A-71
50-348/364-CIVP
2/20/92

APCo Exhibit 71

REV. 1
11/10/82

QUALIFICATION TYPE TEST REPORT

OF MULTI-POINT TERMINAL STRIPS FOR USE IN LIMITORQUE VALVE ACTUATORS FOR PWR SERVICE

PROJECT #681041

REPORT B0119

TEST PERFORMED 1 DECEMBER 1981 to 28 APRIL 1982

PREPARED BY LIMITORQUE CORPORATION
TEST LABORATORY

Prepared by _____
Charles H. Cox
Assistant Chief Test Engineer

Date July 1, 1982

Approved by _____
Walter J. Lenkowski

Accepted by _____
Joseph B. Brad

NUCLEAR REGULATORY COMMISSION

Docket No. 50-348/364-CivP — Exh. No. 71

In the matter of Alabama Power Company

Staff — IDENTIFIED 3:40 p.m. 2/20/92

Applicant ✓ — RECEIVED 3:41 p.m. 2/20/92

Intervenor — REJECTED

Contr

Contractor — DATE 2/20/92

Other — WITNESS

Reporter L Edap

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TEST LABORATORY

Prepared by Chas. H. Cox
Charles H. Cox
Assistant Chief Test Engineer

Date July 1, 1982

Approved by
Walter J. Denkowski

Accepted by J. B. Drake
Joseph B. Drake

TABLE OF CONTENT

LIST OF APPENDICES

1.0 INTRODUCTION

Several types of multi-point terminal strips (see Section 2.0-Identification of Test Samples) typically used in Limitorque valve actuators for service in a Pressurized Water Reactor (PWR) containment chamber in Nuclear Power Station application, were submitted for qualification to the type test specified by IEEE 382-72.*

As a vehicle for test sequences, a Limitorque SMB-0 valve actuator with a nuclear motor was fixtured to accept all test samples simultaneously. The terminal strips were then subjected to tests as sequenced in the Limitorque Terminal Block Qualification Test Procedure (Revision 4), including Thermal Aging and Mechanical Cycling, Irradiation, Seismic Testing, and Loss of Coolant Accident simulation, with acceptance criteria as specified in Appendix F.

*Note: Although the general type test procedure references IEEE 382-72, portions of the test involving heat aging and seismic tests reference IEEE 344-75 and IEEE 382-80.

2.0 *IDENTIFICATION OF TEST SAMPLES

Marathon 300	8 pt.	2 each
Marathon 1600	6 pt.	1 each
Buchanan 0222	6 pt.	1 each
Buchanan 0524	6 pt.	1 each
General Electric EB-5	6 pt.	1 each
Curtis Type "L"	6 pt.	1 each

*See photographs of test samples, Appendix J.

3.0 TYPE TEST PROCEDURE

The type test plan consists of the following basic sections and which were performed in the order shown. This is in accordance with IEEE 382-72 & 382-80.

1) Thermal and Electrical Aging
2) Irradiation
3) Seismic Testing
4) Loss of Coolant Accident Simulation
5) Post Test Inspection

3.1 Aging Test Procedures

3.1.1 Thermal Aging

The terminal strips were heat aged at the Limitorque Research and Development Laboratory to an effective age of forty years (minimum). Appendix A contains a data summary of the thermal age test.

3.1.2 Electrical Aging

Electrical Aging was performed at the Limitorque Research and Development Laboratory concurrent with

thermal aging. All test samples were wired in series to a 15 lb-ft nuclear motor which was mounted to an SMB-00 valve actuator located external to the heat age chamber. (See Figure 2). The SMB-00-15 was then operated through a full open-close-open cycle at rated torque (250 lb-ft) and thrust (14,000 lb.) values for a total of 2,000 operating cycles (minimum). Related data summarization can be found in Appendix B.

3.1.3 Radiation Aging

A total accumulative dose of 204 MegaRads was incurred by the terminal strip test samples.

Exposure criteria is discussed in Section 3.2 of this report.

3.2 Radiation Exposure

The test samples were subjected to gamma radiation by placing them in a Cobalt-60 field of 0.40 MegaRads per hour (average) at an air equivalent dose. A total accumulative dose of 204 MegaRads (minimum) was applied after thermal and electrical aging sequences were completed.

The radiation exposure was conducted at Isomedix, Inc., Parsippany, New Jersey, beginning on 24 December, 1981, and terminating on 23 January, 1982. A test certificate was supplied by Isomedix, Inc. and is presented in Appendix C. The test samples were returned to Limitorque Corporation at completion of irradiation.

3.3 Seismic Testing

The seismic tests were performed at Acton Environmental Testing Corporation, Acton, Massachusetts using a hydraulic, piston-actuated, single axis seismic simulator.

The test samples (mounted in a Limitorque SMB-0 housing) were subjected to a series of single frequency sine dwells performed at 1/3 octave intervals from 2.0 Hz. to 32 Hz. and at an acceleration of 6.0 g. At the lower frequencies, the shake table was operated at its maximum capabilities. Each dwell lasted a total of fifteen (15) seconds duration. During each 15 second dwell, a Limitorque SMB-00-15 actuator (with the motor wired to the test samples--in series) was operated (thrust seat-torque switch trip) a full open to close to open cycle. Testing was performed in each of the three mutually orthogonal axes.

A copy of Acton's Report #17346-82N appears as Appendix D.

3.4 Loss of Coolant Accident Simulation

The Loss of Coolant Accident (L.O.C.A.) simulation was performed at the Limitorque Research and Development Test Facility beginning

on 28 March, 1982, and ending on 28 April, 1982. All associated test data can be found in Appendix E.

3.4.1 Test Description

The test samples were mounted in an SMB-0 actuator arranged to breathe per standard containment actuator construction and wired according to Figure 3. The mounting position utilized is identical to that described in Limitorque's test report B-0058 as the worst case orientation. This assembly was then placed into a test chamber with all electrical wiring exiting the chamber through flexible conduit connections. External wires were attached (per Figure 3) to a conjunction for megger purposes and electrical operation of specified terminal strips. Pressure and temperature were monitored using a Fluke Datalogger. (Pressure-temperature profile is shown as Figure 4.)

Cooling coils mounted inside the test chamber provided cooling capacity to reduce temperature at various plateaus during the test profile.

A spray system was provided for delivery of the specified chemical solution during the test profile. Flow meters mounted on the exterior of the test chamber provided control and monitoring of the fluid flow. Spray information can be found in Appendix I.

3.4.2 Test Procedure for L.O.C.A. Test

The temperature/pressure profile illustrated in Figure 5 indicates the schedule for measuring insulation resistance of power and terminal strip leads, cycling of the SMB-00-15 actuator (external to the test chamber), and spray delivery.

Temperature and pressure was maintained during the entire test period (30 days) using periodic controlled injections of steam into the test chamber, coupled with heating elements attached beneath the test chamber. This insured a saturated atmosphere in the test chamber.

3.5 Post Test Inspection

A visual inspection of the test samples was made at the conclusion of the accident simulation. (See photographs, Appendix J.)

3.6 Final Inspection

A complete physical inspection of the test samples was made at conclusion of all tests. Results are indicated in Section 4.4.

4.0 TEST RESULTS

4.1 Acceleration Aging

4.1.1 Thermal Aging

Thermal aging was concluded on 18 December, 1981, having

subjected the test samples to a temperature of 138°C (dry air environment) for a total of 300 hours. See Appendix A for data summary of aging process.

4.1.2 Electrical Aging

Electrical Aging was concluded on 18 December, 1981 with a total of 2,002 cycles as described in Section 3.1.2. Related data summary can be found in Appendix B.

4.1.3 Radiation Aging

The exposure to radiation (gamma ray) of the test samples was completed on 23 January, 1982 at Isomedix, Inc. A total of 204 MegaRads (minimum) air equivalent dose was applied. A certificate of compliance can be found in Appendix C.

4.2 Seismic Testing

Seismic tests were concluded at Acton Environmental Testing Corporation on 10 March, 1982. The analyzed test data is presented in Acton Report #17346-82N (Appendix D).

No evidence of physical damage or malfunction was observed as a result of seismic testing.

4.3 Loss of Coolant Accident Test Results

The L.O.C.A. test was performed at the Limitorque Research and Development Laboratory, commencing on 28 March, 1982 and terminating on 28 April, 1982. All test samples performed in accordance with specified acceptance criteria (Appendix F).

4.4 Post Test Inspection

An inspection of the test samples after the L.O.C.A. test revealed:

1) Marathon 300 - Phenolic was unaffected (except for apparent chemical deposits) and electrical characteristics approached baseline readings at room ambient.

2) Marathon 1600 - Same as #1.

3) Buchanan 0222 - Same as #1.

4) Buchanan 0524 - Same as #1.

5) General Electric EB-5 - Same as #1.

6) Curtis Type "L" - Same as #1.

5.0 CONCLUSION *

It is concluded, based on the motor operator performance and the megger values measured during the test and attested to in this report, that the multi-point terminal strips described herein are suitable for use in Limitorque valve actuators for use in a Pressurized Water Reactor containment chamber in a Nuclear Power Station application in a loss of coolant accident condition.

*Note: It is noted that the megger reading of the G.E. EB-5 terminal block dropped in values slightly below those of the Marathon 300 terminal block. Prior experience with the G.E. EB-5 forces us to attribute this to an unexplained random situation that forced the megger readings below their expected value. In a recent proprietary containment chamber test (that was more severe), a spare contact of a G.E. EB-5 terminal block was meggered throughout the test with a minimum recorded value of 4 K-ohms.

APPENDIX A

THERMAL AGING DATA SUMMARY

1.0 SPECIFICATIONS

1.1 Specimen Identification

(See Section 2.0 of this report.)

1.2 Test

(Reference Procedures)

1.2-1 Temperature	138°C (280°F) max. 141.55°C (286.8°F) min. 136.61°C (277.9°F)
1.2-2 Duration	300 hours
1.2-3 Environment	Dry Air

2.0 RESULTS

The test samples have been tested at a temperature of 138°C for 300 hours to yield an accelerated life of 40 years (minimum). Testing was begun on 4 December, 1981, and completed on 18 December, 1981. Resistance data taken before and after thermal aging (photographs in Appendix J) can be found in Appendix E, Tables 1 through 7.

