AMP

QUALIFICATION TEST REPORT | 110-11004

REL. 2-2-82

AMP* INSULATED TERMINALS AND SPLICES FOR CLASS 1E, INSIDE CONTAINMENT SERVICE IN NUCLEAR POWER GENERATING STATIONS

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1.0 INTRODUCTION

This test report contains the results of testing performed between March and October, 1981 on AMP Radiation Resistant 150°C PIDG* and PLASTI-GRIP* terminals and Environmental Sealed Splices. Testing was performed in accordance with AMP Product Specification 108-11023, Rev. B, which was written by AMP to provide a test plan that would comply with the guidelines set forth in IEEE Standards 323-1974, 383-1974, and Nu Reg 0588, Revision 1, Category 1 for Class 1E (Safety Related) inside containment service in nuclear power generating stations (PWR and BWR). These products are rated for a 40-year qualified life at 90°C. Visual inspections, Dielectric Voltage Withstand, Static Heating, Thermal Aging and Pull-Out tests were performed in AMP Laboratories. Visual inspections, Vibration Aging, Seismic Vibration and SLB/LOCA testing were performed by National Technical Systems, Testing Division, Chatsworth, CA. Radiation Exposure was done by Isomedix, Inc., Parsippany, New Jersey.

2.0 APPLICABLE DOCUMENTS

The following documents of the issue in effect at the date of qualification testing constituted a part of this test report to the extent specified herein.

108-11023, Rev B	AMP Product Specification for Insulated Terminals and Splices for Class 1E, Inside Containment Service in Nuclear Power Generating Stations
IEEE 101 A-1974	IEEE Guide for the Statistical Analysis of Thermal Life Test Data
IEEE 323-1974	IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
US NRC Reg. Guide 1.89	(For IEEE 323-1974)
IEEE 383-1974	IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations
US NRC Reg. Guide 1.131	(For IEEE 383-1974)
IEEE 344-1975	IEEE Recommended Practices for Seismic Qualification of Class IE Equipment for Nuclear Power Generating Stations
US NRC Reg. Guide 1.1	(For IEEE 344-1975)
UL 486 A, Seventh Edition	Wire Connectors for Use with Copper Conductors
NU REG 0588 Rev. 1, Category 1	NRC Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment
MIL-STD-45662	Calibration System Requirements

3.0 CONCLUSIONS

As summarized in this report, it has been demonstrated that all terminals and splices were capable of performing their required functions throughout their 40-year qualified life and during the subsequent Design Basis Events (DBE) of Seismic, Radiation Exposure, Steam Line Break (SLB)/Loss of Coolant Accident (LOCA) and post-LOCA conditions.

This determination is based on the following tests and observations.

3.1 Initial Measurements and Thermal Aging. Baseline measurements were made of current carrying and insulating capabilities of each terminal and splice initially and after Thermal Aging. Temperature Rise requirements were taken from UL Standard 486 A, Seventh Edition. The Dielectric Withstand requirement of 2200 VAC rms was established using the industry accepted practice of testng to twice the rated voltage of a component plus 1000 volts. All terminals and splices met these requirements initially and after Thermal Aging, as shown in the Test Results section of this report.

3.2 Vibration Aging and Seismic. During the Vibration Aging and Seismic Vibration, all circuits were monitored to detect electrical discontinuities greater than two microseconds duration; there were none

3.3 SLB/LOCA Exposure. During the SLB/LOCA/post-LOCA conditions, test specimens were energized with 65 amperes AC rms on the #6 AWG circuits and 7 amperes on the other circuits, with a potential of 600 VAC rms between all adjacent circuits. Shortly into the exposure, due to excessive leakage currents, the 600 volt potential was removed from the circuits. All circuits continued to carry their test currents throughout the entire 30-day period.

To determine the cause of excessive leakage current between mutually insulated circuits, immediately upon completion of the 30-day LOCA exposure, and as soon as the test chamber was sufficiently cooled and opened, the electrical box, still inside the chamber, was opened and the lead-in cables removed from the circuit. A 600 VAC rms potential was applied between all adjacent circuits inside the box. There was no leakage current exceeding 50 microamperes. Further investigation showed the wire insulation split and some came completely off of some of the lead-in cables outside the electrical box, exposing bare wires touching together. This was the determined cause of short circuits, not the components inside the box.

3.4 Post-LOCA Measurements and Evaluation.

A. Dielectric Withstand. All circuits withstood a test potential of 2200 VAC rms applied between all adjacent terminals and splices inside the electrical box. There was no evidence of dielectric breakdown or flashover between any circuit.

All terminals and splices were then removed from the box and subjected to Dielectric Withstand testing as specified in Paragraph 4.2. The minimum breakdown voltage of any terminal or splice was 1106 VAC rms, or more than twice the maximum 480 volt service in which this product is used. (See Test Results Section of this report for more complete analysis).

Terminals and splices were re-installed in the electrical box as before and a dielectric withstand voltage applied between all adjacent circuits to achieve breakdown. The minimum breakdown voltage between any adjacent circuits was 7,968 VAC rms.

The above evaluations demonstrate that all terminals and splices tested are capable of continued performance of their required function with adequate margin for an extended period of post-LOCA conditions.

B. Static Heating. After LOCA exposure, all circuits inside the electrical box were energized with their rated currents (See Table IV) and the temperature of each terminal and splice was measured. The maximum temperature rise over ambient temperature of any terminal or splice did not exceed 80°F, which would be a maximum actual temperature of 280°F if operating under post-LOCA ambient conditions of 200°F. This is below the normal long-term operating temperature rating of 302°F for the product and demonstrates that the terminals are capable of handling their rated currents during extended post-LOCA conditions. In fact, only one #12 AWG terminal was this high. All other terminal temperatures were less than 44°F above ambient. Further analysis of this one higher-than-normal terminal temperature showed that the cause was the bolted joint connection, not the crimp termination.

Further evaluation using the UL 486 A technique as for baseline measurements is shown in the Test Results section of this report.

4.0 QUALIFICATION TEST PLAN

4.1 Test Sample Configuration. The following quantities of ring tongue terminals and environmental sealed splices were tested on the wire sizes shown. The insulating sleeves on the terminals and splices are extruded from KYNAR material (trademark of Pennwalt Corporation). This material is a Polyvinylidene Fluoride composition (PVF_2).

Test Groups 1 through 4 were thermally aged to simulate 40 years at 90°C and Test Groups 5 through 9 were unaged.

