Sheath $< 1 \times 10^{-6}$ cc/sec.

7.2 Connector Item 2 to Sheath $< 1 \times 10^{-6}$ cc/sec.

7.3 splice $< 1 \times 10^{-6}$ cc/sec. 9-11-96

(Limit = 1 x 10^{-6} cc/sec maximum)

Pass/Fail

MFG 34 ERI 7 9-14-96 9/14/96

Tech Stamp/Date

8.0 Test Equipment List

Nomenclature	Manufacturer & Model No.	Identification No.	Calibration Due Date
High Resistance Bridge	GR1644A	A10764	1-12-97
Capacitance Bridge	BK 830	A14981	2-28-97
Hi-Pot	AR5205A	A14600	2-9-97
Temperature Chamber	KEITHLY 871	A14310	1-8-97
Helium Leak Detector	ALCHTEL ASM 151T	A15077	DAILY
Digital Multimeter	FLUKE 21	A15196	11-2-96

ERI QA TEST 5

WHITTAKER ELECTRONIC RESOURCES QA REVIEW:

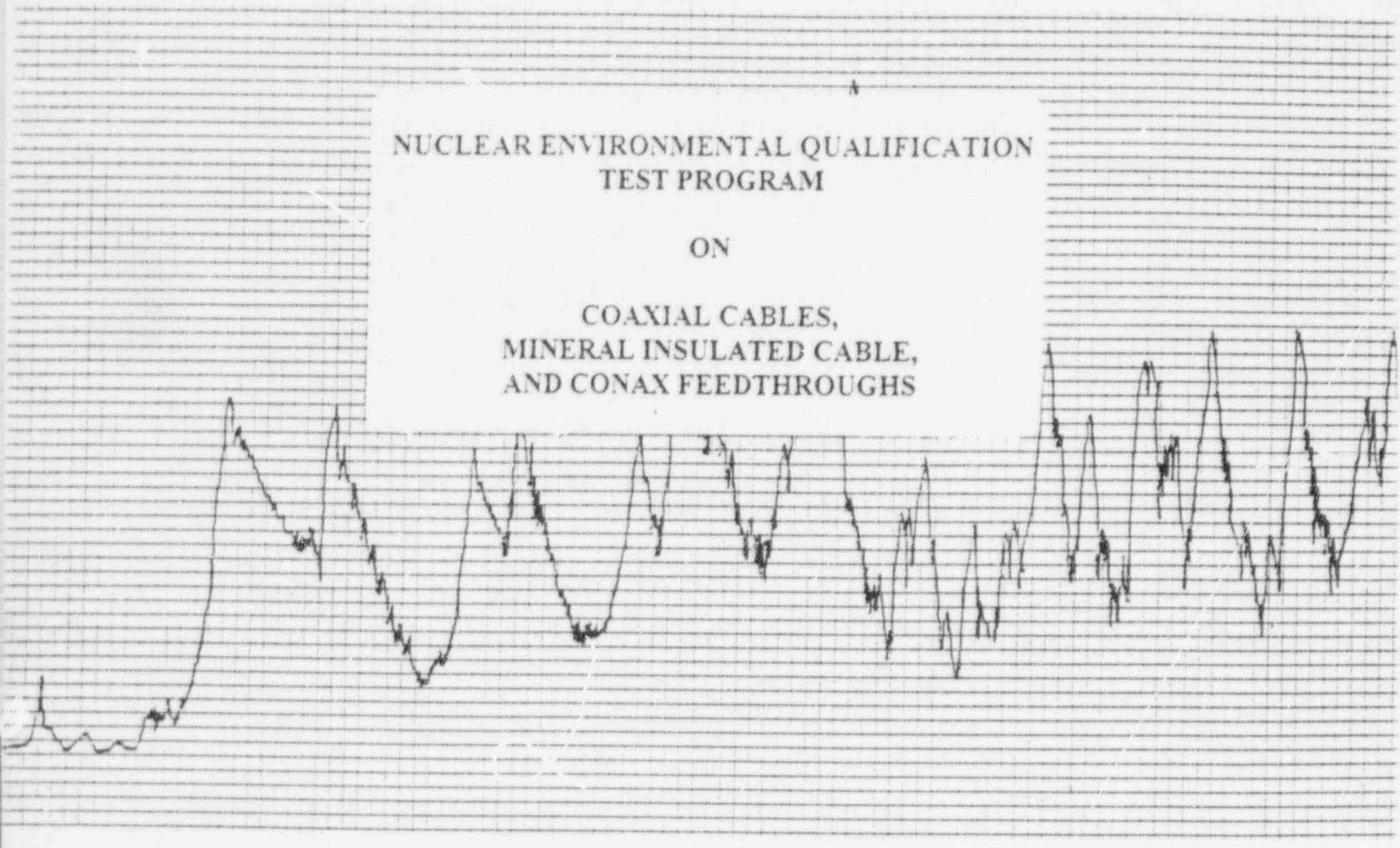
DATE: 9-14-96

PROPRIETARY INFORMATION

Attachment F

WYLE Lab Test Report 45662-1, Environmental Qualification Test Program on Coaxial Cables, Mineral Insulated Cable and Conax Penetration Feedthroughs (101 Pages)

wyle laboratories
Huntsville, Alabama



NUCLEAR ENVIRONMENTAL QUALIFICATION
TEST PROGRAM

ON

COAXIAL CABLES,
MINERAL INSULATED CABLE,
AND CONAX FEEDTHROUGHS

NEQ

NUCLEAR ENVIRONMENTAL QUALIFICATION

REPORT

NEQ
Nuclear Environmental Qualification Test Report

wyle laboratories

REPORT NO. 45662-1

WYLE JOB NO. 45662

CUSTOMER P.O. NO. 6H686902

PAGE 1 OF 100 PAGE REPORT

DATE October 16, 1996

SPECIFICATION(S) See References in Paragraph 5.0

1.0 CUSTOMER Southern California Edison Company

ADDRESS 5000 Pacific Coast Highway, San Clemente, CA 92674

2.0 TEST SPECIMEN Coax Cable, Mineral Insulated Cable, and Coax Feedthroughs

3.0 MANUFACTURER See Paragraph 6.0

4.0 SUMMARY

Coax Cables, Mineral Insulated Cable, and Coax Feedthroughs, as described in Paragraph 6.0 and hereinafter called the specimens, were subjected to a test program as required by Southern California Edison (SCE) Company Purchase Order 6H686902 and Wyle Laboratories' Test Procedure 45662, Revision A. This test program was performed on August 15 through September 28, 1996.

The test program consisted of the following:

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

The specimens completed the required test as specified in Wyle Laboratories' Test Procedure 45662, Revision A, except as described in Paragraph 11.0 and in Notice of Anomaly No. 1 contained in Appendix I of this report.

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. 5268

Wade Dorland, 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.

Wade D Dorland 10/25/96

SUBSCRIBED and sworn to before me this 25th day of Oct. 19 96

Susan A. Fosbo

Notary Public in and for the State of Alabama at large

My Commission expires September 1 19 97

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 10/24/96
Robert Hardy, Project Engineer

APPROVED BY Don Smith 10/24/96
D. E. Smith, Department Manager

WYLE Q. A. R G Thomas 10-25-96
R. G. Thomas, Q.A. Manager

wyle laboratories
Huntsville, Alabama

(jjd)

5.0 REFERENCES

- Southern California Edison Company Purchase Order No. 6H686902.
- Wyle Laboratories' Test Procedure 45662, Revision A.
- Wyle Laboratories' Quotation No. 543/1030/DB.
- IEEE Standard 323-1974 "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."
- 10 CFR 21, "Reporting of Defects and Non-Compliance."
- 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants."
- Wyle Laboratories' (Eastern Operations) Quality Assurance Program Manual, Revision 1.

6.0 SPECIMEN DESCRIPTION

The specimens for this test program consisted of the following:

Coax Cables

- **Specimen No. 1:** 250' length of Rockbestos RSS-6-104/LE
- **Specimen No. 2:** 250' length of Rockbestos RSS-6-104/LE
- **Specimen No. 3:** 250' length of Rockbestos RSS-6-104/LE

Each of the above specimens had a moisture dam installed by SCE at each end of the cable. See Appendix IX for the moisture dam installation procedure.

Mineral Insulated (MI) Cable

Approximately 30 feet of ABB/Whittaker Mineral Insulated Cable, Part No. 16-28-00290-5.

Coax Feedthroughs

Four (4) Conax Buffalo 75-ohm Coax Feedthroughs: 24" long with 6" pigtails at each end with HN-coax jack connectors (with Amphenol 82-321 type interface) and Raychem WCSF-N shims at each end. Conax Buffalo part number 7LK3-21000-01.

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. Defects are reportable in accordance with the requirements of 10 CFR Part 21.

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
- Thermal Aging (Cable Specimens 1, 2, and 3 only)
- Radiation Exposure (Cable Specimens 1, 2, and 3 only)
- LOCA Simulation (Cable Specimen with the longest qualified life, MI cable, and feedthroughs)
- 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.

10.0 PROCEDURES (Continued)

10.2 Thermal Aging

The three Rockbestos coax cable samples were individually wound into coils and secured in individual cable trays. The coils were approximately 48" long, and the bend radius of the cables was 20 times the diameter of the cable (see Photographs 1 through 3 in Appendix III). The cable specimens were then placed in Wyle thermal aging chambers and thermally aged in air as follows:

- Cable Sample 1 - 102.5 hours at 115°C (239°F)
- Cable Sample 2 - 135 hours at 120°C (248°F)
- Cable Sample 3 - 135 hours at 125°C (257°F)

The temperatures were controlled to +5/-0°F. The thermal aging times were controlled to +1/-0 hour. See Appendix IV for the aging chamber temperature charts.

The specimens were not energized for thermal aging.

10.3 Radiation Exposure

The three Rockbestos coax cable samples, while still secured to individual cable trays, were exposed to gamma radiation using a Cobalt-60 source. The total dose for the exposure was 155.18 Mrads gamma (see Appendix V for the radiation facility Certificate of Conformance). The three Rockbestos coax cable samples were to be exposed to 1.74E8 rads gamma radiation during the Radiation Exposure phase of the program. At the request of SCE, in response to information provided to them after radiation exposure had begun, concerning the material properties of the moisture dams installed in each specimen cable, the specimens were removed from the radiation exposure prior to receiving the total required dose. The actual dose received by the specimens was 155.18 Mrads (see Notice of Anomaly No. 1 in Appendix I).

The radiation exposure was measured as air equivalent gamma using a Cobalt-60 source at a dose rate between a minimum of 0.75 Mrads and a maximum of 0.84 Mrads per hour. The dose rate was measured at the geometic centerline of the specimens. The test specimens were rotated within the cable trays during the radiation exposure to ensure a uniform dose distribution.

The specimens were not energized during the radiation exposure.

10.0 **PROCEDURES (continued)**

10.4 **LOCA Simulation**

10.4.1 Test Setup

10.4.1.1 **Specimen Preparation**

The Conax feedthrough penetrations were installed in a Wyle-provided test chamber flange using 1" Swagelok fittings. The Swagelok fittings were hand tightened onto the feedthrough penetrations and then tightened with a wrench 1-1/4 turns. The feedthrough penetrations were positioned approximately halfway through the flange so that half of the penetration was inside the test chamber and half was outside the test chamber (see Photograph 9).

While still secured to the cable tray, Cable Specimen 2 and the MI cable specimen were connected to the four Conax Buffalo feedthroughs following the directions of the SCE representative on site for testing. The connectors of Cable Specimen 2 were tightened snugly by hand. The connectors of the MI cable specimen were tightened to 126 in/lb. The required torque on the MI cable connectors, as directed by the SCE (and ABB/CE) representative on site, was 110 in/lb. The torque on the connectors was 126 in/lb due to a crow's-foot adapter on the torque wrench which was not accounted for at the time the connectors were torqued.

Cable Specimen 2 and the MI cable test specimen were covered with Raychem WCSF-N heat shrink sleeves as follows:

Cable Specimen 2 used the SCE installed moisture dam (Appendix IX), which shimed the cable with a 12 inch piece of WCSF-200N. A six inch shim of WCSF-300N was applied over the WCSF-200 shim. The penetration feedthrough specimen pigtail used a two and one half inch shim of WCSF-300N installed by Conax. After the connectors were mated, a single 12 inch piece of WCSF-500N was centered over the connector and shrunk.

The MI cable specimen was shimed using six inches of WCSF-200N. A six inch piece of WCSF-300N was added over the WCSF-200N as a second shim. The penetration feedthrough specimen pigtail used a two and one half inch shim of WCSF-300N installed by Conax. After the connectors were mated, a single 12 inch piece of WCSF-500N was centered over the connector and shrunk.

10.0 PROCEDURES (Continued)

10.4.1 Test Setup (Continued)

10.4.1.2 Monitoring

The specimens' electrical parameters were monitored and recorded by SCE personnel using equipment provided by Wyle as specified by SCE and SCE-provided equipment.

Two thermocouples were mounted close to the feedthrough penetration/cable specimen junction following the direction of the customer. The thermocouples were monitored and recorded during the test (see Appendix VI for the temperature plots).

The test chamber ambient 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 VI.

10.4.2 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. 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 5 days.

Starting at approximately the 8-minute and 20-second point of the test, chemical spray was initiated inside the test chamber. The chemical spray consisted of deionized water with 3000 ppm boron added for a pH between 4.0 and 4.5 at the beginning of the Accident Test. The chemical spray was captured and recirculated and was sprayed for 24 hours. The pH of the chemical spray gradually increased due to steam condensate and was 6.0 at the end of the 24-hour spray. The chemical spray rate was 0.15 gpm/sq. ft. The chemical spray flow rate plot contained in Appendix VI shows the flow rate of the chemical spray pump which equates to 2.475 gpm for 0.15 gpm/sq. ft.

Following the completion of five days of accident simulation testing, the SCE representative directed that the temperature of the test chamber be raised to 250°F for five minutes then raised to 300°F for an additional five minutes.

10.5 Post-Test Inspection

The specimens were visually inspected following the completion of the Accident Test.

11.0 RESULTS

A visual inspection of the cable samples following the Thermal Aging revealed the specimens to be in good shape with no visible damage. The specimens had become stiffer and were slightly stuck together.

A visual inspection of the cable samples following the Radiation Exposure revealed the specimens to be in good shape. However, visible degradation common to all three specimens was found. Each specimen had multiple indentations in the jackets. It was determined that these indentations were made where each specimen was lying on the cable tray it was attached to. During the Radiation Exposure, the specimens were removed from the trays and flipped over in the tray to provide a more even dose distribution. This rotation allowed the indentations to be seen.

Additionally, Cable Specimen 3 had some indentations which penetrated the jacket and exposed the metal braid underneath. It is believed that these indentations were caused during the Thermal Aging phase. Cable Specimen 3 had also been damaged at the radiation facility. During the course of the Radiation Exposure, one end of Cable Specimen 3 had become sharply bent. It was theorized that when the cables were removed from the trays for rotation, the specimen was not secured to the tray in the same manner as it was originally. The elevated temperature of the radiation exposure cell, 120°F according to the radiation facility, allowed the specimen to become soft and pliable which allowed the weight of the connector at the damaged end to bend down due to gravity (see Notice of Anomaly No. 2 in Appendix I).

Following the discovery of the damage to Specimen 3 after it was returned from the radiation facility, the SCE representative on site for testing directed that Specimen 3 (30-year specimen) not be used in the Accident Test and that Specimen 2 (20-year specimen) be used for Accident Testing purposes.

The specimens completed the test program as specified in Paragraph 9.0 and as specified by the SCE representative on site for testing. A post-test visual inspection revealed that both specimens appeared to be in good shape with no visible damage caused by the Accident Test.

11.0 RESULTS (Continued)

The following appendices are included in this report:

Appendix	Contents
I	Notices of Anomaly
II	Figure
III	Photographs
IV	Thermal Aging Chamber Circular Charts
V	Radiation Facility Certificate of Conformance and Sketches
VI	Accident Test Plots
VII	Conax Buffalo Certificate of Conformance
VIII	Instrumentation Equipment Sheets
IX	SCE Moisture Dam Installation Procedure
X	Wyle Laboratories' Test Procedure 45662, Revision A

APPENDIX I

NOTICES OF ANOMALY

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wyle laboratories

ORIGINAL

NOTICE OF ANOMALY

DATE: September 25, 1996

NOTICE NO.: 1 P.O. NUMBER: 6H686902 CONTRACT NO.: N/A

CUSTOMER: Southern California Edison WYLE JOB NO.: 45662

NOTIFICATION MADE TO: Wayne Nakamoto NOTIFICATION DATE: 9/13/96

NOTIFICATION MADE BY: Bobby Hardy VIA: Phone

CATEGORY: ☐ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/13/96

PART NAME: Coax Cables PART NO. N/A

TEST: Radiation Exposure I.D. NO. N/A

SPECIFICATION: WLTP 45662, Revision A PARA. NO. 2.3

REQUIREMENTS:

The three Rockbestos coax cable samples, while still secured to the individual cable trays, shall be exposed to gamma radiation using a Colbalt-60 source. The total dose for the exposure shall be 1.74E8 rads gamma.

DESCRIPTION OF ANOMALY:

At the request of Southern California Edison, in response to new information provided to them concerning the material properties of the specimens, the specimens were removed from the radiation exposure prior to receiving the total required dose.

DISPOSITION - COMMENTS - RECOMMENDATIONS:

The actual total dose received by the specimens was 155.18 Mrads. The customer will make the final decision as to the disposition.

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

VERIFICATION:

PROJECT ENGINEER: Robert Hardy 9/25/96 "Robert Hardy"

TEST WITNESS: N/A PROJECT MANAGER: Don Smith 9/25/96 Don E. Smith

REPRESENTING: N/A INTERDEPARTMENTAL COORDINATION:

QUALITY ASSURANCE: R Thomas 9-25-96

ORIGINAL

NOTICE OF ANOMALY

DATE: October 16, 1996

NOTICE NO.: 2 P.O. NUMBER: 6H686902 CONTRACT NO.: N/A

CUSTOMER: Southern California Edison (SCE) WYLE JOB NO.: 45662

NOTIFICATION MADE TO: Wayne Nakamoto NOTIFICATION DATE: 9/20/96

NOTIFICATION MADE BY: Bobby Hardy VIA: In person

CATEGORY: ☒ SPECIMEN ☒ PROCEDURE ☐ TEST EQUIPMENT DATE OF ANOMALY: 9/18/96

PART NAME: Coax Cables PART NO. N/A

TEST: Radiation Exposure and LOCA Simulation I.D. NO. N/A

SPECIFICATION: WLTP 45662, Revision A PARA. NO. 2.3 and 2.4

REQUIREMENTS:

The three Rockbestos coax cable samples, while still secured to the individual cable trays, shall be exposed to gamma radiation using a Colbalt-60 source.

While still secured to the cable tray, Cable Specimen 3 and the MI cable specimen shall be configured and connected following the directions of SCE prior to being placed in the LOCA simulation chamber.

DESCRIPTION OF ANOMALY:

Following the return of the specimens from the radiation facility, it was found that Specimen 3 (30-year specimen) had been damaged. During the course of the Radiation Exposure, one end of Specimen 3 had become sharply bent. It is theorized that when the cables were removed from the trays for rotation, the specimen was not secured to the tray in the same manner as it was originally. The elevated temperature of the radiation exposure cell, 120°F according to the radiation facility, allowed the specimen to become soft and pliable which allowed the weight of the connector at the damaged end to bend down due to gravity.

DISPOSITION - COMMENTS - RECOMMENDATIONS:

The SCE representative on site for testing directed that Specimen 3 not be used in the LOCA Simulation and Specimen 2 (20-year specimen) be used instead.

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

VERIFICATION:

TEST WITNESS: N/A

REPRESENTING: N/A

QUALITY ASSURANCE: R E Thomas 10-11-96

PROJECT ENGINEER: Robert Hardy 10/16/96
Robert Hardy

PROJECT MANAGER: Don Smith 10/16/96
Don E. Smith

INTERDEPARTMENTAL COORDINATION:

APPENDIX II

FIGURE

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Figure A
SONGS 2&3 Peak Temp/Press & Req Profile

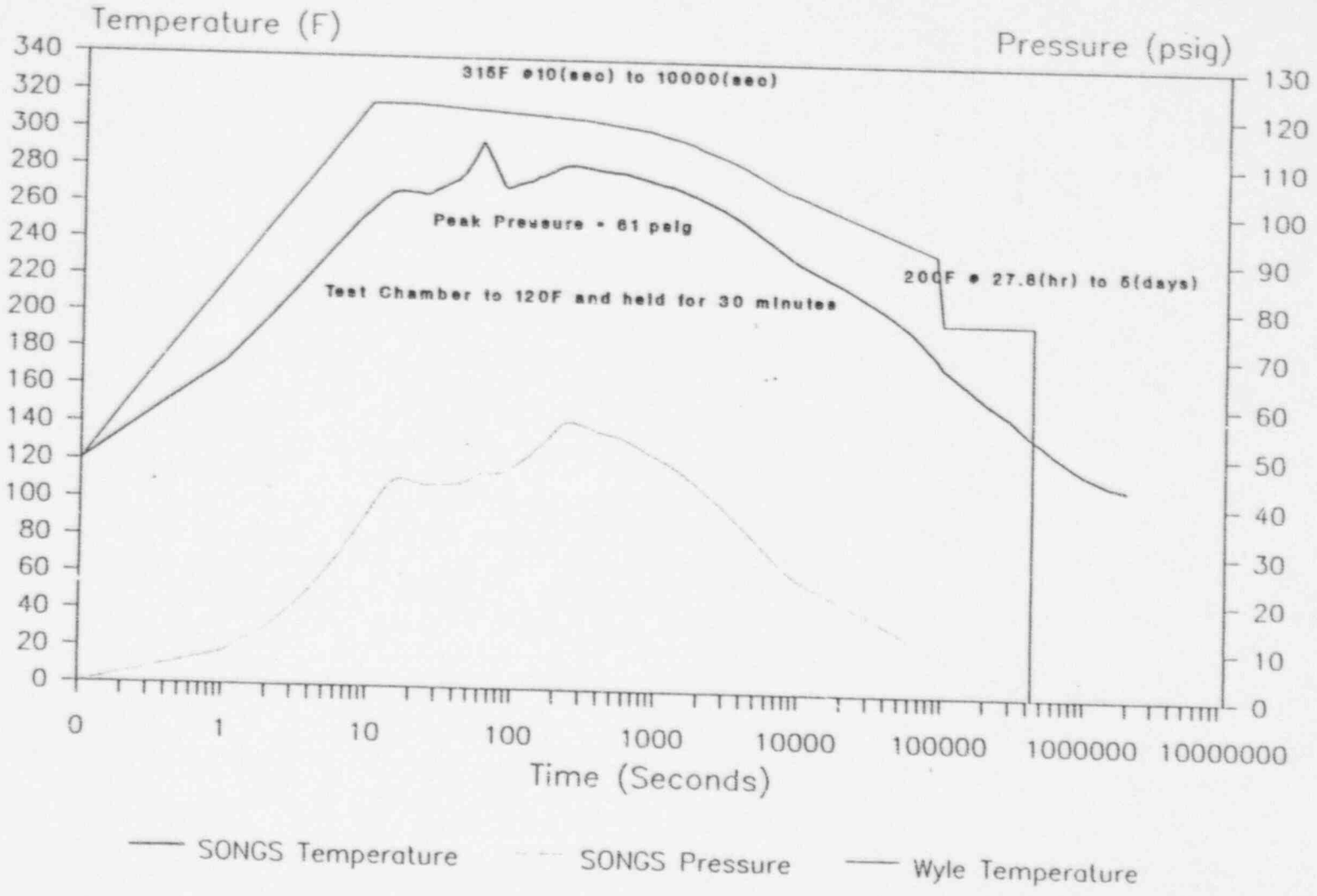

FIGURE 1. ACCIDENT TEST PROFILE

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APPENDIX III

PHOTOGRAPHS

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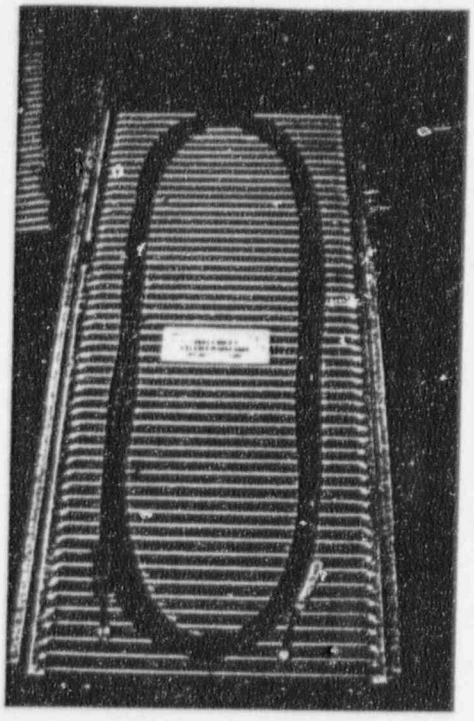
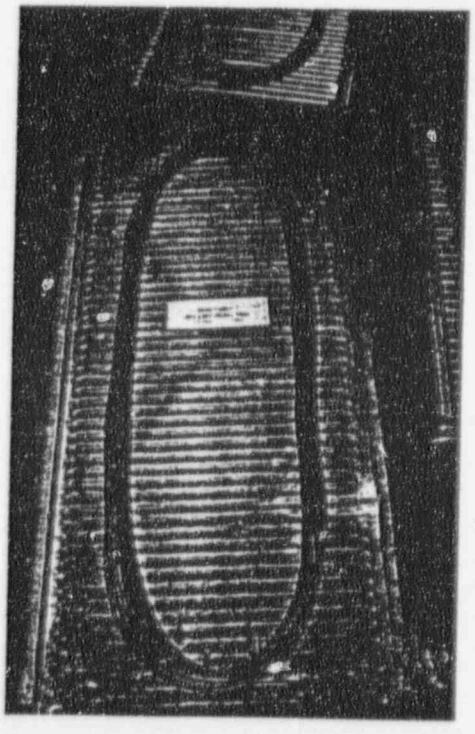
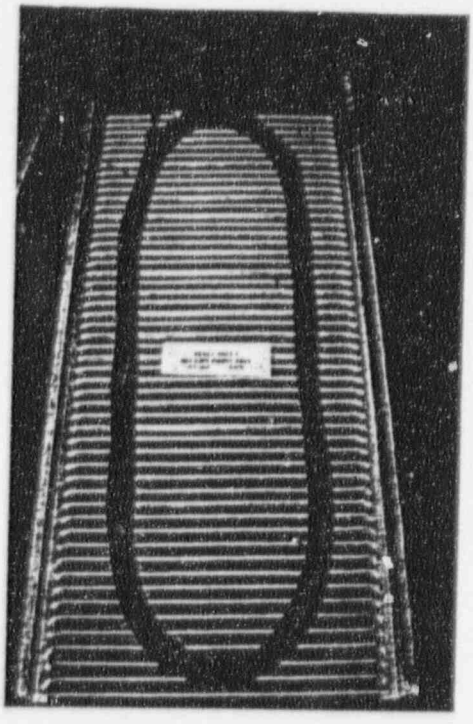


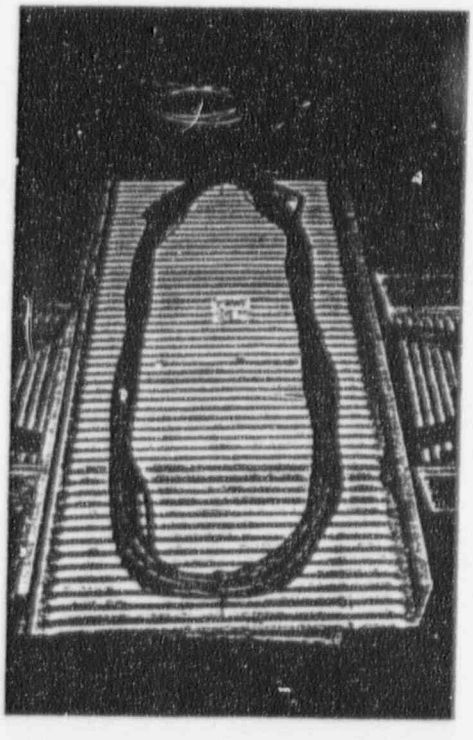
PHOTOGRAPH 1
SPECIMEN CABLE 1 INSTALLED IN A CABLE TRAY



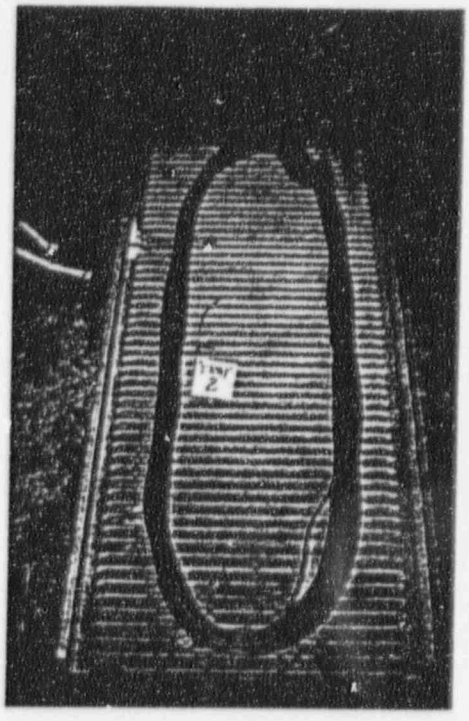
PHOTOGRAPH 2
SPECIMEN CABLE 2 INSTALLED IN A CABLE TRAY



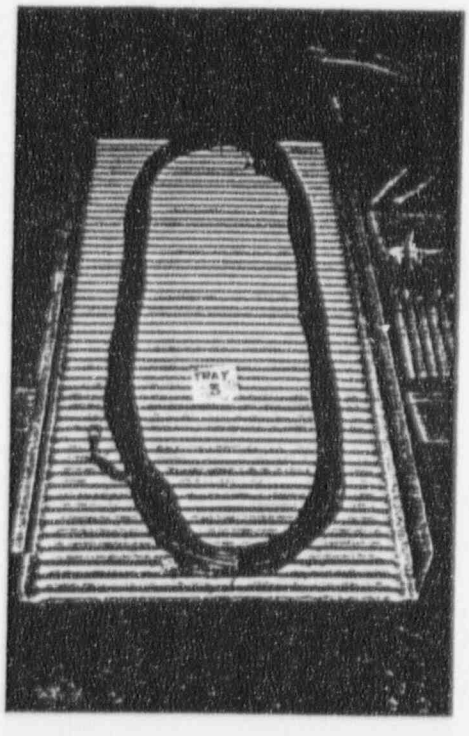
PHOTOGRAPH 3
SPECIMEN CABLE 3 INSTALLED IN A CABLE TRAY



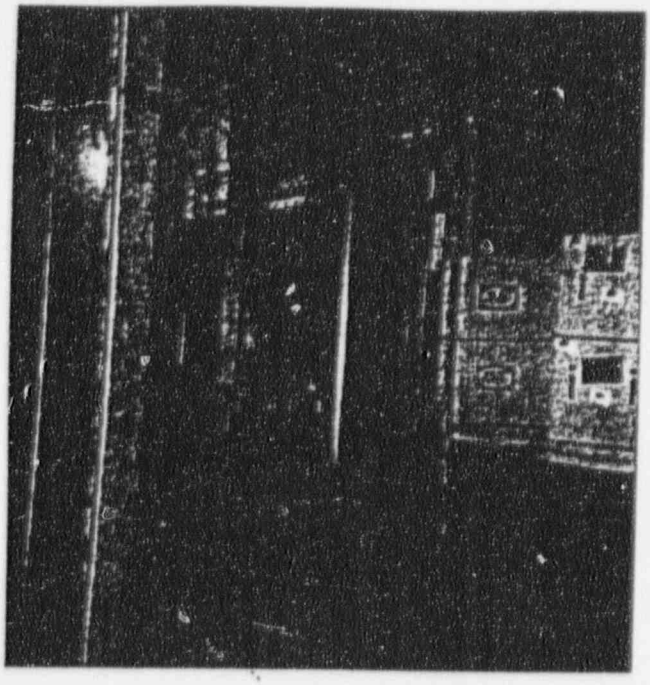
PHOTOGRAPH 4
SPECIMEN CABLE 1 FOLLOWING RADIATION EXPOSURE



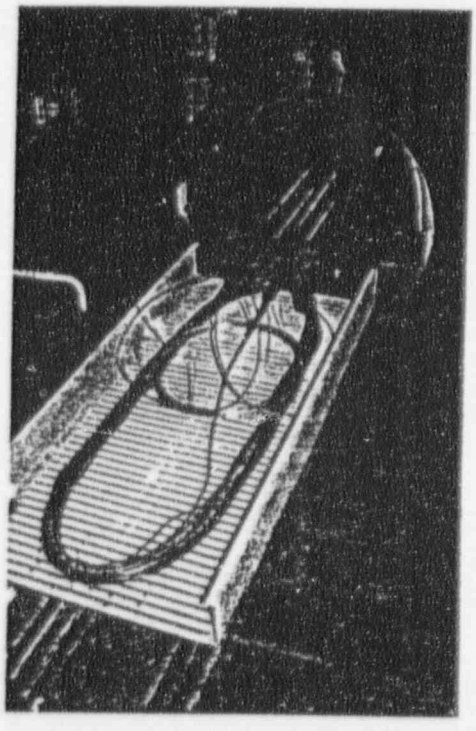
PHOTOGRAPH 5
SPECIMEN CABLE 2 FOLLOWING RADIATION EXPOSURE



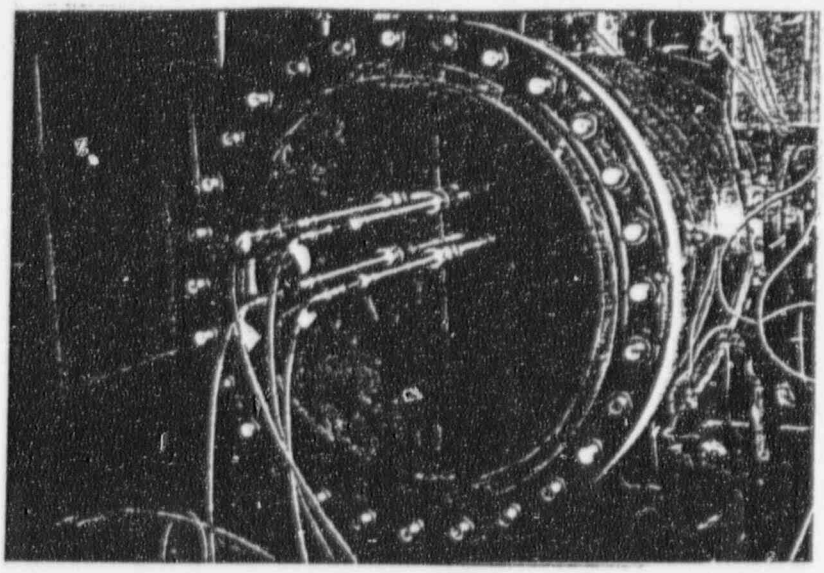
PHOTOGRAPH 6
SPECIMEN CABLE 3 FOLLOWING RADIATION EXPOSURE
(NOTE SHARPLY BENT END)