APPENDIX B

ELECTRICAL AGING DATA SUMMARY

1.0 SPECIFICATIONS

1.1 Specimen Identification

(See Section 2.0 of this report)

1.2 Test

1.2-1	Total number of cycles during thermal aging	2,002
	(a) Number of cycles per hour during cycling sequences	@ 7

Note: Additional, unrecorded cycles were incurred during setup procedures.

2.0 RESULTS

The test specimens were electrically aged, having been subjected to simulated operating current loads a total of 2,002 cycles.

Testing was conducted at the Limitorque Research and Development Laboratory beginning on 4 December, 1981 and concluding once 2,000 cycles had been reached (before 18 December, 1981).

APPENDIX C

CERTIFICATE OF IRRADIATION

ISOMEDIX

February 11, 1982

Mr. Charles Cox
Limitorque Corporation
P.O. Box 11318
Lynchburg, Virginia 24502

Dear Mr. Cox:

This will summarize parameters pertinent to the irradiation of one (1) SMB-0-15 Valve Actuator, as per your Purchase Order No. RD-416 dated December 9, 1981.

The actuator was exposed for a period of 529 hours at an average dose rate of 0.40 megarads. The calculated dose based on dosimetry is 211 megarads. Halfway through the exposure, the specimen was rotated 180 degrees to give a more uniform dose distribution.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeter, utilizing a Bausch and Lomb Model 710 spectrophotometer as the readout instrument. This system is calibrated directly with NBS, with the last calibration being September 08, 1981. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the samples somewhat, but the temperature did not exceed 120 degrees F, as indicated by previous measurements on an oil solution in the same relative position.

Irradiation was initiated on December 24, 1981 and was completed on January 23, 1982.

Very truly yours,

ISOMEDIX, INC.

David P. Constantine

David P. Constantine
Production Manager

DC/mjb

cc: Mr. George Dietz

APPENDIX D

SEISMIC TEST REPORT

ACTON ENVIRONMENTAL TESTING CORPORATION

Test Report No. 17346-82N
Revision 1 - 7/21/82

No. of Pages 16

Report of Test

FOR

SEISMIC TESTING OF SEVEN (7)
MULTIPOINT TERMINAL BLOCKS
FOR LIMITORQUE CORPORATION
R&D PROJECT #681041

Purchase Order No. RD-472

Prepared by: Timothy W. Fofoff Date 3/29/82
Timothy W. Fofoff, Project Engineer
Acton Environmental Testing Corporation
533 Main Street, Acton, Massachusetts 01720

Reviewed & Approved by: William C McGinnis Date 4-2-82
William C. McGinnis, Chief Dynamics Test Engineer
Acton Environmental Testing Corporation

TWF/tjw

REVISION RECORD

DATE	REVISION NUMBER	PAGE NUMBER	PARAGRAPH NUMBER	CHANGES OR ADDITIONS	APPROVED BY
	0	----------FIRST ISSUE----------			
7/21/82	1	Cover - page 7		Report edited in its entirety to reflect a change from the vehicle actuator to the terminal blocks as the test item	

ACTON ENVIRONMENTAL TESTING CORPORATION

ADMINISTRATIVE DATA

1.0 PURPOSE OF TEST: Seismic testing of seven (7) multipoint terminal blocks for Limitorque Corporation R&D Project No. 681041

2.0 MANUFACTURER: Limitorque Corporation
P.O. Box 11318
Lynchburg, VA 24506

3.0 MANUFACTURER'S TYPE OR MODEL NO.: N/A

4.0 DRAWING, SPECIFICATION OR EXHIBIT: Limitorque Test Procedure Project No. 681041

5.0 QUANTITY OF ITEMS TESTED: Seven (7)

6.0 SECURITY CLASSIFICATION OF ITEMS: Unclassified

7.0 DATE TEST COMPLETED: March 10, 1982

8.0 TEST CONDUCTED BY: M. Cormier

9.0 DISPOSITION OF SPECIMENS: Returned to Limitorque Corporation

10.0 ABSTRACT: Refer to Section 4.0

Report No. 17346-82N
Rev. 1

ENVIRONMENTAL ACTON TESTING CORPORATION

1.0 TEST ITEM

Seven (7) selected multipoint terminal blocks were submitted by Limitorque Corporation for seismic testing at the Acton Environmental Testing Corporation. The terminal blocks were tested in accordance with the seismic test procedure for Limitorque R&D Project No. 681041.

2.0 TEST REQUIREMENTS

The purpose of the test was to subject the SMB-0 Actuator to seismic aging for an environmental qualification test of selected multipoint terminal blocks.

3.0 TEST PROCEDURES

3.1 Test Mounting

The multipoint terminal blocks were mounted inside the switch compartment of an SMB-0 Actuator. The SMB-0 Actuator was bolted to an aluminum fixture. The actuator/fixture plate assembly was rigidly clamped to the single axis hydraulic shaker for the seismic dwell testing. The SMB-0 Actuator was wired in series through the terminal blocks to an SMB-00 Actuator Motor mounted on a special fixture. The motor mounted on the special fixture was not included during the seismic testing. All mounting fixtures were supplied by Limitorque.

3.2 Test Conditions

The SMB-00 Actuator Motor was arranged to operate simulating thrust seat (torque switch trip) in one direction and position seat in the alternate (open) direction. The stroke time was set for six (6) seconds.

3.3 Test Monitoring

The terminal blocks housed within the SMB-0 Actuator were visually monitored for any evidence of mechanical damage or deterioration by Limitorque personnel.

3.3 Test Monitoring (continued)

The SMB-0 Actuator was instrumented with three (3) triaxial groups of accelerometers. The accelerometers were located as follows: .

ACCELEROMETER	SENSE	LOCATION
1	V	On fixture
2	H_1	
3	H_2	
4	V	On rotor end cap
5	H_1	
6	H_2	
7	V	On Actuator SMB-0
8	H_1	
9	H_2	

H_1 - Parallel to the Motor Axis

H_2 - Perpendicular to the Motor Axis

V - Vertical

Outputs from all accelerometers, through appropriate signal conditioning, were recorded on visicorder recording paper, which is included with this report.

The terminal blocks were monitored for functional integrity by the operation of the SMB-00 Actuator via wiring through the terminal blocks.

3.4 Sine Dwell Test

The sine dwell test was performed in three (3) mutually orthogonal axes of excitation, two (2) horizontal and one (1) vertical. The test consisted of a sinusoidal waveform of 15 seconds duration, with peak horizontal or vertical accelerations of 6g at each of the following frequencies; 2.0, 2.5, 3.15, 4.0, 5.0, 6.3, 8.0, 10, 12.5, 16.0, 20.0, 25.0, 32.0, and 35.0 Hz. Due to limitations of the shaker table, the maximum accelerations at 2.0 and 2.5 Hz were 4g 5g, respectively.

During each dwell, the SMB-00 Actuator was operated through a full close-stroke-open-stroke cycle via terminal blocks mounted in the SMB-0 Actuator.

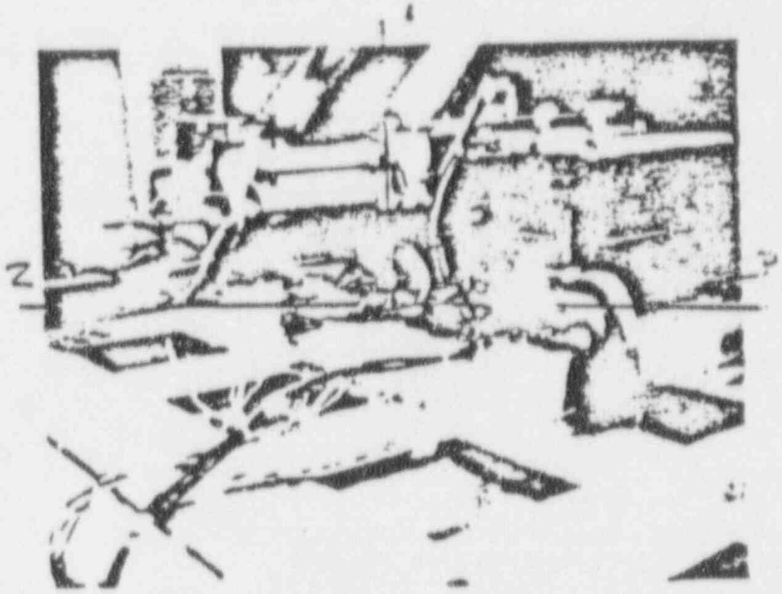
At the completion of the dwell testing in all three (3) axes of the SMB-0 Actuator, the SMB-00 Actuator was operated from open-to-close back to open. The terminal blocks mounted in the SMB-0 switch compartment were examined by Limitorque personnel.

4.0 TEST RESULTS

No anomalies in operation of the seven (7) multipoint terminal blocks were encountered during the sine dwell testing of the terminal blocks in any of the three (3) axes of excitation of the vehicle SMB-0 Actuator.

At the conclusion of the testing, the terminal blocks within the SMB-0 switch compartment were visually inspected by Limitorque personnel.