TABLE I

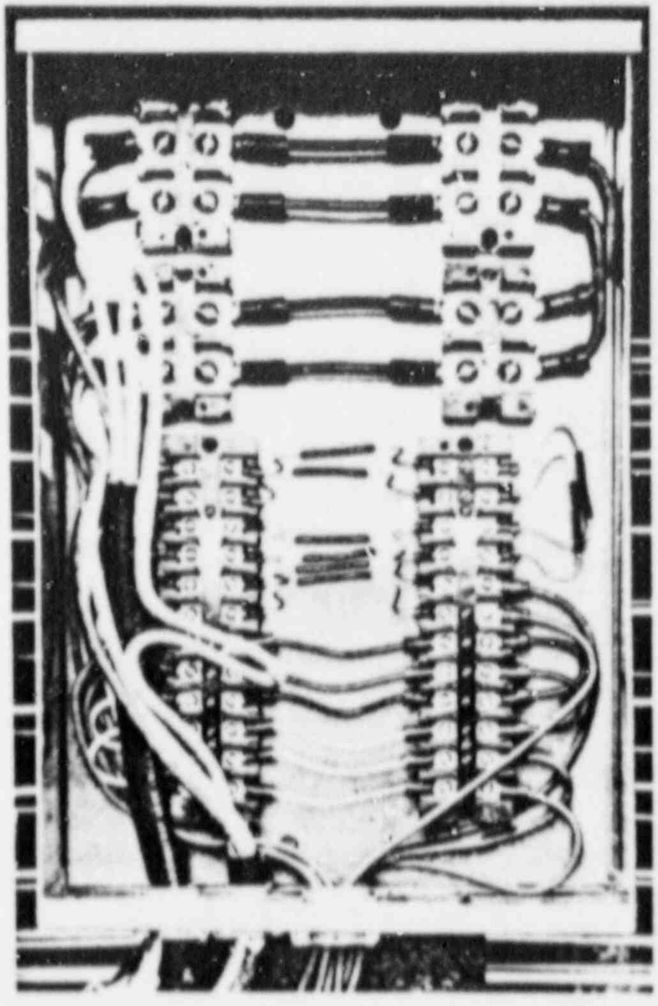
Sample Group	Product Tested	Part No.	Wire Range	Wire Size Tested	Quantity	Crimping Tool
1	PIDG	53425-1	12-10	12	12	59239-4
2	PLASTI-GRIP	53946-1	6	6	8	‡
3	Splice	52979	20-16	18	6	59275
4	PIDG	53409-1	22-16	18	12	59250
5	PIDG	53425-1	12-10	12	8	59239-4
6	PLASTI-GRIP	53946-1	6	6	8	‡
7	Splice	52979	20-16	18	4	59275
8	PIDG	53409-1	22-16	18	8	59250
9	PIDG	53426-1	12-10	10	8	59239-4

‡ Tool P/N 69120, Head P/N 69066, Die P/N 47237-1

4.2 Test Sample Preparation. Terminals and splices selected for testing are representative of current production. Preparation of test specimens was conducted in accordance with the applicable AMP Instruction Sheets governing assembly and crimping technique. Terminals were crimped to the ends of 4-inch lengths of the specified conductors except for those crimped to the lead-in wires and tested in the unaged condition. Splices had a 3-inch length of wire crimped to each end, with a ring-tongue terminal crimped to each end of those.

After initial measurements and Thermal Aging were completed, terminals and splices were fastened to vertically mounted terminal barrier blocks with the wires extending out horizontally from the block. Barrier blocks were General Electric EB-25 (for wire sizes 8 and smaller) and EB-1 (for Size 6), without covers, and were mounted inside a NEMA Type 3 ventilated electrical box.
(See Photo 1)

PHOTO #1



4.3 Wire. The following conductors used for test are of the type approved for Class 1E service in nulear power generating stations except for the size 18 wire. All conductor insulations are rated at 600 volts.

Wire Size AWG	Wire Type
12	Brand-Rex Untrol Control Cable, unplated conductors
6	Rockbestos Firewall III, XHHW, NEC, Type TC, tin-plated conductors
18	Tensolite SNC 726-Z-18, ETFE TEFZEL insulated, 7 strand, tin-plated conductors
10	Anaconda -Y UL Type SIS VW-1

4.4 Test Sequence. Testing was performed on all terminals and splices in the sequence shown in Table II. Test Group I consisted of Sample Groups 1 thru 4 (aged) and Test Group II consisted of Sample Groups 5 thru 9 (unaged). (See Paragraph 4.1, Table I).

TABLE II

QUALIFICATION INSPECTION			
Test or Examination	Paragraph	Test Group and Sequence	
		I	II
Visual Examination	4.6.1	1-5-11-13-15	1-8-10
Dielectric Voltage Withstand	4.6.2	2-6 – 16 §	2 – 11 §
Static Heating	4.6.3	3-7 – 17 §	3 – 12 §
Thermal Aging	4.6.4	4	
Vibration Aging	4.6.5	8	4
Seismic Vibration (OBE)	4.6.6	9	5
Seismic Vibration (SSE)	4.6.6	10	6
Radiation Exposure	4.6.7	12	7
SLB/LOCA	4.6.8	14	9
Pull Out	4.6.9	18	13

§ Measurements were first taken on test specimens still mounted in the electrical box. Samples were then removed from the box and measurements taken in the normal manner in accordance with UL Standard 486 A.

4.5 Test Equipment. The following equipment was used to conduct the tests described in this Test Report. All standards used are traceable to the National Bureau of Standards and calibration records are available upon request. Instrument calibration is conducted in accordance with MIL-STD-45662.

TEST EQUIPMENT

Test or Examination	Eqipment	Mfr.	Model	Accuracy	Calibration Interval	Date Last Calibrated
Static Heating	DC Power Supply	Mid-Eastern	674-98	NA	NA	NA
	Millivoltmeter	Weston	1261	1% FS	3 mo	1-13-81 / 10-22-81
	Thermocouple Indicator	Doric	DS-500	+/- 1.5°F	6 mo.	9-10-80 / 9-14-81
Dielectric Withstand	Dielectric Tester	AMP	Ser. 999	2%	3 mo	1-30-81 / 11-02-81
Pull Out	Tensile Machine	Tinius Olsen	LOCAP 5000	1%	6 mo	11-02-81
Heat Age	Oven	Blue M	POM-566-A	+/-1°C	NA	NA
Vibration Aging Seismic Vibration Radiation LOCA	Tests were performed by National Technical Systems, Test Division, Chatsworth, CA.					

4.6 Test Methods.

4.6.1 Visual Examination. Prior to test, terminals and splices were visually examined for evidence of physical damage, improper assembly, or any defects which could render them unsuitable for testing. Upon completion of Thermal Aging, Vibration, Radiation Exposure and SLB/LOCA, samples were again visually examined prior to measurements.