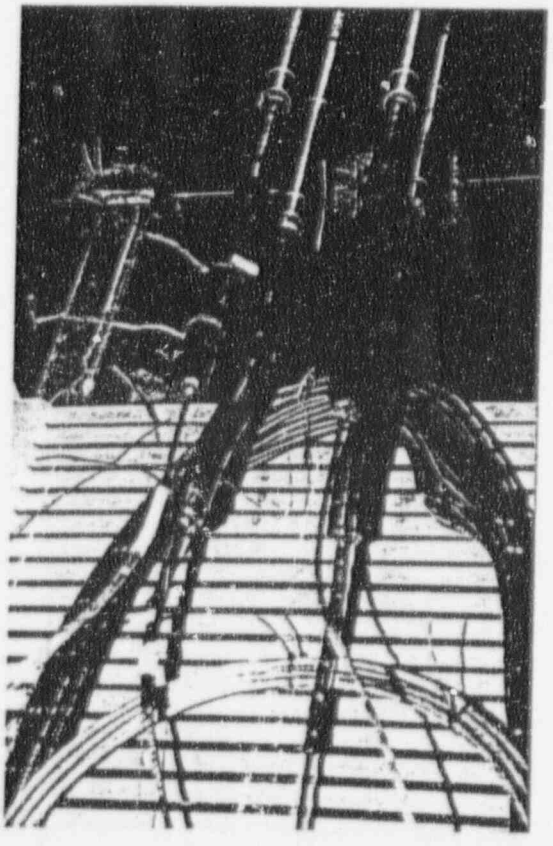
PHOTOGRAPH 7
CABLE SPECIMENS IN RADIATION FACILITY



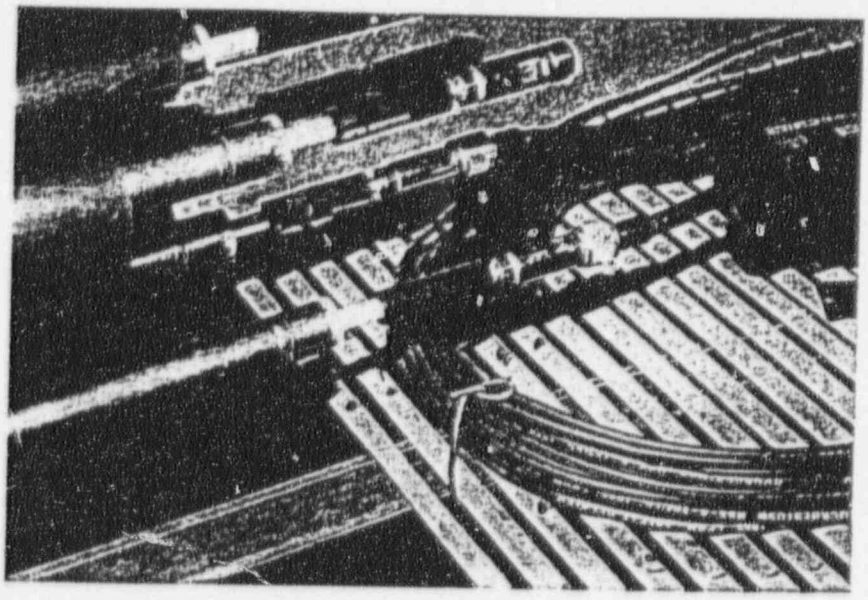
PHOTOGRAPH 8
CABLE SPECIMEN 2 AND THE MI CABLE ATTACHED TO
THE CONAX BUFFALO FEEDTHROUGHS AND READY
FOR INSTALLATION INTO THE TEST CHAMBER



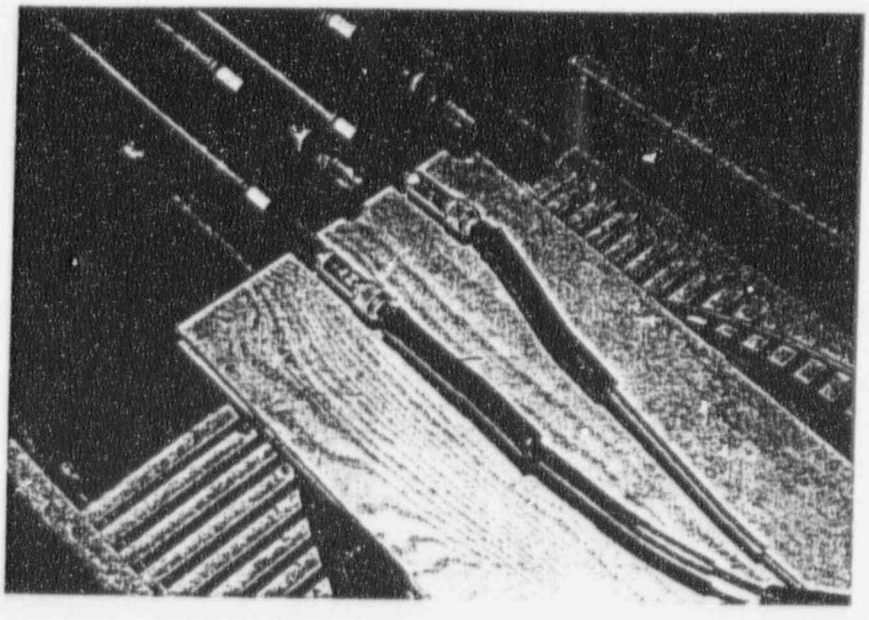
PHOTOGRAPH 9
OUTSIDE VIEW OF FLANGE WITH CONAX BUFFALO
FEEDTHROUGHS INSTALLED AND CONNECTED TO INSTRUMENTATION



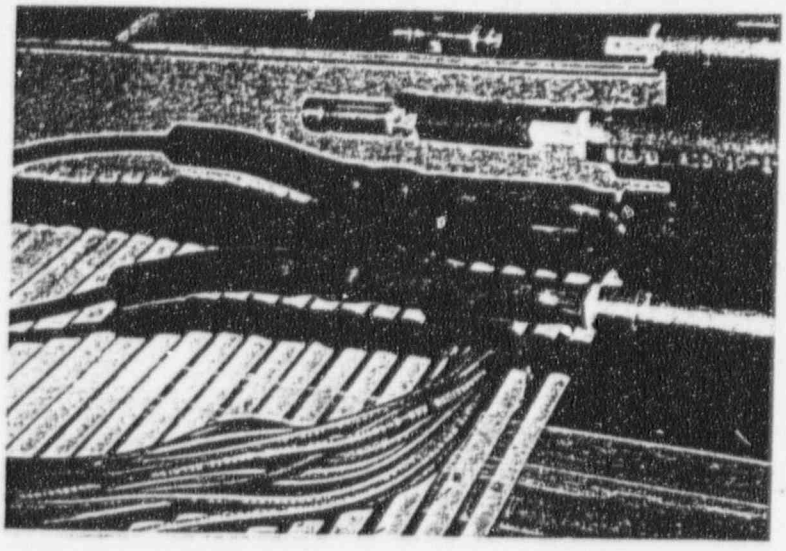
PHOTOGRAPH 10
THERMOCOUPLE PLACEMENT



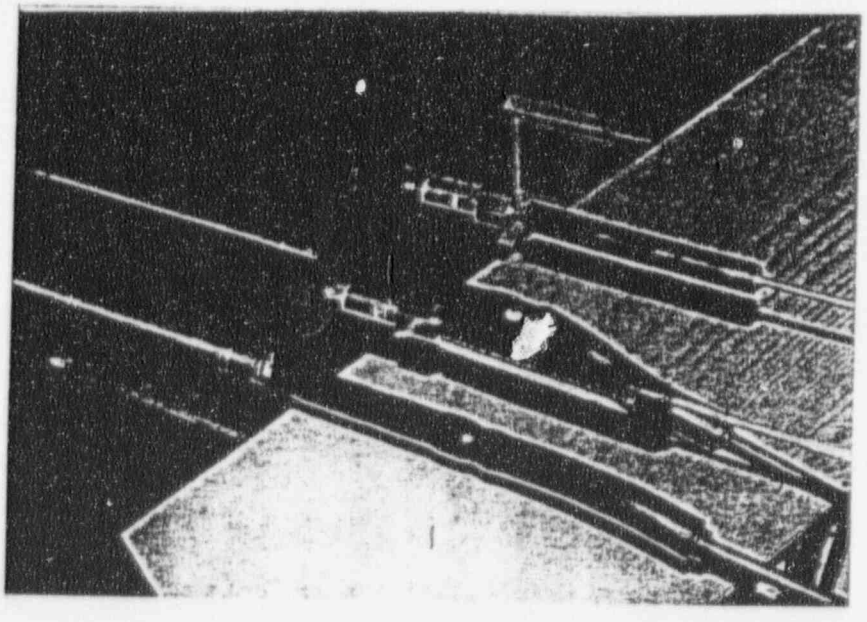
PHOTOGRAPH 11
CONNECTION PROCESS FOR ROCKBESTOS CABLE SPECIMEN 2
(CABLE CONNECTED TO FEEDTHROUGHS INSIDE TEST CHAMBER)



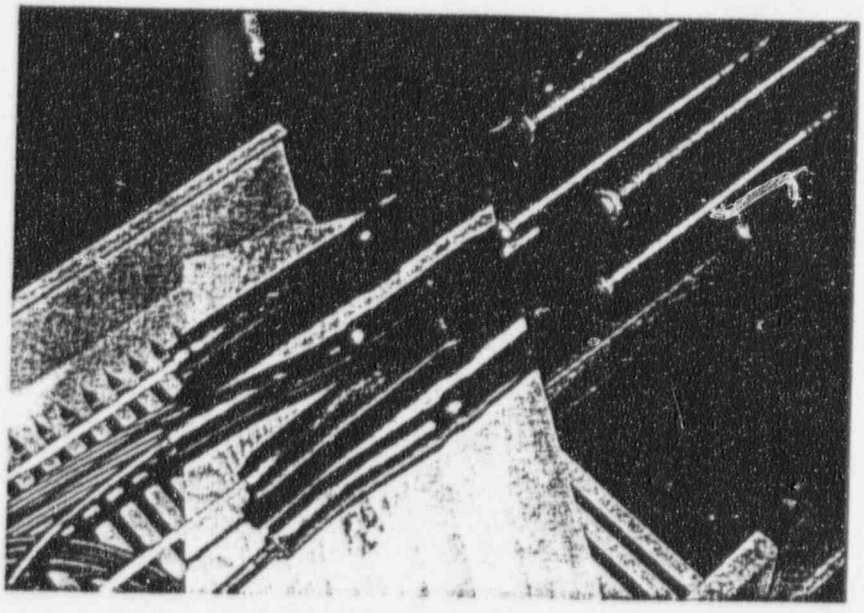
PHOTOGRAPH 12
RAYCHEM WCSF-300 SHIM INSTALLED OVER MOISTURE DAM
AREA OF ROCKBESTOS SPECIMEN 2



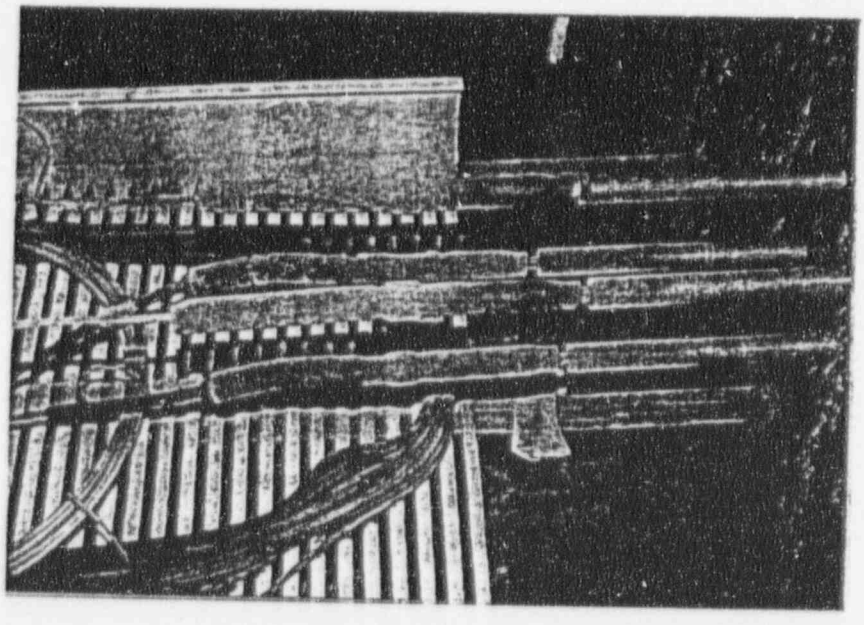
PHOTOGRAPH 13
RAYCHEM WCSF-500 INSTALLED OVER CONNECTORS
ON ROCKBESTOS SPECIMEN 2



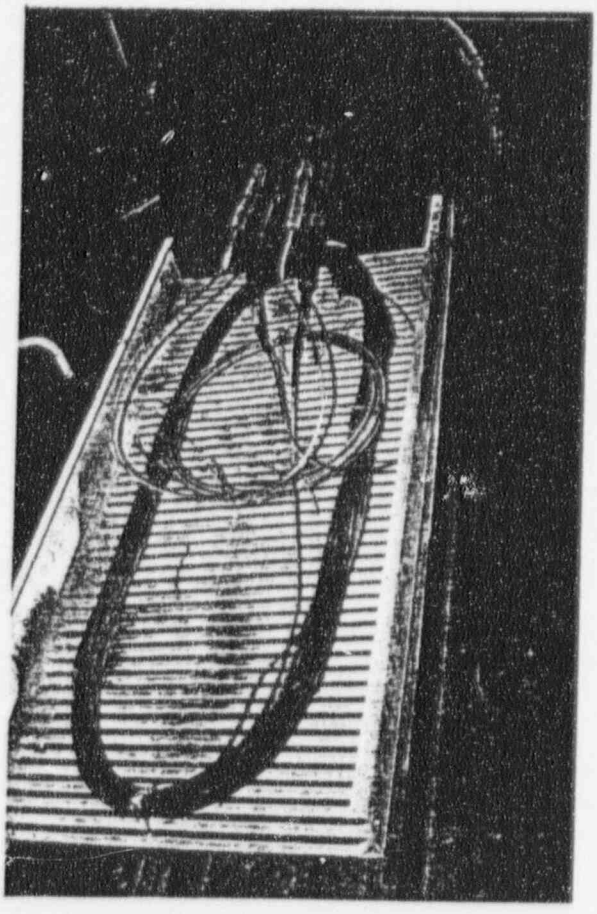
PHOTOGRAPH 14
CONNECTION PROCESS FOR MINERAL INSULATED CABLE SPECIMEN
(CABLE CONNECTED TO FEEDTHROUGHS INSIDE TEST CHAMBER) WITH
RAYCHEM WCSF-300 SHIMS INSTALLED ON MI CABLE



PHOTOGRAPH 15
RAYCHEM WCSF-500 INSTALLED OVER CONNECTORS
ON MINERAL INSULATED SPECIMEN



PHOTOGRAPH 16
POST-ACCIDENT TEST VIEW OF CONAX BUFFALO FEEDTHROUGHS
AND CABLE CONNECTIONS



PHOTOGRAPH 17
POST-ACCIDENT TEST VIEW OF SPECIMENS IN CABLE TRAY

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APPENDIX IV

THERMAL AGING CHAMBERS CIRCULAR CHARTS

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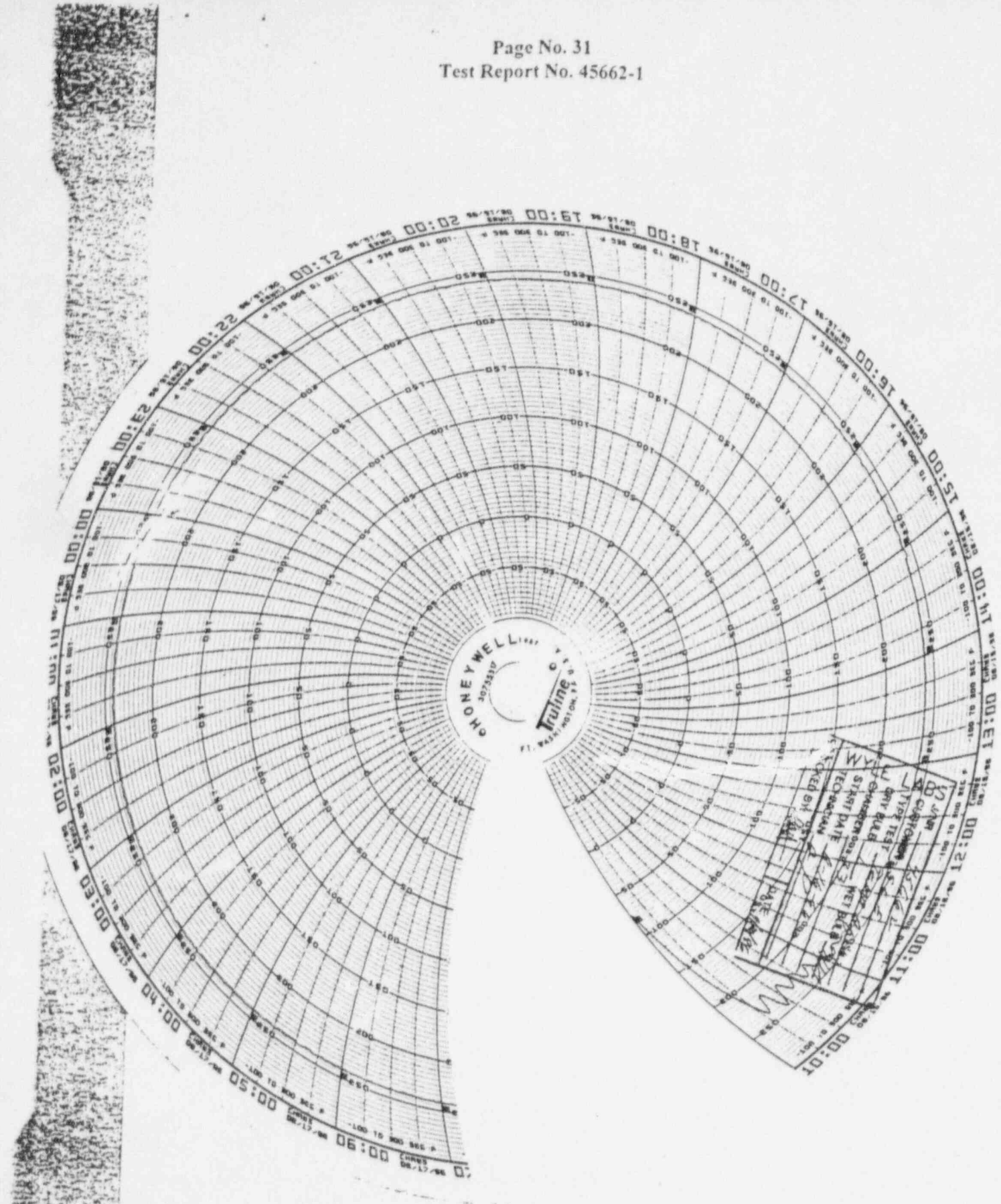
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Truline
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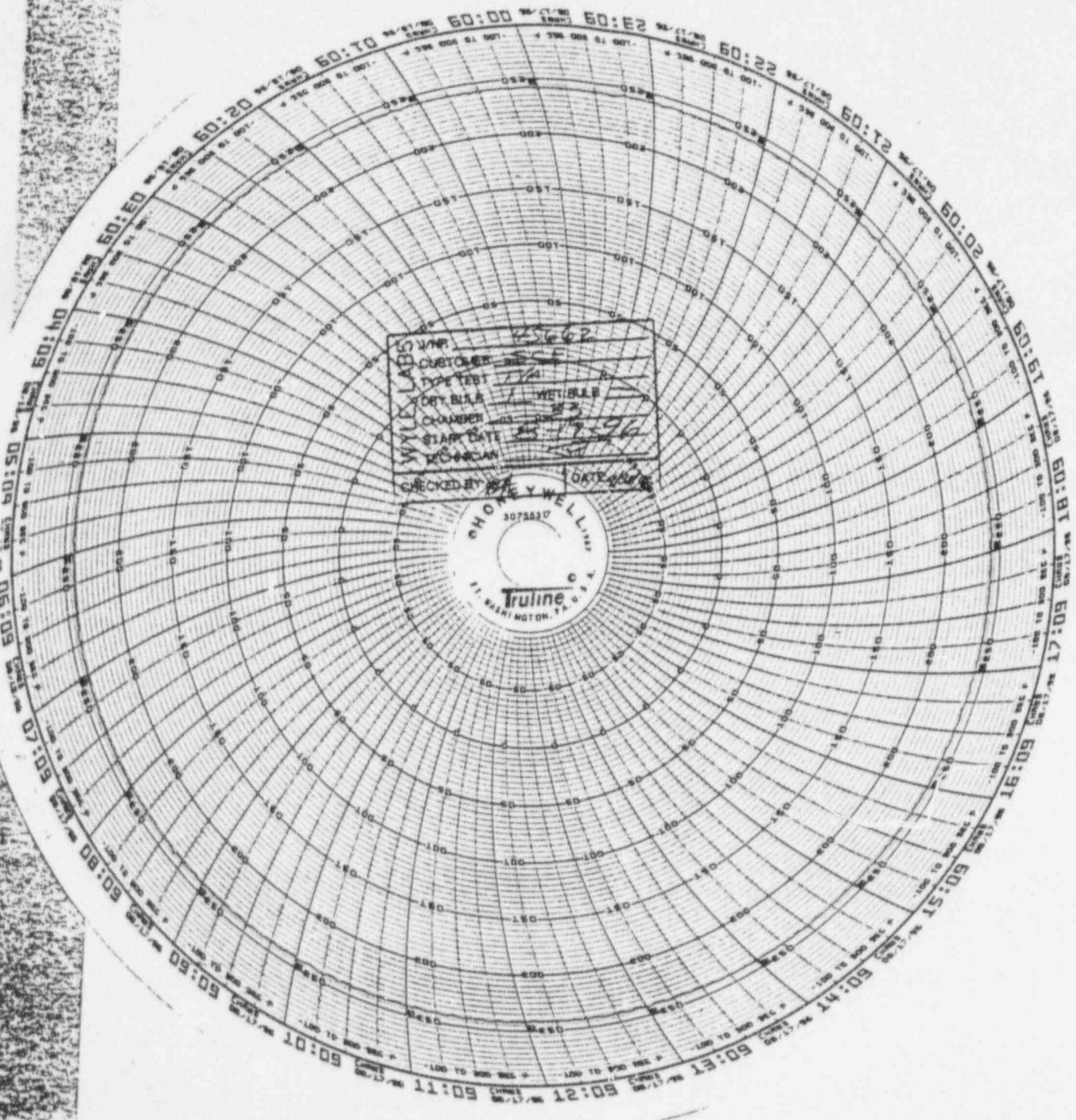
SPECIMEN 1


W/NP 45662
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CHAMBER
START DATE
TECHNICIAN
CHECKED BY
DATE
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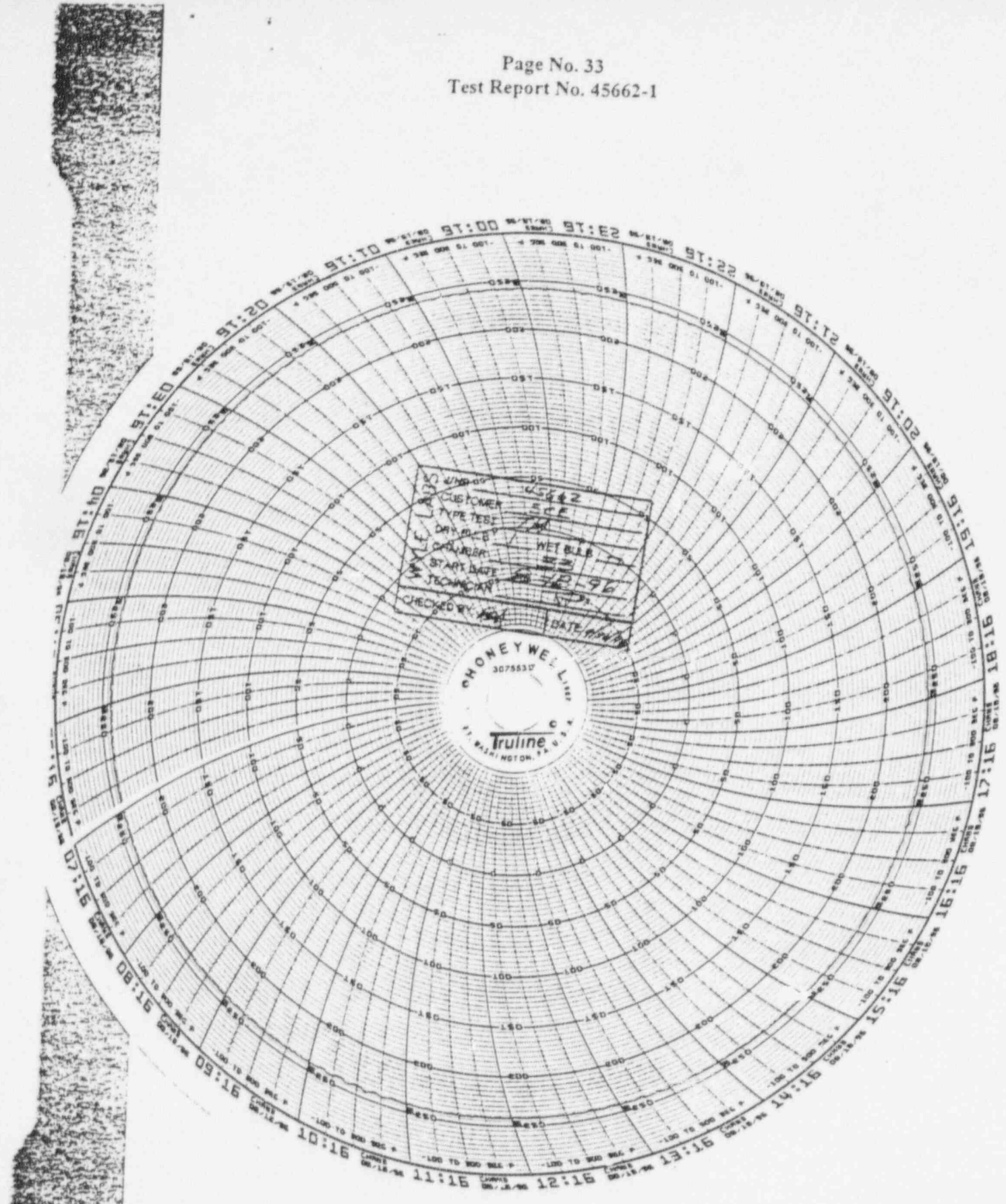
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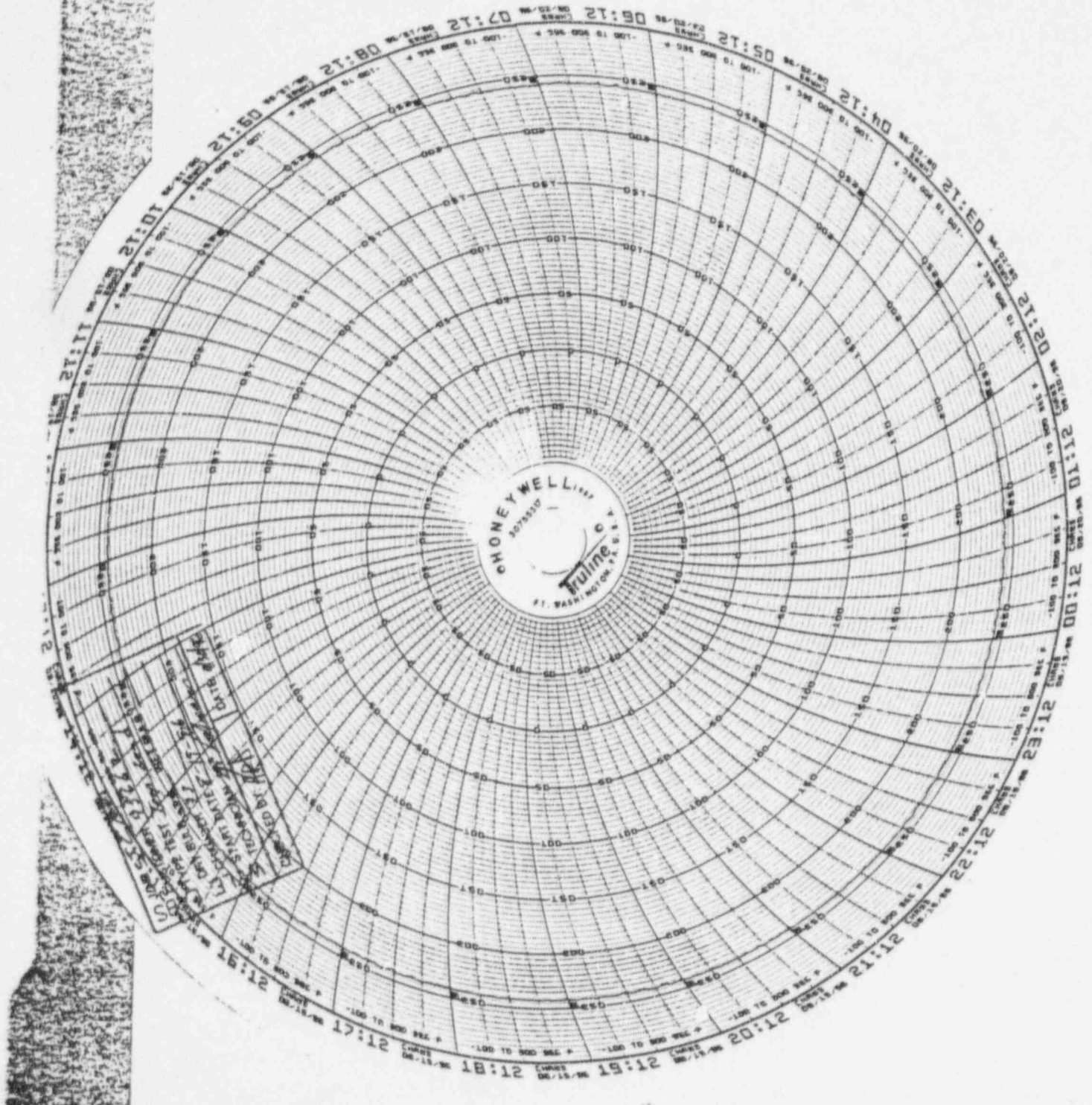
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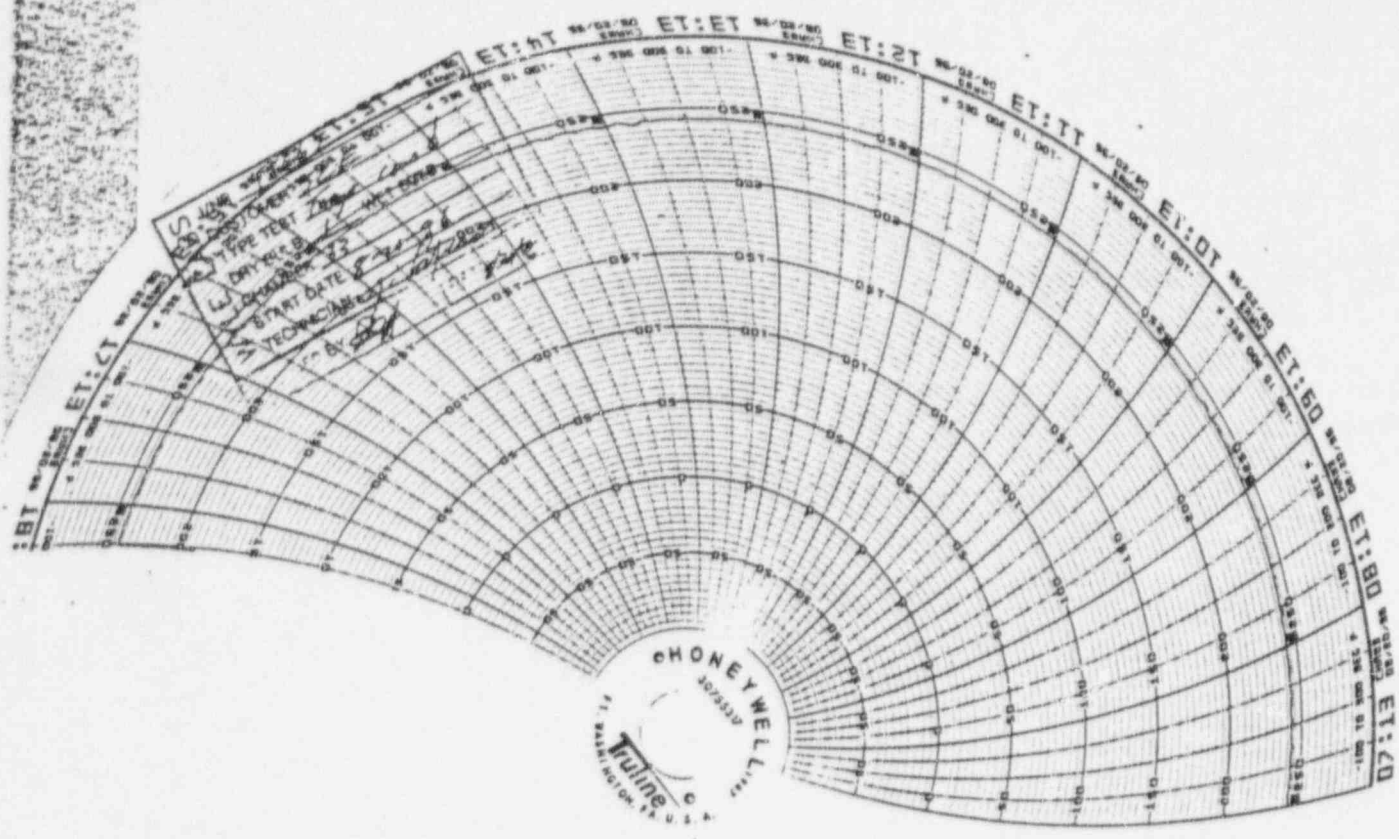
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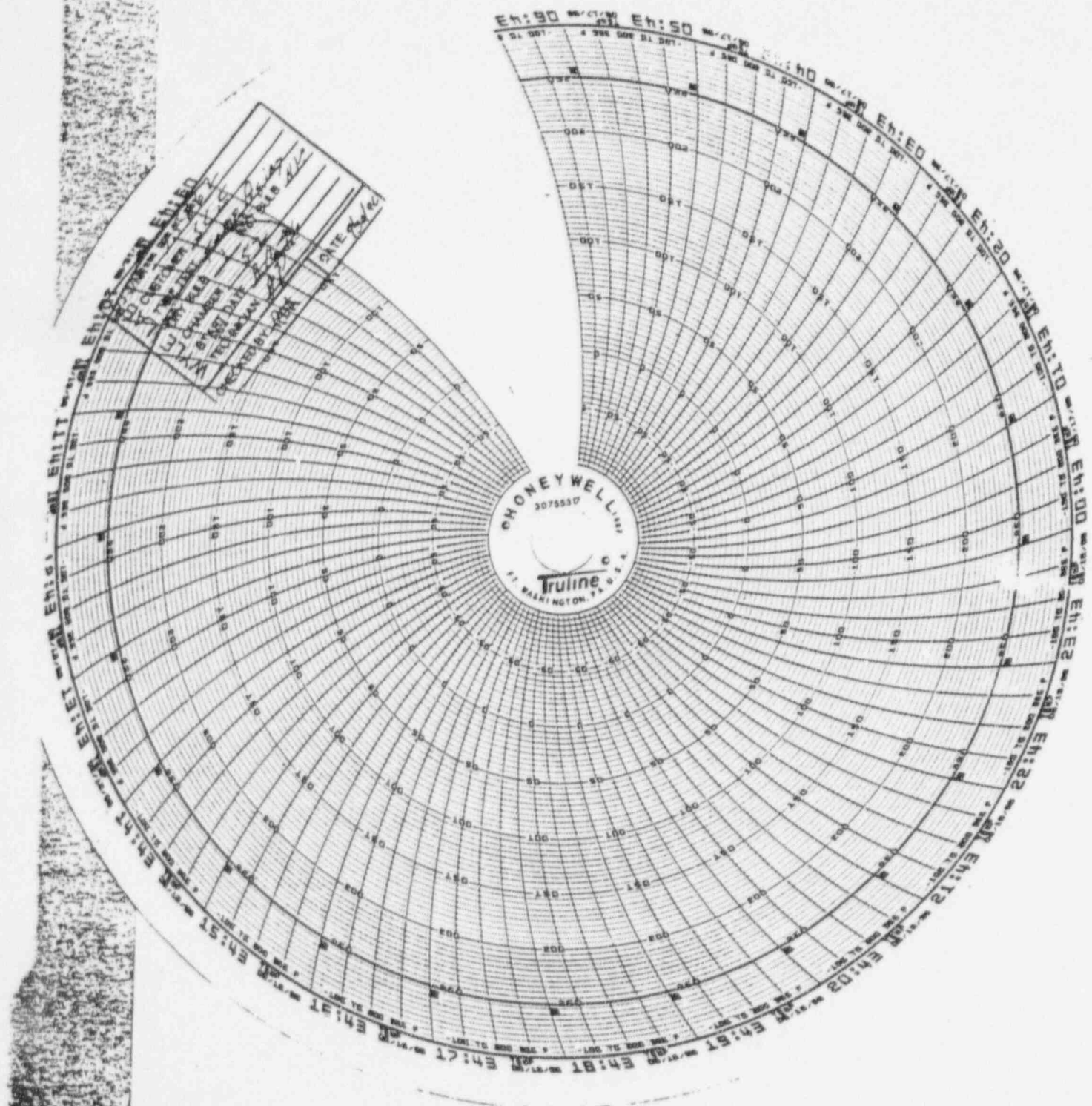
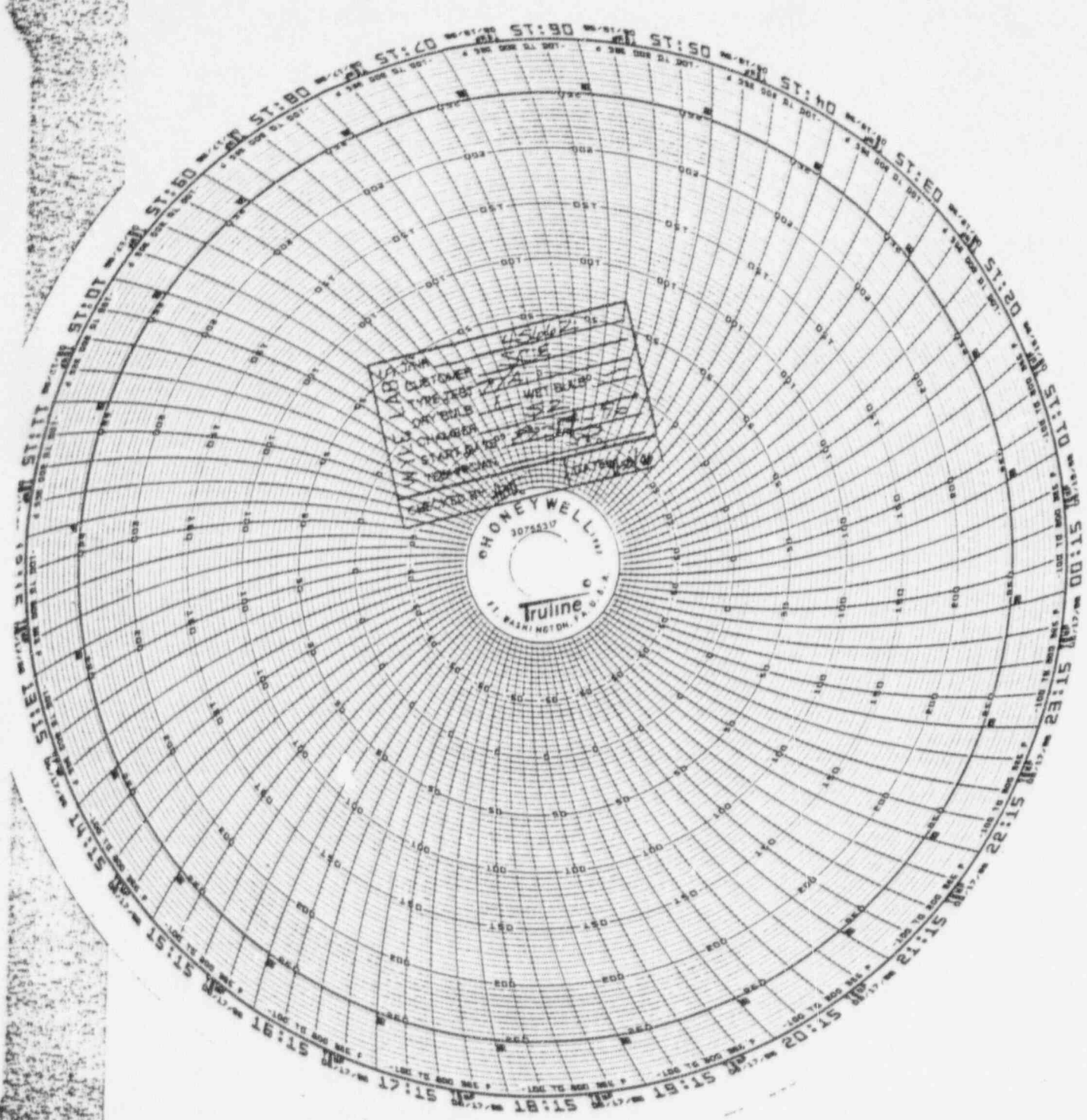