5.0 PHOTOGRAPHS



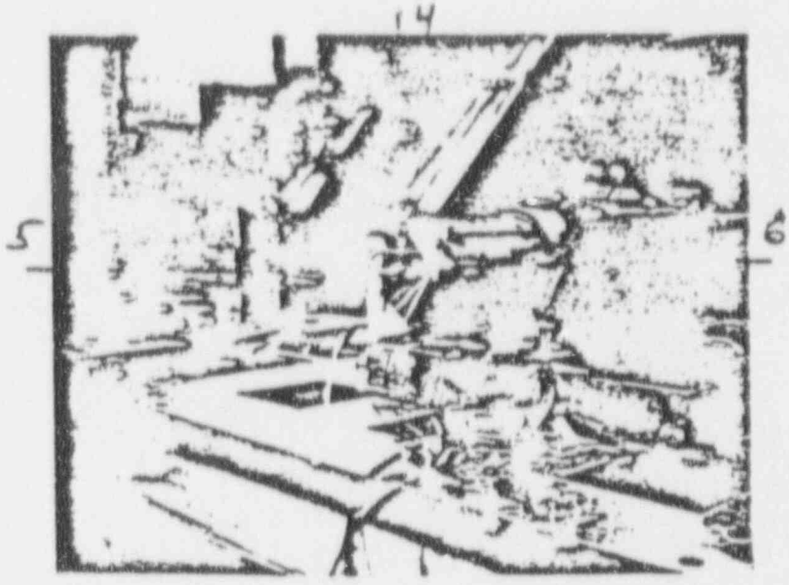
PHOTOGRAPH 1

SMB-0

LOCATION OF ACCELEROMETERS 1, 2, AND 3

Report No. 17346-P2N

ACTON ENVIRONMENTAL TESTING CORPORATION



PHOTOGRAPH 2

SMB-0

LOCATION OF ACCELEROMETERS 4, 5, AND 6

PHOTOGRAPH 3

SMB-0

LOCATION OF ACCELEROMETERS 7, 8, AND 9

Report No. 17346-82N

PHOTOGRAPH 4

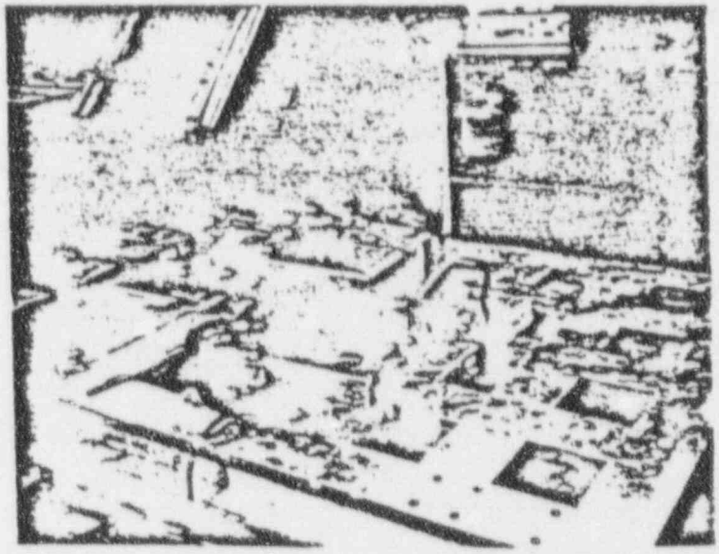
SMP-^

VERTICAL (V) AXIS OF EXCITATION

TEST #1

Report No. 17346-82N

ACTON ENVIRONMENTAL TESTING CORPORATION



PHOTOGRAPH 5

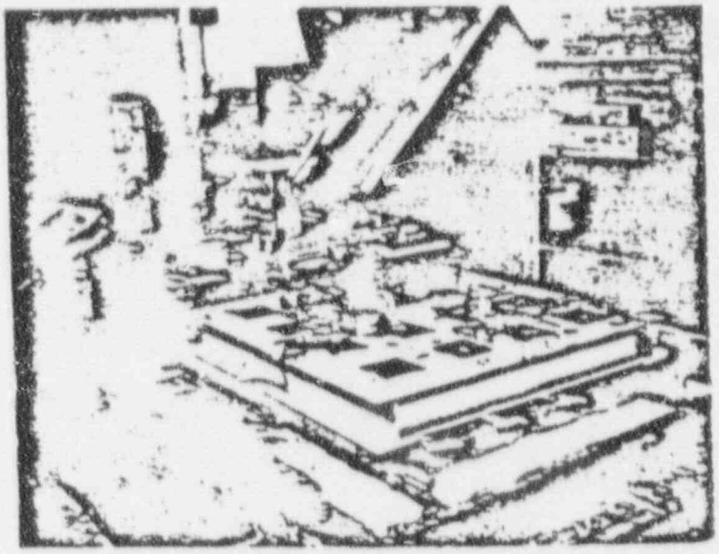
SMB-0

HORIZONTAL (H_1) AXIS OF EXCITATION
PARALLEL TO MOTOR AXIS

TEST #2

Report No. 17346-82N

ACTON ENVIRONMENTAL TESTING CORPORATION



PHOTOGRAPH 6

SMB-0

HORIZONTAL (H_2) AXIS OF EXCITATION
PERPENDICULAR TO MOTOR AXIS

TEST #3

Report No. 17346-82N

6.0 TEST EQUIPMENT LIST

TEST EQUIPMENT LIST

NAME	MFGR.	MODEL	SER.NO.	RANGE	ACCURACY	INV.#	CAL.FREQ.
Accelerometer	PCB	302A	4442	1 Hz - 5 KHz	±5%	AC335	6 months
Accelerometer	PCB	302A	4437	1 Hz - 5 KHz	±5%	AC343	6 months
Accelerometer	PCB	302A	2833	1 Hz - 5 KHz	±5%	AC359	6 months
Accelerometer	PCB	302A	2845	1 Hz - 5 KHz	±5%	AC383	6 months
Accelerometer	PCB	302A	695	1 Hz - 5 KHz	±5%	AC385	6 months
Accelerometer	PCB	302A	2852	1 Hz - 5 KHz	±5%	AC394	6 months
Accelerometer	PCB	302A	2855	1 Hz - 5 KHz	±5%	AC410	6 months
Accelerometer	PCB	302A	1817	1 Hz - 5 KHz	±5%	AC435	6 months
Accelerometer	PCB	302A	1820	1 Hz - 5 KHz	±5%	AC436	6 months
W/B Decade Amplifier	ALI	500A	858	5 to 1 MHz ±1dB Output 20V/20k Ohm	±1%	AM302	OFS
Scope, Storage	TEK	T912	T912 B011852	DC - 10 MHz Dual Trace	±3%	OS302	6 months
Earthquake Simulator Hydraulic Actuator	MTS	908.34-01 204.63S		24" DA max. DC-200 Hz, 22K force lbs	±5% ampl	PE367	6 months
Controller	MTS	443.115		DC to 2000 Hz	±1%	PE367	
Power Supply	Dennison	Mod. 63		120 GPM Max. 3K-5K psi max 250 HP	NA		
Power Supply	PCB	483A	299	12 Channel Gain: X1	±2%	PE379	6 months
Visicorder	HON	1508	161715R	12 Channel - Metric	±1 db	RE347	6 months
Visicorder	HON	1508	15-419	12 Channels, 8" Paper	±1 db	RE349	6 months
Sweep Oscillator	Ling	CO-100A (701C)	120	0.2 Hz to 5.0 KHz 0.1 to 9.9 octave/minute	±1%	SG321	6 months

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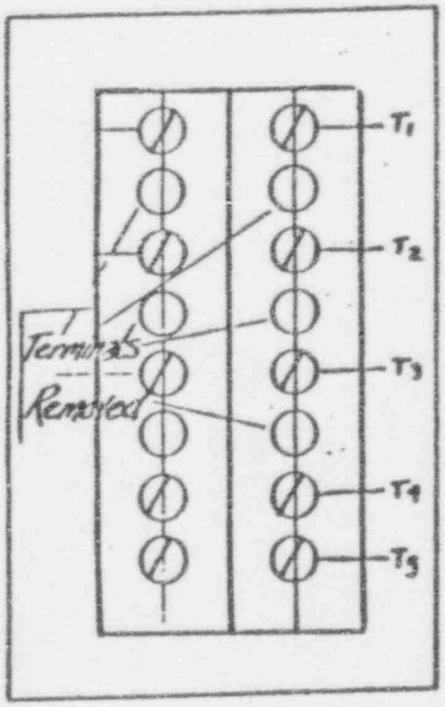
APPENDIX E

L.O.C.A. DATA SUMMARY

INSULATION RESISTANCE TERMINAL LEADS

TERMINAL IDENTIFICATION MARATHON 300 (Alternate)

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

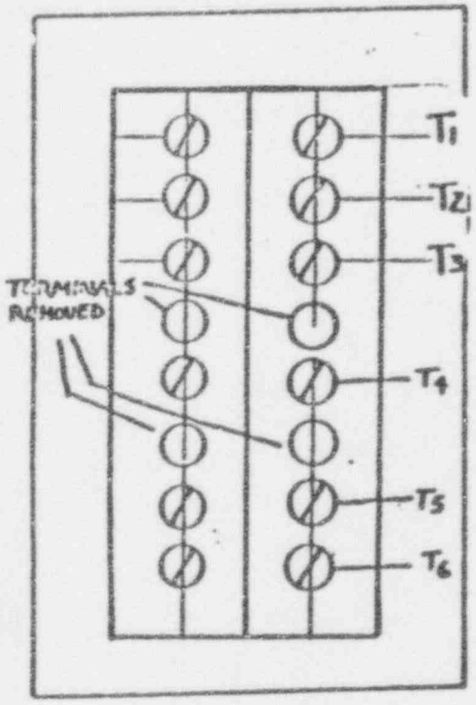
DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T_1	T_2	T_3	T_4	T_5						
12/4/81	A	∞	∞	∞	∞	∞						
12/18/81	B	∞	∞	∞	∞	∞						

* EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

INSULATION RESISTA TERMINAL LEADS

TERMINAL IDENTIFICATION MARATHON 300 (PRIMARY)

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T_1	T_2	T_3	T_4	T_5	T_6					
12/4/81	A	∞	∞	∞	∞	∞	∞					
12/18/81	B	∞	∞	∞	∞	∞	∞					