4.6.2 Dielectric Voltage Withstand.

4.6.2.1 UL Method.

A. Terminals. Terminals were dipped in molten insulating wax to a depth to sufficiently cover and seal the exposed end. Care was taken to insure that the wax did not cover the crimp area. The waxed end of each terminal was then embedded in #12 lead shot (.050" diameter) to a depth sufficient to cover the crimped areas of barrel and insulation support or grip. A test potential of 2200 volts rms, 60 Hz was applied at a rate of 500 volts per second between the conductive parts of the terminals and the lead shot and held for a period of 1 minute.

B. Splices. Splices were embedded in shot to a depth sufficient to cover the entire splice and all seal areas and tested to 2200 VAC rms as specified for terminals.

4.6.2.2 Inside Electrical Box Measurements. The 2200 VAC rms dielectric withstand potential was applied between all adjacent circuits, held for one minute, then increased until dielectric breakdown or flashover occurred between circuits.

4.6.3 Static Heating.

4.6.3.1 UL Method. Crimped terminals were bolted back-to-back, with the bolts not extending more than 1/4 inch beyond the outer surface of the nut (See Figure I) and subjected to a continuous current of the value specified in Table III. Thermocouples were fastened to all crimped wire barrels of terminals and splices for temperature measurement. Measurements were recorded after the temperature had stabilized (when three consecutive readings, within a 15-minute period, were the same).

FIGURE 1

TABLE III

Static Heating Test Currents and Pull Out Requirements		
Wire Size	Test Current (Amperes DC)	Pull Out Force (Pounds Minimum)
18	17	20
12	25	70
10	40	80
6	95	100

4.6.3.2 In Service Box Measurements. After SLB/LOCA exposure, before samples were removed from the electrical box, temperature rise measurements were taken on each terminal while energizing all circuits with their rated currents as follows:

TABLE IV

Wire Size (AWG)	Current Rating (Amperes)
18	7
12	20
6	65

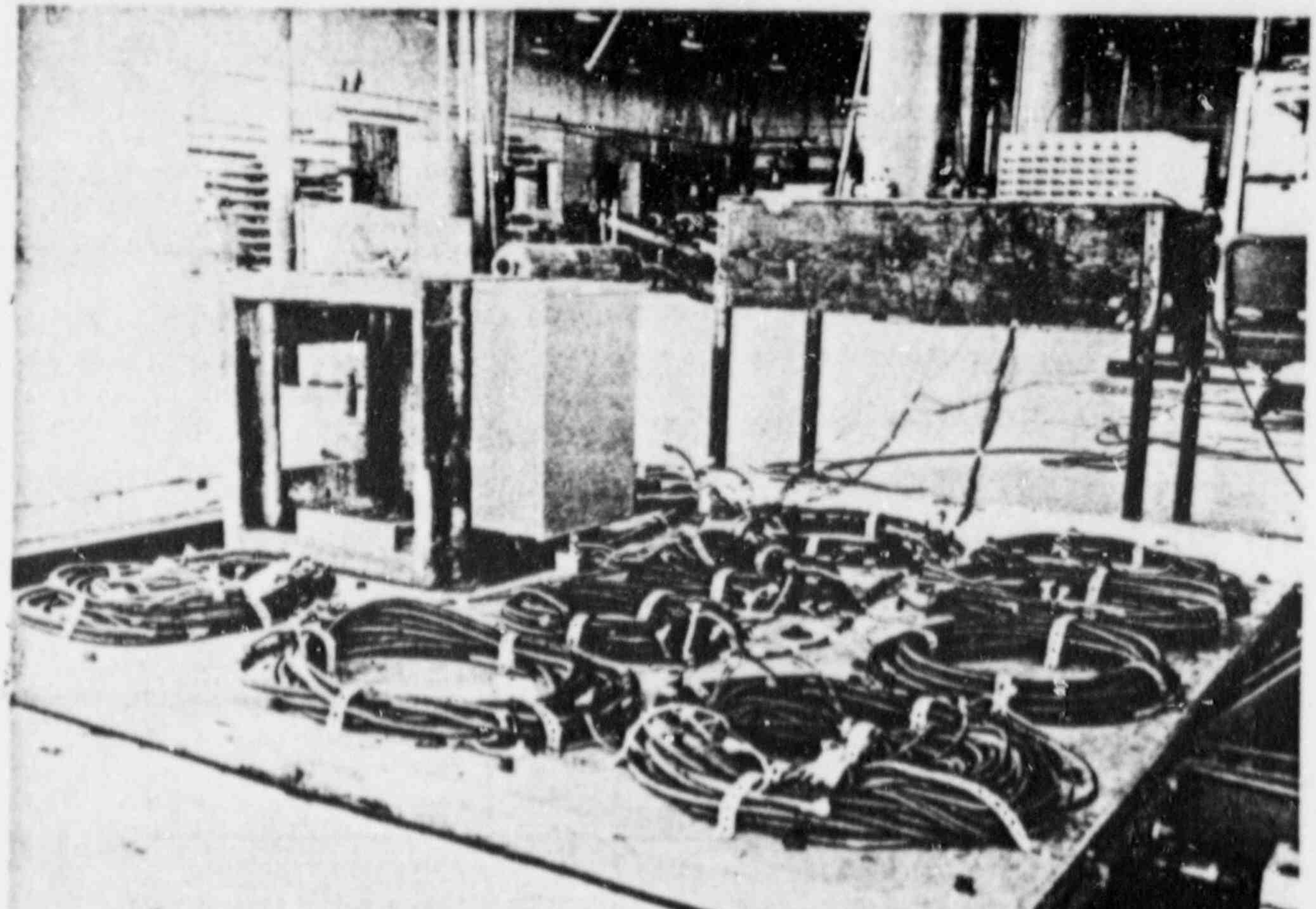
Size 10 terminals could not be tested at their rated current because they were only used on lead-in wires and were used to energize smaller wire sizes.

4.6.4 Thermal Aging. All Test Group I test specimens were pre-aged prior to radiation exposure by subjecting them to a temperature of 165°C (+2,-0°C) in an air-circulating oven for a period of 21 days to correlate to their qualified life of 40 years at 90°C. This temperature/time relationship was extrapolated from the Arrhenius equation, log Y = A + B/T, with the intercept being -9.2020455 and the regression coefficient B as 5964.3978. This equation was derived from isothermal gravimetric data generated by Pennwalt Corporation.