SPECIMEN 2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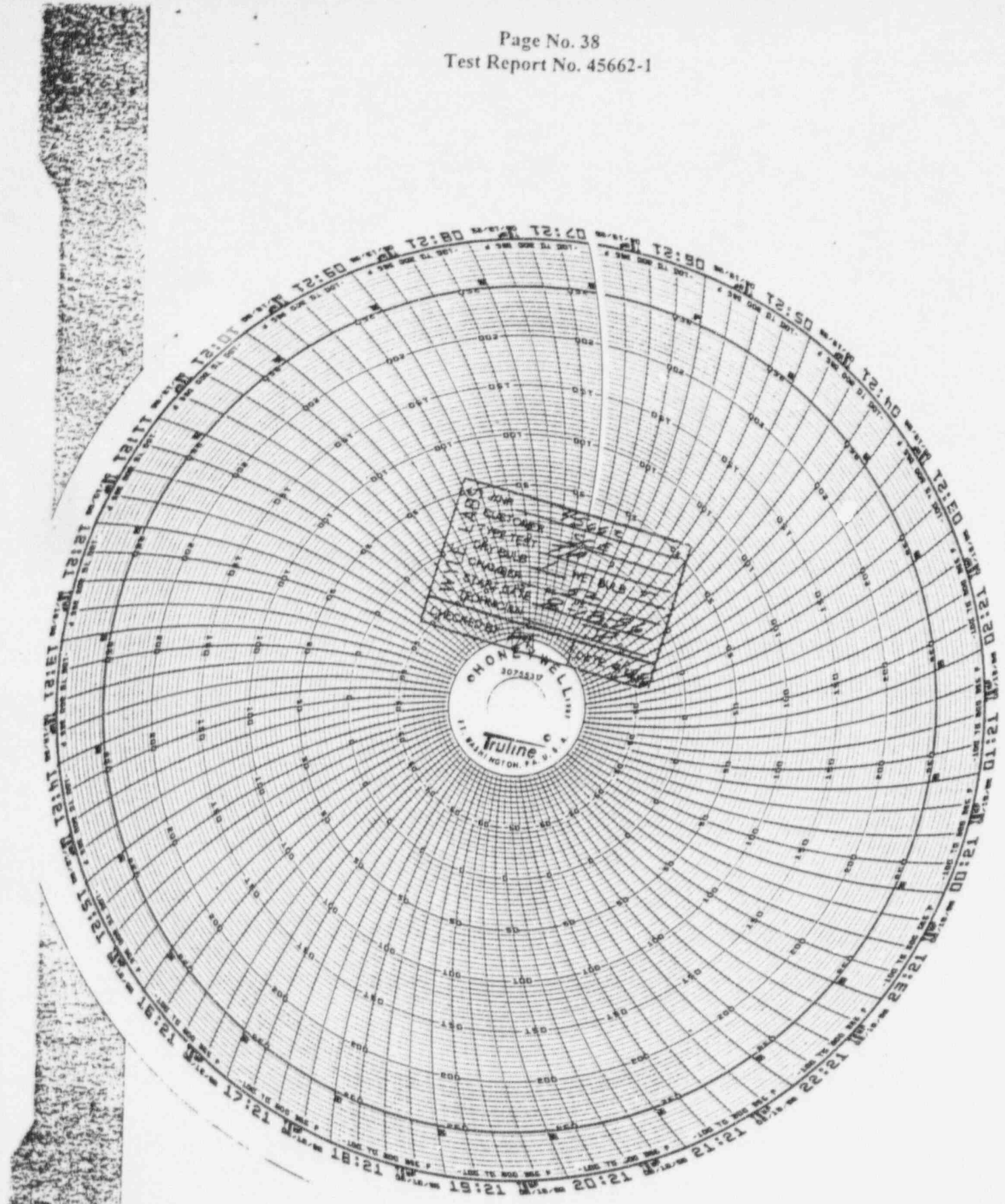
DRY BULB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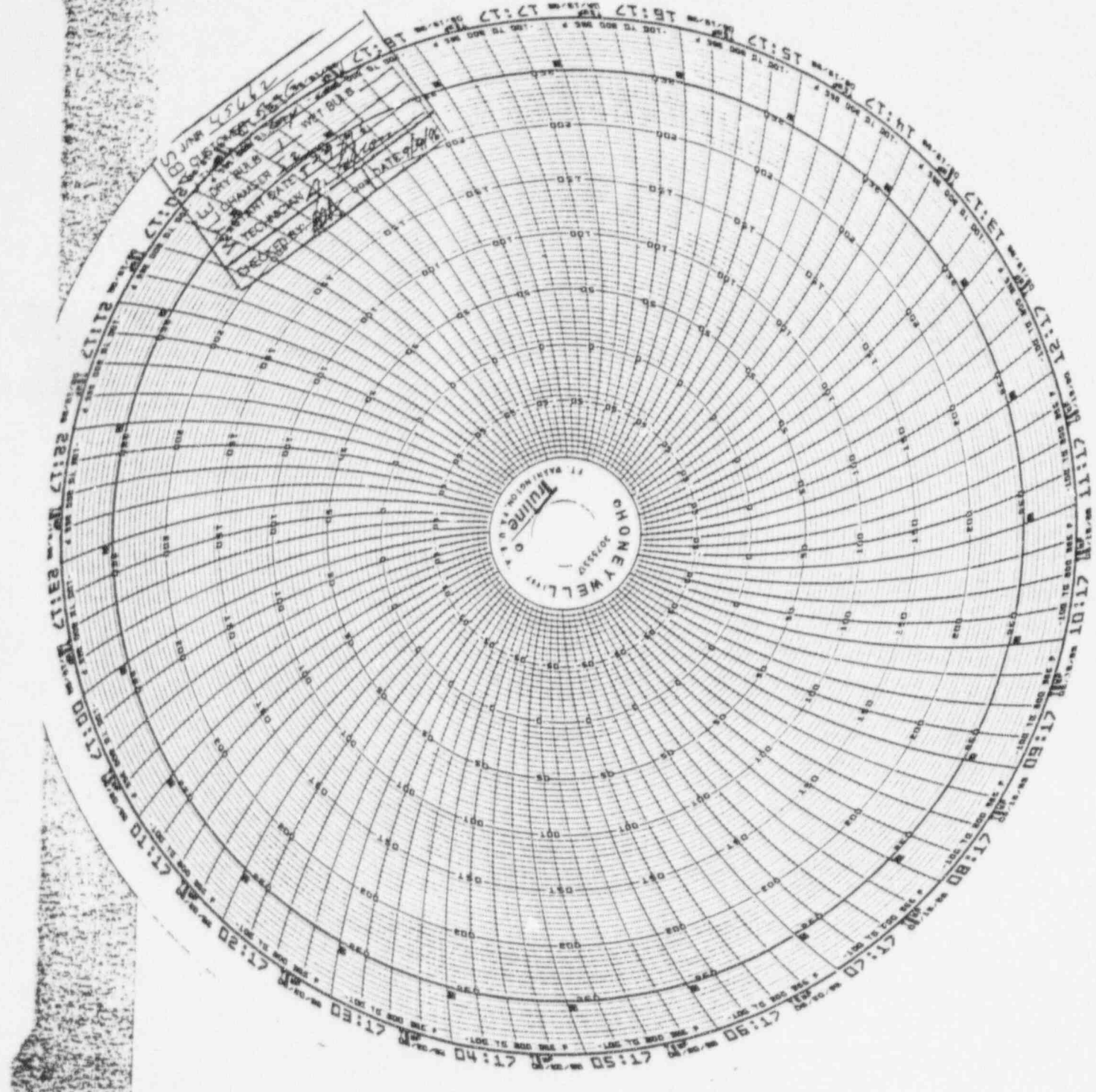
WASHINGTON, PA. U.S.A.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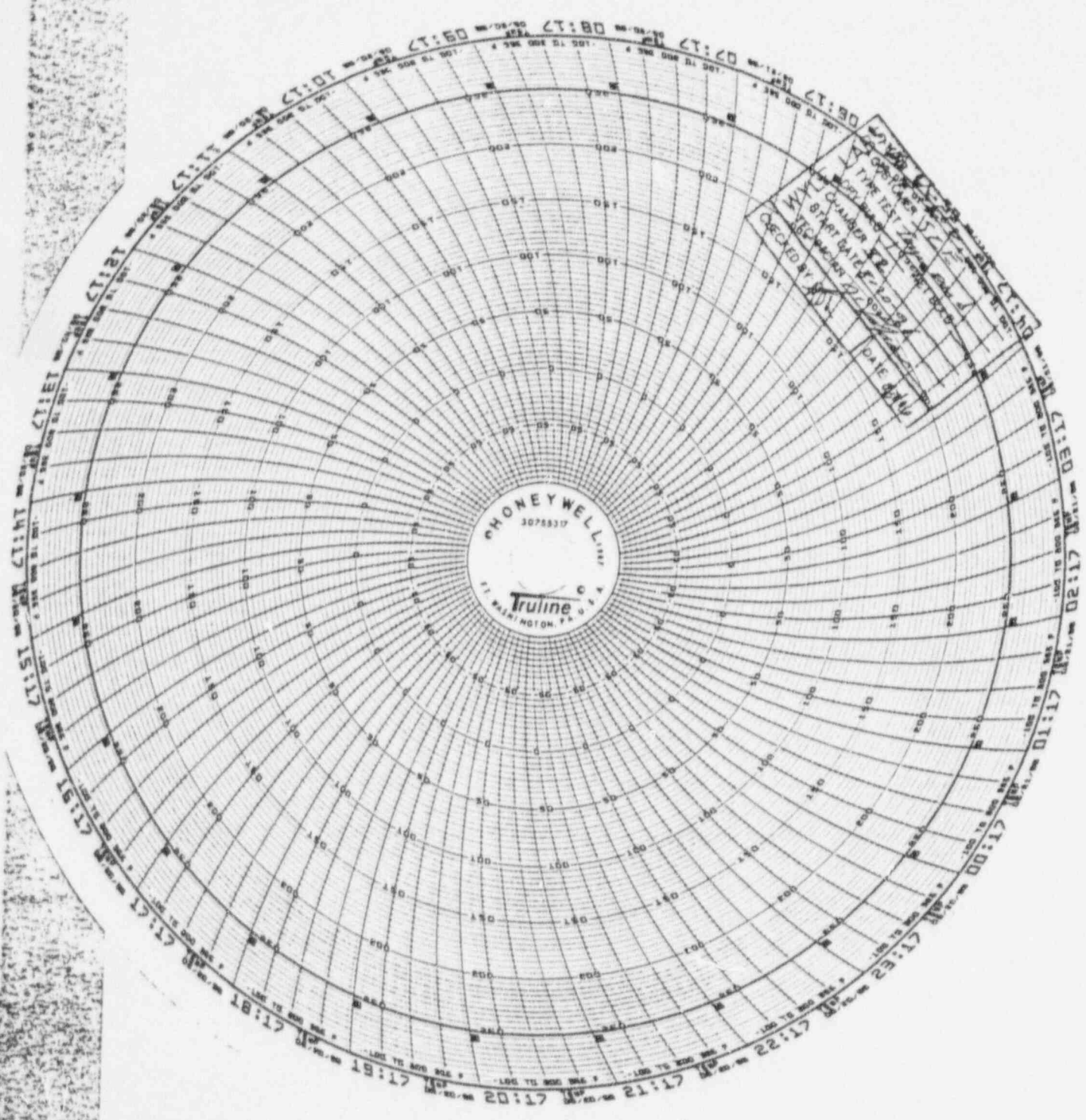
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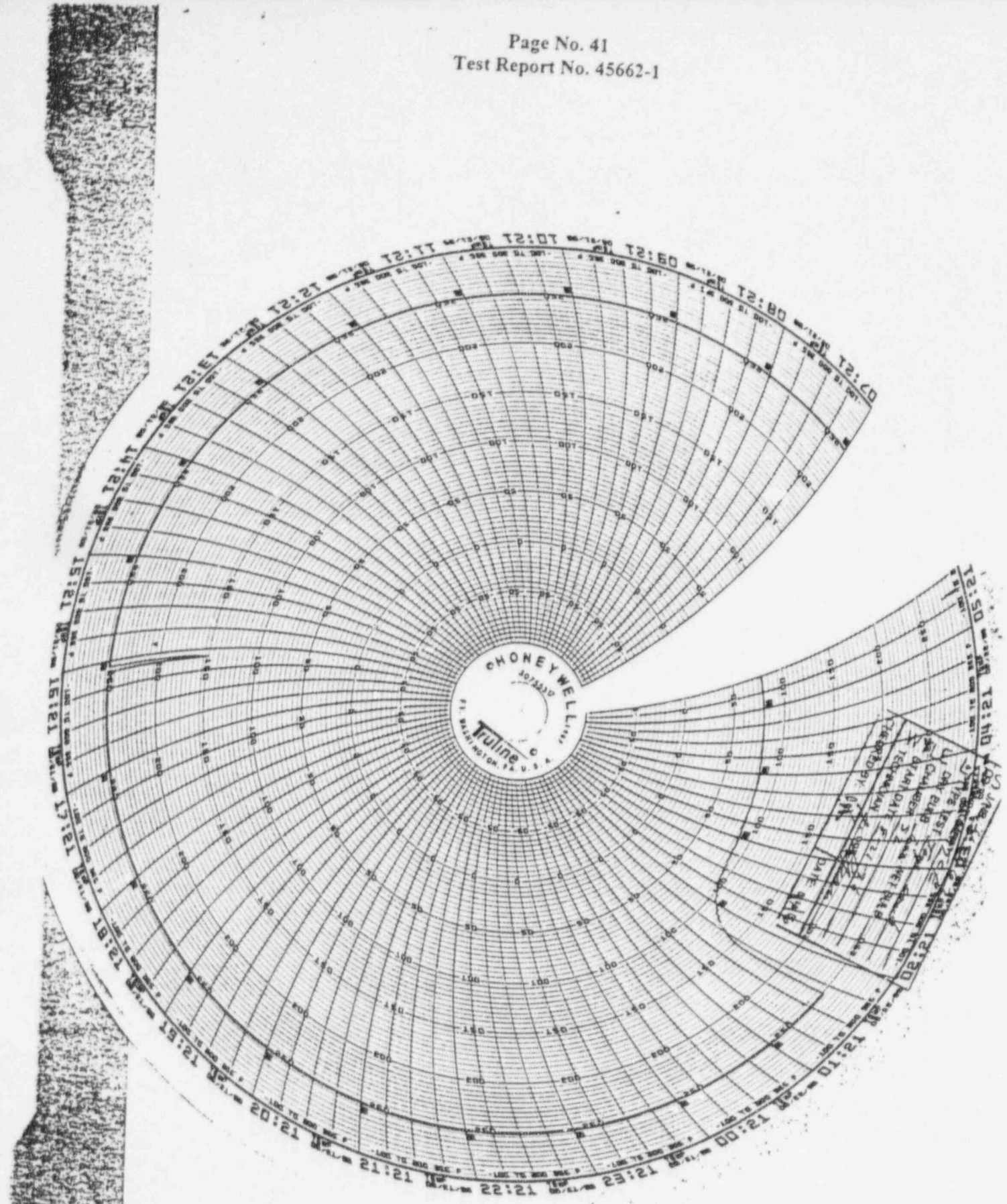
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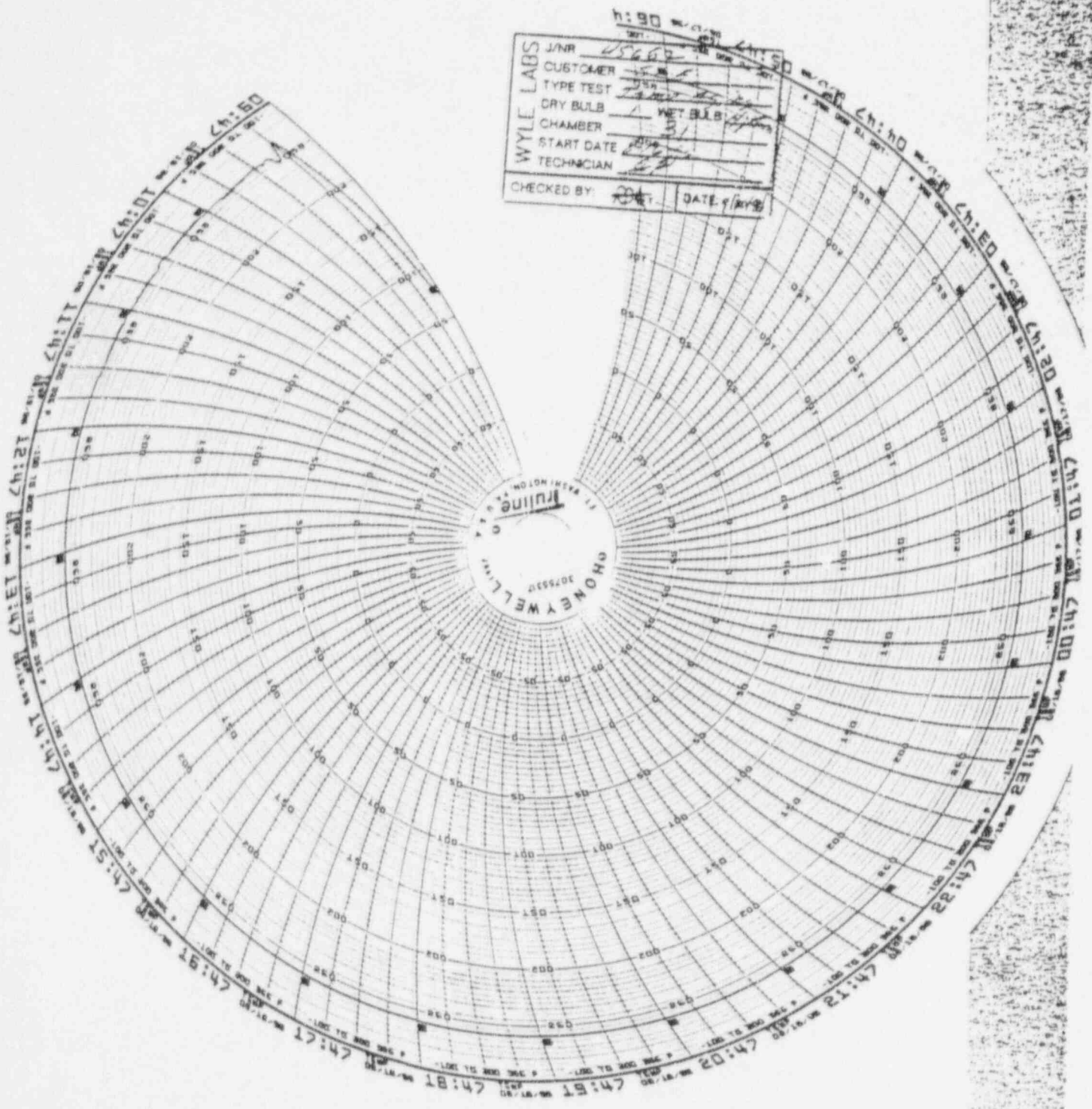
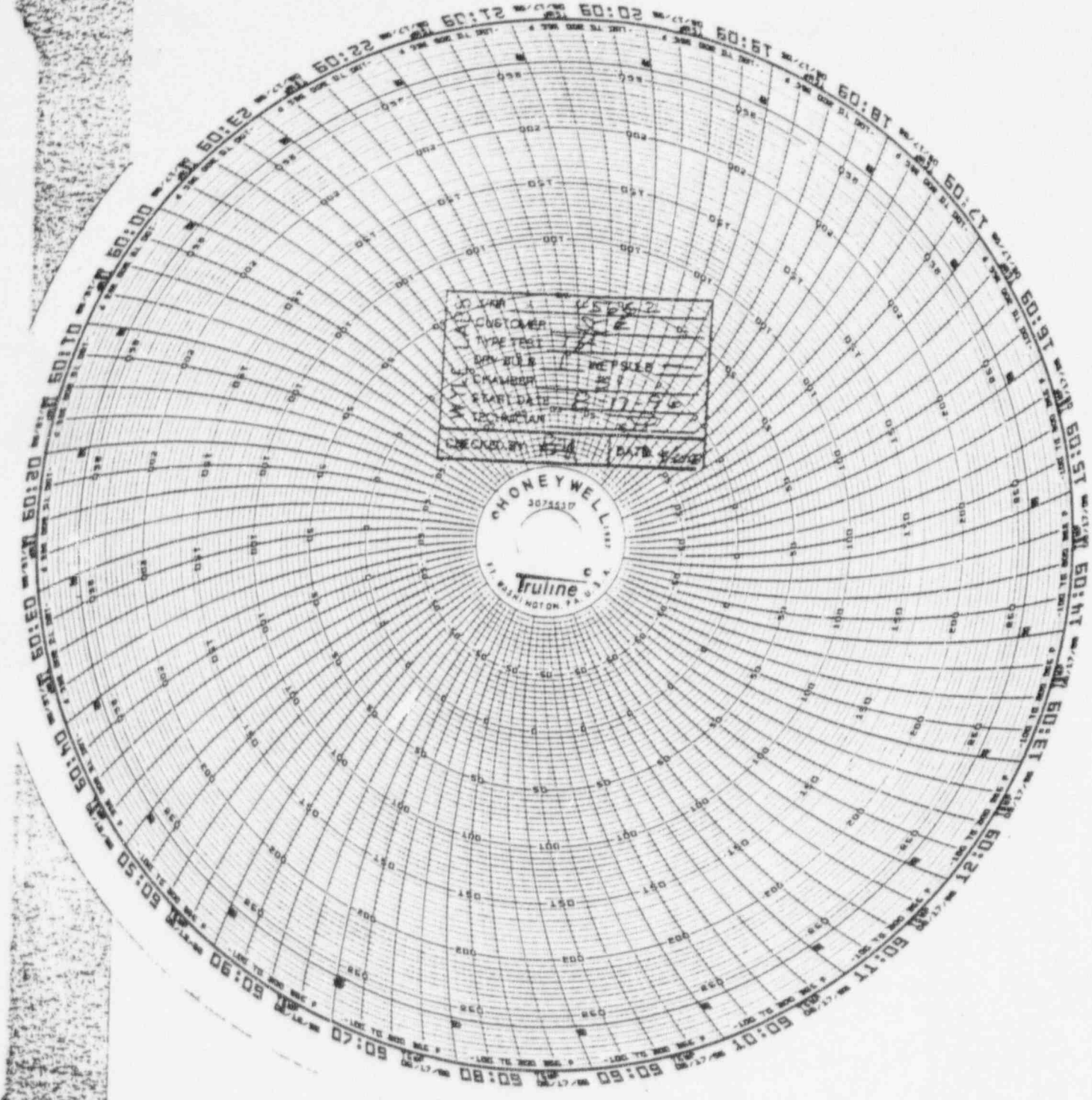
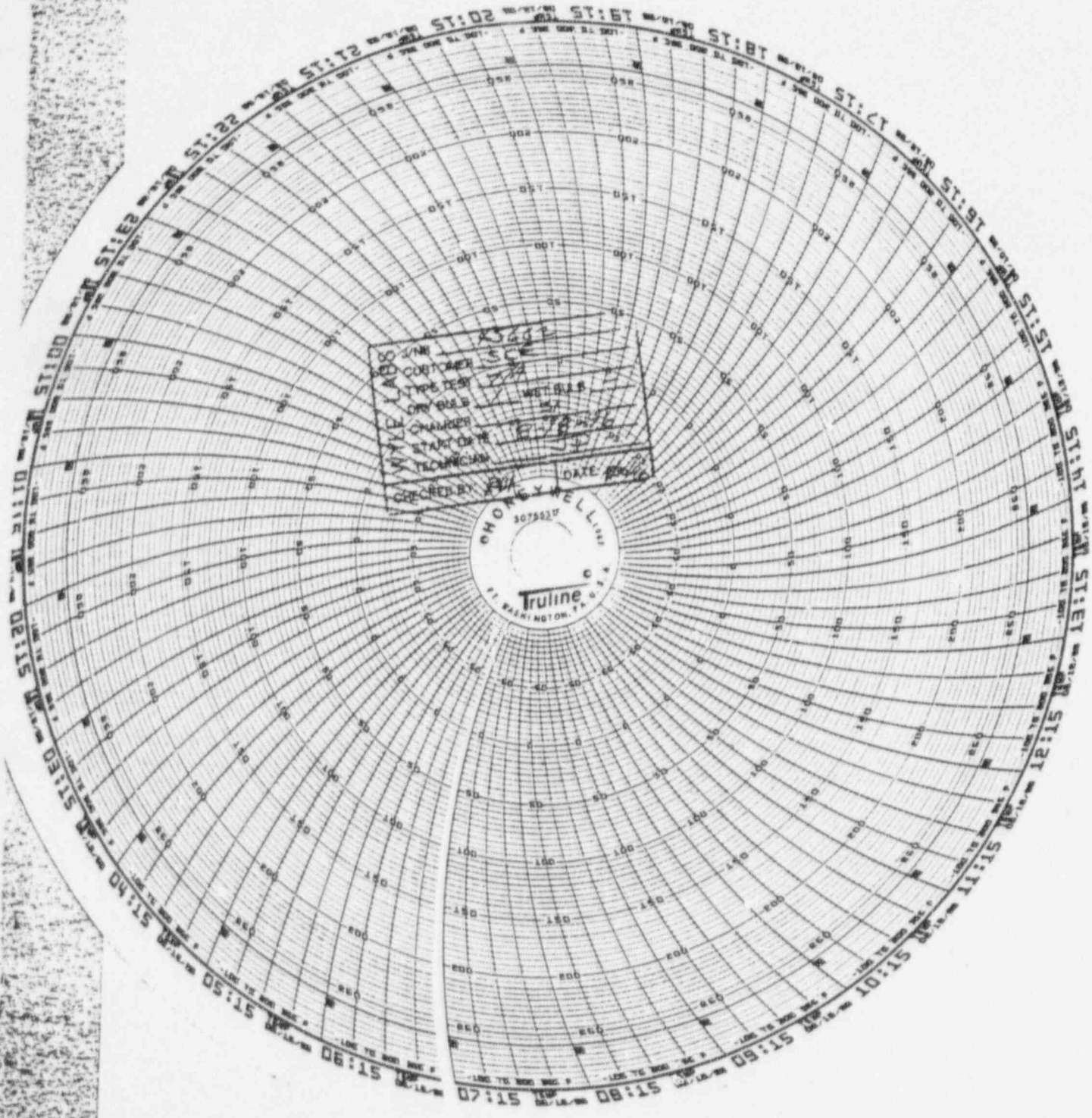
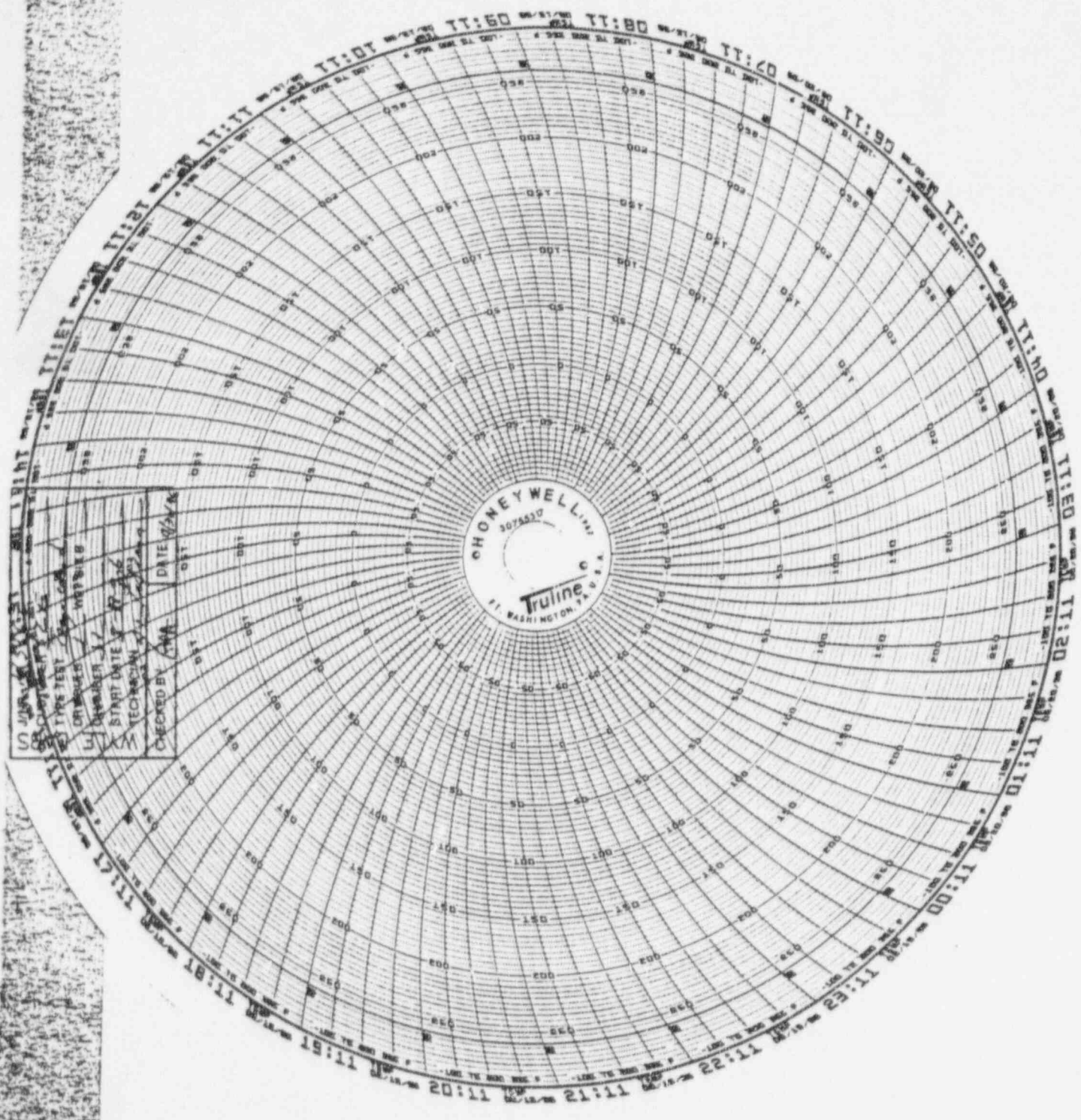
Truline
WASHINGTON, PA. U.S.A.