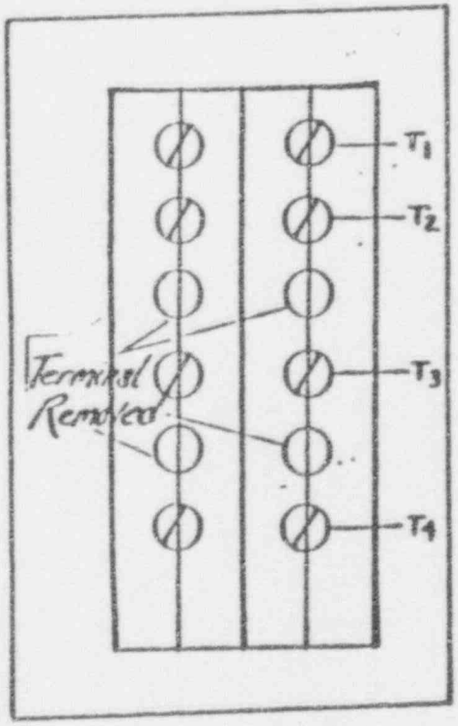
* EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

TABLE II

INSULATION RESISTA TERMINAL LEADS

TERMINAL IDENTIFICATION BUCHANAN 0524

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

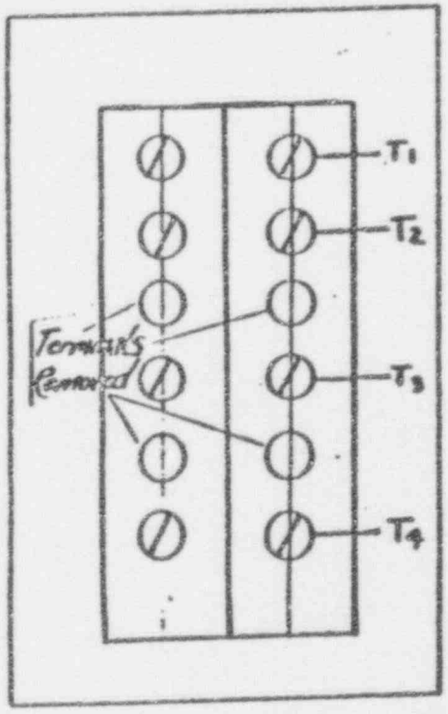
DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T1	T2	T3	T4							
12/4/81	A	∞	∞	∞	∞							
12/18/81	B	∞	∞	∞	∞							

*
EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

INSULATION RESISTAN TERMINAL LEADS

TERMINAL IDENTIFICATION BUCHANAN 0222

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T1	T2	T3	T4							
12/4/81	A	∞	∞	∞	∞							
12/10/81	B	∞	∞	∞	∞							

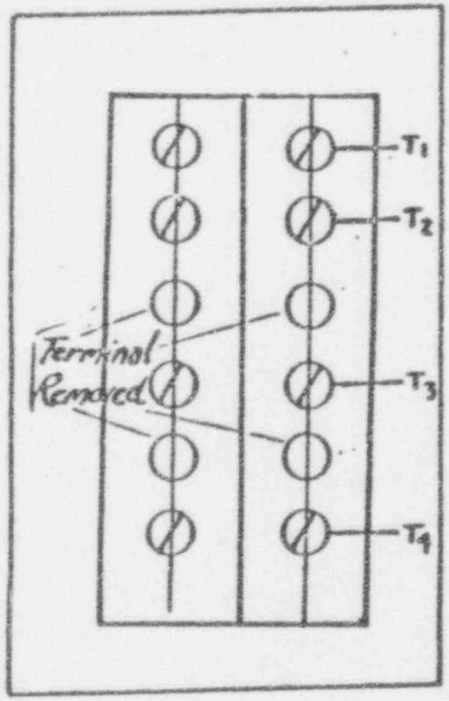
* EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

TABLE 14

INSULATION RESISTANCE : TERMINAL LEADS

TERMINAL IDENTIFICATION CURTIS "L"

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T_1	T_2	T_3	T_4							
12/4/81	A	∞	∞	∞	∞							
12/16/81	B	∞	∞	∞	∞							

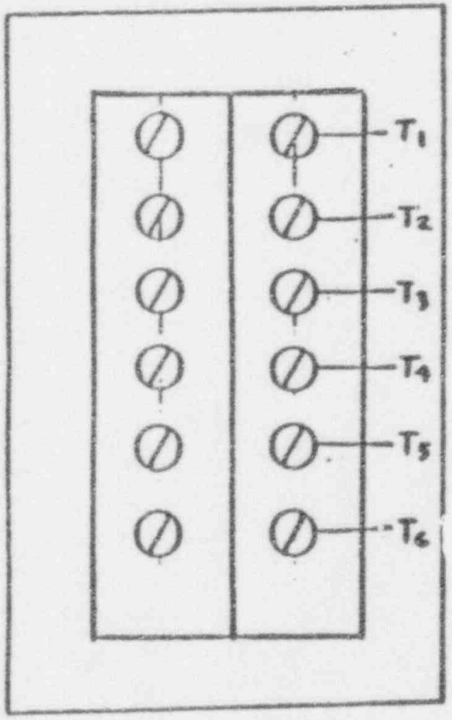
* EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

TABLE V

INSULATION RESISTANCE TERMINAL LEADS

TERMINAL IDENTIFICATION MARATHON 1600

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T_1	T_2	T_3	T_4	T_5	T_6					
12/4/81	A	∞	∞	∞	∞	∞	∞					
12/18/81	B	∞	∞	∞	∞	∞	∞					

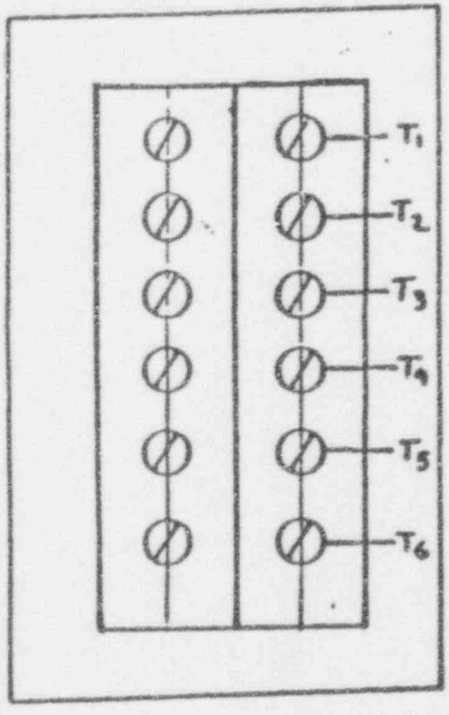
*
EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

TABLE VI

INSULATION RESISTAN TERMINAL LEADS

TERMINAL IDENTIFICATION GE-EB-5

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T_1	T_2	T_3	T_4	T_5	T_6					
12/4/81	A	∞	∞	∞	∞	∞	∞					
12/18/81	B	∞	∞	∞	∞	∞	∞					

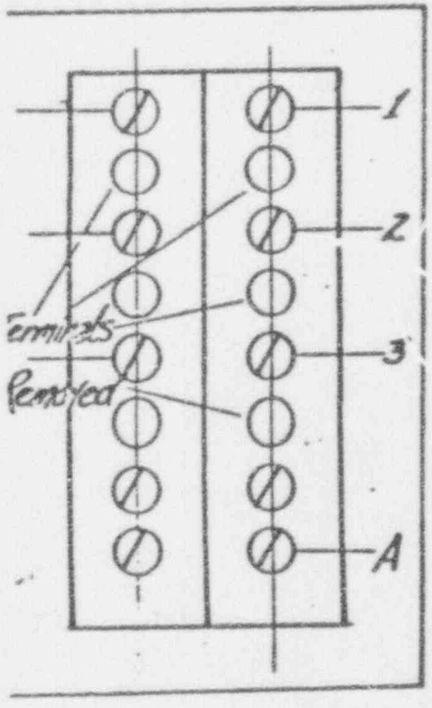
* EVENT A - PRE-THERMAL AGE
EVENT B - POST-THERMAL AGE

TABLE VII

INSULATION RESISTANCE — TERMINAL LEADS

TERMINAL IDENTIFICATION MARATHON 300 (Alternate power loads)

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND) 1		2		3		A		LEAD TO LEAD 1/2	2/3	3/A
3/29/82	0	>2000		>2000		>2000		>2000				
3/29/82	1	40K		100K		200K		100K				
3/29/82	2	9.0		9.0		100		5.0				
3/29/82	3	5.0		3.0		1.0		3.0				
3/29/82	4	100K		100K		100K		40K				
4/12/82	5	1K		.9K		.9K		400K		4.4	4.0	3.5
4/12/82	6	80K		40K		15K		1K		15K	20K	10K
4/28/82	7	5K		4K		4K		7.5K		7.5K	7.5K	5K
4/23/82	8	40K		400K		40K		15K		1.0	600K	100K

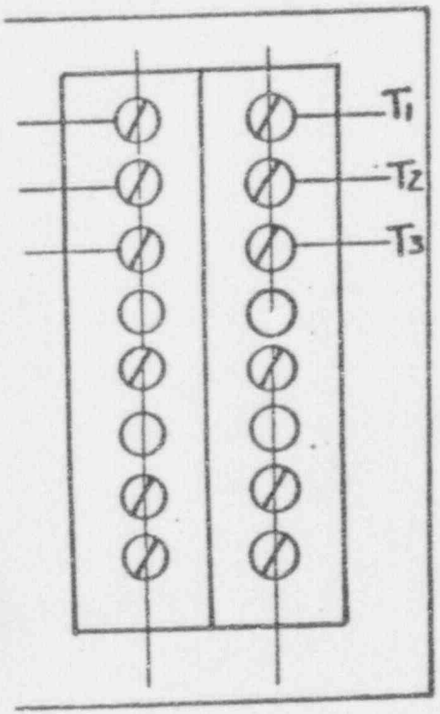
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE 1

INSULATION RESISTANCE — MINAL LEADS

TERMINAL IDENTIFICATION MARATHON 300 (Motor Leads)