4.6.5 Vibration Aging. The electrical box containing the terminals and splices under test was rigidly mounted to the vibration shaker table (See Photo #2). Suitable lead-in wires were connected to the test leads in series fashion so that all terminals could be monitored throughout the test for electrical discontinuities exceeding 2 microseconds duration. The entire test assembly was subjected to 90 minutes of sinusoidal vibration in each of the three major orthogonal axes, at an applied acceleration of 0.75 g peak over the frequency range of 5 Hz to 100 Hz. The sweep rate was one octave per minute and input levels were as follows:

Frequency (Hz)	Levels
5-7.75	0.025 inch double amplitude
7.75-100	0.75 g

PHOTO #2



4.6.6 Seismic Vibration. Upon completion of Vibration Aging in each of the three major orthogonal axes, the monitored electrical box was subjected to five biaxial seismic events at the Operating Basis Earthquake (OBE) level followed by one biaxial event at the Safe Shutdown Earthquake (SSE) level. Each seismic event consisted of random motion which was amplitude controlled in 1/3-octave bandwidths from 1 Hz to 35 Hz. Each event was 30 seconds in duration.

The electronic signals from two piezoresistive accelerometers mounted on the seismic simulator in the two active axes, were analyzed in 1/12-octave bandwidths between 0.1 Hz and 100 Hz, with a spectrum analyzer, at a damping ratio of 5 percent. The Test Response Spectra (TRS) met, or exceeded, the OBE and SSE Required Response Spectra (RRS). See Figures II and III for examples of one event each, OBE and SSE.

FIGURE II
OBE (RRS AND TRS)

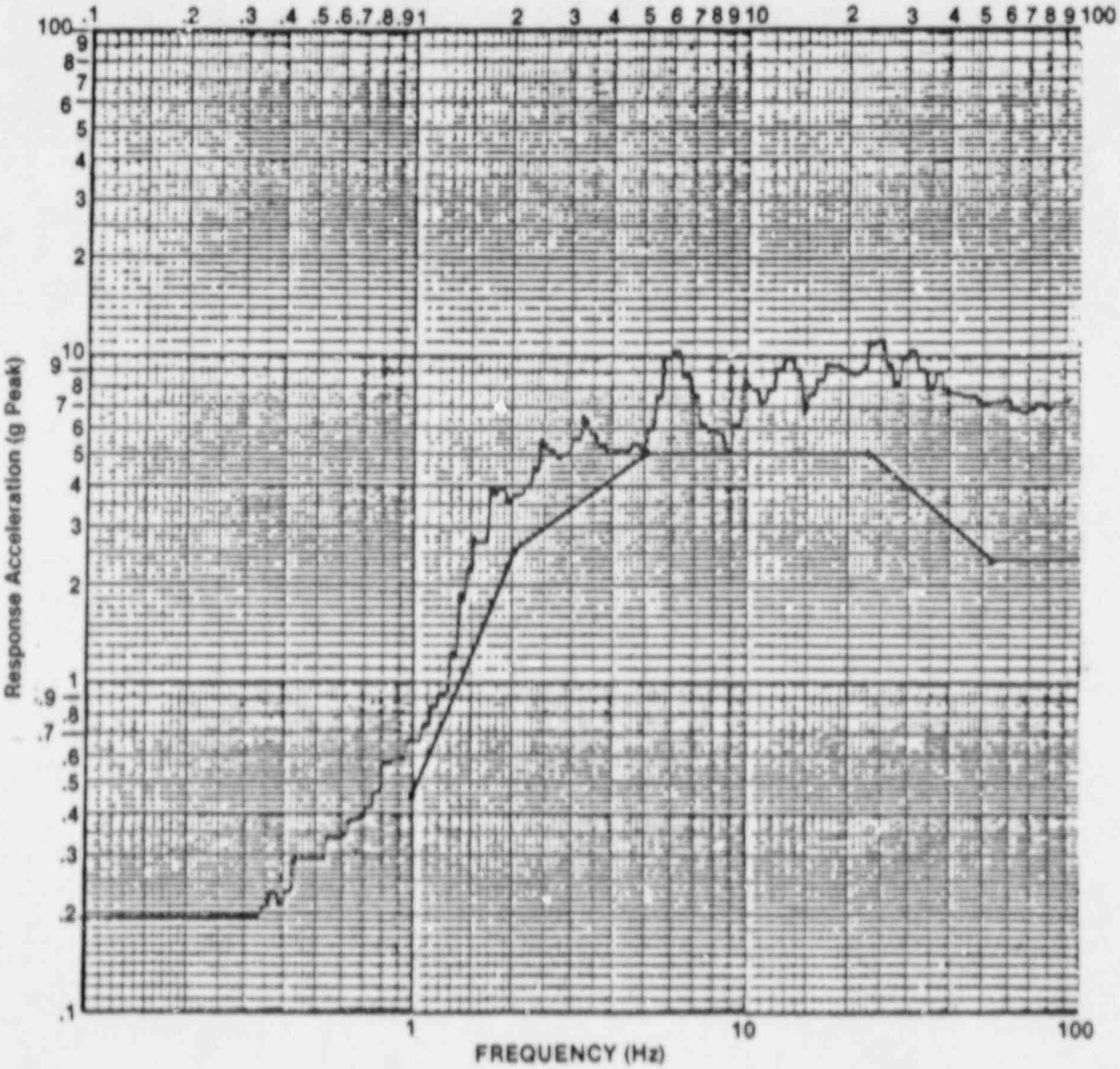
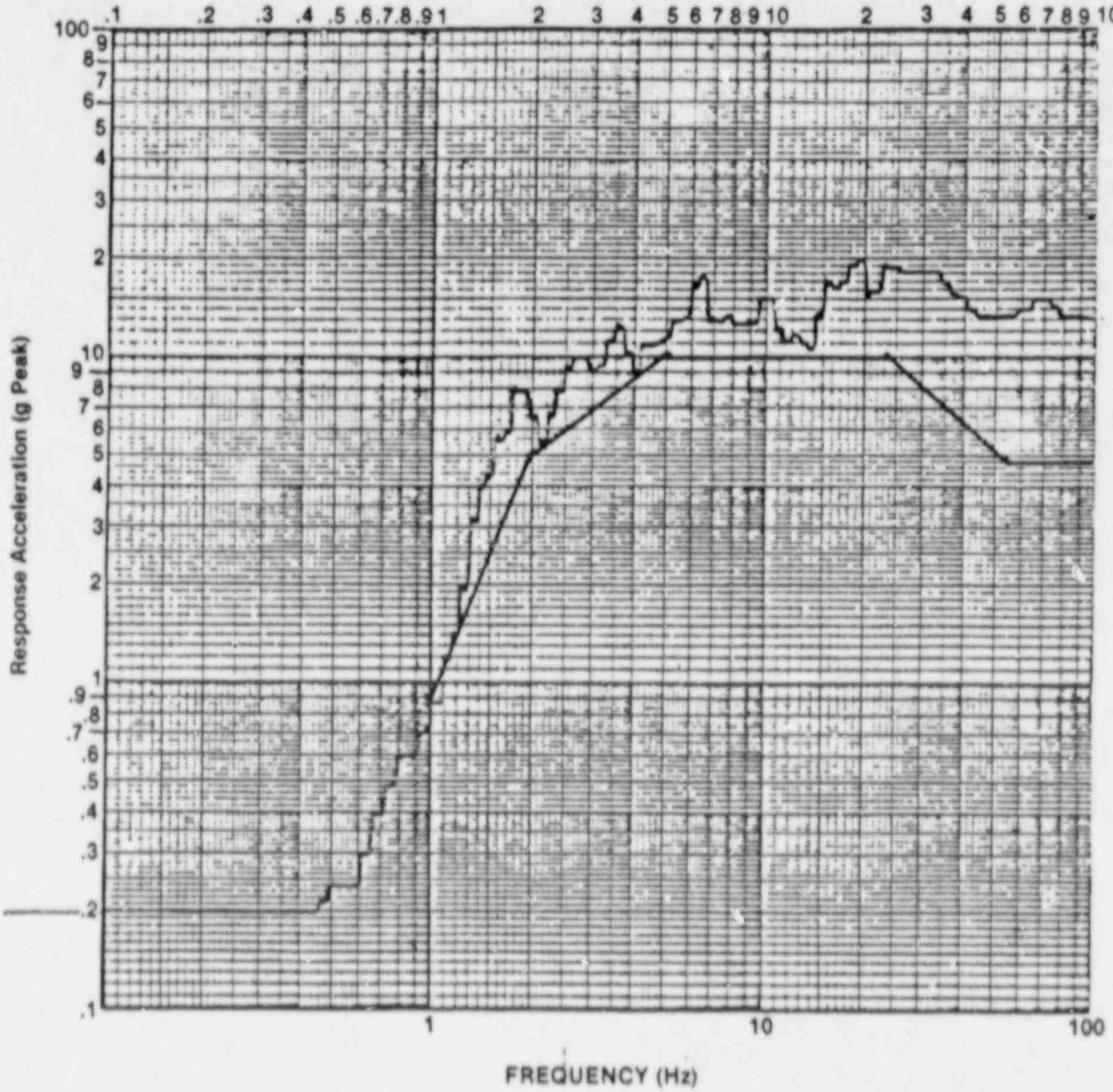