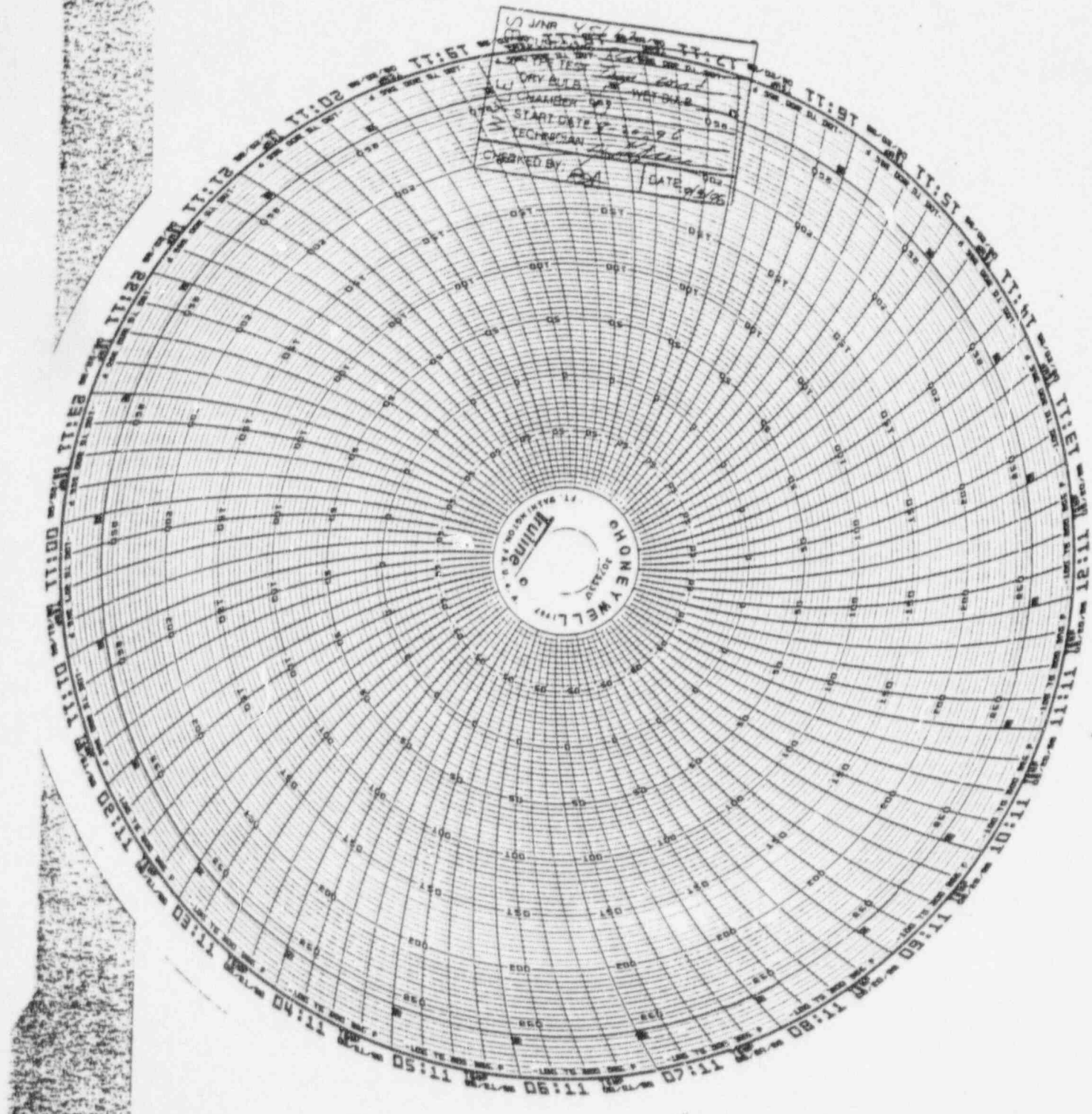

WYLE LABS
J/NR 45662
CUSTOMER
TYPE TEST
DRY BULB
WET BULB
CHAMBER
START DATE
TECHNICIAN
CHECKED BY:
DATE 9/XX/82
CHONEY WELL
Truline

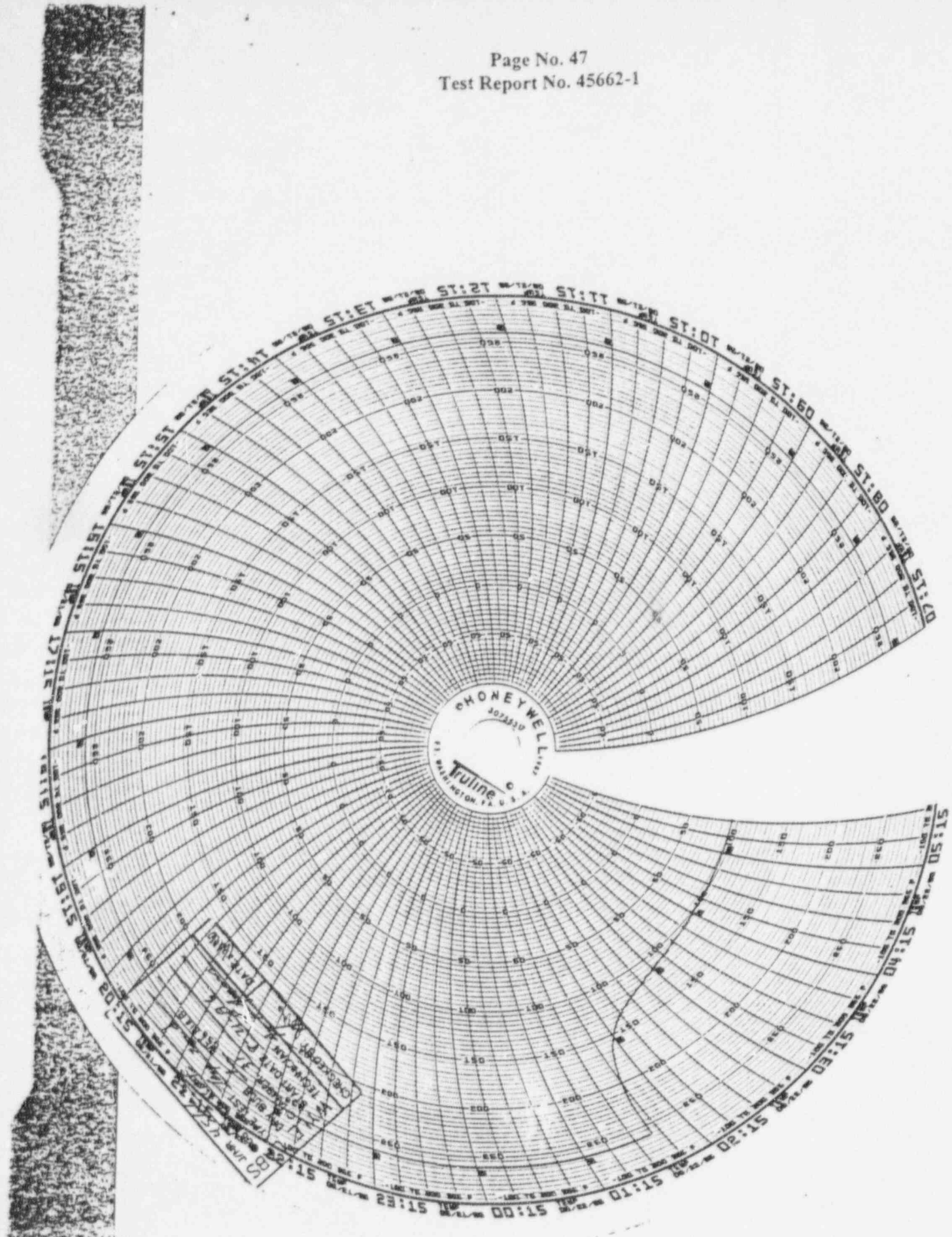
SPECIMEN 3


HONEYWELL
Truline
FT. WASHINGTON, PA. U.S.A.


Honeywell
Truline
WET BULB
DRY BULB
DATE


HONEYWELL
Truline
11 WASHINGTON
DATE
CHECKED BY


HONEYWELL
Fulline
DRY BULB
WET BULB
START DATE
TECHNICIAN
CHECKED BY:
DATE


HONEYWELL
Truline

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APPENDIX V

RADIATION FACILITY CERTIFICATE OF CONFORMANCE AND SKETCHES

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ISOMEDIX OPERATIONS
9 APOLLO DRIVE
WHIPPANY, NJ 07981

ISOMEDIX (OPERATIONS), INC.
COMPONENT IRRADIATION CERTIFICATION

CUSTOMER	WYLE LABORATORIES	P.O. #	4-8485-P
AIR EQUIV. REQUIRED DOSE (MRADS)	174.00		
RATE NOT TO EXCEED (MRADS/HR)	1.00		

SPECIMENS:

QTY	PART NO.	SERIAL NO.	DESCRIPTION
3	#s 1,2,3	N/A	COAX CABLE SPECIMENS

DATA:

SOURCE TYPE: COBALT-60 GAMMA					
TOTAL DELIVERED DOSE (AIR) MRADS:		MIN:	155.18	MAX:	173.80
DOSE RATE (AIR) MRADS/HR:		MIN:	.75	MAX:	.84
TOTAL EXPOSURE HOURS:		206.9			
SPECIMEN ROTATION	2-WAY:	4-WAY:	X	NONE:	
DATE IN:	08/30/96	DATE OUT:	09/16/96		

DOSIMETRY:

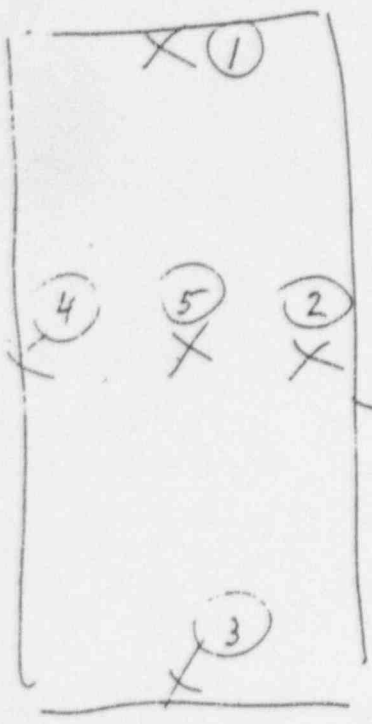
DOSIMETER TYPE:	HARWELL PERSPEX	BATCH:	DS
TOLERANCE:	±8%	CALIBRATION DATE	03/22/96
READOUT INSTRUMENT:		GENESYS 2	
SERIAL NO.:	3W27215002	CALIBRATION DATE	07/19/96
COMMENTS:	* CABLE SPECIMENS WERE REMOVED PRIOR TO RECEIVING REQUIRED DOSE SPECIFICATIONS PER CUSTOMER'S MEMO DATED 09/13/96.		

ATTACHMENTS:

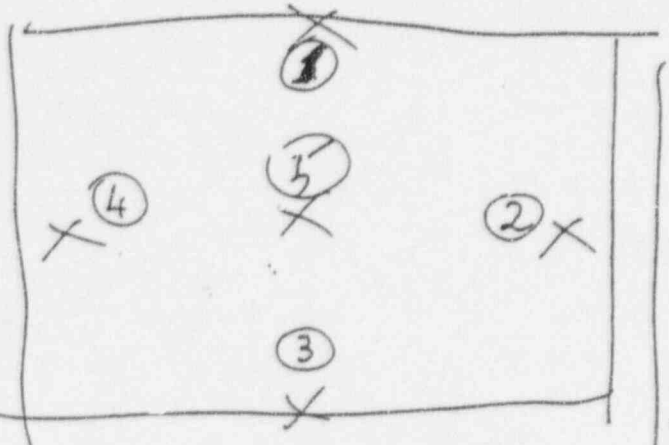
WORKSHEETS:	N/A	DRAWINGS:	N/A
NOTICE OF ANOMOLY:		N/A	
AUTHORIZED SIGNATURE:			
TITLE:	QA MANAGER	DATE:	09/17/96

Form 1702.3
Original

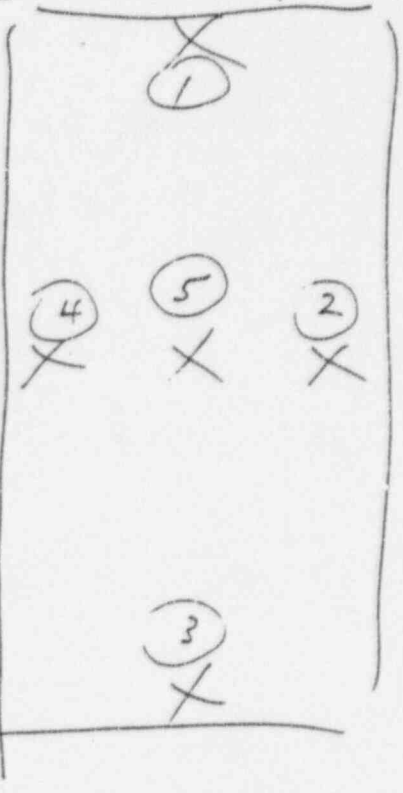
A (TEST # 1)



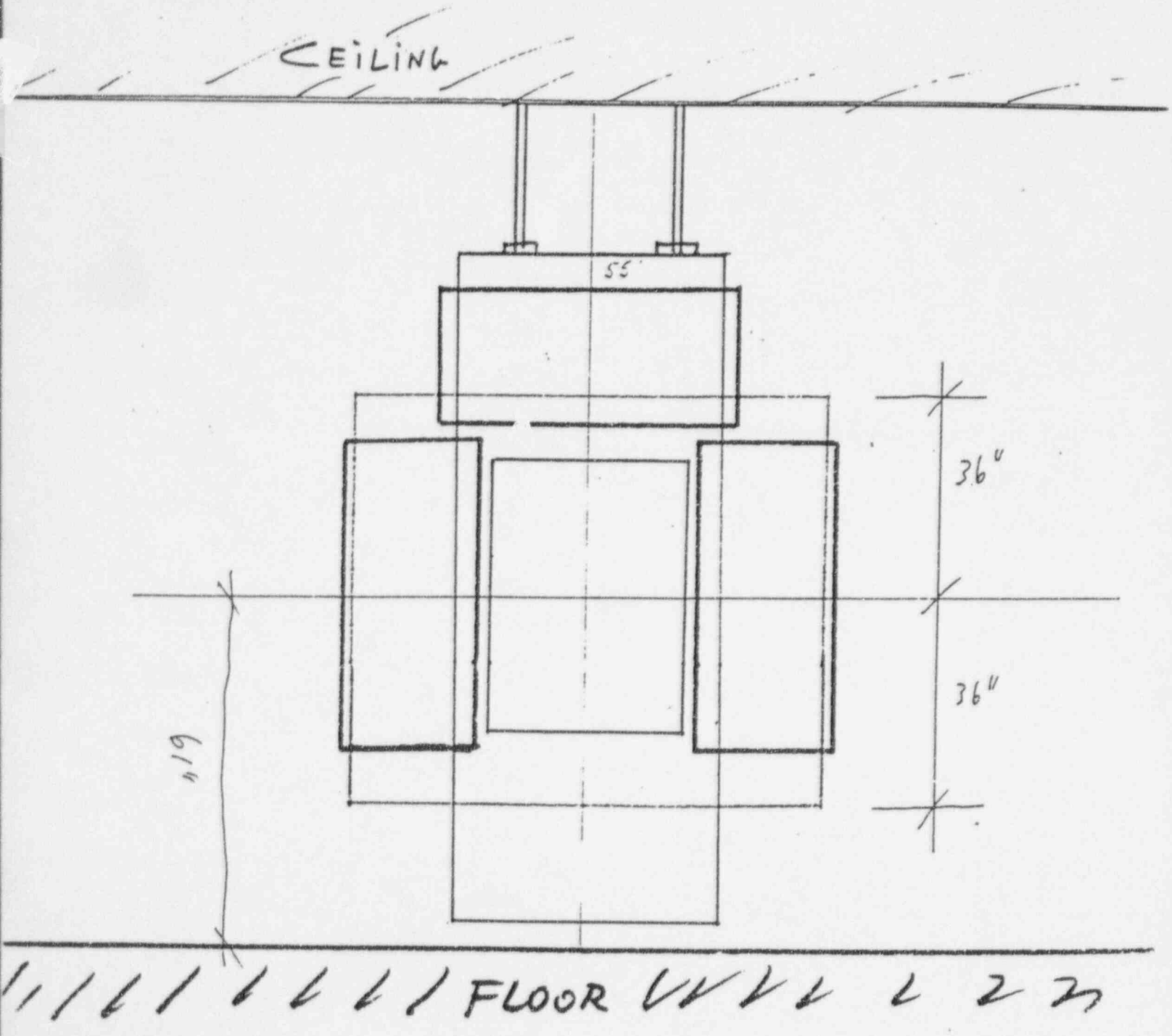
B (TEST # 2)



C (TEST # 3)



08.24.96


CEILING
55
36"
36"
19"
FLOOR

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APPENDIX VI

ACCIDENT TEST PLOTS

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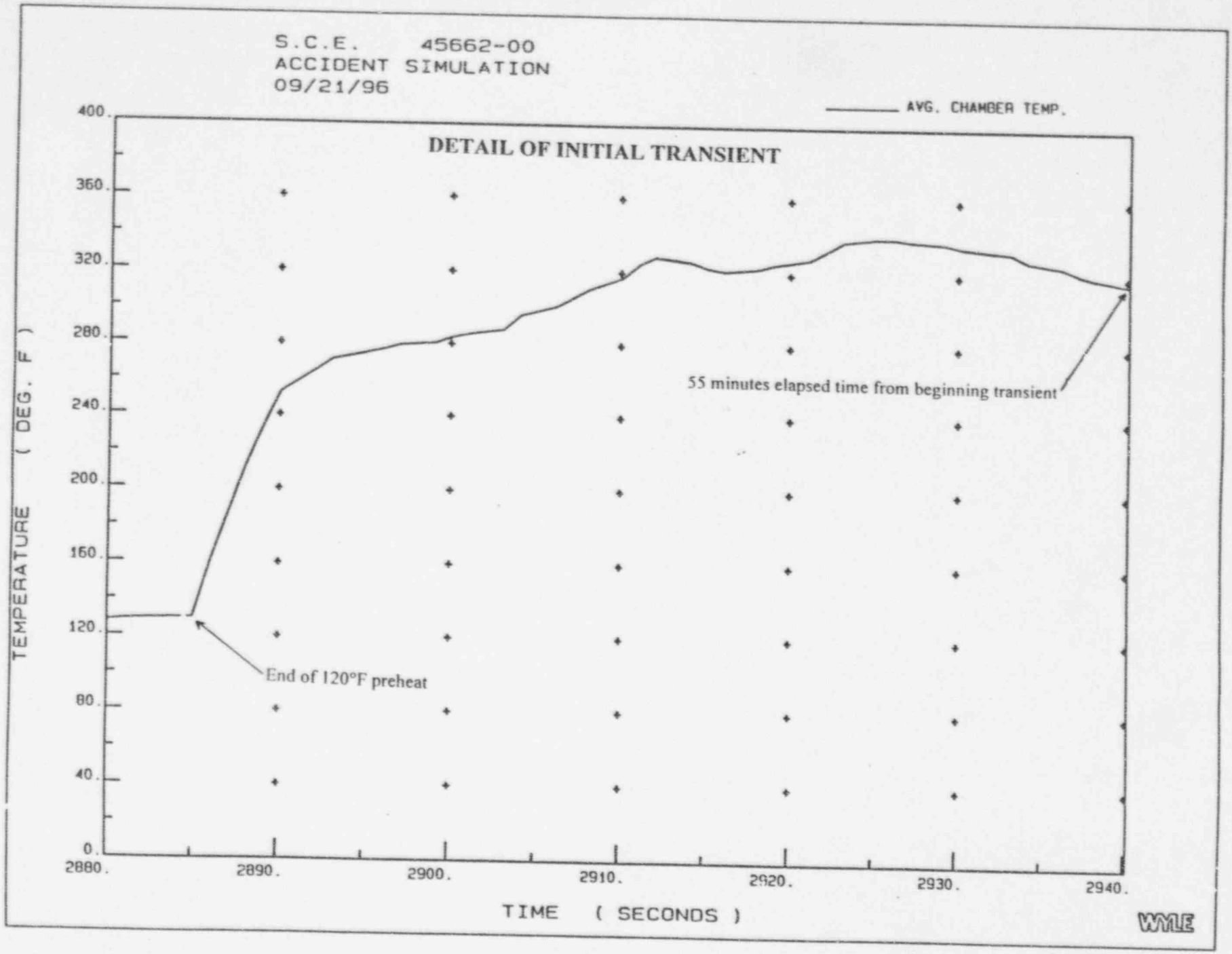
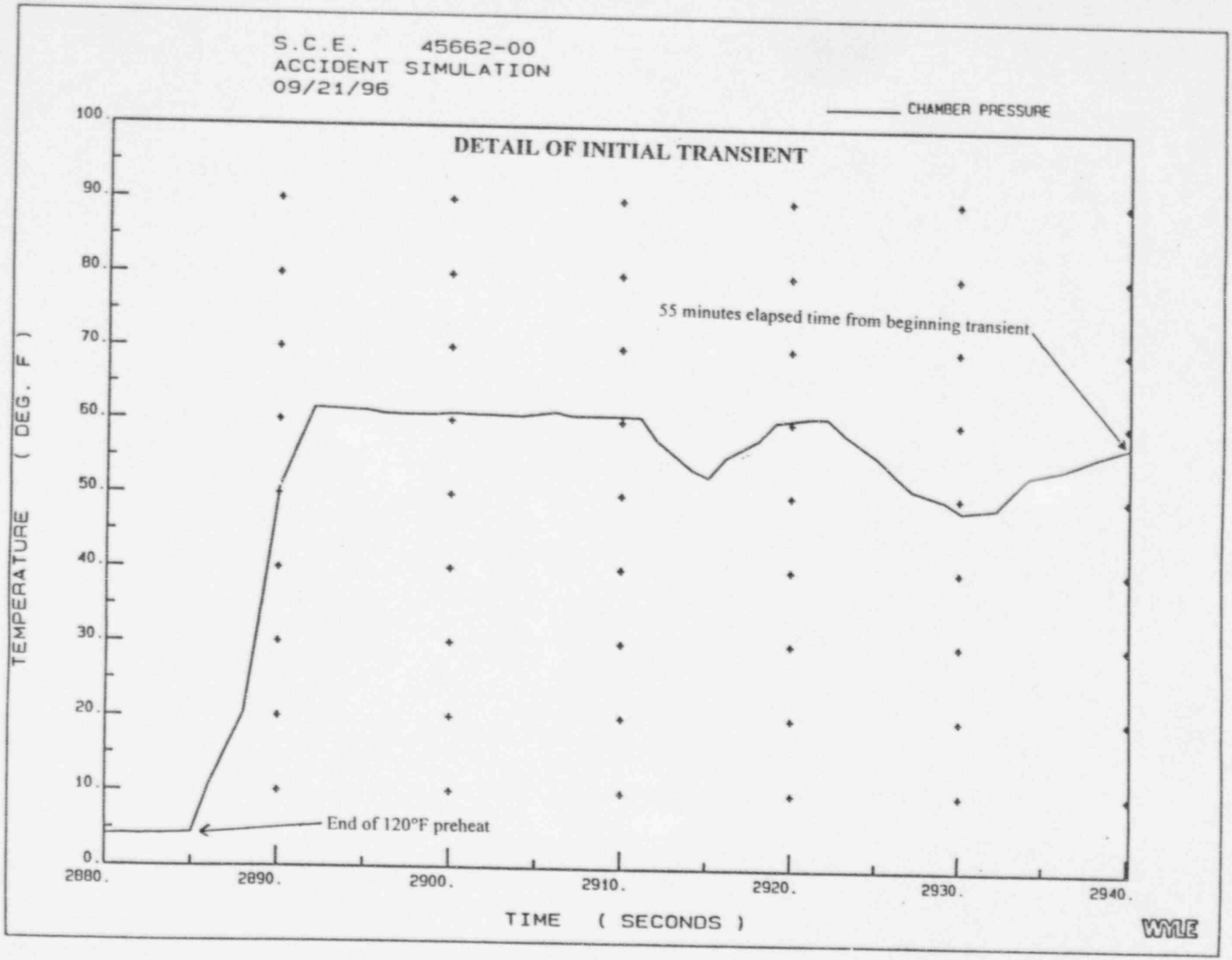
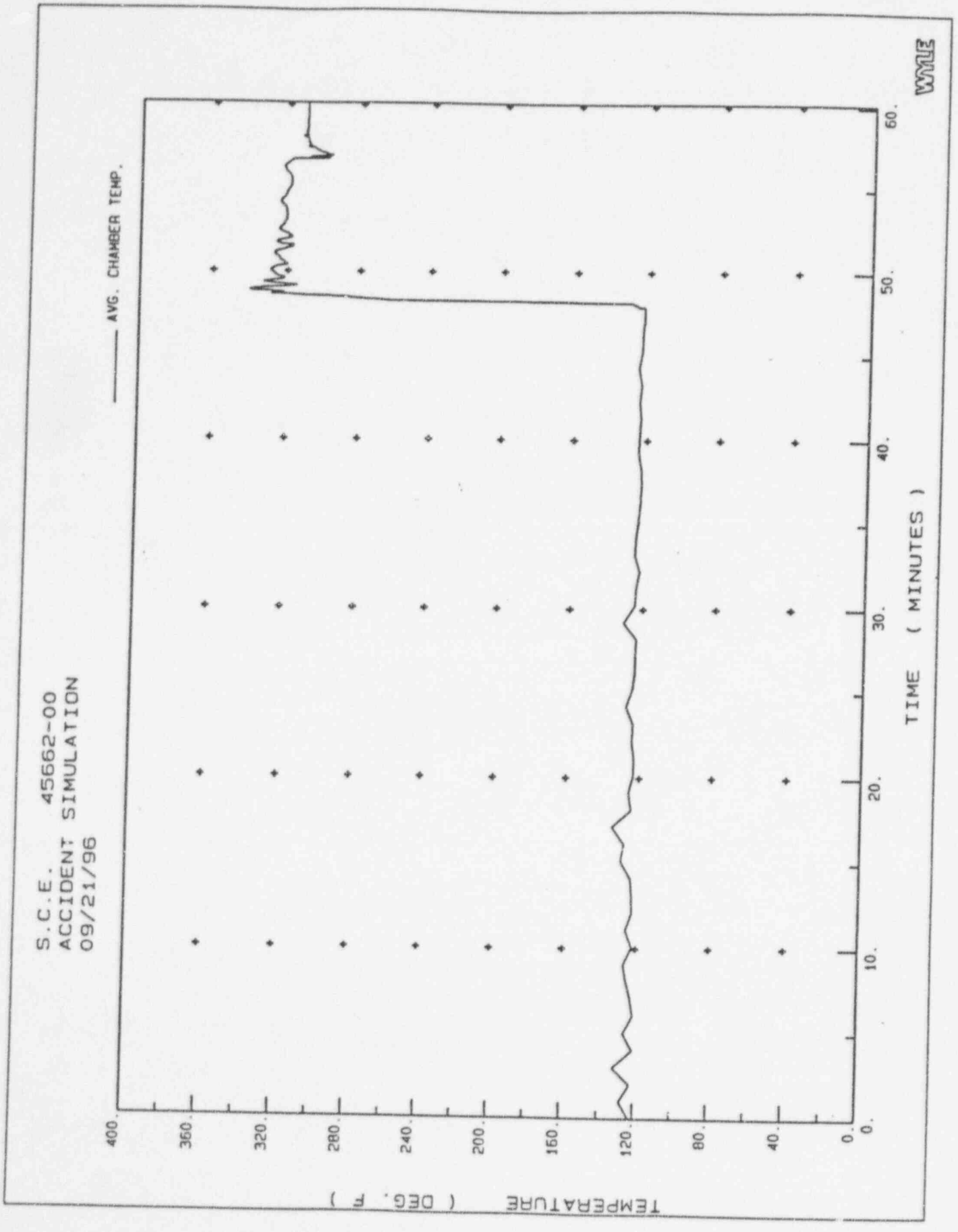
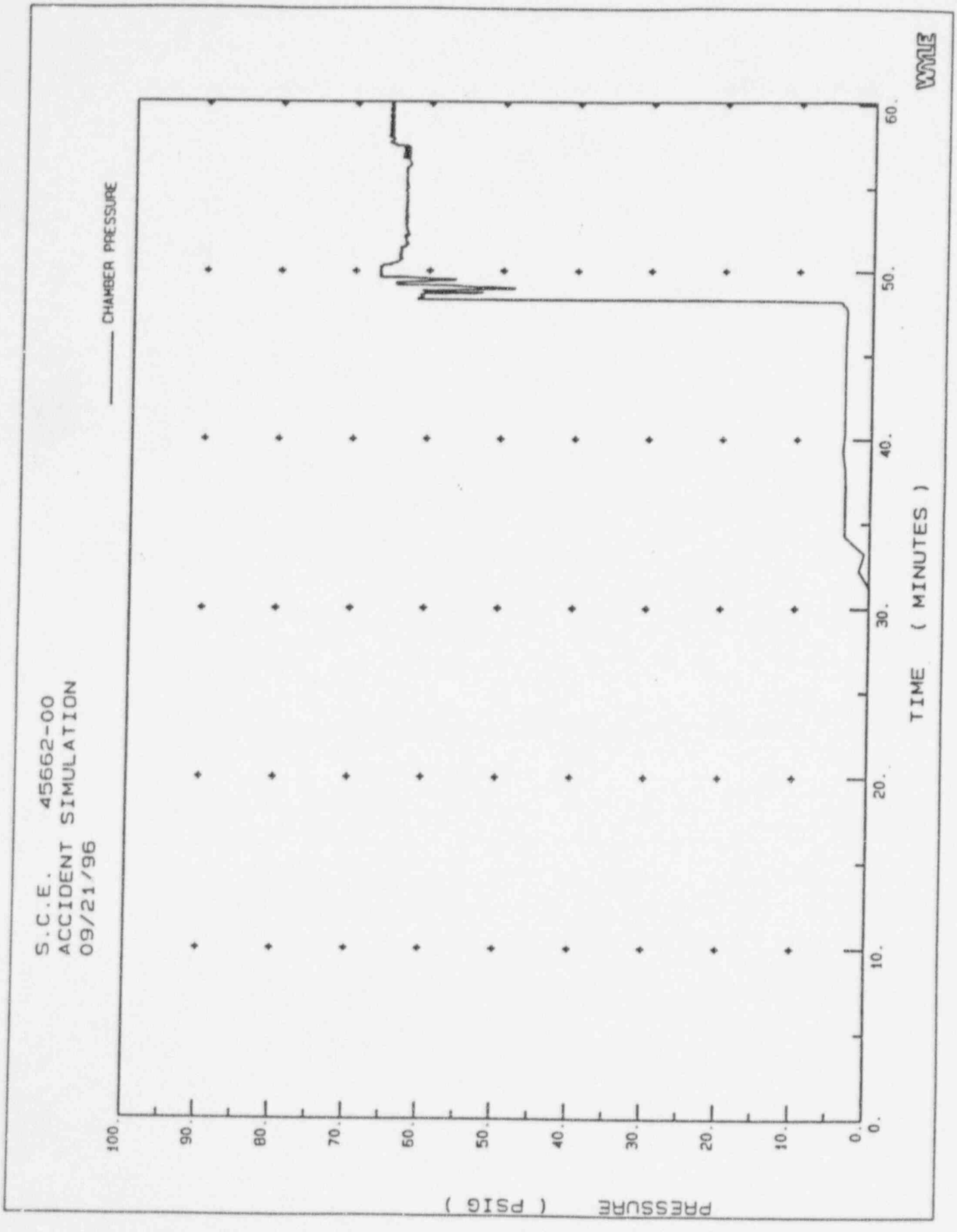
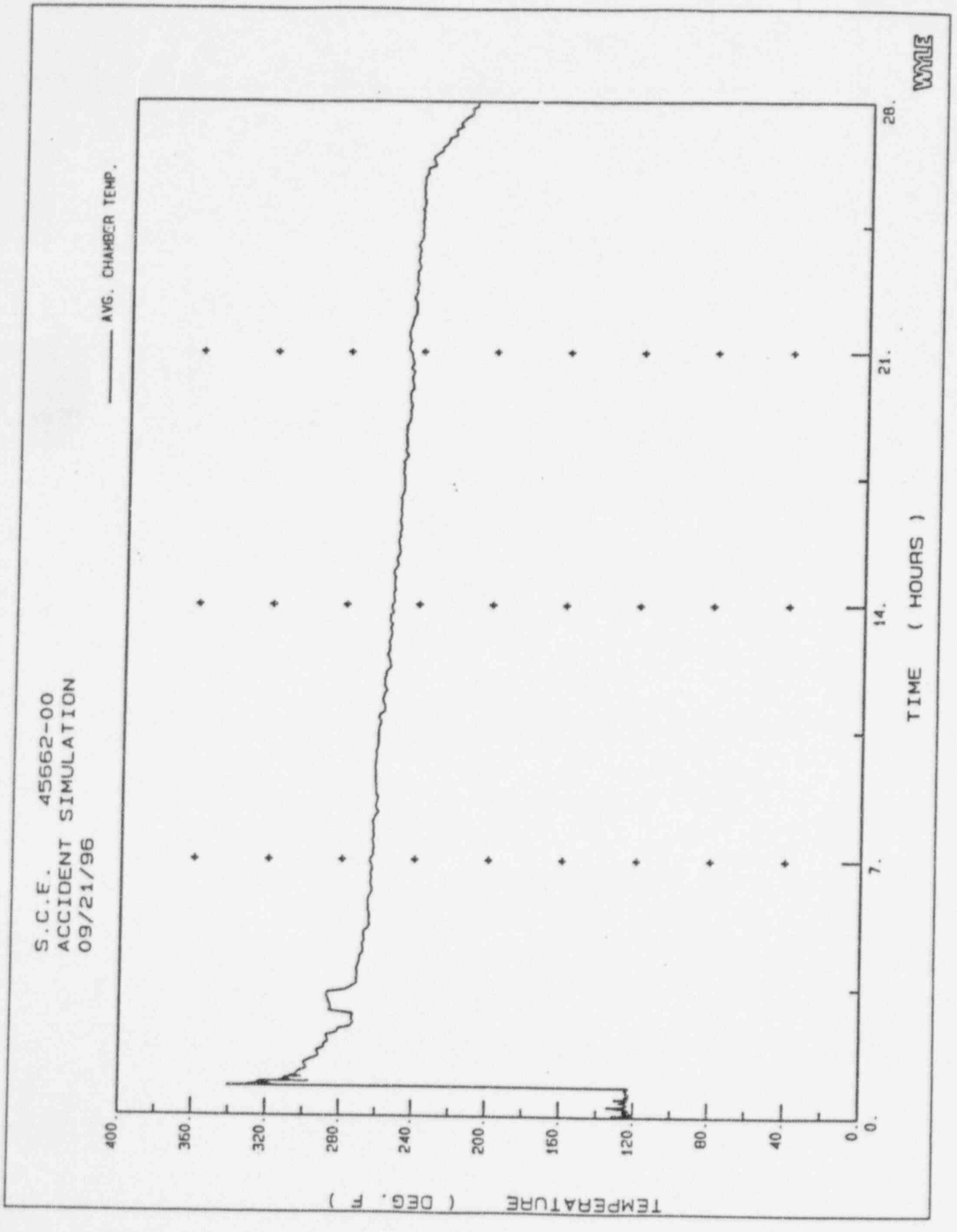
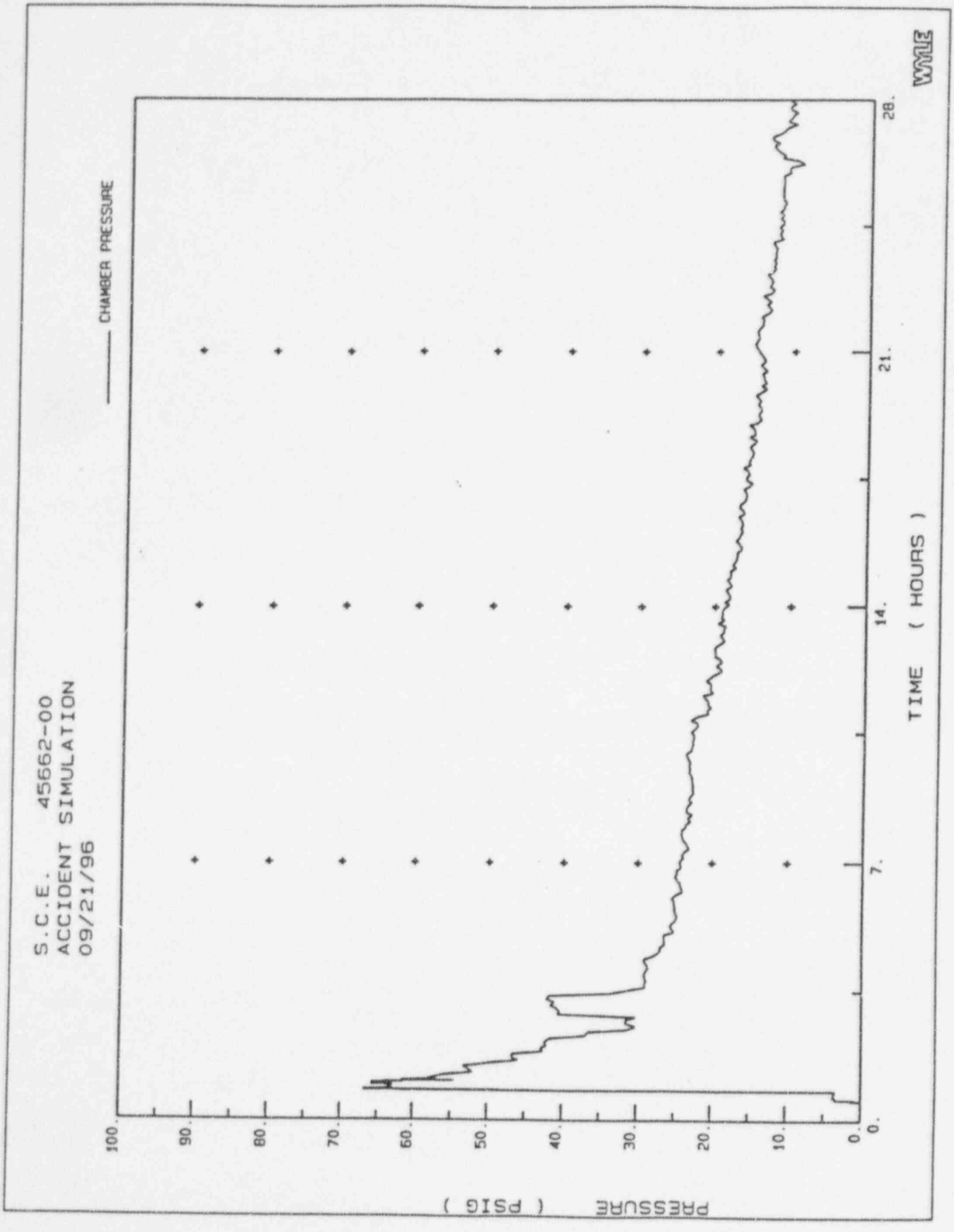