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	* EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		T1		T2		T3						
3/29/82	0	>2000		>2000		>2000						
3/29/82	1	400K		400K		400K						
3/29/82	2	8.0		8.0		8.0						
3/29/82	3	1.5		600K		600K						
3/29/82	4	200K		200K		200K						
4/2/82	5	5K		5K		5K						
4/12/82	6	5K		5K		5K						
4/28/82	7	7.5K		7.5K		7.5K						
4/28/82	8	1.5		1.5		1.5						

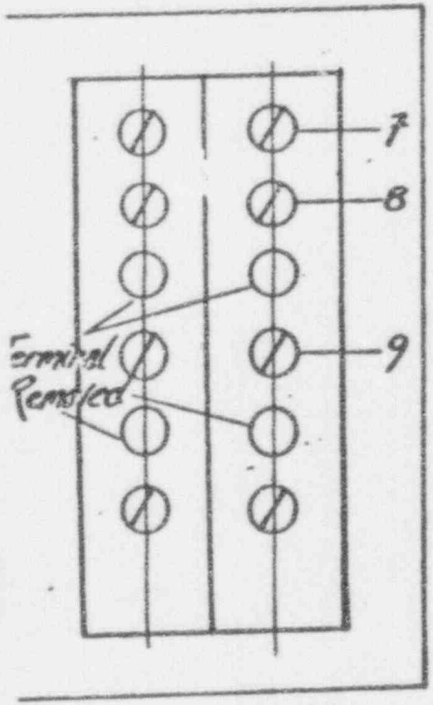
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE 11

INSULATION RESISTANCE JUNAL LEADS

TERMINAL IDENTIFICATION Buchanan 0524

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		7		8		9				7/8		8/9
3/29/82	0	>2000		>2000		>2000						
3/29/82	1	15		2		2						
3/29/82	2	2		2		500K						
3/29/82	3	5		7.5		1						
3/29/82	4	100K		600K		200K						
4/2/82	5	2K		1K		1K				15		2.0
4/12/82	6	40K		40K		20K				15K		15K
4/28/82	7	75K		75K		4K				75K		75K
4/28/82	8	1		100K		40K				1.5		100K

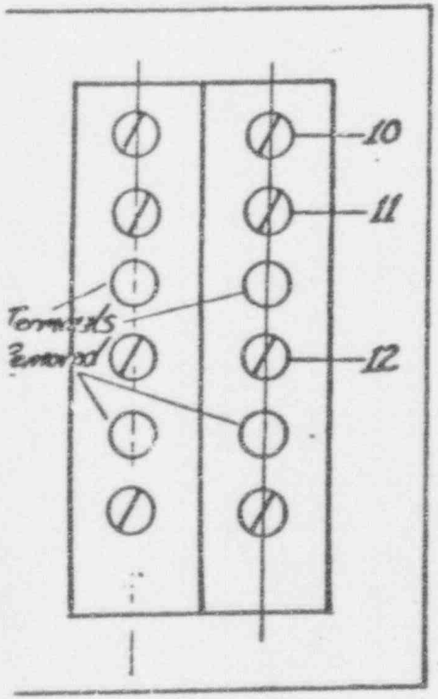
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE III

INSULATION RESISTANC .RMINAL LEADS

TERMINAL IDENTIFICATION BUCHANAN 0222

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	* EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		10		11		12				10/11		11/12
3/29/82	0	>2000		>2000		>2000						
3/29/82	1	1.0		800K		40K						
3/29/82	2	300K		200K		300K						
3/29/82	3	1.5		10		1.0						
3/29/82	4	100K		40K		40K						
4/2/82	5	3K		1.5K		3K				4.5		5.2
4/12/82	6	40K		40K		40K				40K		40K
4/28/82	7	10K		5K		10K				10K		15K
4/28/82	8	200K		200K		600K				400K		800K

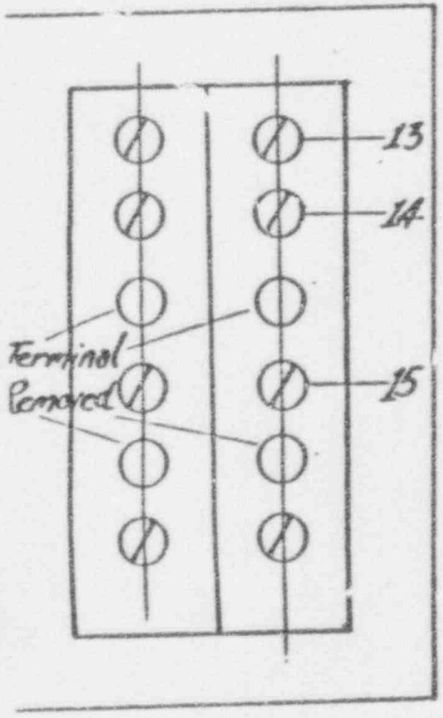
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE IV

INSULATION RESISTANCE ... MINAL LEADS

TERMINAL IDENTIFICATION Curtis "L"

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	* EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		13		14		15				13/14		14/15
3/29/82	0	>2000		>2000		>2000						
3/29/82	1	200K		200K		600K						
3/29/82	2	10K		10K		40K						
3/29/82	3	200K		200K		400K						
3/29/82	4	7.5K		4K		15K						
4/2/82	5	800K		700K		1K				2		2.8
4/12/82	6	7.5K		5K		5K				5K		7.5K
4/28/82	7	1.5K		1.5K		1.5K				2K		5K
4/28/82	8	15K		7.5K		7.5K				20K		15K

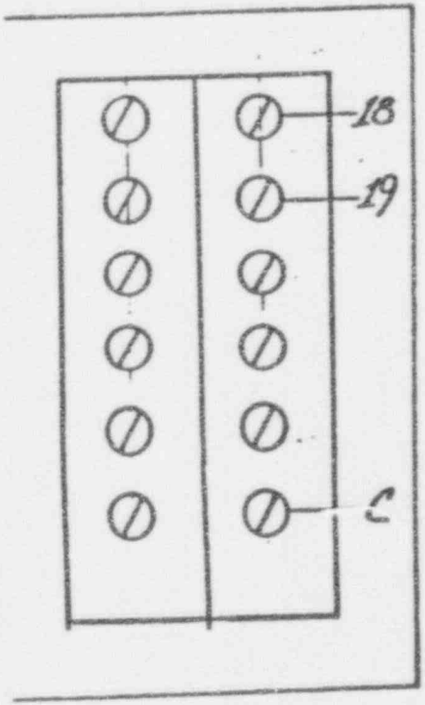
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE V

INSULATION RESISTANCE — MINAL LEADS

TERMINAL IDENTIFICATION MARATHON 1600

TERMINAL CONFIGURATION



ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	* EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		18		19		C				18/19		A/C
3/29/82	0	>200		>200		>200						
3/29/82	1	200K		200K		2.0						
3/29/82	2	100K		200K		100K						
3/29/82	3	200K		200K		200K						
3/29/82	4	7.5K		10K		10K						
4/2/82	5	1.5K		1.5		1K				2.2		2.0
4/12/82	6	7.5K		10K		7.5K				5K		10K
4/28/82	7	3K		4K		3K				3K		5K
4/28/82	8	40K		40K		40K				40K		80K

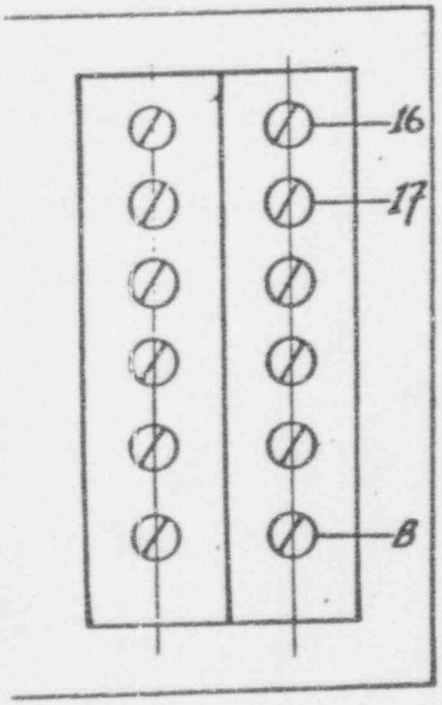
* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE VI