FIGURE III
SSE (RRS AND TRS)



4.6.7 Radiation Exposure. Test specimens were exposed to gamma radiation from a Cobalt 60 source to a total accumulated (equivalent air) dosage of 259 megarads at a nominal dose rate of 0.34 megarad per hour. This dosage accounts for 50 megarads throughout the normal 40-year operating life, plus 209 megarads during DBE and post-DBE conditions.

4.6.8 Steam Line Break (SLB)/Loss of Coolant Accident (LOCA). Test specimens were energized with 600 volts AC rms between adjacent terminals and carried test currents of 7 amps on the 18, 12, and 10 AWG circuits, and 65 amps on the #6 AWG circuit to monitor for electrical short circuits and circuit continuity.

The electrical box containing the test specimens was placed inside the LOCA autoclave and subjected to Loss of Coolant for a period of 30 days in accordance with IEEE STD 323-1974. A simulated Steam Line Break (SLB) and an additional peak transient were also included as shown in Figure IV. Test conditions encompassed both the PWR and BWR profiles, using the temperature/pressure profile specified for BWR's and the chemical spray specified for PWR's except 50 ppm hydrazine was included in the solution. Also, NaOH was added to yeild a pH of 12.5 for the first 2 hours, then the pH decreased to 10.5 for the remainder of the test exposure.

To accomplish the Steam Line Break and provide margin to the specification parameters, the following profile was performed:

FIGURE IV (A)
SLB/LOCA Temperature Profile

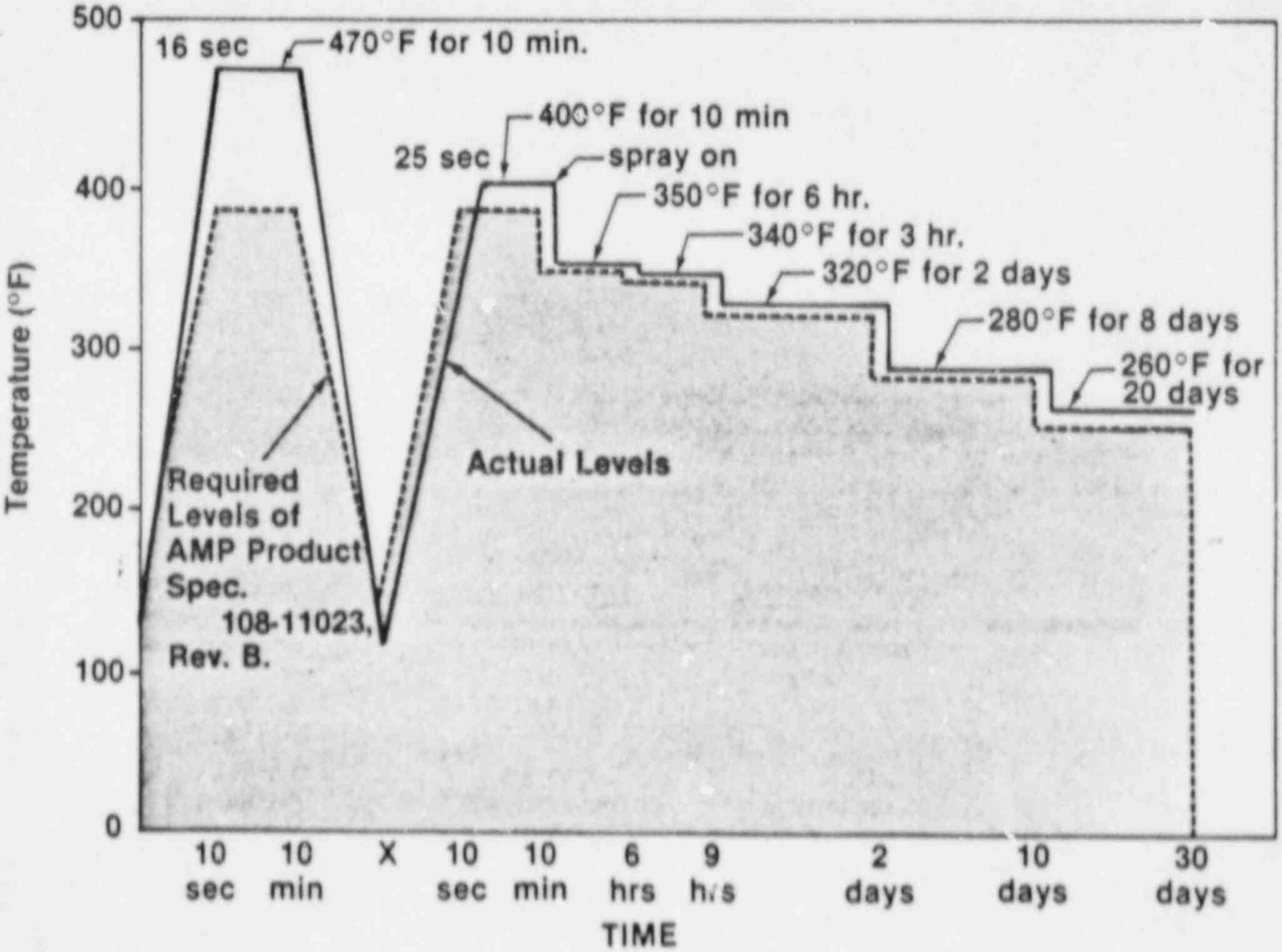
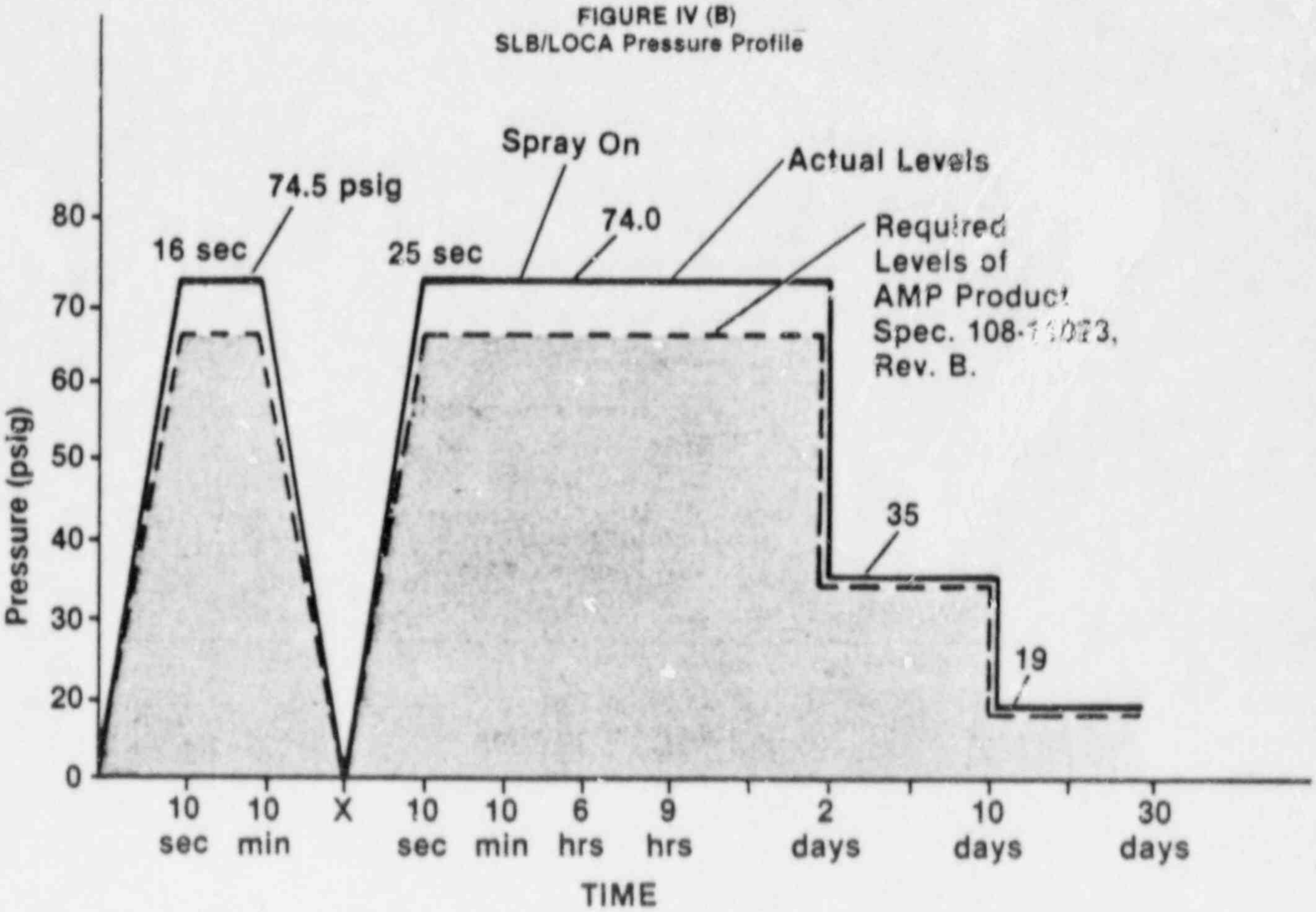


FIGURE IV (B)
SLB/LOCA Pressure Profile



As shown in Figures IV(A) and IV(B), the following time/temperature/pressure profile was followed. For the Steam Line Break, superheated steam at 74 psig was used.
NOTE: The required specification peak transient levels were to be 382°F/65 psig. Actual levels were 470°F/74.5 psig and 400°F/74 psig.