S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
AVG. CHAMBER TEMP.
DETAIL OF INITIAL TRANSIENT
55 minutes elapsed time from beginning transient
End of 120°F preheat
TEMPERATURE (DEG. F)
TIME (SECONDS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
2880.
2890.
2900.
2910.
2920.
2930.
2940.
WYLE

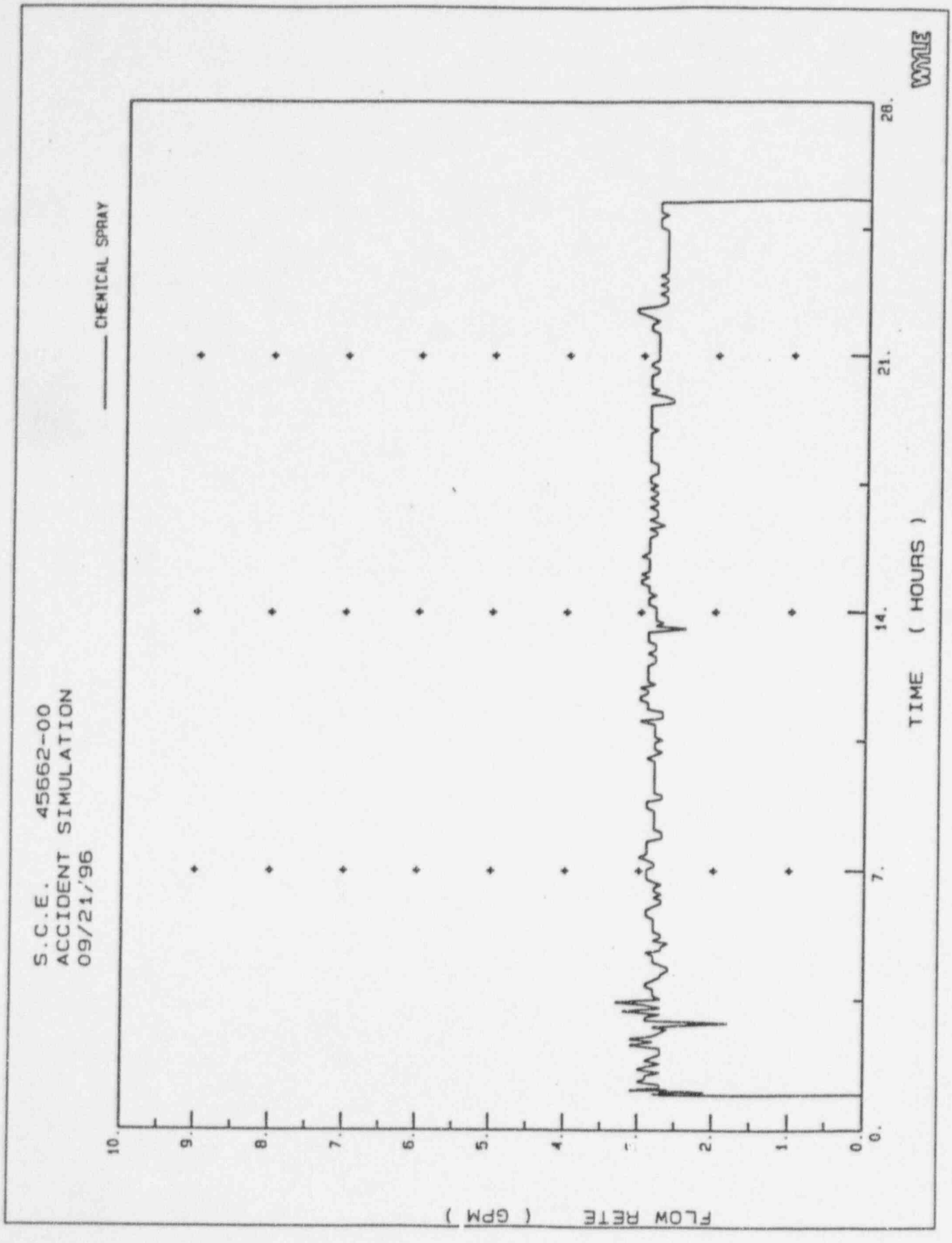

S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
CHAMBER PRESSURE
DETAIL OF INITIAL TRANSIENT
55 minutes elapsed time from beginning transient
End of 120°F preheat
TEMPERATURE (DEG. F)
TIME (SECONDS)
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
2880.
2890.
2900.
2910.
2920.
2930.
2940.
WYLE

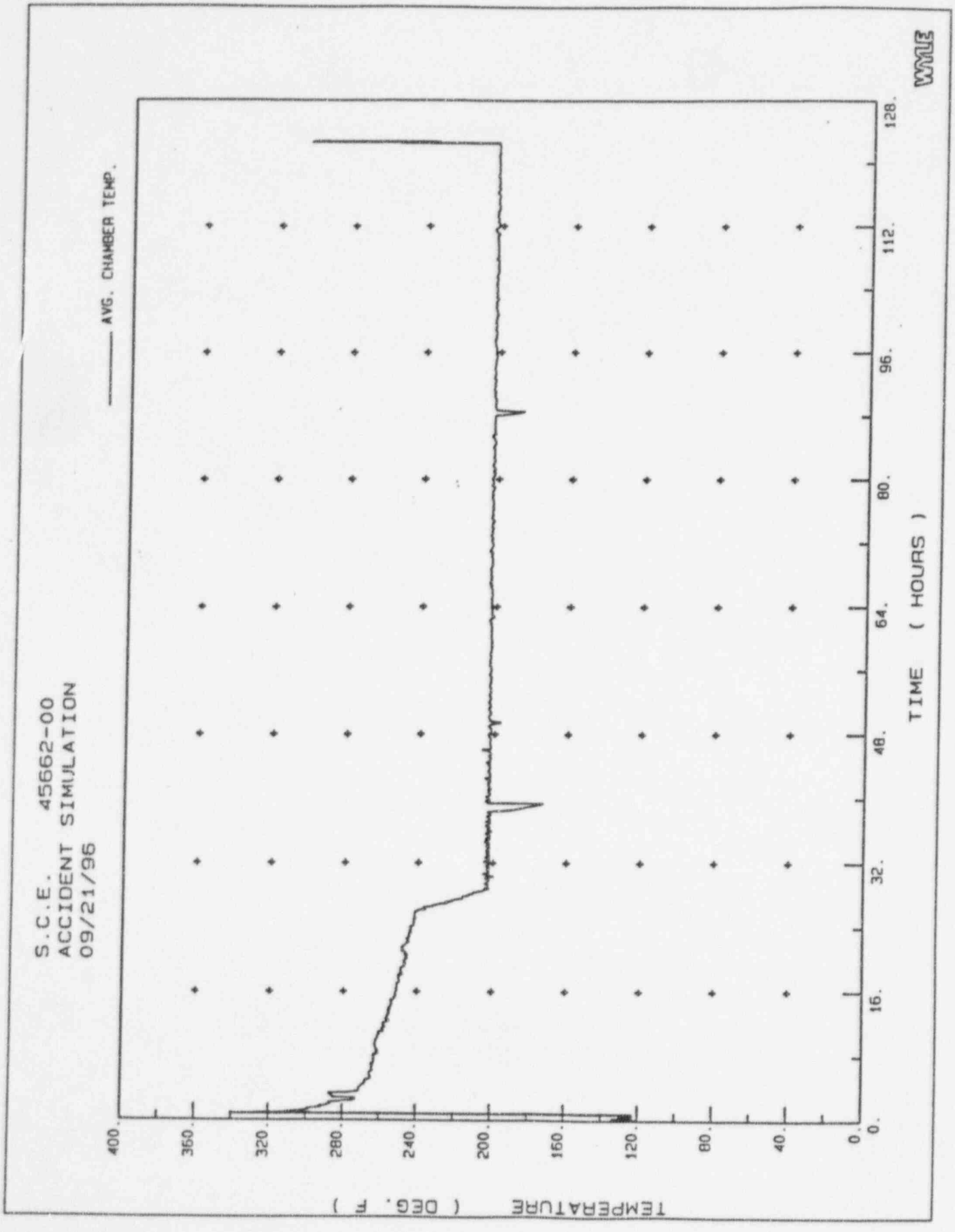

S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
AVG. CHAMBER TEMP.
TEMPERATURE (DEG. F)
TIME (MINUTES)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
10.
20.
30.
40.
50.
60.
WYLE

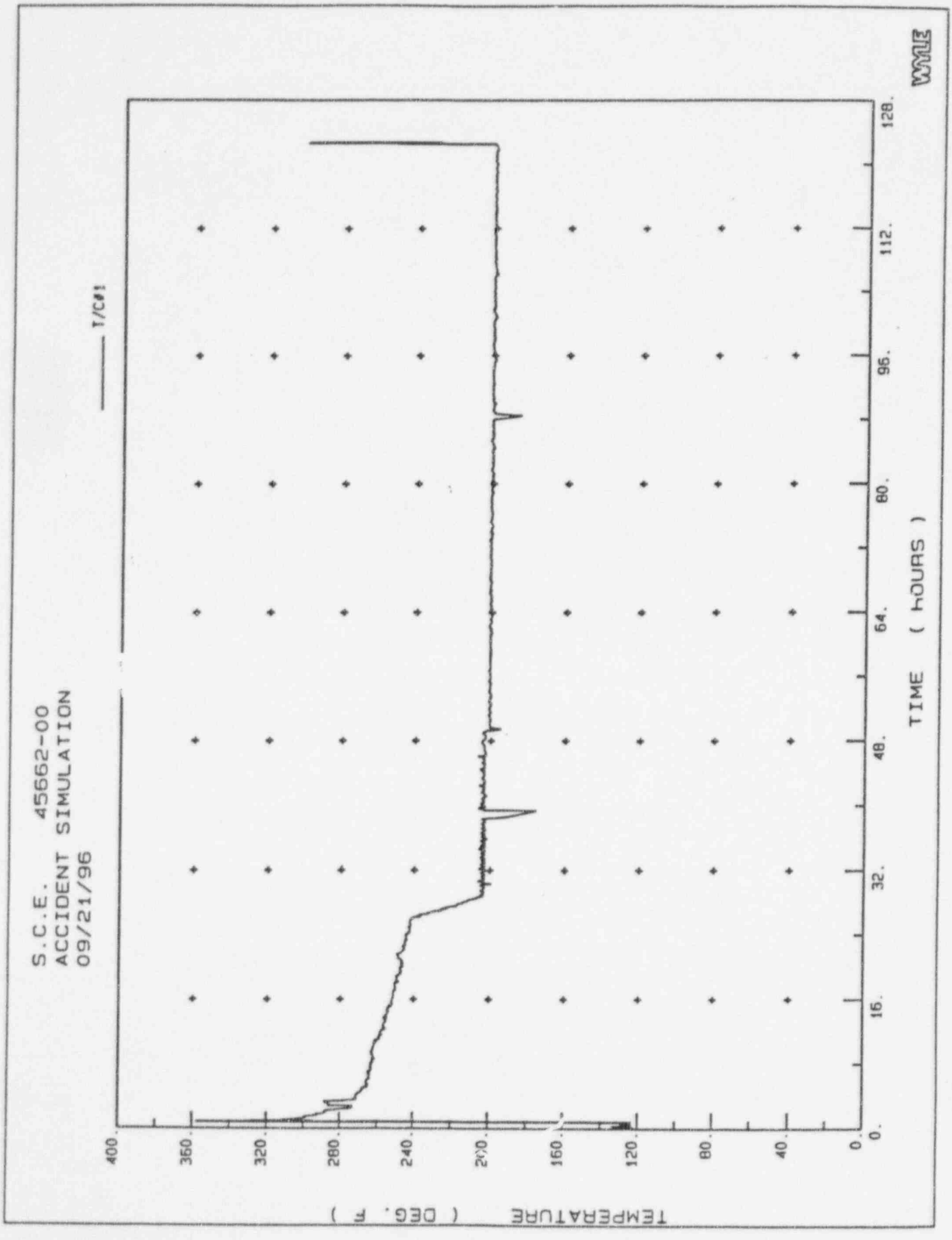

S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
CHAMBER PRESSURE
PRESSURE (PSIG)
TIME (MINUTES)
WYLE
100.
90.
80.
70.
60.
50.
40.
30.
20.
10.
0.
0.
10.
20.
30.
40.
50.
60.

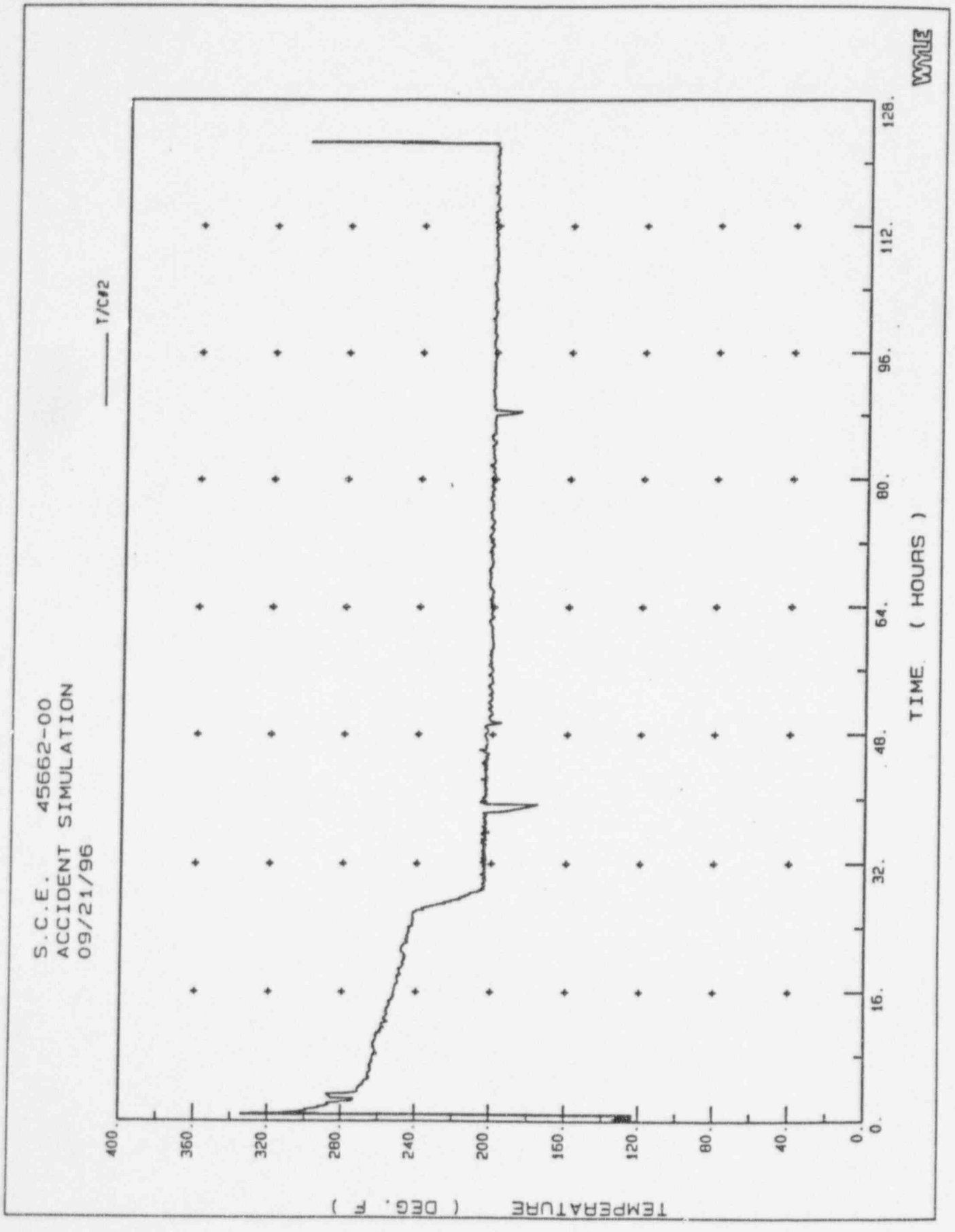

S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
AVG. CHAMBER TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
7.
14.
21.
28.
WYLE


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
CHAMBER PRESSURE
PRESSURE (PSIG)
TIME (HOURS)
0.
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.
7.
14.
21.
28.
WYLE


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
CHEMICAL SPRAY
FLOW RETE (GPM)
TIME (HOURS)
0.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
7.
14.
21.
28.
WYLE


S.C.E.
45662-00
ACCIDENT SIMULATION
09/21/96
AVG. CHAMBER TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
16.
32.
48.
64.
80.
96.
112.
128.
WMI


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
T/C#1
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
16.
32.
48.
64.
80.
96.
112.
128.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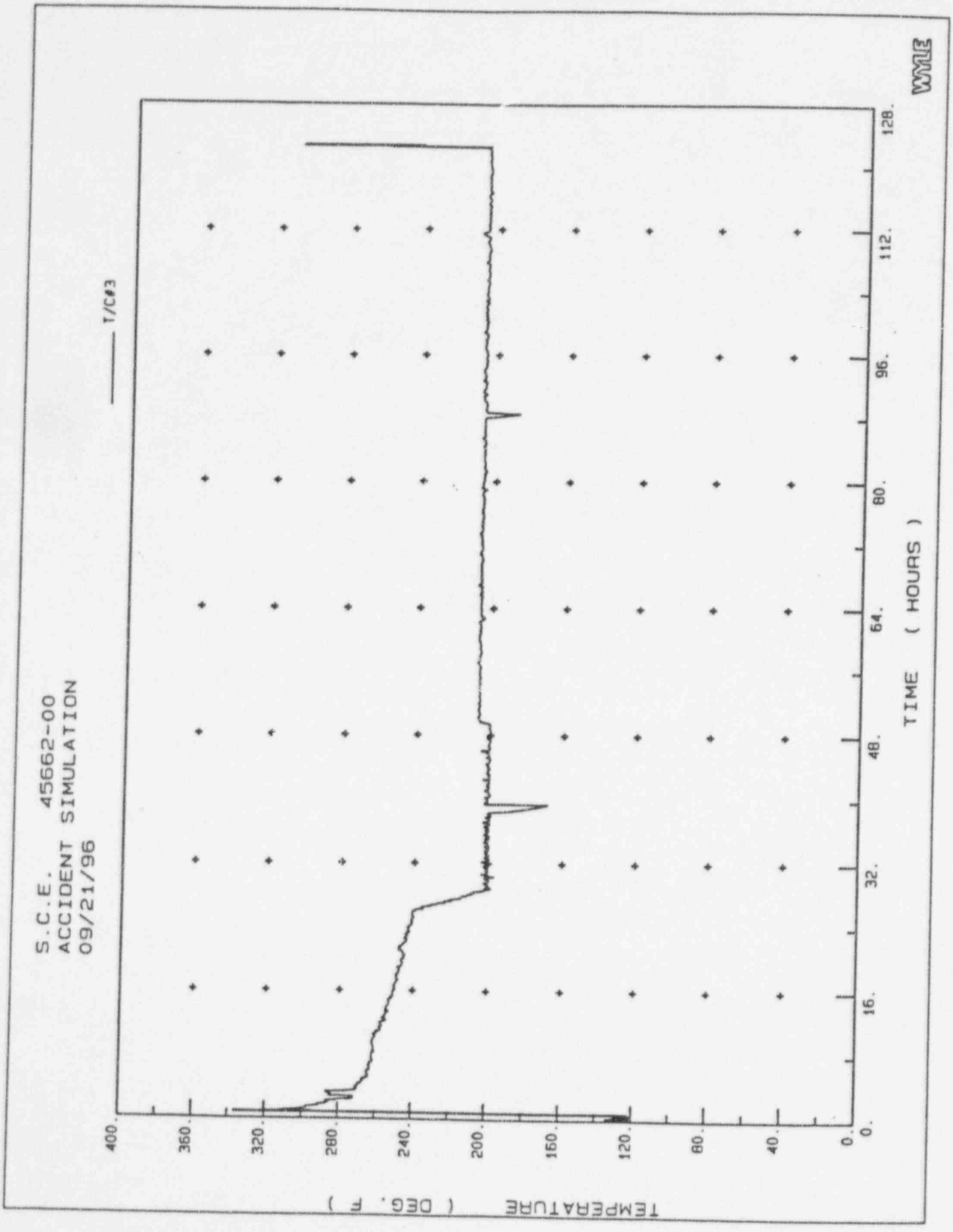
ACCIDENT SIMULATION
09/21/96
T/C#2
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
16.
32.
48.
64.
80.
96.
112.
128.
WYLE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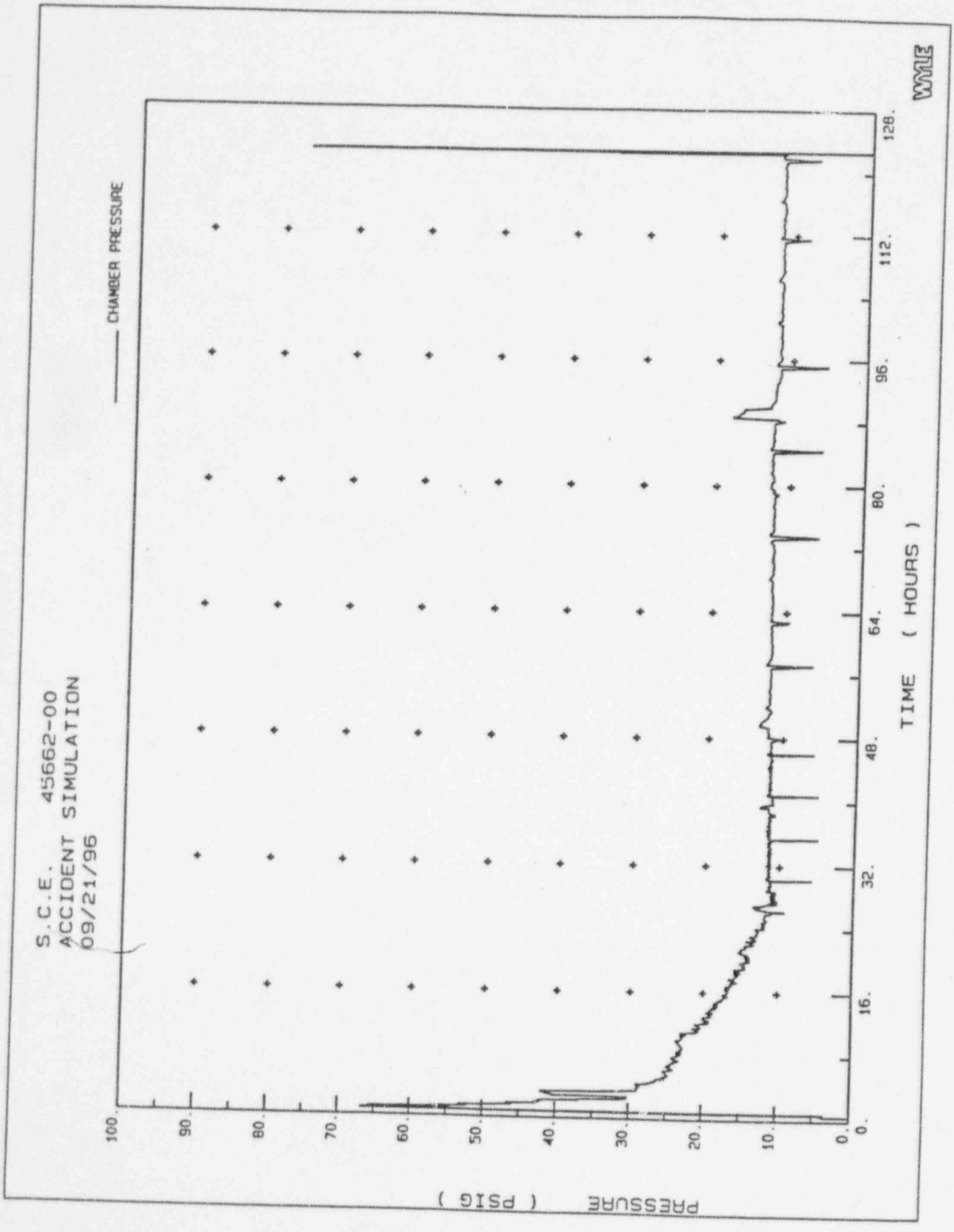
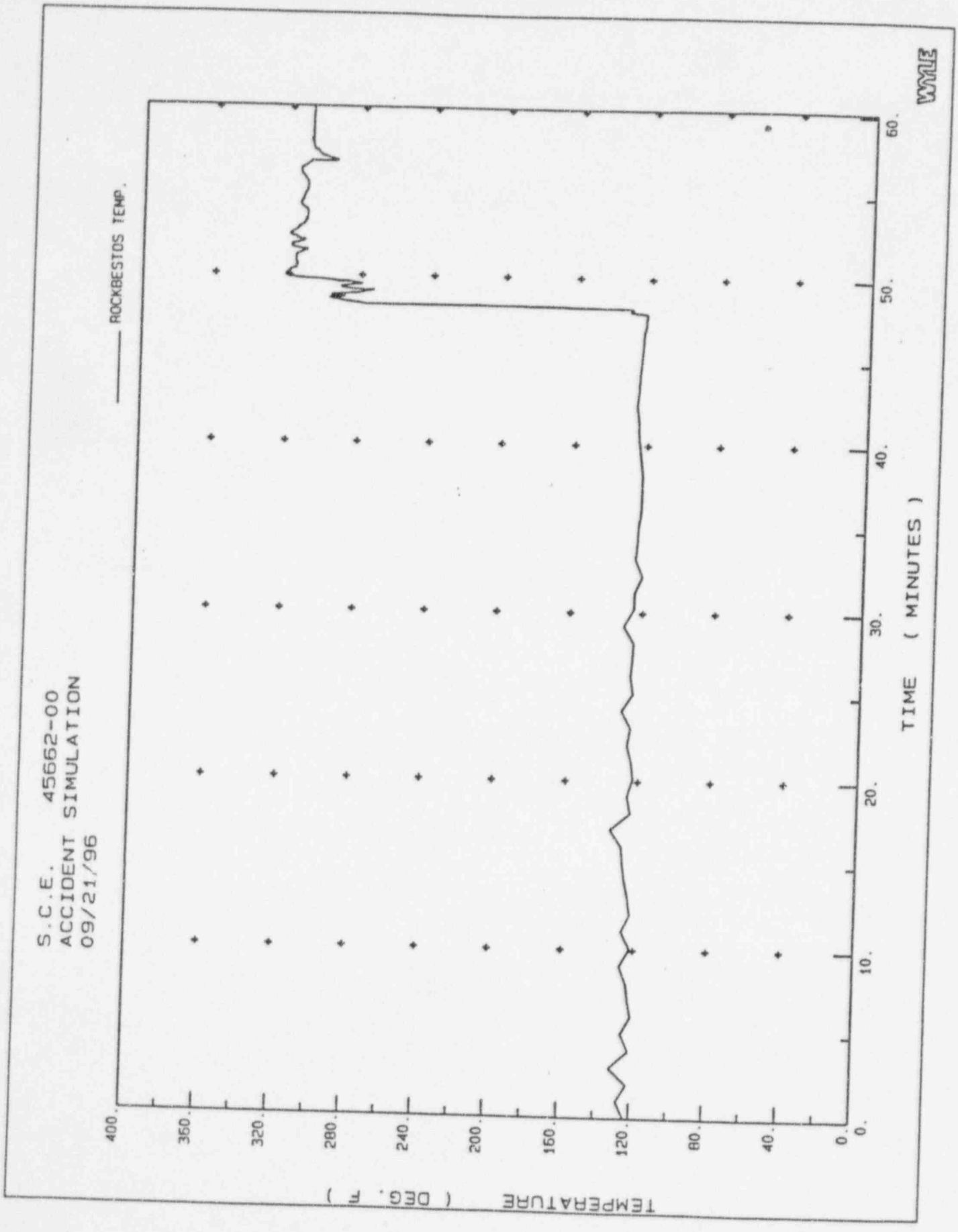
ACCIDENT SIMULATION
09/21/96
T/C#3
TEMPERATURE (DEG. F)
TIME (HOURS)
0.
40.
80.
120.
160.
200.
240.
280.
320.
360.
400.
16.
32.
48.
64.
80.
96.
112.
128.
WYLE