INSULATION RESISTANCE MINAL LEADS

TERMINAL IDENTIFICATION GE-EB-5

TERMINAL CONFIGURATION



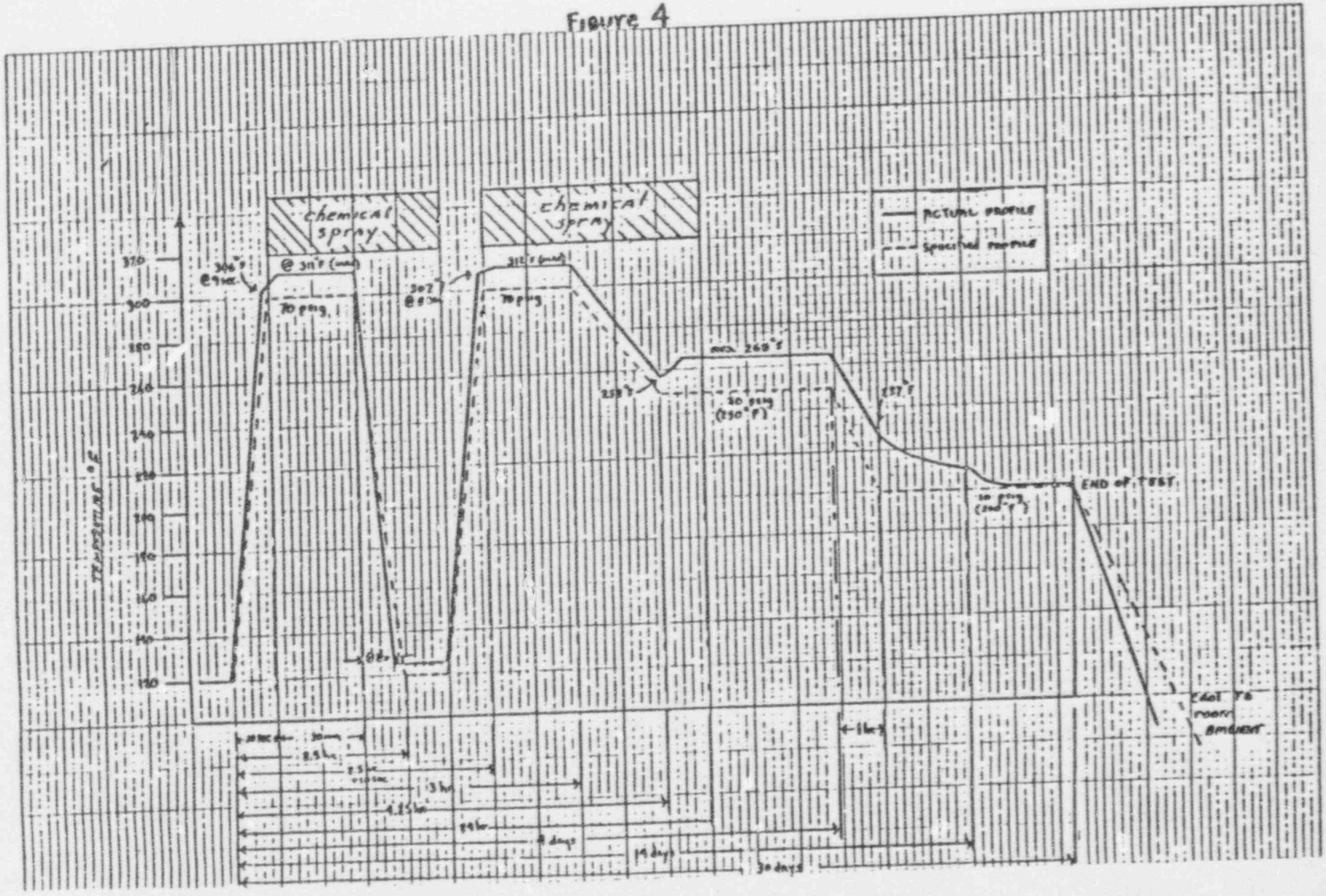
ALL RESISTANCE MEASUREMENTS IN MEG-OHMS UNLESS OTHERWISE INDICATED

DATE	*EVENT	TERMINAL DESIGNATION (LEAD TO GROUND)								LEAD TO LEAD		
		16	17		B					16/17		17/B
3/29/82	0	>2000	>2000		>2000							
3/29/82	1	100K	200K		1.5							
3/29/82	2	400K	2.0		100K							
3/29/82	3	200K	200K		800K							
3/29/82	4	40K	40K		20K							
4/2/82	5	.7K	.8K		.5K					1.3		1.8
4/2/82	6	10K	10K		7.5K					7.5K		10K
4/28/82	7	2K	3K		2K					3K		5K
4/28/82	8	15K	40K		4K					40K		120K

* REFER TO FIGURE 5 FOR ACCIDENT PROFILE/EVENT CORRELATION

TABLE V11

Figure 4


chemical spray
chemical spray
ACTUAL PROFILE
SPECIFIED PROFILE
370
300
280
260
240
220
200
180
160
140
120
306°F @ 9 min.
@ 311°F (max)
70 psig
207 @ 8 min.
312°F (max)
70 psig
max 269°F
259°F
20 psig (250°F)
257°F
END OF TEST
20 psig (200°F)
Cool to room AMBIENT
30 sec
30 min
8.5 hr
2.5 min
2.5 min
3 hr
4.5 hr
9 hr
4 days
19 days
30 days
1 hr

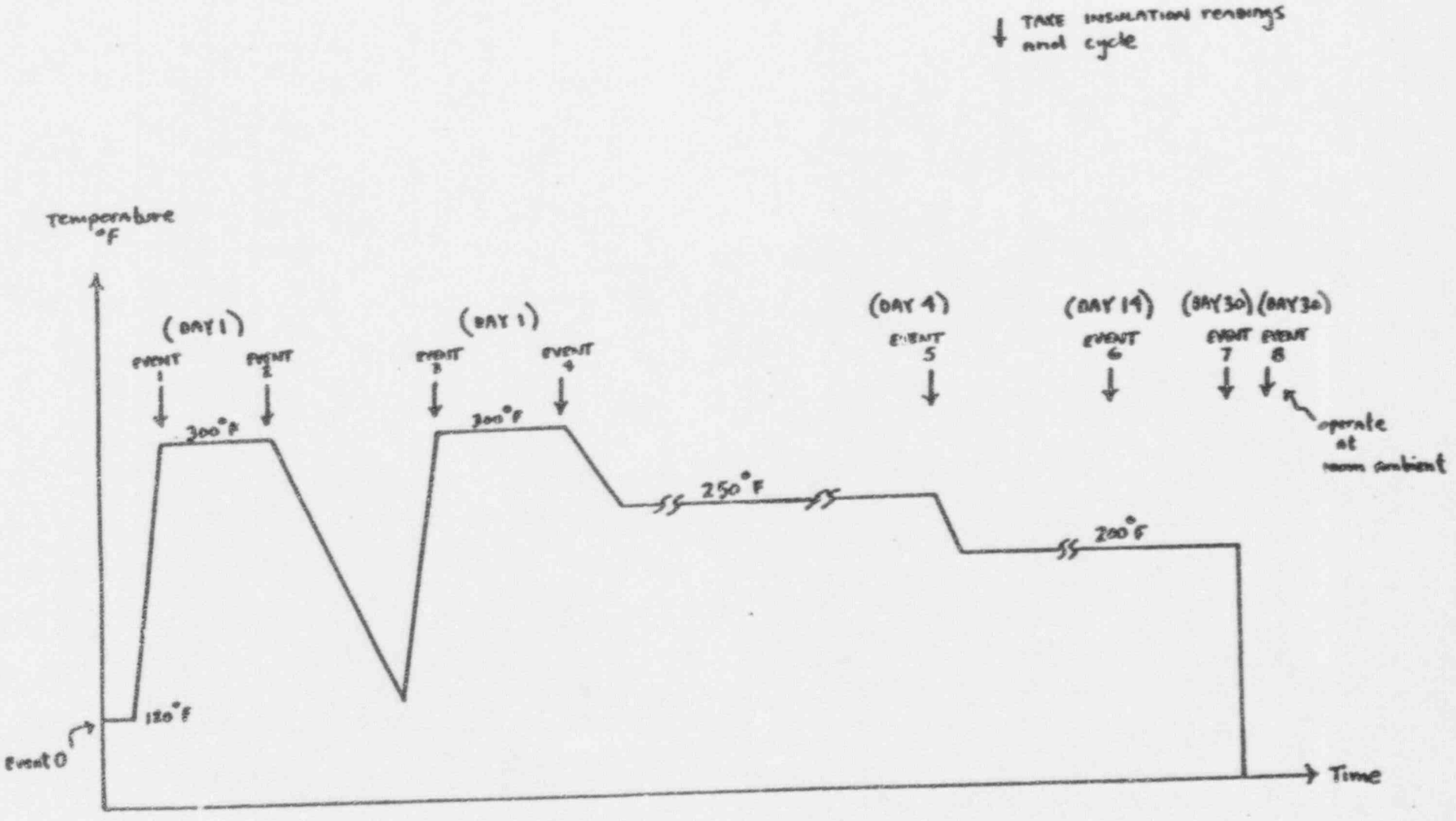

↓ TAKE INSULATION readings and cycle
Temperature °F
(DAY 1)
EVENT 1
EVENT 2
(DAY 1)
EVENT 3
EVENT 4
(DAY 4)
EVENT 5
(DAY 14)
EVENT 6
(DAY 30)
EVENT 7
(DAY 36)
EVENT 8
operate at room ambient
300°F
300°F
250°F
200°F
120°F
Event 0
Time

Figure 5

APPENDIX F

ACCEPTANCE CRITERIA

Terminal Strip Environmental Test Acceptance Criteria

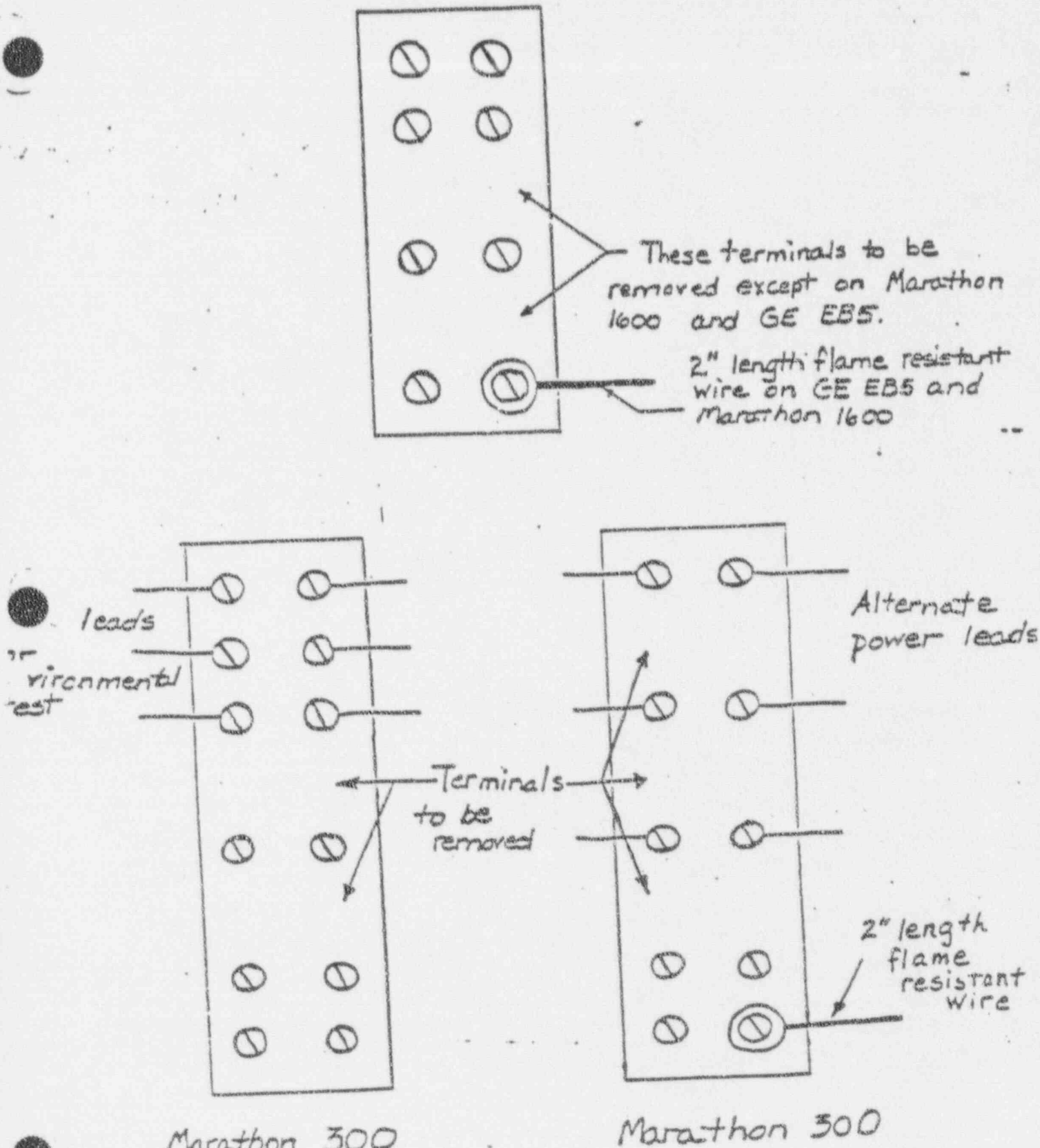
The acceptance criteria is based on the motor operator's ability to function during the loca test. Power to the motor is connected to the two Marathon 300 terminal blocks.