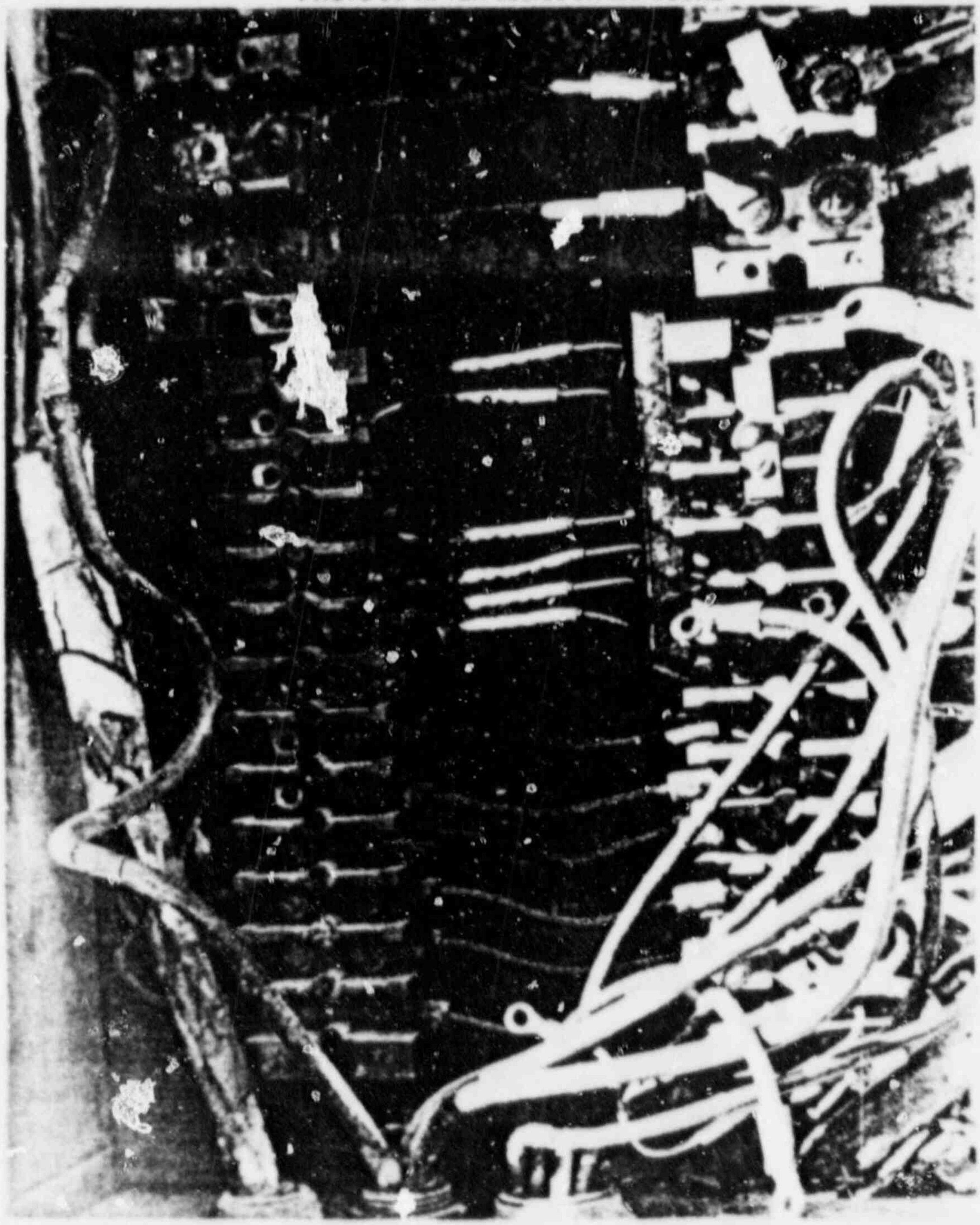
Step	Time (Progressive)	Temperature (°F)	Pressure (PSIG)
Margin Transient:			
1	0 sec to 16 sec	117 to 470	0 to 74.5
2	16 sec to 10 min	remain at 470	74.5
3	Unspecified	decrease to 106	decrease to 0
LOCA:			
4	X to 25 sec	106 to 400	0 to 74
5	25 sec to 10 min	remain at 400	remain at 74
6	10 min to 6 hr	remain at 350	remain at 74
7	6 hr to 9 hr	remain at 340	remain at 74
8	9 hr to 2 days	remain at 320	remain at 74
9	2 days to 10 days	remain at 280	remain at 35
10	10 days to 30 days	remain at 260	remain at 19

4.6.9 Pull Out Force. Test specimens were placed in a tensile testing machine. An axial force was applied to the terminals at a rate of 1 inch per minute until the force specified in Table III was reached. The force was maintained for 1 minute and then released.

5.0 TEST RESULTS

5.1 Visual Examination. When examined prior to test, all test specimens were free from any defects or damage and were properly assembled to their respective lengths of wire. Visual examination after Thermal Aging, Vibration Aging, Seismic Vibration, Radiation Exposure, and SLB/LOCA Exposure, showed all insulating sleeves in place and no evidence of splitting, blistering, cracking, or any type of deterioration of any sleeves on terminals or splices except for creases on the underside of some terminals after LOCA, where they were pressed against the barrier block corners (see Paragraph 5.2, Table V, Note 3 for more complete description).

PHOTO #3 AFTER SLB/LOCA EXPOSURE



5.2 Dielectric Voltage Withstand.

5.2.1 UL Method. Initially and after Thermal Aging, all terminals and splices withstood the 2200 VAC rms test potential with no evidence of dielectric breakdown or flashover.

When tested as specified in Paragraph 4.6.2, after the SLB/LOCA exposure, all terminals and splices withstood the 2200 VAC rms test voltage except the following:

TABLE V

Description	No. of Specimens Less than 2200 VAC	Minimum Breakdown Voltage (VAC rms)	Visual Observations
#6 Term. (aged)	none	NA	
(unaged)	none	NA	
#12 Term. (aged)	2	1563	3
(unaged)	3	1243	3
#18 Term. (aged)	4	1648	1
(unaged)	2	1407	3
#18 Splices (aged)	4	1766	2
(unaged)	none	NA	
#10 Term. (unaged)	4	1106	1

1 Puncture in crimp area.

2 Puncture in crimp or window area of the splice.

3 Visual inspection of the insulating sleeves of these terminals showed a sharp, indented line across the sleeve where it was pressed down against the sharp edge of the barrier block (See Figure VA). This could have been caused during installation or by subsequent handling during testing. The specified maximum SLB temperature was to be 382°F; the actual temperature on the first transient was 470°F for 10 minutes. Temperature on the second transient was 400°F for 10 minutes. (See Figure IV and SLB/LOCA profile).

A precaution to minimize this condition would be to make sure that when installing ring tongue terminals, the tongue is not bent backwards, causing the wire barrel insulation to be forced down onto the edge of the barrier block. Also, care should be taken during the wiring of electrical boxes to avoid jamming terminal barrels down against the barrier block edges (See Figure VB).

FIGURE VA

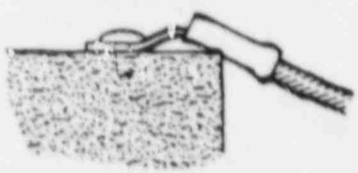
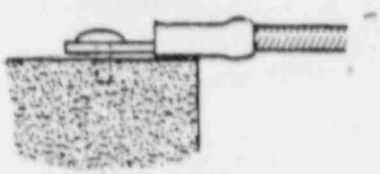


FIGURE VB



As seen from the above data, all terminal and splice insulating sleeves exhibited a minimum breakdown voltage of 1106 VAC rms, or more than twice the maximum 480 volt service in which they are used.