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
CHAMBER PRESSURE
PRESSURE (PSIG)
TIME (HOURS)
0.
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.
16.
32.
48.
64.
80.
96.
112.
128.
WYLE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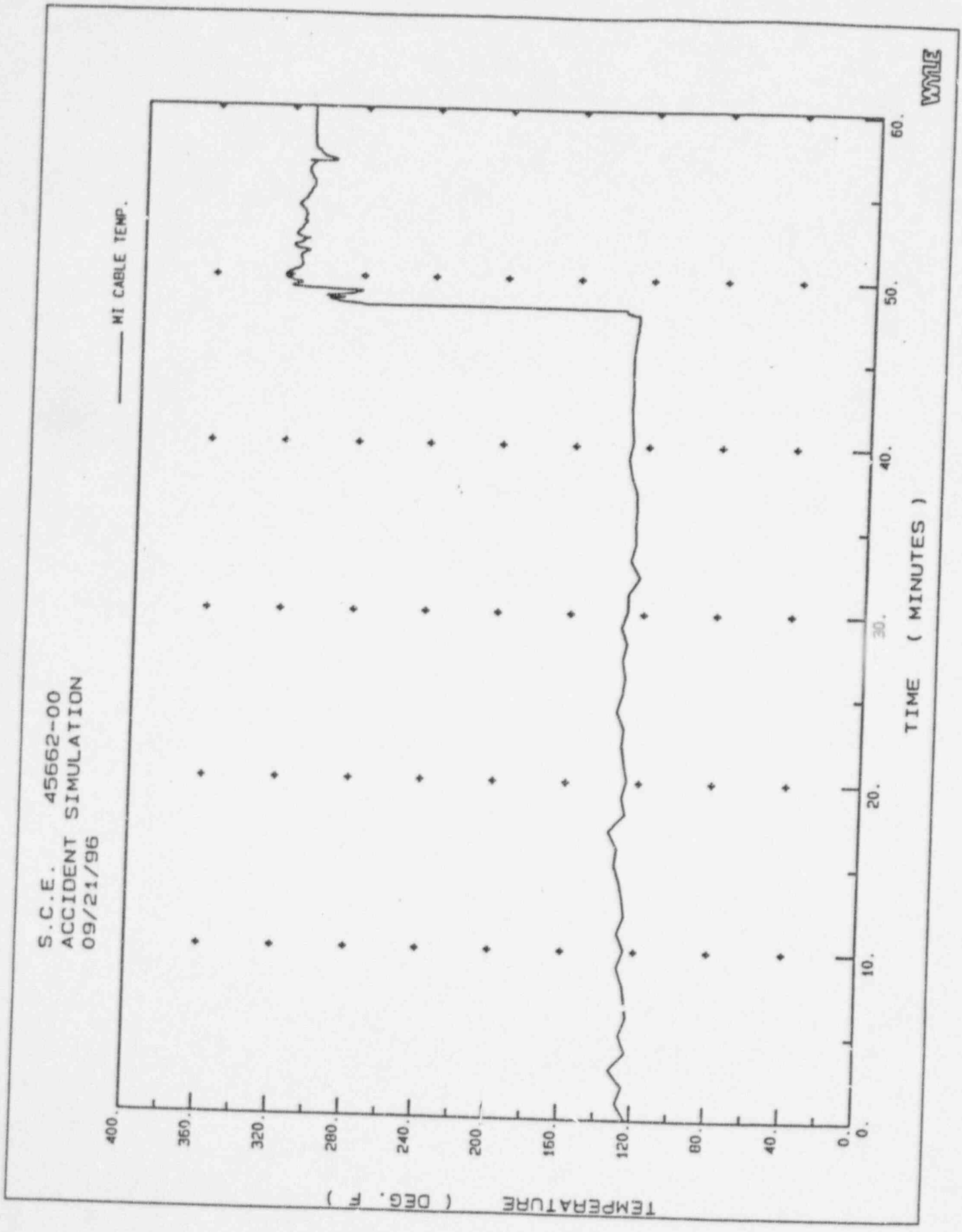
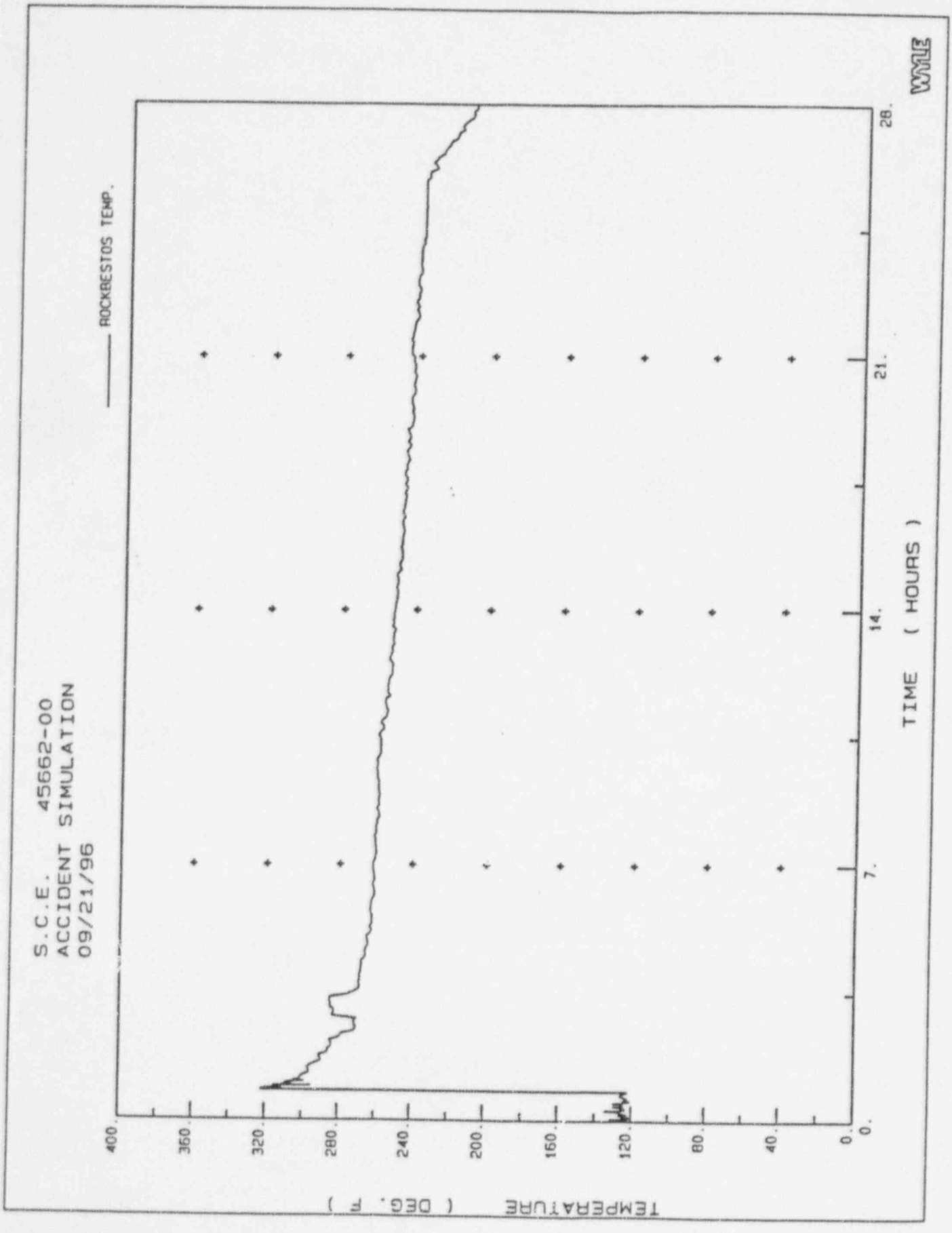
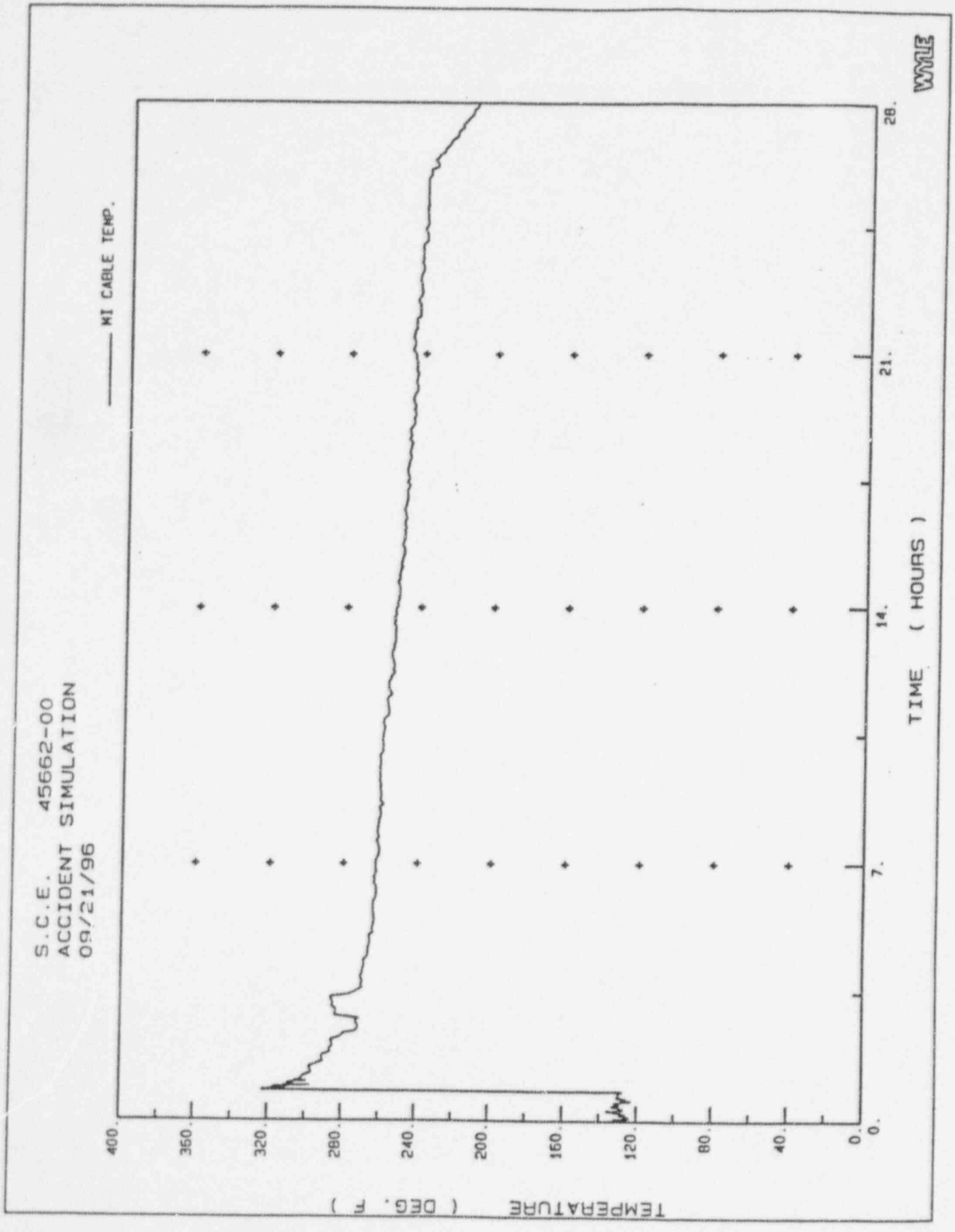
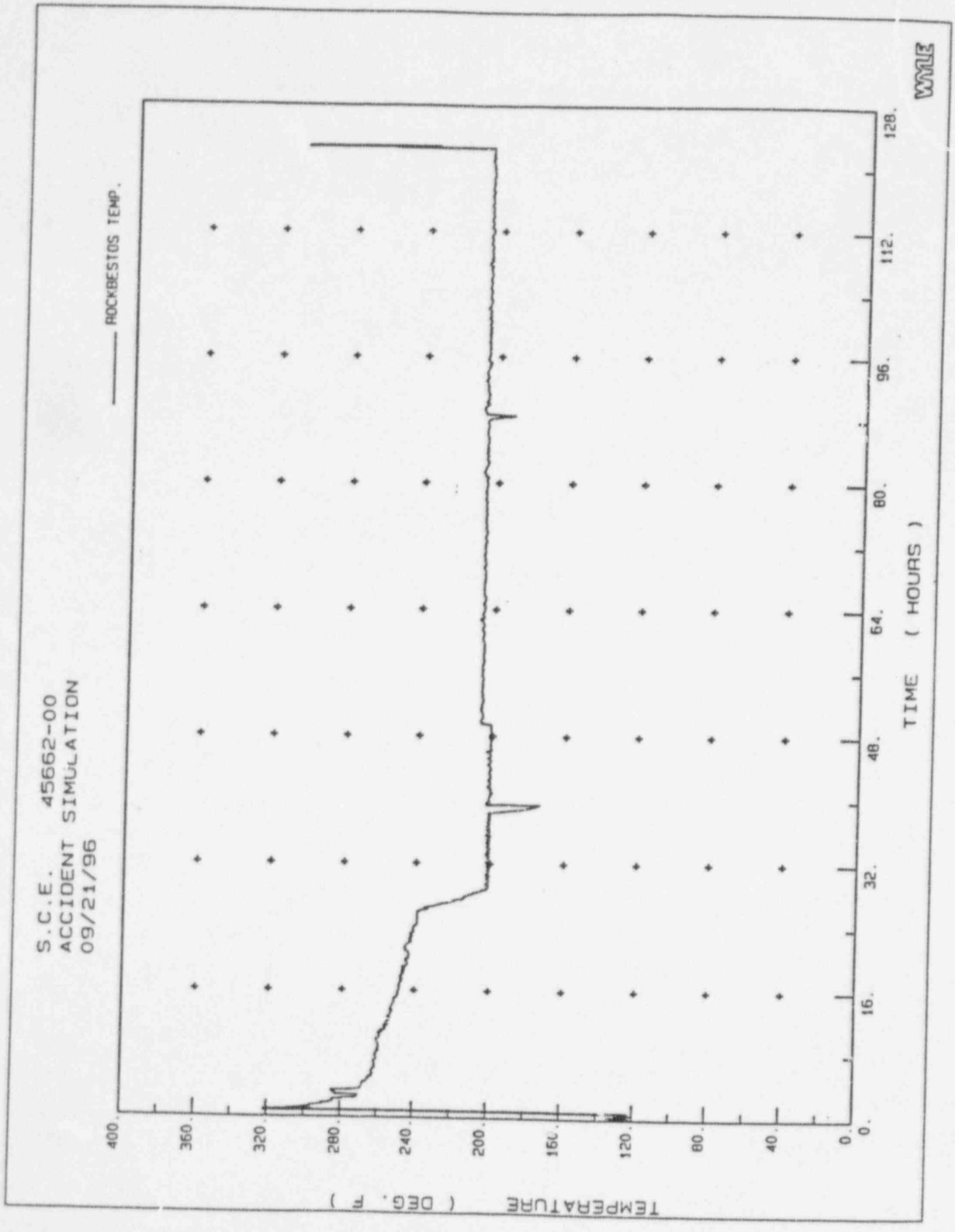
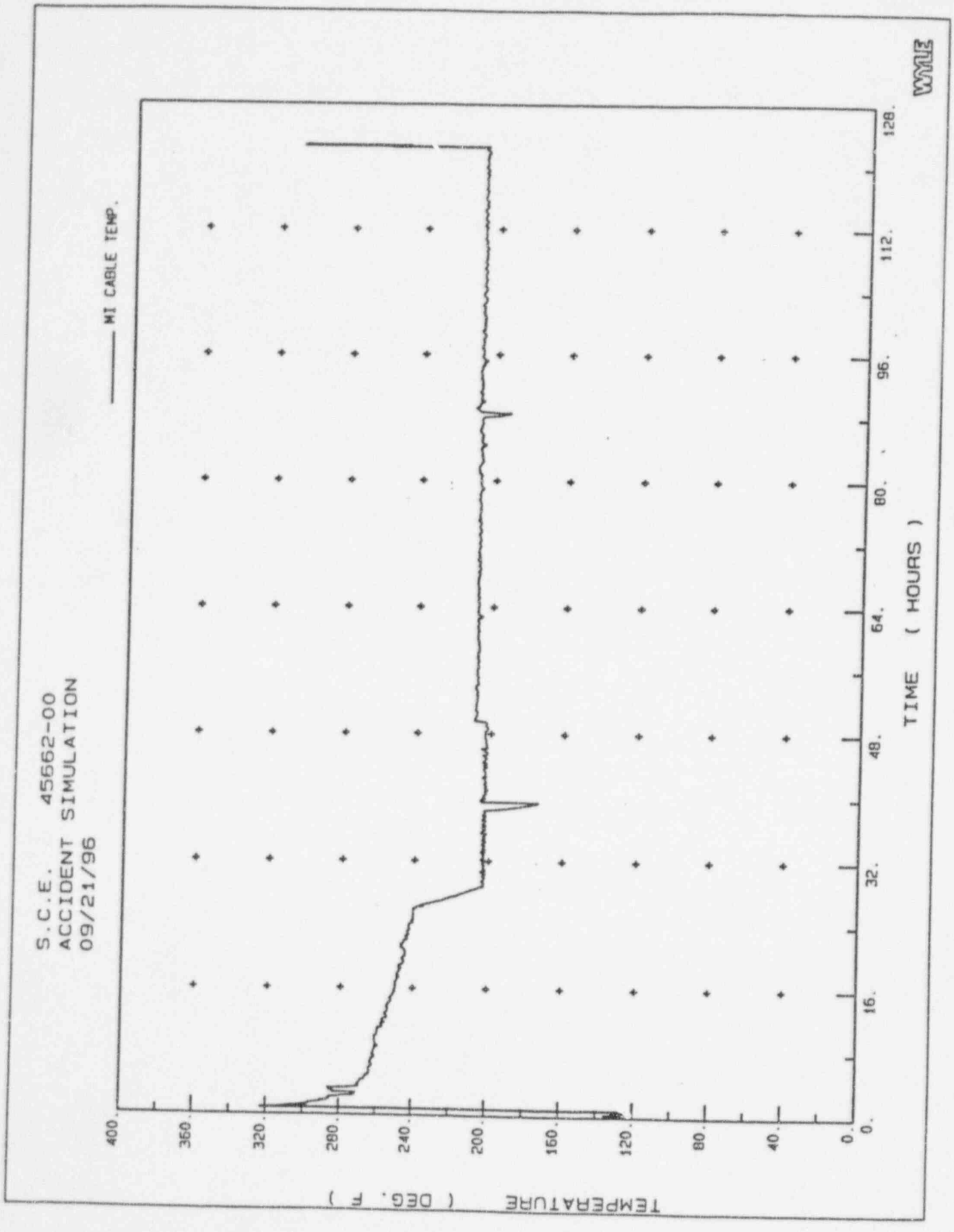
ACCIDENT SIMULATION
09/21/96
ROCKBESTOS TEMP.
TEMPERATURE (DEG. F)
TIME (MINUTES)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
10.
20.
30.
40.
50.
60.


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
MI CABLE TEMP.
TEMPERATURE (DEG. F)
TIME (MINUTES)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
10.
20.
30.
40.
50.
60.
WYLE


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
ROCKBESTOS TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
7.
14.
21.
28.
WKF


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
MI CABLE TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
7.
14.
21.
28.
WMI


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
ROCKBESTOS TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
400.
360.
320.
280.
240.
200.
160.
120.
80.
40.
0.
0.
16.
32.
48.
64.
80.
96.
112.
128.


S.C.E. 45662-00
ACCIDENT SIMULATION
09/21/96
MI CABLE TEMP.
TEMPERATURE (DEG. F)
TIME (HOURS)
0.
40.
80.
120.
160.
200.
240.
280.
320.
360.
400.
16.
32.
48.
64.
80.
96.
112.
128.
WYLE

APPENDIX VII

CONAX BUFFALO CERTIFICATE OF CONFORMANCE

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Conax Buffalo

CONAX BUFFALO CORPORATION • 2300 WALDEN AVENUE, BUFFALO, NEW YORK 14225
716-684-4500 • 1-800-223-2389 • FAX: 716-684-7433

IMI

Certificate of Conformance

To: **Southern California Edison**
San Onofre Nuclear Generating Station
San Clemente, CA 92672

Customer Purchase Order: **8H066002** Sales Order: **7NG700**

Item	Part Number	Conax Buffalo Identification	Qty
1	7LK3-21000-01	Feedthrough Assembly, 75 ohm Coax	4
5	N45183-096	Heat Shrink Tubing	8

We Certify:

1. *Items supplied were produced in conformance with all contractually applicable specifications as referenced in the subject Purchase Order.*
2. *Items supplied were produced from materials for which Conax Buffalo has available for examination, chemical and/or physical test reports, or other evidence of conformance to applicable specifications.*
3. *All inspections, tests, and calibrations utilized equipment calibrated in accordance with the requirements of MIL-STD-45662A and traceable to the National Institute of Standards and Technology.*
4. *Items supplied were produced in accordance with onax Buffalo Quality Program Manual, Revision R, dated 6/21/95. The requirements of 10CFR21 apply to this order.*
5. *Items supplied are new manufacture.*

Certified By Curt Pratt
Curt Pratt, Quality Engineer

8/22/96
Date

Conax Buffalo

CONAX BUFFALO CORPORATION • 2300 WALDEN AVENUE. BUFFALO. NEW YORK 14225
716-684-4500 • 1-800-223-2389 • FAX: 716-684-7433

IMI

CERTIFICATE OF CONFORMANCE

CUSTOMER: SOUTHERN CALIFORNIA EDISON CO.

NUCLEAR PLANT: SAN ONOFRE

CUSTOMER ORDER NO.: 8H066002

CONAX BUFFALO ORDER NO.: 7NG700

CONAX BUFFALO PART NOS: 7LK3-21000-01
N44079-03
N45181-024
N45182-019
N45183-096

CONAX BUFFALO CERTIFIES THAT THE EQUIPMENT SUPPLIED ON THIS ORDER IS QUALIFIED IN ACCORDANCE WITH IEEE STD. 317-1976 AND IS THE SAME AS, OR EQUAL TO, THAT WHICH WAS QUALIFIED AND TESTED UNDER CONAX BUFFALO REPORT IPS-1054 AND THAT THE USE OF THIS EQUIPMENT DOES NOT EFFECT THE ORIGINAL QUALIFICATION.

CONAX BUFFALO CORPORATION
2300 WALDEN AVENUE
BUFFALO, NY 14225

R. L. NIKANDER
PROJECT ENGINEER
NUCLEAR PRODUCTS DIVISION

7/2/96
DATE

Conax Buffalo
2300 WALDEN AVENUE, BUFFALO, NY 14225-0273

Data Sheet B

Customer: Southern California Edison Co.
Project: Wyle Laboratories
Customer P.O.: SE066002
Item No.: 1

Conax Sales Order: 7NG700
Conax Feedthrough P/N: 7LK3-21000-01
Feedthrough Type: 75 Ohm Coax
Quantity: 4

Ref. Section IPS-4	Type of Test (Requirements)	Test Acceptance (Stamp)
9.1	Visual Inspection *(Drawing Conformance and Cleanliness)*	CONAX G INSP
9.2	Helium Leak Test	He. T. 3
9.3	Conductor/Shield Continuity	N.P. 14
Per Drawing 7LK3-21000 & IPS-1886 9.1	Dielectric Strength Test *(1 minute , All Values @ +.5/-.0* kvac) Center Conductor to Shield 2.2 kvac Shield to Ground: 0.5 kvac	N.P. 14
Per Drawing 7LK3-21000 & IPS-1886 10.1	Insulation Resistance (Ohms min. @500 vdc) Conductor to Shield: 10^{12} ohms Shield to Ground: 10^{8} ohms	N.P. 14

Conax Quality Control: [signature] Date: 8-22-96

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APPENDIX VIII

INSTRUMENTATION EQUIPMENT SHEETS

INSTRUMENTATION EQUIPMENT SHEET

F 1

DATE: 08/16/96
TECHNICIAN: J. PATTERSON

JOB NUMBER: 45662-00
CUSTOMER: SCE

TEST AREA: ENV CH 31
TYPE TEST: THERMAL AGING

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	CONTR TEMP	RESEARCH	61011	5546-120	094518	1000°F	.5%	05/25/96	11/21/96
2	TEMP ALARM	RESEARCH	61034	140139	000718	1000°F	.5%	08/16/96	02/12/97
3	RECORD TEMP	HONEYWELL	DR4500	9530Y52209330003	112494	MULTI	1°F	06/02/96	08/30/96

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 J. Patterson 8-16-96

CHECKED & RECEIVED BY R. Davis 8/16/96

Q.A. TR Hamilton 8/16/96

INSTRUMENTATION EQUIPMENT SHEET

F 1

DATE: 08/16/96
TECHNICIAN: J. PATTERSON

JOB NUMBER: 45662-00
CUSTOMER: SCE

TEST AREA: ENV CH 33
TYPE TEST: THERMAL AGING

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	RECORD TEMP	HONEYWELL	DR450T	9244885050004	109831	MULTI	.4°F	06/18/96	09/16/96
2	CONTR TEMP	RESEARCH	61011	060155	094524	0 TO 1000°F	.5%	08/13/96	02/07/97
3	TEMP ALARM	RESEARCH	639LLP	16	011289	1000°F	.5%	07/31/96	01/27/97

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 J. Patterson 8-16-96

CHECKED & RECEIVED BY R. Hauf 8/16/96

Q.A. TR Hamilton 8/16/96

INSTRUMENTATION EQUIPMENT SHEET

F 1

DATE: 08/16/96
TECHNICIAN: J. PATTERSON
JOB NUMBER: 45662-00
CUSTOMER: SCE
TEST AREA: ENV CH 52
TYPE TEST: THERMAL AGING

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	CONTR TEMP	HONEYWELL	N/A	N/A	100787	200*C	.5%	05/28/96	11/22/96
2	TEMP ALARM	RESEARCH	61034	240158	000716	-175 TO 375*F	.5%	04/27/96	10/24/96
3	RECORD TEMP	HONEYWELL	DR4500	9604Y62426790001	112702	-200 TO 600*F	.4*F	07/15/96	10/11/96

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 J. Patterson 8-16-96

CHECKED & RECEIVED BY R. Hauf 8/16/96

Q.A. T.K. Hamilton 8/16/96

INSTRUMENTATION EQUIPMENT SHEET

F 1

DATE: 09/20/96
TECHNICIAN: P. WADSWORTH

JOB NUMBER: 45662-00
CUSTOMER: SCE

TEST AREA: LOCA
TYPE TEST: LOCA

NO.	INSTRUMENT	MANUFACTURER	MODEL#	SERIAL #	WYLE #	RANGE 1	ACCURACY 1	CALDATE	CALDUE
1	DATA ACQ SYS	DAYTRONIC	10K25771	NA	103957	MULTI	MFG	09/16/96	09/16/97
2	STRAIN PWR	VISHAY	2110	29261	096721	15 VDC	1% REG	08/12/96	11/08/96
3	COND STRAIN	VISHAY	2120	15705	096202	GAIN	2%	08/12/96	11/08/96
4	CONTR TEMP	RESEARCH	61011	06015546-120	094523	-175 TO 375*F	.5%	08/13/96	02/07/97
5	TEMP ALARM	RESEARCH	61034	401-85	100159	-175 TO 375*F	.5%	08/13/96	02/07/97
6	RECORD TEMP	HONEYWELL	452X1-B	7710879928003	108367	400*F	.5%	08/14/96	11/12/96
7	AMPL TEMP MV	AGM ELECTRONICS	EA4002	410	092920	1000*F	1%	08/12/96	02/07/97
8	AMPL TEMP MV	AGM ELECTRONICS	EA4002	648	092917	1000*F	1%	08/12/96	02/07/97
9	AMPL TEMP MV	AGM ELECTRONICS	EA4002	650	092919	1000*F	1%	08/12/96	02/07/97
10	CONTR TEMP	RESEARCH	61011	25-061	000735	1500*F	.5%	08/14/96	02/10/97
11	CONTR TEMP	RESEARCH	61011	825061	000721	1500*F	.5%	08/14/96	02/10/97
12	CONTR TEMP	RESEARCH	61011	32-033	100163	1500*F	.5%	08/14/96	02/10/97
13	CONTR TEMP	RESEARCH	61011	32-032	100162	1500*F	.5%	08/14/96	02/10/97
14	TEMP ALARM	RESEARCH	61034	401-90	100160	2000*F	.5%	08/14/96	02/10/97
15	TEMP ALARM	RESEARCH	61034	401-81	100158	2000*F	2000*F	08/14/96	02/10/97
16	TEMP ALARM	RESEARCH	61034	401-78	100161	2000*F	.5%	08/14/96	02/10/97
17	TEMP ALARM	RESEARCH	61034	31524	094515	2000*F	.5%	08/14/96	02/10/97
18	TEMP ALARM	RESEARCH	639LLP	312910	011796	2000*F	.5%	08/15/96	02/11/97
19	TEMP ALARM	RESEARCH	61031	1-0154	000707	2000*F	.5%	08/15/96	02/11/97
20	TEMP ALARM	RESEARCH	61031	101-55	000704	2000*F	.5%	08/15/96	02/11/97
21	TEMP ALARM	RESEARCH	639LLP	31291	011803	-125 TO 375*F	2000*F	08/15/96	02/11/97
22	MTR MEGOHM	GEN RAD	1864	657113180	011898	50K - 50T OHM	2-5% RANGE	09/18/96	03/17/97
23	THERMOMETER DIG	FLUKE	2190A	208	094906	MULTI	.03%	08/14/96	11/12/96
24	PRESS XDUCER	MB ELECT	151HAC	41021	100600	100 PSIA	1% FS	08/21/96	02/17/97
25	PRESS GAUGE	USG	4 1/2 IN	N/A	105330	100 PSI	1% FS	08/14/96	11/12/96
26	FLOW MTR	RAMAPO	MARK V	6404	092470	1 - 10 GPM	CERT	08/15/96	08/15/97
27	FLOW MTR	RAMAPO	MARK V	6404	092471	1 - 10 GPM	CERT	08/15/96	08/15/97
28	CHART RECORDER	ASTROMED	MT95K2	N/A	R84412	MFG	CERT	05/29/96	05/29/97
29	ELECTROMETER	KEITHLEY	610C	73953	112880	MFG	CERT	09/04/96	09/04/97
30	ELECTROMETER	KEITHLEY	610C	80992	112876	MFG	CERT	08/30/96	08/29/97
31	ELECTROMETER	KEITHLEY	610CR	20420	112881	MFG	CERT	09/04/96	09/04/97
32	RES DECADE	IET	RS-201	N/A	109492	9,999,999 OHMS	.1%	03/05/96	03/05/97
33	TORQUE WRENCH	STURTEVANT	6062	7009	011818	200 IN/LBS	5%	05/21/96	11/15/96

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 9/20/96

CHECKED & RECEIVED BY P. Hart 9/20/96

Q.A. [illegible] 9/20/96

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APPENDIX IX

SCE MOISTURE DAM INSTALLATION PROCEDURE

Southern California Edison Company
San Onofre Nuclear Generating Station Units 2&3

High Range Radiation Monitor
Moisture Dam Installation Instruction

Prepared By: Wayne Nakamoto Date 8-6-96

Reviewed By: Bob Greene Date 08/06/96

SONGS 2 & 3
HRRM Moisture Dam Installation Instructions

TABLE OF CONTENTS

SONGS 2 & 3
HRRM Moisture Dam Installation Instructions

1 INTRODUCTION

This procedure provides general instructions for moisture barrier preparation on Rockbestos RSS-6-104/LE coaxial cable used for the SONGS 2 & 3 High Range Radiation Monitor (HRRM) system.

2 SCOPE

The scope of this moisture dam installation procedure is limited to the SONGS 2 & 3 HRRMs. The plant Ids are 2(3) RE-7820-1 and 2(3) RE-7820-2.