Therefore, the lowest megger value measured on either of the two (2) Marathon 300 terminal blocks is considered the minimum megger value acceptable on the remainder of the test samples.

APPENDIX G

WIRING DIAGRAMS

Figure 1- Wiring Arrangement



THERMAL/ELECTRIC [illegible]ISHIC AGE WIRING DIAGRAM

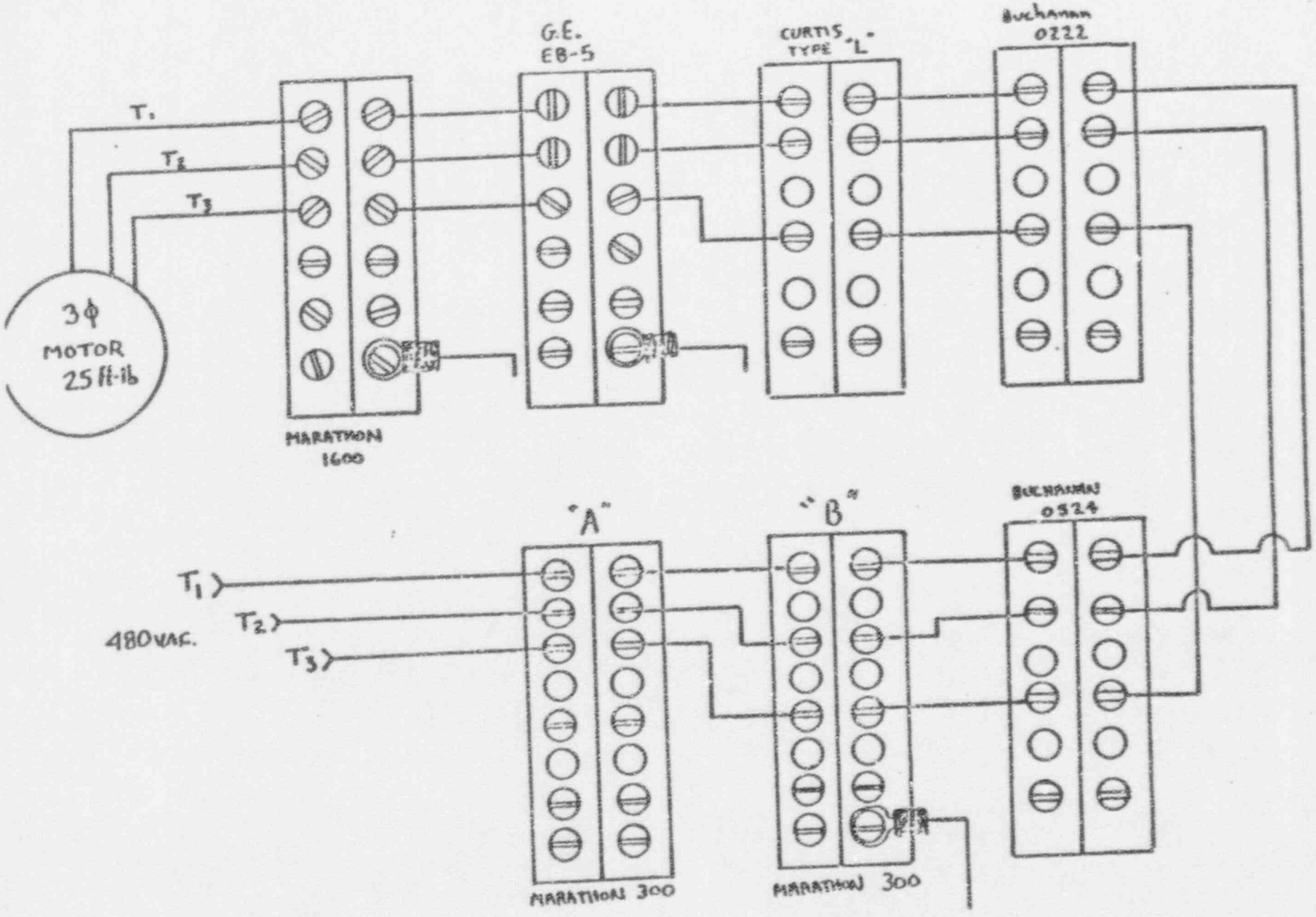
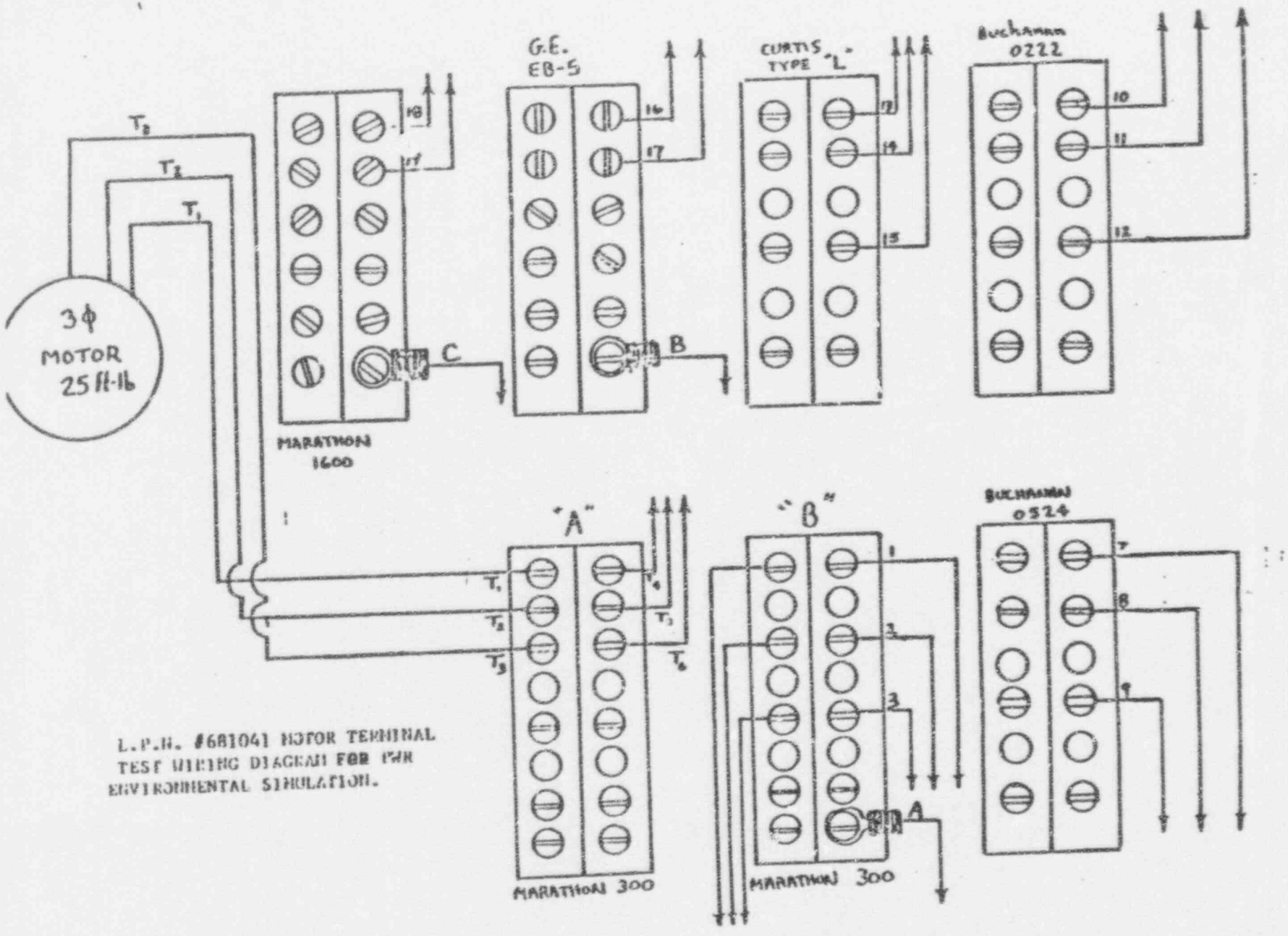


Figure 2



L.P.H. #681041 MOTOR TERMINAL TEST WIRING DIAGRAM FOR PWR ENVIRONMENTAL SIMULATION.