5.2.2 Inside Electrical Box Measurements. Post-LOCA testing was also performed on all terminals and splices mounted on the barrier blocks inside the electrical box, as in actual service. A test potential of 2200 VAC rms was applied between all adjacent circuits and held for 1 minute. The voltage was then increased to breakdown. The minimum voltage breakdown between any adjacent circuits was 7,968 VAC rms.

The test results have demonstrated that all terminals when installed and used as described in this report performed their required functions with adequate margin, even without taking the precautions stated in Paragraph 5.2.1.

5.3 Static Heating.

5.3.1 UL Method. The following temperatures were measured on terminal and splice wire barrels while carrying their specified test currents as determined by UL 486 A, Seventh Edition. The values recorded are the temperatures in °F of terminal barrels above ambient temperature while conducting the specified test current.

TABLE VI

Sample Group	Wire Size	Test Current (Amperes DC)		Initial	Rise After Thermal Aging	Temperature After Radiation and LOCA
1 (1)	12	25	min.	22	22	22
			max.	30	29	30
			avg.	26	26	24
2 (2)	6	95	min.	37	34	28
			max.	43	38	59
			avg.	40	36	38
3 (3)	18	17	min.	21	26	25
			max.	28	34	36
			avg.	24	31	31
4 (1)	18	17	min.	24	21	23
			max.	31	46	42
			avg.	28	31	32
5 (4)	12	25	min.	23	NA	29
			max.	37		93
			avg.	29		59
6 (5)	6	95	min.	28	NA	41
			max.	40		122
			avg.	34		67
7 (6)	18	17	min.	22	NA	31
			max.	30		68
			avg.	25		49
8 (4)	18	17	min.	16	NA	31
			max.	25		71
			avg.	20		48
9 (4)	10	40	min.	20	NA	36
			max.	26		73
			avg.	22		48

(1) PIDG Terminals, thermally aged

(2) PLASTI-GRIP Terminals, thermally aged

(3) Enviromental Sealed Splices, thermally aged

(4) PIDG Terminals, unaged

(5) PLASTI-GRIP Terminals, unaged

(6) Environmental Sealed Splices, unaged

These measurements show that all terminal and splice wire barrel temperatures were less than the UL requirement of 90°F rise used as baseline reference, except one #12 AWG unaged terminal which had a temperature rise of 93° F and one #6 terminal on one of the lead-in wires, with a rise of 122°F while carrying 146 percent rated current. This latter terminal was severely bent and deformed, apparently from handling sometime during installation or disassembly operations. This data, in conjunction with the following measurements, show that terminals and splices as installed in the electrical box or barrier blocks are capable of handling their rated currents during extended post-LOCA conditions without damage or degradation to any components.

5.3.2 In Service Box Measurements. The following temperatures were measured on thermally aged and unaged terminals as installed on barrier blocks, inside the electrical box. Overall temperature is now influenced by the crimp interface of the wire to the terminal barrel and the bolted joint interface of the terminal tongue to the barrier block pad. The values recorded are the °F of terminal barrels above ambient temperature while conducting the rated currents shown below.

TABLE VII

Wire Size (AWG)	Rated Current (Amperes DC)		Temperature Rise (°F) Initial	Temperature Rise (°F) After LOCA
6	65	min.	12	14
		max.	16	44
		avg.	14	23
12	20	min.	5	9
		max.	28	80 (1)
		avg.	17	24
18(terms.)	7	min.	0	0
		max.	6	9
		avg.	1	3
18 (splices)	7	min.	.	2
		max.	.	9
		avg.	.	6

NOTES: (1) Only one out of the 20 terminals in this group was high. The max. temperature rise of the next highest terminal in the group was 35°F. Further analysis showed that the heating was being generated at the bolted connection, not the crimp termination.

#10 AWG lead-in wires not included in these measurements.

5.4 Pull Out. The mechanical integrity of the crimped terminals and splices after all environmental exposures was demonstrated by the Pull Out test. All terminals and splices withstood for one minute the forces required to UL Standard 486 A, Seventh Edition, shown in Table III of this report.

6.0 TEST MARGIN

This test report describes the tests which were conducted to demonstrate the product's ability to function satisfactorily under the required conditions. All of the tests described in this report were designed to accelerate, or "over test", the product to assure that an adequate margin does exist between expected or possible operating conditions and the test conditions. These judgements are based on accepted engineering and test practices as follows: (Reference Paragraph 5.6 of this specification for a list of tests and their sequence.)

6.1 Static Heating. Temperature measurements were taken on each terminal barrel with the specified test current passing through the crimp connection to determine the heating effects caused by this current. The method use and the performance criteria for initial or baseline measurements are derived from Ul Standard 486 A, Seventh Edition. Measurements were also taken after exposure to simulated aging and accident conditions to demonstrate electrical integrity and the ability of the terminals to carry their rated currents during a nuclear accident and throughout an extended post-LOCA period.

6.2 Radiation Exposure. IEEE Standard 383-1974, Paragraph 2.4.2 states that test specimens should be subjected to gamma radiation to a dosage of 200 x 10^6 rads (50 + 150 Mrad). This report specifies a total accumulated dosage of 259 x 10^6 rads, which is considered adequate margin.

6.3 LOCA/SLB. Paragraph 1.3.5.3 of IEEE Standard 383-1974 states that margin shall be demonstrated by application of multiple transients, increased level, or justifiable means. The test profile shown in Figure IV of this report is based on the profile for Environmental Simulation (combined PWR/BWR) shown in Figure A1, Appendix A of IEEE 323-1974, with the addition of a simulated steam line break to 470°F on the first transient, 400°F on the second transient, plus higher temperatures on all plateaus after the LOCA.

6.4 Dielectric Voltage Withstand. Dielectric testing at 2200 VAC rms, 60 Hz in accordance with the UL Standard 486 A provides sufficient margin over normal service conditions for baseline measurements. Terminals of this type are normally applied to 300- or 600-volt rated wire or cable and used in systems not exceeding 480 volts rms.

6.5 Pull Out Force. The Pull Out requirements of this report are derived from commercial specification, UL Standard 486 A, Seventh Edition. These values are the accepted standard for this type of wire termination and are considered to provide adequate margin of safety over normal service conditions.

Ref: 3029-400 (1-7)