3 MOISTURE DAM INSTALLATION INSTRUCTIONS

3.1 Materials

3.1.1 Amphenol HN connectors (Part Number 82-816)

3.1.2 Raychem WCSF-200N

3.1.3 Raychem S1119 Adhesive Tape

3.1.4 22 AWG Solid Strand Copper Conductor

3.2 Installation Details

3.2.1 Install the Amphenol HN connector on the field cable per appropriate procedure

3.2.2 Locate the point on the cable 2 - 2.5 inches away from field end of Amphenol connector.

3.2.3 Remove 3 inches of the coaxial cable jacket.

3.2.4 CAREFULLY remove 2 inches of the coaxial cable shield leaving half inch of shield on both ends.

CAUTION: When removing the shield, be careful not to damage/gouge the coaxial cable insulation.

SONGS 2 & 3
HRRM Moisture Dam Installation Instructions

3.2.5 Apply S1119 adhesive tape under the #22 AWG wire to build up (one or two layers).

3.2.6 Solder four #22 AWG solid strand copper conductor across the shield (90 * apart)

3.2.7 Wrap S1119 adhesive tape over the #22 AWG wire with one layer.

3.2.8 Apply minimum of 8 inches in length of the WCSF-200N over the moisture dam construction

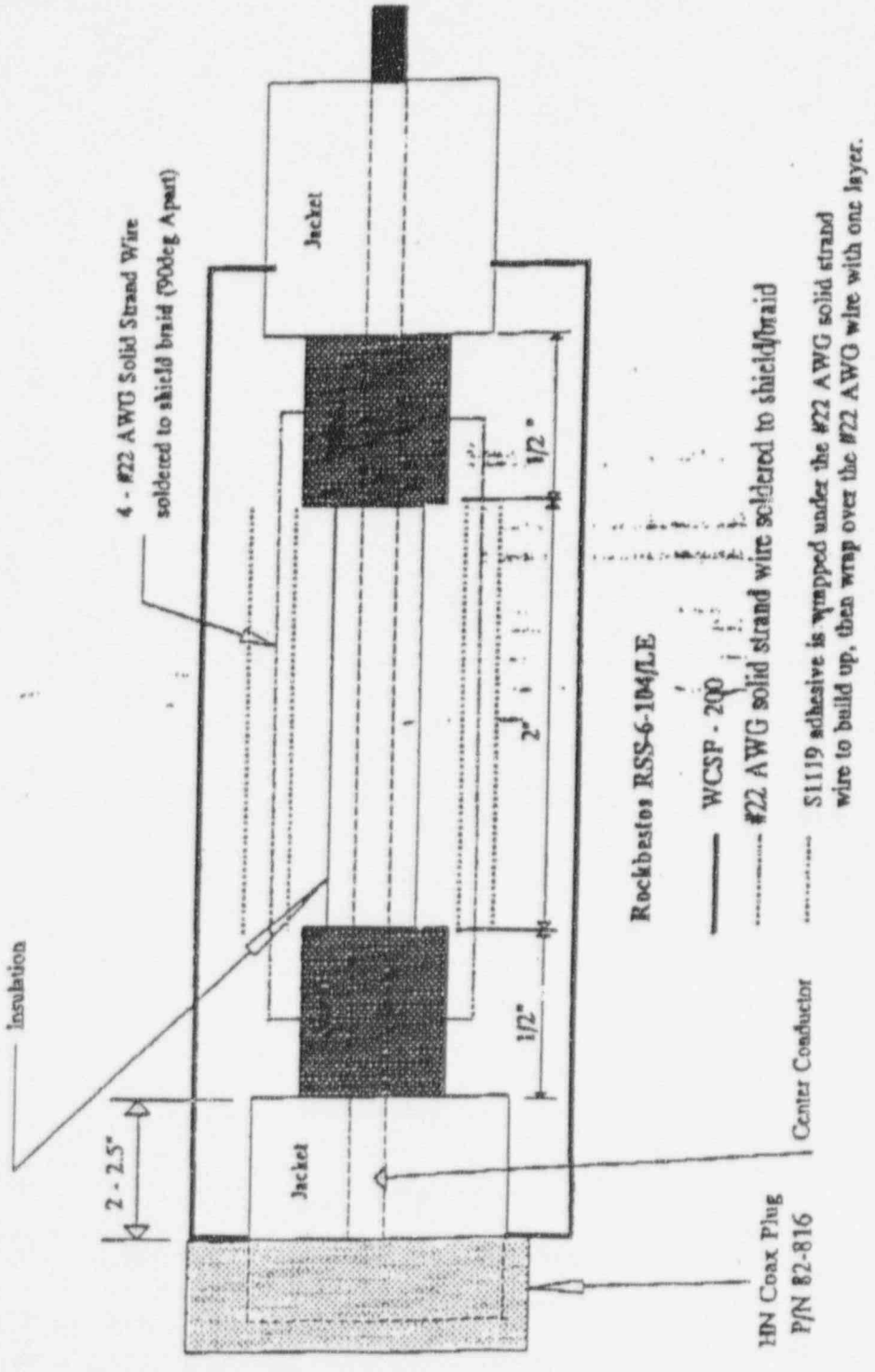
3.3 Cable samples 1, 2 and 3 have completed in accordance with steps 3.2.1 thru 3.2.8

Prepared by: Rad Monitor Tech Date: 8-8-96

Prepared by: Rad Monitor Tech Date: 8-8-96

SONGS 2 & 3
HRRM Moisture Dam Installation Instructions

FIGURE 1
MOISTURE DAM DESIGN



APPENDIX X

WYLE LABORATORIES TEST PROCEDURE 45662, REVISION A

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wyle laboratories
Huntsville, Alabama 35807
FAX (205) 830-2109, Phone (205) 837-4411

TEST PROCEDURE NO. 45662

DATE August 13, 1996

REVISION A: September 10, 1996

TEST PROCEDURE FOR AGING AND LOCA SIMULATION TESTING OF COAXIAL CABLES AND LOCA SIMULATION TESTING OF CONAX FEEDTHROUGHS

FOR

Southern California Edison Co.

APPROVED BY: _____ APPROVED BY PROJECT MANAGER: Don Smith 8/14/96
FOR: _____ D. Smith

APPROVED BY: _____ APPROVED BY QUALITY ENGINEER: R Hamilton 8/15/96
FOR: _____ for R. G. Thomas

APPROVED BY: _____ APPROVED BY PROJECT ENGINEER: Robert Hardy 8/14/96
FOR: _____ R. Hardy

REVISIONS

REV. NO.	DATE	PAGES AFFECTED	BY	APP'L.	DESCRIPTION OF CHANGES
A	9/10/96	2, Para. 1.0	BH	9/11/96	Changed purpose of testing
A	9/10/96	2, Para. 1.1	BH	9/11/96	Added Mineral Insulated cable
A	9/10/96	3, Para. 2.4.1	BH	9/11/96	Added Mineral Insulated cable to Test Setup
A	9/10/96	5	BH	9/11/96	Removed SCE Profile from plot
A	9/10/96	6	BH	9/11/96	Added SCE-provided profile

(rdh)

Revision A

1.0 SCOPE

This document has been prepared by Wyle Laboratories for Southern California Edison Co. (SCE) to present the procedures for testing the specimens described in Paragraph 1.1 in accordance with the standards, specifications, and other documents listed in Paragraph 1.2.

The purpose of testing is to establish and/or quantify the capability of a coaxial cable "Moisture Dam" configuration to prevent moisture intrusion and migration through the coaxial cable jacket and down the shield to the coaxial connectors, and thus leading to failure of maintaining signal continuity. Also, this test will establish the capability of Mineral Insulated cable to maintain picoamp range signal continuity under a simulated LOCA environment. Both cables will be connected to Conax coaxial feedthroughs and tested as an integrated system simulating the High Range Radiation Monitor (HRRM) system. A

1.1 Specimen Description

The specimens for this test program consist of one (1) Mineral Insulated (MI) cable, three (3) 250' Rockbestos coax cable samples and four (4) Conax feedthrough penetrations. The Rockbestos cable samples will be provided by SCE. The Conax coaxial feedthroughs will be provided by Conax and the MI cable will be supplied by ABB Combustion Engineering. A

1.2 Qualification Standards, Specifications, and Documents

- Wyle Laboratories' Quotation No. 543/2649/DB.
- Southern California Edison Co. Purchase Order No. 6H686902.
- IEEE Standard 323-1974 "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations."
- 10 CFR 21, "Reporting of Defects and Noncompliance."
- 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants."
- Wyle Laboratories' (Eastern Operations) Quality Assurance Program Manual, Revision 1.

2.0 TEST REQUIREMENTS

2.1 Receipt Inspection

An inspection shall be performed upon receipt of the specimens at Wyle Laboratories. The specimens shall be checked to ensure that they are as described in Paragraph 1.1. All data furnished with the specimens shall be recorded. The specimens shall be visually inspected for obvious physical damage.

Revision A

2.0 TEST REQUIREMENTS (continued)

2.2 Thermal Aging

The three Rockbestos coax cable samples shall be individually wound into coils and secured in individual cable trays. The individual coils shall be approximately 48" long, and the bend radius of the cable shall be 20 times the diameter of the cable. The cable specimens shall then be placed in Wyle thermal aging chambers and thermally aged in air as follows:

- Cable Sample 1 - 102.5 hours at 115°C (239°F) to simulate 10 years
- Cable Sample 2 - 135 hours at 120°C (248°F) to simulate 20 years
- Cable Sample 3 - 135 hours at 125°C (257°F) to simulate 30 years

The temperatures shall be controlled to +5/-0°F. The thermal aging times shall be controlled to +1/-0 hour.

The specimens shall not be energized for thermal aging.

The temperatures and durations of thermal aging were provided to Wyle by SCE.

2.3 Radiation Exposure

The three Rockbestos coax cable samples, while still secured to individual cable trays, shall be exposed to gamma radiation using a Cobalt-60 source. The total dose for the exposure shall be 1.74E8 rads gamma.

The radiation exposure shall be measured as air equivalent gamma using a Cobalt-60 source at a dose rate not to exceed 1.0E6 rads per hour. The dose rate shall be measured at the geometric centerline of the specimens. The test specimens shall be rotated, if necessary, during the radiation exposure to ensure a uniform dose distribution. Specimen powering or monitoring is not required during the radiation exposure.

The total dose and dose rate were provided to Wyle by SCE.

2.4 LOCA Simulation

2.4.1 Test Setup

While still secured to the cable tray, Cable Specimen 3 and the MI cable specimen shall be configured and connected following the directions of SCE prior to being placed in the LOCA simulation chamber. Cable Specimens 1 and 2 will be used as backup samples should problems occur with either of the other samples. A

The Conax feedthrough penetrations shall be installed in a Wyle-provided test chamber flange using 1" Swagelok fittings. The Conax feedthrough penetrations shall then be connected to Cable Specimen 3 and the MI cable specimen following the directions of SCE. The configuration and connection of the specimens shall be documented in the final test report. A

2.4.2 Monitoring

The cable specimens' electrical parameters shall be monitored by SCE personnel using equipment provided by Wyle as specified by SCE.

One thermocouple shall be mounted on the jacket of each cable test specimen to monitor actual cable surface temperature. The placement of the thermocouples shall be at the direction of the customer. The thermocouples shall be monitored and recorded during the test.

2.4 LOCA Simulation (continued)

2.4.2 Monitoring (continued)

The test chamber ambient temperature and pressure shall be recorded throughout the duration of the test. Temperature versus time plots shall be provided for all specimen mounted thermocouples. Additionally, average chamber temperature versus time plots and chamber pressure versus time plots shall be provided in the final test report.

2.4.3 Accident Test

The test chamber temperature shall be increased to approximately 120°F and held for a minimum of 30 minutes prior to the application of steam to simulate the accident profile shown in Figure 1. The accident profile shown in Figure 1 includes a 15°F temperature margin and a 10% pressure margin. The initial transient shall be performed on a best-effort basis. The transient shall be continued until the peak conditions are achieved. The test shall have a duration of approximately 5 days.

Starting at approximately the 5-minute point (or as directed by SCE) of the test, chemical spray shall be initiated inside the test chamber. The chemical spray shall consist of deionized water with 3000 ppm boron added for a pH of approximately 4.5. The chemical spray shall be captured and recirculated. The pH of the chemical spray shall be gradually raised due to steam condensate. The chemical spray flow rate shall be 0.15 gpm/sq. ft. on a best effort basis.

At the initiation of chemical spray, the test chamber environment shall become saturated. Due to the pressure limitations of the test chamber, the profile of the LOCA simulation shall be based on the required pressure after chemical spray is started. The temperature of the chamber will be at a point relative to the pressure for a saturated environment.

2.5 Post-Test Inspection

The specimens shall be visually inspected, and their condition shall be recorded.

3.0 TEST REPORTS

Two bound copies, and one unbound reproducible copy, of a test report describing the test requirements, procedures, and results shall be issued.

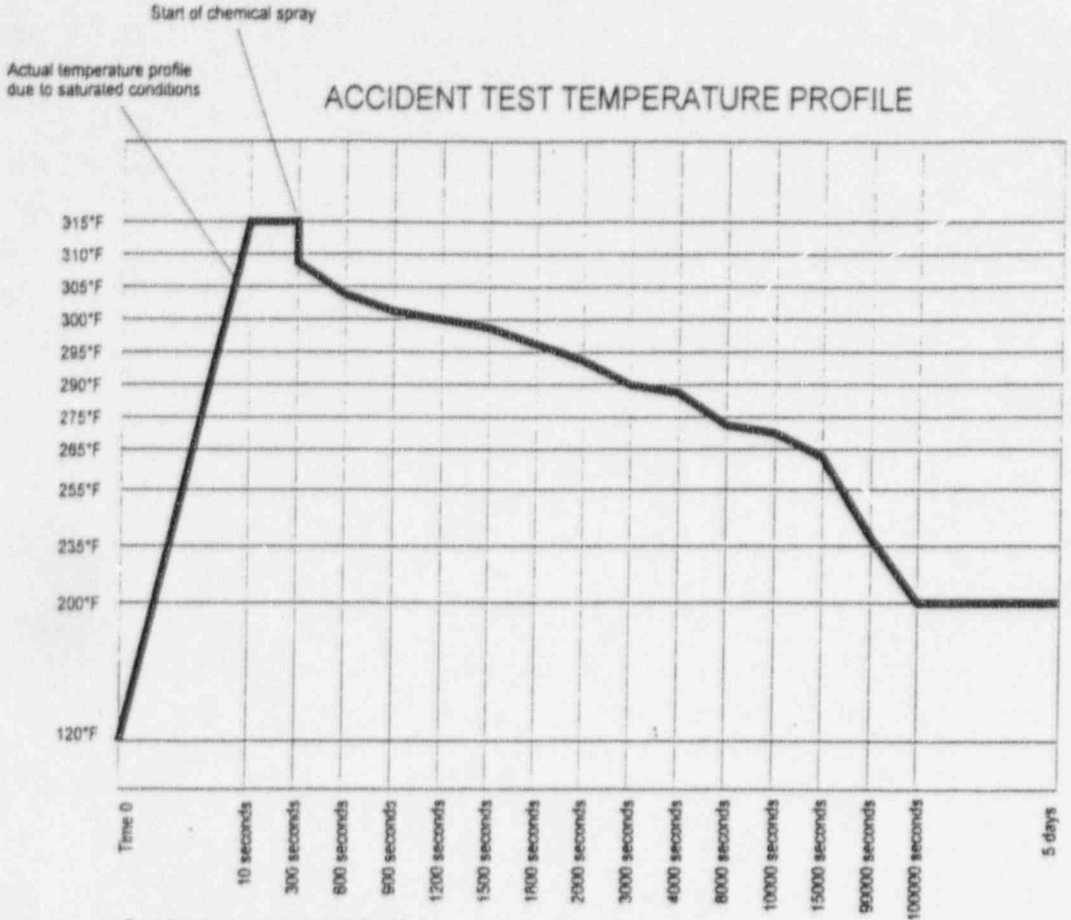
4.0 QUALITY ASSURANCE

The test program shall be performed under the requirements of Wyle Laboratories' Quality Assurance Program. This program follows the pertinent requirements of 10 CFR 50 Appendix B, ANSI N45.2, and the daughter standards. Defects shall be reportable under the requirements of 10 CFR Part 21.

INSTRUMENTATION

All instrumentation, measuring, and test equipment to be used in the performance of this test program shall be 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.

REVISION A



Chemical spray started at approximately the 5-minute point (when environment is stable). Duration of chemical spray is 24 hours.

TIME	PRESS. (psig)	TEMP. (°F)
10 sec	61	315
300 sec (5 min)	61	308.5
600 sec (10 min)	57.2	304.8
900 sec (15 min)	55	302.9
1200 sec (20 min)	52.25	300
1500 sec (25 min)	50.1	298
1800 sec (30 min)	48.2	296
2000 sec (33.3 min)	46.9	294
3000 sec (50 min)	42	289
4000 sec (66.6 min)	38.25	285
8000 sec (133.3 min)	28.5	271.6
10000 sec (2.7 hr)	26	269
15000 sec (4.16 hr)	22.9	263
90000 sec (25 hr)	9.5	238
100000 sec (27.7 hr)	8.8	200
5 days	8.8	200

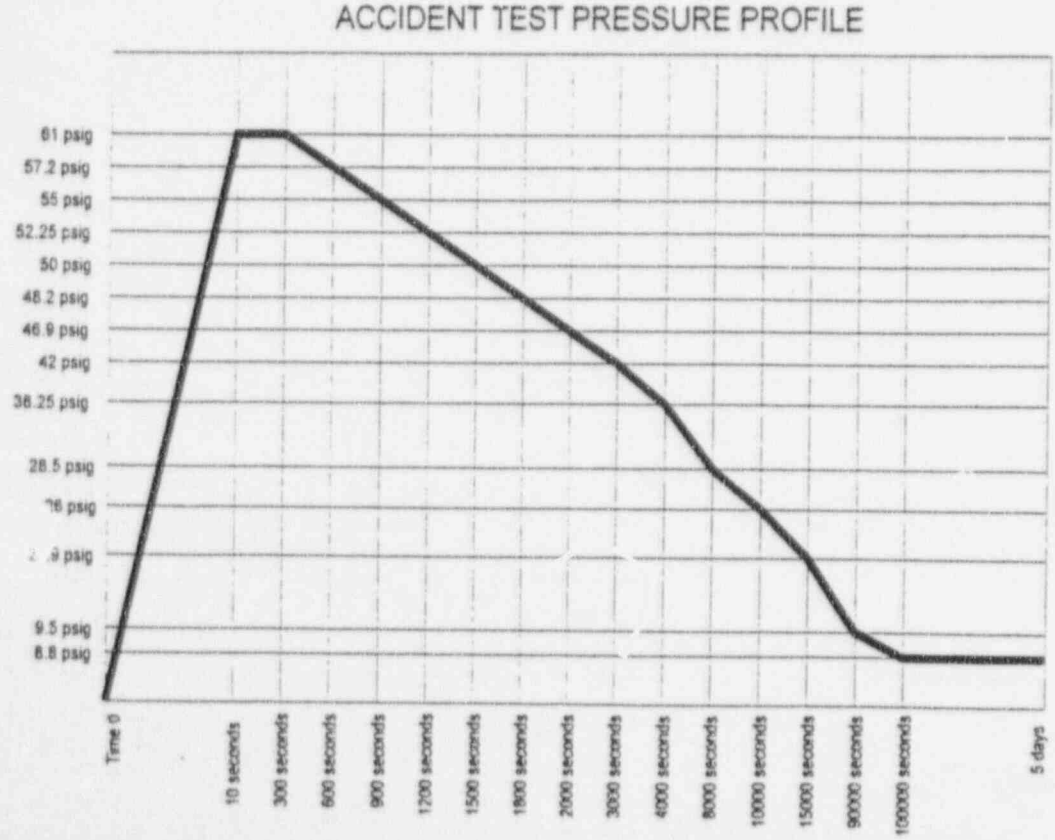


FIGURE 1

Figure A

SONGS 2&3 Peak Temp/Press & Req Profile

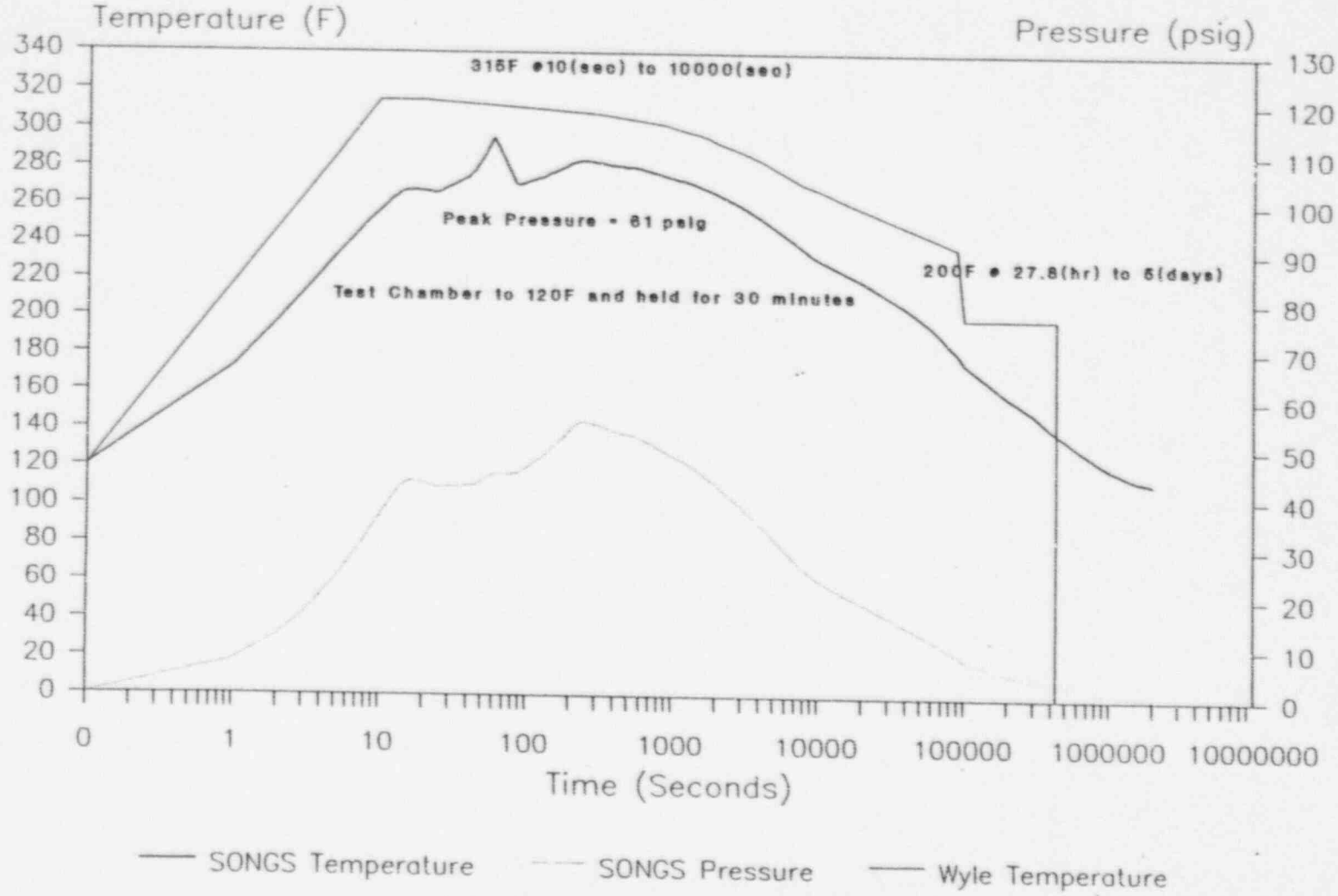


FIGURE 2

Attachment G

CGI Lab Test Report 96-3414

HRRM Connector Moisture Test Setup and Detail "A" Moisture Dam Design

(7 Pages)

G.1 SCE Commercial Grade Item (CGI) Dedication Laboratory "Moisture Dam" Pressurized Submergence Test

Prior to the WYLE LOCA test, pressurized submergence testing of "moisture dam" modified and unmodified Rockbestos RSS-6-104/LE coaxial cables was performed at the CGI laboratory. The objective of this test was to determine the effectiveness of the "moisture dam" modification in preventing fluid migration down the coaxial cable shield into the connector backshell. This testing is documented in CGI Laboratory Test Report 96-3414 (Reference 6.15, provided as Attachment G). A summary of the CGI Laboratory pressurized submergence test is presented below.

G.1.1 SCE CGI "Moisture Dam" Pressurized Submergence Test Setup

From Wednesday, June 12 through Monday, June 17, 1996, SCE performed a pressurized water submergence test on three Rockbestos RSS-6-104/LE cable specimens. The test specimens are described as follows:

Specimen #1: Approximate six foot length of Rockbestos RSS-6-104/LE with no "moisture dam" installed. BNC connectors installed at each end.

Specimen #2: Approximate six foot length of Rockbestos RSS-6-104/LE with no moisture dam installed. One BNC and one N connector.

Specimen #3: Approximate six foot length of Rockbestos RSS-6-104/LE with moisture dam installed. See Attachment G, page 5 of 15 for a figure of the tested "moisture dam" configuration. BNC connectors installed at each end.

A detailed figure of the test setup is presented in Attachment G, page 4 of 15, and is briefly described as follows: The test specimens were installed in a pressure vessel containing a 3,000 ppm boric acid and tap water solution. The pressure vessel cable penetrations were sealed with swagelock fittings. Each test specimen had approximately six inches of jacket removed from the portion of the cable located inside the pressure vessel. This jacket removal ensured that the cable shield was exposed directly to the boric acid solution, and would simulate the porosity of a typical 250 foot installed cable during LOCA conditions. The specimens were connected to a Keithly 261 pico ampere signal generator using BNC connectors. A Keithly 610 pico ammeter was used to monitor test specimen output. All test specimens had approximately four inches of jacket removed from the cable portion located outside the pressure vessel. This was done to protect the Keithly 261 current source from moisture migrating through the pressure vessel penetrations, up the cable shield, and shorting the current source.

G.1.2 SCE CGI "Moisture Dam" Test Performance Summary

The pressure vessel was pressurized using instrument air to 70 psig. The input current of all three cable specimens was held at 50 pico amperes. Within minutes of pressurizing the vessel, cable specimen #1, without the "moisture dam" demonstrated an output reading of 173E-9 amps, much greater than the 50 pico ampere input signal. This was assumed to be

the result of a battery effect. When further investigation led to loosening the BNC connector backshell, water sprayed out, indicating that water was trapped and retained behind the connector backshell. For cable specimen # 2, the N connector face showed signs of moisture leakage at less than a five psig pressure differential. The output current reading was 0 pico amperes. Cable specimen #3, with the "moisture dam" maintained stable signal continuity throughout the test. The output current was measured at 49.7 pico amperes.

The results of this pressurized submergence test indicate that the "moisture dam" is successful in preventing moisture from traveling up the coaxial cable braid into connector backshell. Cable specimens #1 and #2, without the moisture dam, experienced moisture intrusion into the connector, resulting in erratic output currents.

It should be noted that there are Electro Magnetic Interference (EMI) issues associated with the "moisture dam" design. These EMI issues are addressed in CHAR Services Report CSR096 (Reference 6.10, provided as Attachment H). The EMI issues are related to the location of #22 AWG jumpers used to reconnect the braid over the moisture dam. The results of EMI testing performed by CHAR on several "moisture dam" shield jumper designs resulted in the final design presented in Attachment B of this report.

Commercial Grade Item Dedication Test Lab

CGI LAB TEST REPORT

96-3414

1 of 15

6/18/96

Customer Type: Reverse Engineering Data

PO No.: C/O Rel Rev

PO Line Item No.:

RSO No.: Rev

PEP No.: Rev

MO/CWO No.: Rev

Matcode: 027-75377

Part Name: COAXIAL CABLE

Part No.: RSS-6-104/CE

Supplier Name: ROCKBESTOS

Supplier Code:

Package Holder: BEAGLE, K

Lead Engineer: BEAGLE, K

Sample Size: 3

Lot Size: 1

WNCR: 960600430

Remarks: This test package was initiated to document suspected problems with Radmonitor cable and thier associated penetrations and to document the effectiveness of a engineered patch or dam that would stop the leakage, or fuid migration, of existing cable and penetration configurations.

Test Type: E-AM-00 Test Equipment: AMMETER

1 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96

2 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: N W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96

3 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/ Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96

Test Type: J-PG-02 Test Equipment: PRESSURE GAUGE

1.. 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R551	TORQUE WRENCH 30-150 FT. LBS.	UTICA	2381	7/18/96

2 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: N W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R551	TORQUE WRENCH 30-150 FT. LBS.	UTICA	2381	7/18/96

Commercial Grade Item Dedication Test Lab

CGI LAB TEST REPORT

96-3414

2/15

6/18/96

Customer Type: Reverse Engineering Data

PO No.: C/O Rel Rev

PO Line Item No.:

RSO No.: Rev

PEP No.: Rev

MO/CWO No.: Rev

Matcode: 027-75377

Part Name: COAXIAL CABLE

Part No.: RSS-6-104/CE

Supplier Name: ROCKBESTOS

Supplier Code:

Package Holder: BEAGLE, K

Lead Engineer: BEAGLE, K

Sample Size: 3

Lot Size: 1

WNCR: 960600430

Remarks: This test package was initiated to document suspected problems with Radmonitor cable and thier associated penetrations and to document the effectiveness of a engineered patch or dam that would stop the leakage, or fuid migration, of existing cable and penetration configurations.

Test Type: J-PG-02 Test Equipment: PRESSURE GAUGE

3 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/ Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R551	TORQUE WRENCH 30-150 FT. LBS.	UTICA	2381	7/18/96

Test Type: J-PG-02 Test Equipment: PRESSURE GAUGE

1 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

2 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: N W/O Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

3 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/ Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

Commercial Grade Item Dedication Test Lab

CGI LAB TEST REPORT

96-3414

3/15

6/18/96

Customer Type: Reverse Engineering Data

PO No.: C/O Rel Rev

PO Line Item No.:

RSO No.: Rev

PEP No.: Rev

MO/CWO No.: Rev

Matcode: 027-75377

Part Name: COAXIAL CABLE

Part No.: RSS-6-104/CE

Supplier Name: ROCKBESTOS

Supplier Code:

Package Holder: BEAGLE, K

Lead Engineer: BEAGLE, K

Sample Size: 3

Lot Size: 1

WNCR: 960600430

Remarks: This test package was initiated to document suspected problems with Radmonitor cable and thier associated penetrations and to document the effectiveness of a engineered patch or dam that would stop the leakage, or fuid migration, of existing cable and penetration configurations.

Test Type: J-PG-02 Test Equipment: PRESSURE GAUGE

1 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N: BNC W/ Dam

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

2 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N:

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

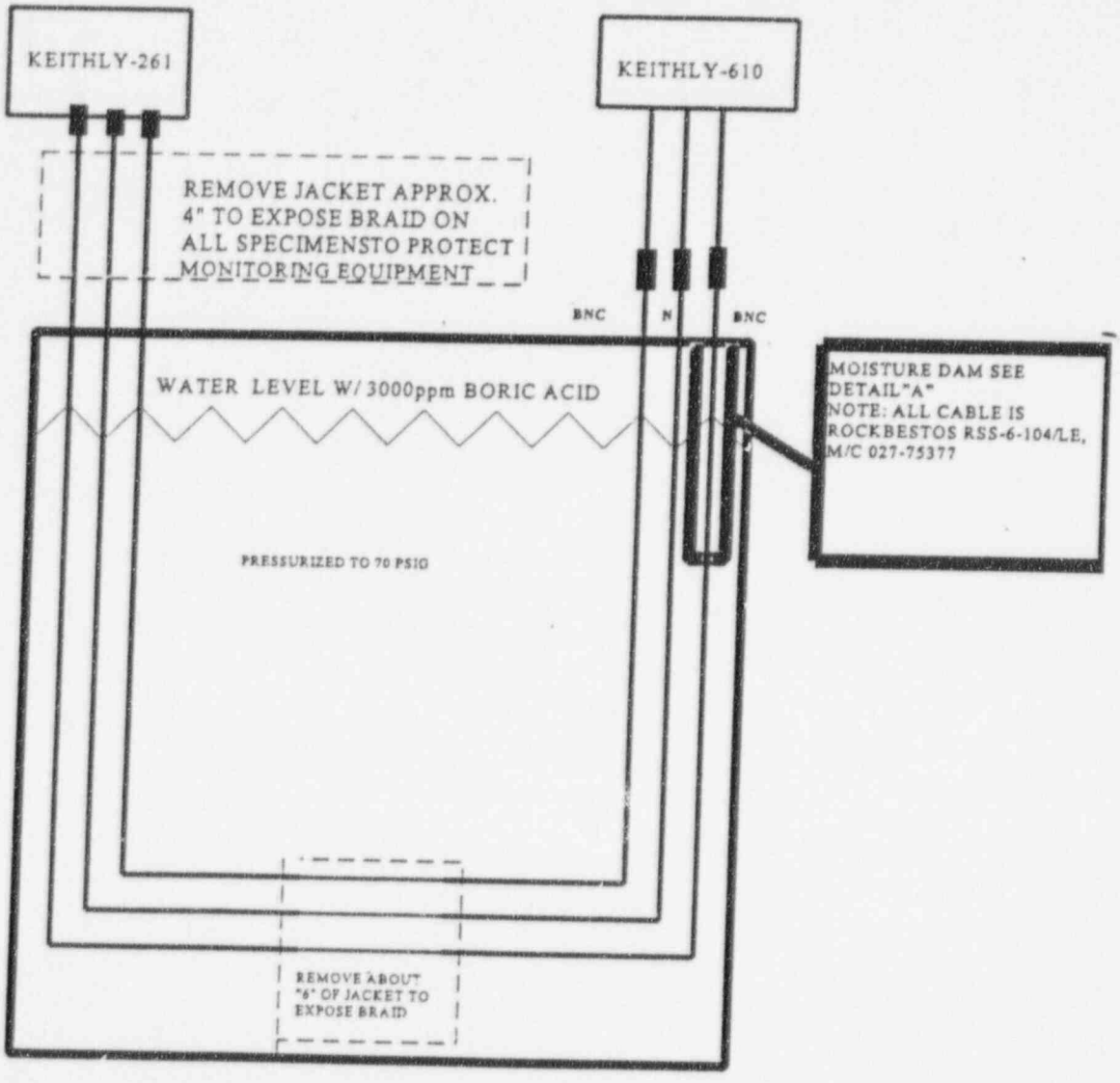
3 . 960621 Test Engineer: BEAGLE, K Test Status: INFO. ONLY Specimen S/N:

M&TE USED	DESCRIPTION	MANUF	MODEL	DUE
I2-8299	PICOAMMETER .1PA-2MA DIGITAL	KEITHLEY	1188	9/22/96
M3-3800	PICOAMP SOURCE .01PA-.1MA	KEITHLEY	1184	10/22/96
QC-R552	GAUGE 200 PSI	US GAUGE	2326	7/15/96

HRRM Conector Moisture Test
6-12-96 to 6-17-96
TLIS 3414

The three test specimens used are listed below all were tested with 5 E -11 amps.

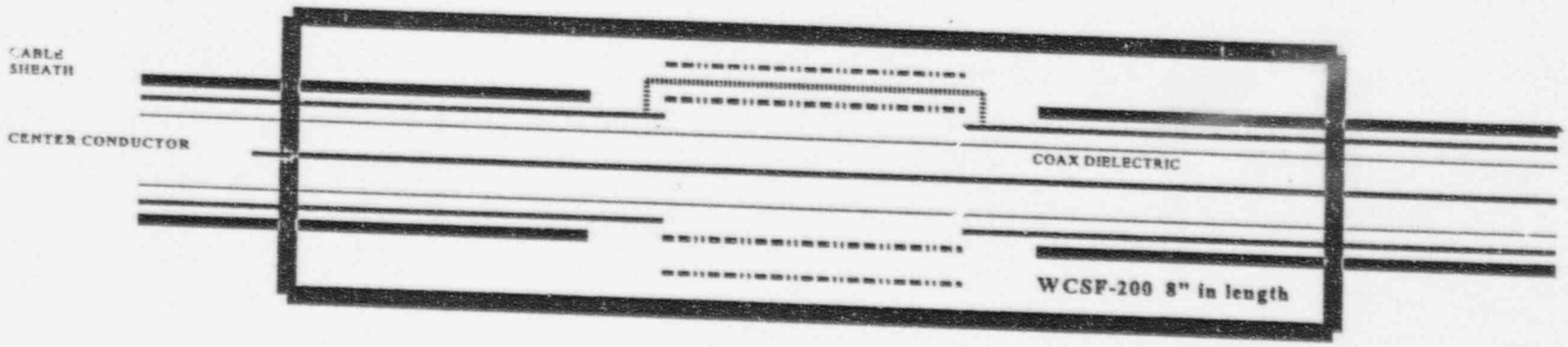
1) BNC CONNECTORS
2) N CONNECTORS
3) MOISTURE BARRIEAR AND BNC CONNECTORS



DETAIL"A"
MOISTURE DAM DESIGN
FOR
SPECIMEN # 3 ONLY
TLIS 3414

NOTE:

1) S1119 adhesive is wrapped under the #22 AWG solid stand wire to build up (one or two layers), then wrap over the #22 AWG wire with one layer.



Coax Sheild/Braid (2" section was removed)

#22 AWG solid strand wire soldered to sheild/braid

S1119 Adhesive 2 inches in width

Test Package No: 3414

Date Completed: 6/18/96 13:32:55

Specimen No: 1

Test Specimen File Name: 96062175

6/15

Test Type: E-AM-00

References: PRE-TEST READINGS

Acceptance Criteria:

Pre Test: Readings are to be taken without leads submerged in watter and before placed in pressure chamber.

Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0497

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 13:33:49

Specimen No: 2

Test Specimen File Name: 96062176

7/15

Test Type: E-AM-00

References: PRE TEST READINGS

Acceptance Criteria:

Pre Test: Readings are to be taken without leads submerged in watter and before placed in pressure chamber.

Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0498

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 13:34:58

Specimen No: 3

Test Specimen File Name: 96062177

8/15

Test Type: E-AM-00

References: PRE-TEST READINGS

Acceptance Criteria:

Pre Test: Readings are to be taken without leads submerged in watter and before placed in pressure chamber.

Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0498

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 13:48:14

Specimen No: 1

Test Specimen File Name: 96062178

9/15

Test Type: J-PG-02

References: PRESSURE CHAMBER

PRE-TEST READINGS

Acceptance Criteria:

Pretest readings are to be taken with leads submerged, pressure vessel head torqued, but without pressure applied. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Anal;sis:

Input nA	Output nA
0.0500	0.0497

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414 Date Completed: 6/18/96 13:49:46

Specimen No: 2 Test Specimen File Name: 96062179

10/15

Test Type: J-PG-02

References: PRESSURE CHAMBER

PRE-TEST READINGS

Acceptance Criteria:

Pretest readings are to be taken with leads submerged, pressure vessel head torqued, but without pressure applied. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0498

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 13:50:56

Specimen No: 3

Test Specimen File Name: 96062180

11/15

Test Type: J-PG-02

References: PRESSURE CHAMBER

PRE-TEST READINGS

Acceptance Criteria:

Pretest readings are to be taken with leads submerged, pressure vessel head torqued, but without pressure applied. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0498

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 14:11:54

12/15

Specimen No: 1

Test Specimen File Name: 96062187

Test Type: J-PG-02

References: PRESSURE TEST @ 70 PSIG

Acceptance Criteria:

Cables submerged with 70 psig applied to test chamber. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	173 (see Notes)

NOTE: This elivated reading was obtain within minutes of pressurization due to leakage through cable shield and what was termed a batterry effect. When investigated less than one drop of liqid was visible in the BNC connector face. However when the BNC backshaell was loosened liquid sprayed out, indicating trapped liquid, at an ellivated pressure, retained by the backshell.

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 14:14:38

Specimen No: 2

Test Specimen File Name: 96062188

13/15

Test Type: J-PG-02

References: PRESSURE TEST @ 70 PSIG

Acceptance Criteria:

Cables submerged with 70 psig applied to test chamber. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0000

Leakage was noted from the N connector face @ less than 5 psig. When the signal lead was connected to the KEITHLY -610 an indication of 0.0000 was obtained indicating that the connector had shorted resulting in a loss of signal. The leak rate at the N connector was approximatelly thirty drops per minute.

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414

Date Completed: 6/18/96 14:15:29

Specimen No: 3

Test Specimen File Name: 96062189

14/15

Test Type: J-PG-02

References: PRESSURE TEST @ 70 PSIG

Acceptance Criteria:

Cables submerged with 70 psig applied to test chamber. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0497

No moisture was noted on connector face and when the BNC backshell was loosened and removed, no moisture was noted.

Test Status: INFO ONLY

Completed By:

Test Engineer: BEAGLE, K

Test Package No: 3414 Date Completed: 6/18/96 14:28:43

Specimen No: 3 Test Specimen File Name: 96062192

15/15

Test Type: J-PG-02

References: PRESSURE TEST #2

Acceptance Criteria:

This test reconfigured the pressure vessel for long term testing of the BNC cable with the dam installed @ 70 psig.. Negligible antenuation @ 5 E -11amps is rquired to confirm proper cable make-up. "The object of this test is to determine if the "moisture seal"/dam shown in Detail A will stop moisture/fluid migration from the cable braid into the connector."

Test Data/Analysis:

Input nA	Output nA
0.0500	0.0498

Specimens 1 and 2 were removed from the pressure vessel to accomidate this test. A second moisture dam was installed on the cable, outside the pressure vessel where the cable sheath had been removed, to protect the signal generator. This test was run unmonitored,over the course of the weekend with final readings taken @ 0900 hours Monday (66 hours @ 70 psig)

Test Status: INFO ONLY

Completed By: 25

Test Engineer: BEAGLE, K

Attachment H

CHAR Report CSR096, "EMI Testing of SONGS Moisture Dam on High Range Radiation Monitor", Dated June 20, 1996.

(15 Pages)

REPORT CSR096

EMI TESTING OF SONGS MOISTURE DAM ON HIGH RANGE RADIATION MONITOR

SUBMITTED TO:

Ken Trotta
San Onofre Nuclear Generating Station
South California Edison

PREPARED BY:

Bret P. Carlin
Test Engineer
CHAR Services, Inc.
Lebanon, PA 17042

REVIEWED AND APPROVED BY:

Richard Meininger
President

June 20, 1996

1.0 INTRODUCTION

1.1 Statement of Work

CHAR Services was asked to perform EMI testing on the proposed moisture dam to determine its relative sensitivity to EMI and to determine a viable approach to desensitize it to EMI.

1.2 Background

The cable that the moisture dam is to be installed on has been experiencing connector failures due to moisture wicking into the connector. The moisture dam is intended to remove this wicking path. On June 14, 1996, CHAR Services was asked to evaluate the design of the moisture dam for it's effects on the EMI sensitivity of the circuit. CHAR Services initially made recommendations to install 4 conductors symmetrically around the cable to reduce the coupling at the moisture dam[1]. CHAR Services was then asked to perform EMI testing on a sample of Rockbestos RSS-6-104/LE Coax Cable with the moisture dam installed in various configurations.

1.3 Summary of Test Results

CHAR Services tested several different moisture dam configurations. CHAR services also tested a similar cable with different moisture dam configurations with an associate lab. The data collected shows that the 4 wire moisture dam is the least EMI sensitive configuration. The test data also indicates that the use of ferrite beads at the moisture dam will also reduce the EMI sensitivity. The data can be seen in tables 1 and 2

2.0 TEST APPROACH

CHAR Services set up the cable on a ground plane to simulate the cable in a cable tray or conduit. Figure 1 shows the testing configurations used to collect the data. At the CHAR Services lab, a frequency generator was used

[1] The original design of the moisture dam places a single conductor on one side of the cable for a 2 inch section. The single conductor eliminates the symmetry of the cable shield at this point. This the eliminates the canceling of shield noise at the center conductor and allows noise to couple in at this point. The 4 symmetrical conductors will serve the same purpose as the shield and cancel shield noise at the center conductor.

to apply 500kHz, 5MHz, and 50MHz, and a pulse injection test. The associate lab used a sweep generator from 20MHz to 80MHz with a spectrum analyzer.

3.0 TEST RESULTS

3.1 CHAR Services found that based on the associate labs data, the coupling level for the single conductor water dam the coupling level was 12 times higher than the good shield compared to 1.6 times higher for the 4 conductors. (See Table 1 and Graph 1)

3.2 CHAR Services found that based on the CHAR labs data, the coupling level for the single conductor water dam was 57 times higher than the good shield compared to 3.5 times higher for the 4 conductors. (See Table 2 and Graph 2)

3.3 CHAR Services found that based on the CHAR pulse injection data, the coupling level for the single conductor water dam the coupling level was 52 times higher than the good shield compared to 2 times higher for the 4 conductors. The pulse injection test better approximates the conditions the cable will see in the plant. (See Table 3)

3.4 CHAR Services found that ferrite beads placed around the moisture dam reduced the level of coupling at the moisture dam to about the same as that for the good shield.

4.0 RECOMMENDATIONS

4.1 Install the moisture dam using the 4 symmetrical wire setup instead of the single wire setup. The single wire will cause increased EMI coupling that will affect the circuits functioning.

4.2 Install 2 ferrite beads on either side of the moisture dam. (See figure 2) Also it would be prudent to install 5 ferrite beads on either side of connectors in the system (such as the penetration), and at any enclosure entrance.

5.0 ATTACHMENTS

5.1 Test Diagram

Figure 1 Test Setups
Figure 2 Ferrite Bead Installation

5.2 Data Tables and Graphs.

Table 1 Associate Lab Test Data
Graph 1 Graph of Table 1
Table 2 CHAR Lab Test Data
Graph 2 Graph of Table 2
Table 3 CHAR Pulse Injection Test Data

5.3 List of Test Equipment

5.4 Fair-Rite Bead Data Sheets

5.5 SONGS Test Information.

Attachment 1

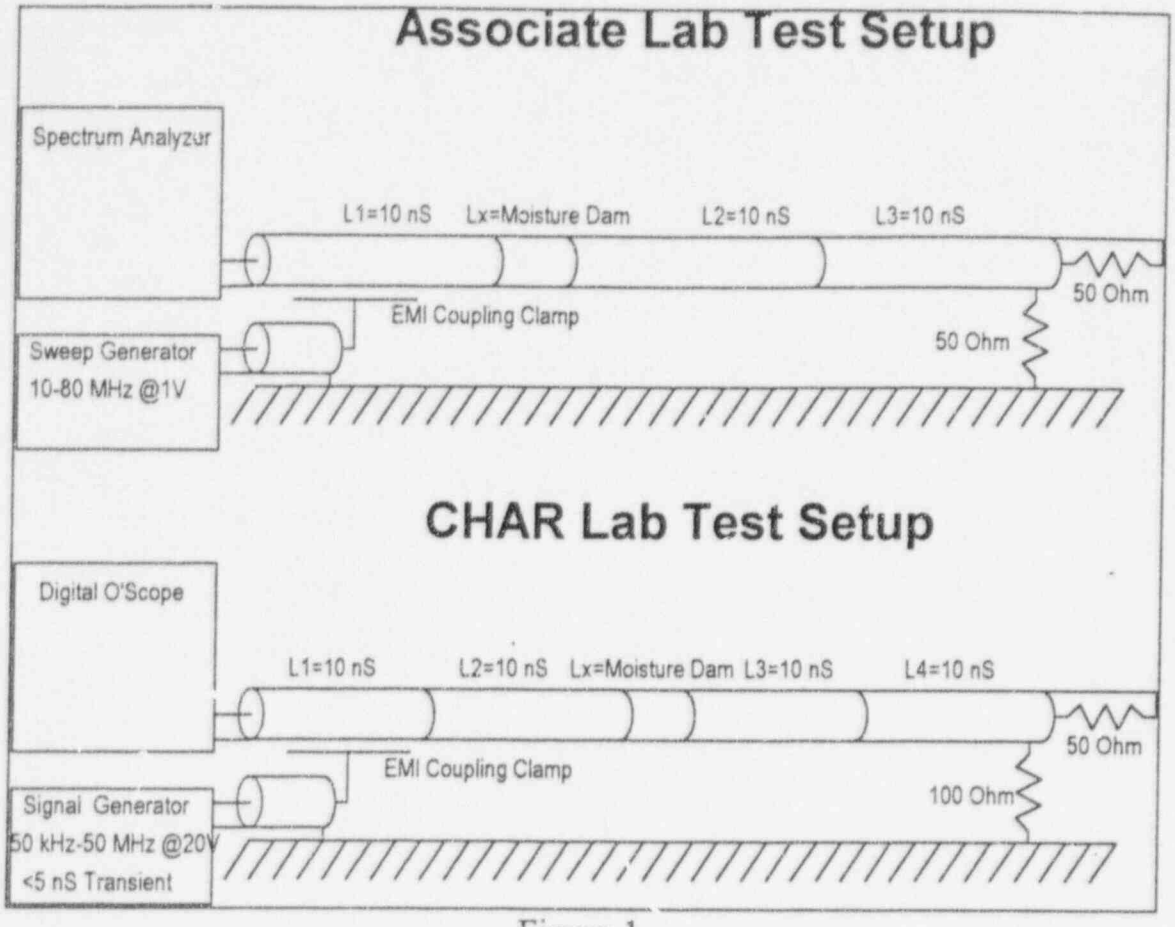


Figure 1

Attachment 1

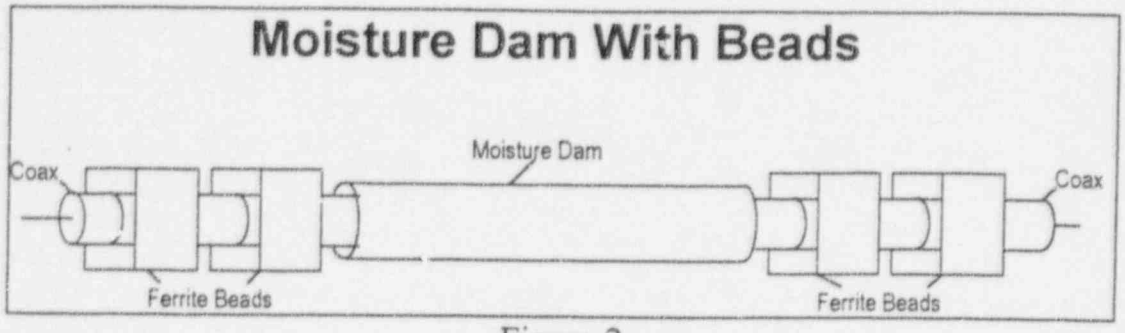
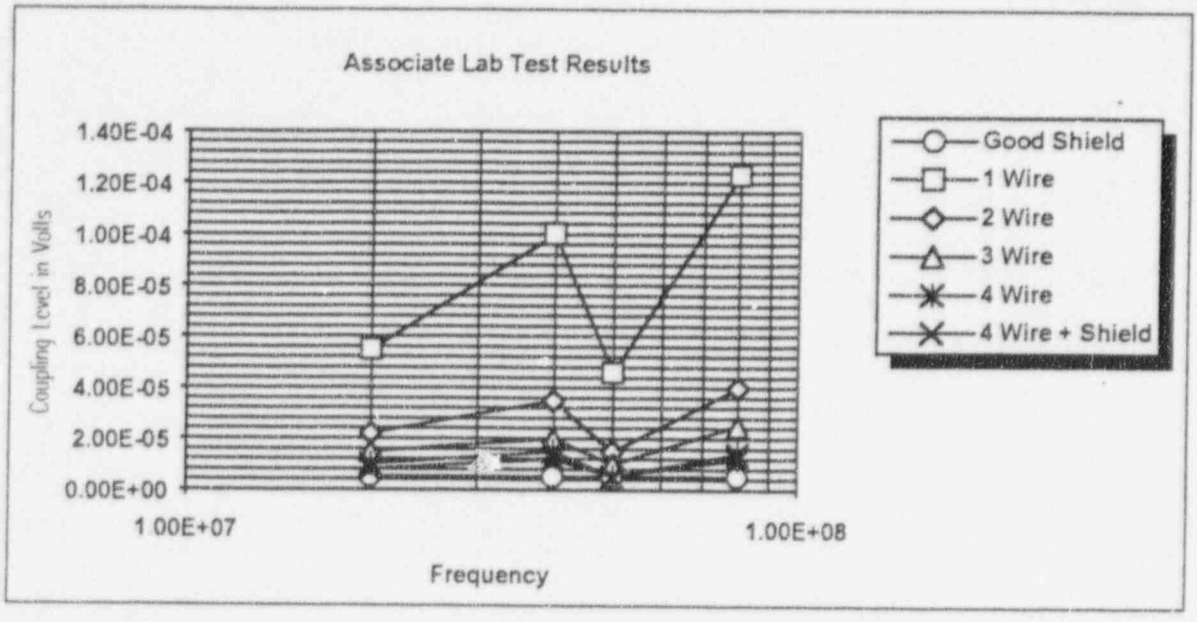


Figure 2

Attachment 2

Associate Lab Test Results				
	20 MHz	40 MHz	50 MHz[2]	80 MHz
Good Shield	5µV	5µV	5µV	5µV
1 Wire	55µV	100µV	46µV	123µV
2 Wire	22µV	35µV	15µV	40µV
3 Wire	15µV	20µV	10µV	25µV
4 Wire	10µV	15µV	5µV	12µV
4 Wire + Shield	8µV	12µV	5µV	14µV

Table 1



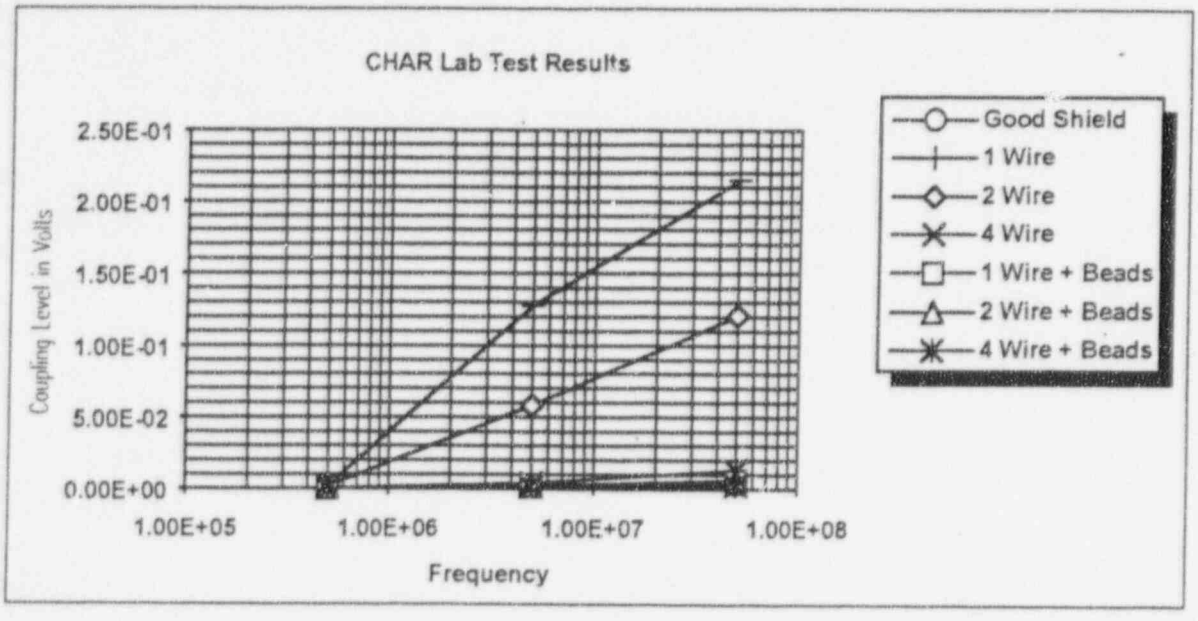
Graph 1

[2] The dip in the data at 50 MHz is due to line resonance. The importance of the data is not the frequency response so much as the relative coupling levels at each frequency.

Attachment 2

CHAR Lab Test Results			
	500 kHz	5 MHz	50 MHz
Good Shield	140 µV	2.18 mV	3.78 mV
1 Wire	1.73 mV	128 mV	215 mV
2 Wire	1.54 mV	58.1 mV	121 mV
4 Wire	140 µV	4.1 mV	13.4 mV
1 Wire + 4 Beads[3]	140 µV	2.4 mV	6.1 mV
2 Wire + 4 Beads	140 µV	1.6 mV	6.4 mV
4 Wire + 4 Beads	140 µV	1.68 mV	3 mV

Table 2



Graph 2

[3] The ferrite beads used during testing were Fair-Rite P/N 0443164151 Type 43 1/2" beads. The beads were installed next to the moisture dam, 2 on either side of the moisture dam. (See figure 2)

Attachment 2

CHAR Services Pulse Injection Test		
	Coupling Level	Coupling location
Good Shield	8.8mV	40nS
1 Wire	458mV	40nS
2 Wire	182mV	40nS
4 Wire	17.7mV	40nS
1 Wire + 4 Beads[4]	9.2mV	40nS
2 Wire + 4 Beads	9mV	40nS
4 Wire + 4 Beads	5.3mV	40nS

Table 3

[4] The ferrite beads used during testing were Fair-Rite P/N 0443164151 Type 43 1/2" beads. The beads were installed next to the moisture dam, 2 on either side of the moisture dam. (See figure 2)

Attachment 3
List of Test Equipment

Equipment	Manufacturer	Type	Serial Number	Cal. Due Date
Digital Oscilloscope	Tektronix	TDS 420	B010336	05/14/97
Signal Generator	Tektronix	PG 508	B043709	N/A
Spectrum Analyzer	Hewlett Packard	HP 8566	N/A	N/A
Sweep Generator	Fluke	6060	N/A	N/A

Attachment 4

PRODUCT DESCRIPTION SHEET

Ferrite Bead

P/N	Type	Max Cable Size
0477164251	77	0.25"
0443164251	43	0.25"
0443167251	43	0.39"
0443164151	43	0.50"

A solid ceramic made of the following constituents:

Iron oxide	65-70%
Zinc oxide	10-15%
Nickel oxide	15-25%

The case is made of Unfilled Nylon 6/6 with a flammability rating of UL94-V0 for beads prior to 7/1/92. After 7/1/92 the flammability rating of the case is UL94-V2.

FAIR-RITE STOCKING DISTRIBUTOR FOR CALIFORNIA

Dexter M. M. D. (Southeast)
6730 Jones Mill Court
Norcross, GA 30092
(404)448-4998
(404)441-9882 (fax)
Don Kusterbeck
Jill Paz

Attachment 4

Round Cable Suppression Cores

Suppression cores for round cables are available for a range of cable diameters. Installed around a cable, these 43 material cores, attenuate any form of EMI emission.

Nylon cases make the assembly of the core halves a snap. Cores are easily installed in equipment where a retrofit proves necessary.

Notes:

- *Available in 43 material. Can also be supplied in 77 material.*
- *Impedance values are based upon single turn measurements, using a HP 4193A.*
- *For performance data on these parts, see page 60 of section "How to Choose Ferrite Components for EMI Suppression".*
- *The Expanded Cable and Connector EMI Suppressor Kit (part number 0199000005) contains a selection of these suppression cores. See page 76.*
- *Cores are controlled for impedance limits only.*

Dimensions *(Bold numbers are in millimeters, light numbers are in inches.)*

Impedance(Ω)

Part Number	Fig.	Max. Cable Diameter	A	B	C	D	Weight (g)	25 MHz Min.	100 MHz ±20%	Cases
2643166751	1	.100	7.56 - 0.25 .296	2.3±0.25 .095	7.8 - 0.8 .297	3.9 - 0.25 .148	1.1	48	93	
2643165451	1	.250	15.0±0.25 .590	6.6±0.3 .260	15.25±0.8 .600	7.5±0.15 .295	7.3	75	155	
2643164251	1	.250	15.0±0.25 .590	6.6±0.3 .260	28.6±0.8 1.125	7.5±0.15 .295	14	130	275	C1
2643167251	1	.390	18.66±0.4 .735	10.15±0.3 .400	28.6±0.8 1.125	9.4±0.15 .370	18	110	225	C2
2643164151	1	.500	25.9±0.5 1.020	13.06±0.3 .514	28.6±0.8 1.125	12.95±0.25 .510	38	125	250	C3
2643625006	2	.300	15.9±0.4 .626	7.9±0.3 .311	14.3±0.4 .563	7.95±0.2 .313	5.0	40	113	C4
2643665806	2	.365	17.5±0.5 .689	9.5±0.3 .374	12.7±0.4 .500	8.75±0.25 .344	5.2	33	88	C5
2643800506	2	.500	21.0±0.5 .827	13.2±0.4 .520	11.9±0.4 .469	10.5±0.25 .413	6.0	28	75	C6
2643806406	2	.590	25.4±0.6 1.000	15.5±0.5 .610	12.7±0.4 .500	12.7±0.3 .500	9.7	34	90	C7

Attachment 4

Round Cable Suppression Cores

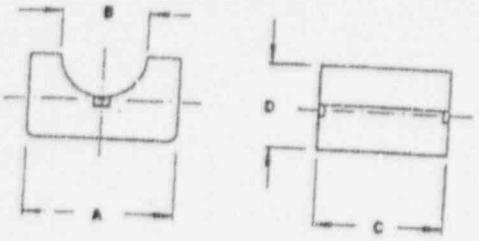


Figure 1

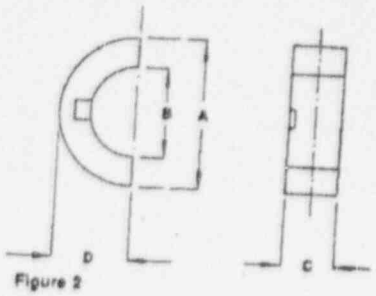


Figure 2

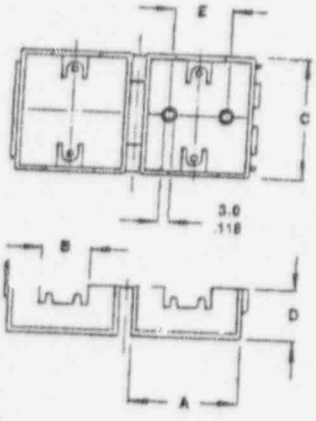


Figure 3

Material: Nylon 6/6
Flammability Rating: UL94-V2

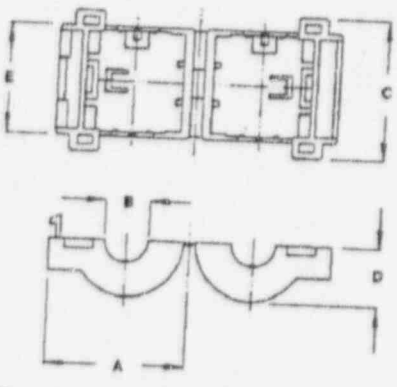


Figure 4

Material: Nylon 6/6
Flammability Rating: UL94-V2

Cases

Dimensions *(Bold numbers are in millimeters, light numbers are in inches.)*

Part Number	Ref.	Fig.	A	B	C	D	E	Part Number Combination Case & 2 Ferrite Parts
0199164251	C1	3	17.8 .705	7.0 .275	32.3 1.272	9.2 .362	9.0 .354	0443164251
0199167251	C2	3	22.1 .870	10.3 .405	32.3 1.272	11.7 .461	9.0 .354	0443167251
0199164151	C3	3	28.2 1.110	10.7 .425	32.6 1.280	16.8 .663	18.0 .709	0443164151
0199625006	C4	4	24.7 .972	7.8 .299	25.8 .998	10.2 .402	17.8 .701	0443625006
0199665806	C5	4	26.3 1.035	9.2 .362	31.4 1.243	11.6 .480	16.4 .646	0443665806
0199800506	C6	4	30.7 1.199	12.8 .504	30.4 1.211	18.7 .500	16.8 .814	0443800506
0199806406	C7	4	34.3 1.350	16.0 .631	31.4 1.230	20.7 .801	19.0 .748	0443806406

Fair-Rite Products Corp. PO Box J, One Commercial Row, Wallkill, NY 12589
Phone (914) 895-2055 • FAX (914) 895-2629

Attachment 5

6/14/96

Brett,

Enclosed is a 50' sample of the Rockbestos RSS-6-104/LE coaxial cable. At $2.87 a foot, this is good stuff!

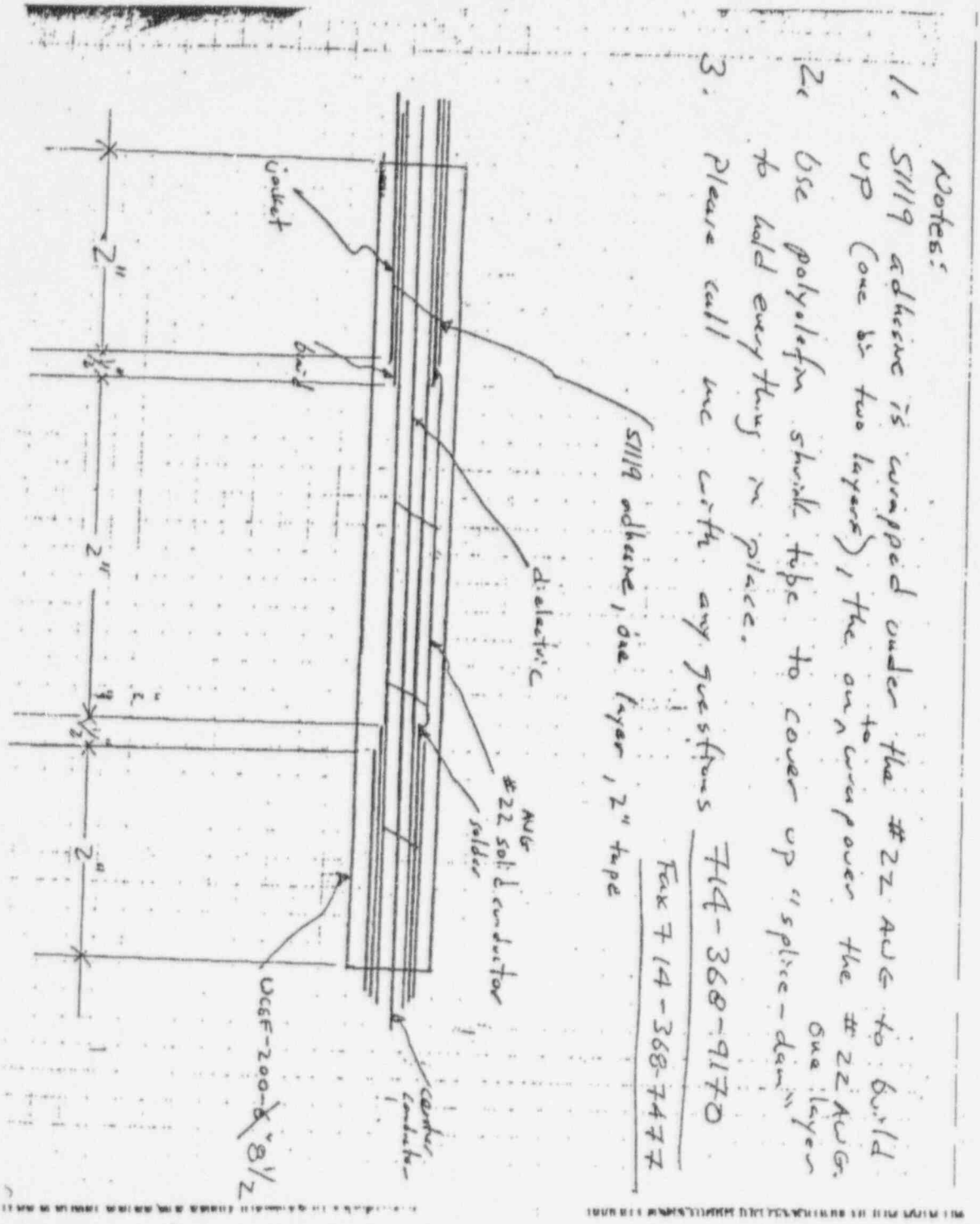
As we discussed, our interest is in using the moisture dam (which we tested @ 70psig - it works!) without introducing significant noise, "coupling points" or other interferance.

Please use the CHAR procedure on an investigative basis for the use of one ○, two ○, three ○ and four ○ #22AWG solid copper jumper wire(s) to connect a two inch braid removal.

I'll be in my office at 714-368-9170 on Monday and Tuesday.

Thank you, Ken Trotta

Attachment 5



Notes:

1. Silig adhesive is wrapped under the #22 AWG to build up (one to two layers), the outer to cover the #22 AWG. one layer
2. Use polyolefin shrink tube to cover up "splice-dam" to hold everything in place.
3. Please call me with any questions 714-368-9170
Fax 714-368-7477

Silig adhesive, one layer, 2" tape