Figure 3

APPENDIX H

INSTRUMENTATION LIST

ORI

CALIBRATION/INSTRUMENTATION AGENDA 3/2 : L.P.N. # 68104-1

TYPE TEST: PWR Environmental - 30 Day Profile CUSTOMER: Terminal Test

ITEM #	INSTRUMENT	MANUFACTUKER	MODEL #	SERIAL #	CALIBRATION LAST	CALIBRATION DUE
1	Data Logger	J.B. Fluke	2240C	2030005	11/81	11/82
2	Graphic Watcher	Esterline Angus	A601C	192358	5/82	5/83
3	Oscillographic Recorder	Gen'l	2600	00781	5/82	5/83
4	Digital VOM	J.B. Fluke	8000A	09034163	8/81	8/82
5	Precision Calibrator	Bill Electronics	625	3426	2/82	2/83
6	Digital Current Meter	F.W. Bell	1776	104785	5/81	5/82
7	115 V A/DC Converter	Gould	13-4418-10	00252	5/82	5/83
8	Bridge Amplifier	Gould	13-4615-30	015208	5/82	5/83
9	DC Amplifier	Gould	13-2615-00	10158	3/82	5/83
10	Flowmeter	Fischer & Porter	10A7559	3RF235A0233A1	12/81	12/82
11	Megar Megger	J.G. Biddle	21159	73-2521	7/81	7/82
12	Pressure Trans.	Paine	212-75-030-07	34577	12/81	6/82
				45078	12/81	12/82
					6/81	6/82
13	Pressure Gage	Safecare/Marsh	R9-73		3/81	3/82
14	Load Cell 50K	Lebow	3474	343		
15-19	Thermocouple	Omega	Type J	018	5/81	5/82
				019	5/81	5/82
				021	5/81	5/82
				022	5/81	5/82
				039	5/82	5/83
20-25	Paul Meters	Triplett	N/A	TE002-V1	2/82	8/82
				V2	2/82	8/82
				V3	2/82	8/82
				TE002-A1	4/81	4/82
				A2		
				A3		

FORM P-70

APPENDIX I

CHEMICAL SPRAY SOLUTION

The test samples (mounted in a Limitorque SMB-0 valve actuator) were sprayed uniformly for 24 hours at periods indicated on Figure 4. The chemical spray solution was prepared using Table 1 of IEEE 382-1972. A sample of the solution was collected for analysis with a copy of the analysis report appearing in this appendix. The desired concentration is 3000 ppm Boron with pH of 10.5.

The flow rate was maintained at approximately .4 gpm.

Analytics
P.O. Box 25249
Richmond, VA 23260

ANALYTICS NO. S0063965
ACCOUNT NO. 63231
DATE May 10, 1982

Limitorque Corp.
5114 Woodall Road
Lynchburg, VA 24506

Attention: Charles Cox

SAMPLE OF: Liquid - 681041

DATE RECEIVED: April 15, 1982

REMARKS: mg/L = milligrams per liter

	RESULT
pH	11.2
Boron	2950 mg/L

R.A. West, Jr.
R.A. West, Jr.

APPENDIX J

PHOTOGRAPHS

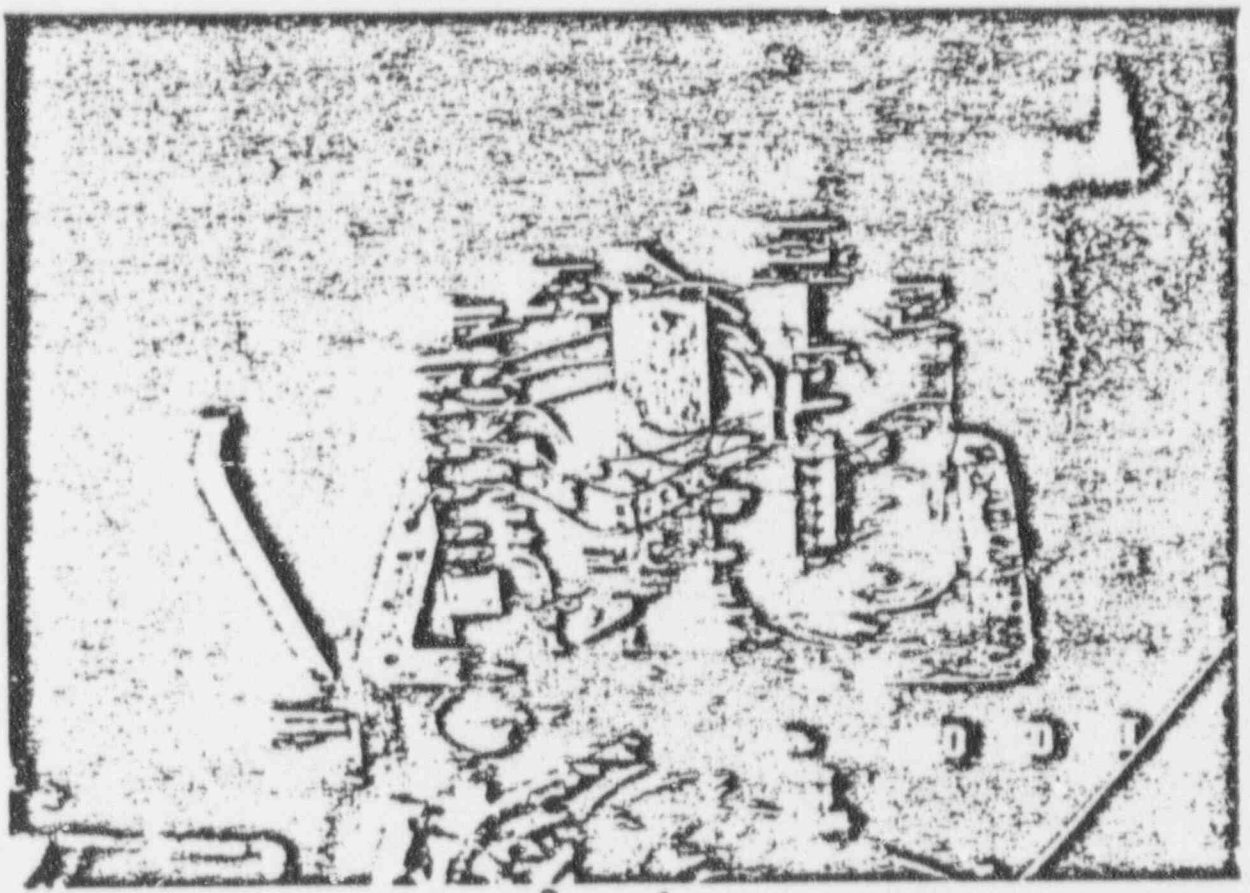


Figure 6

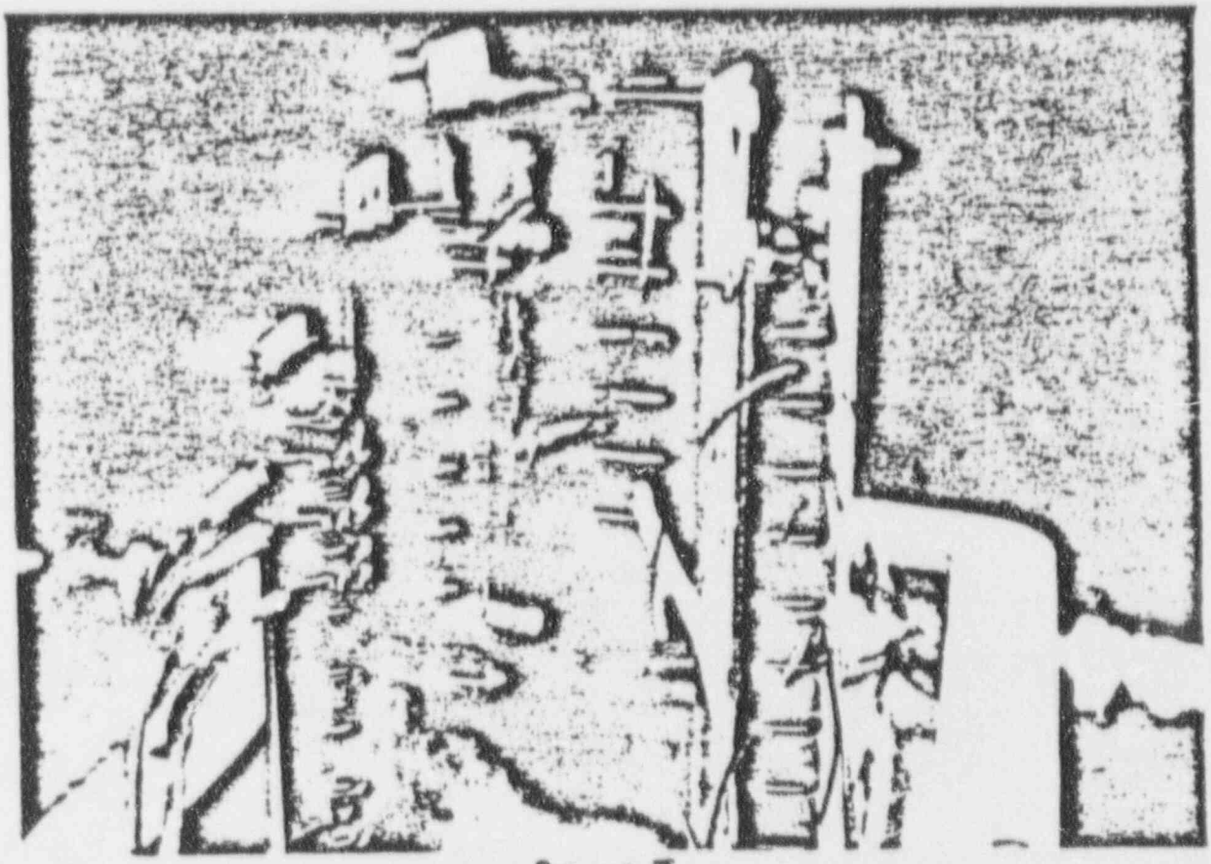


figure 7

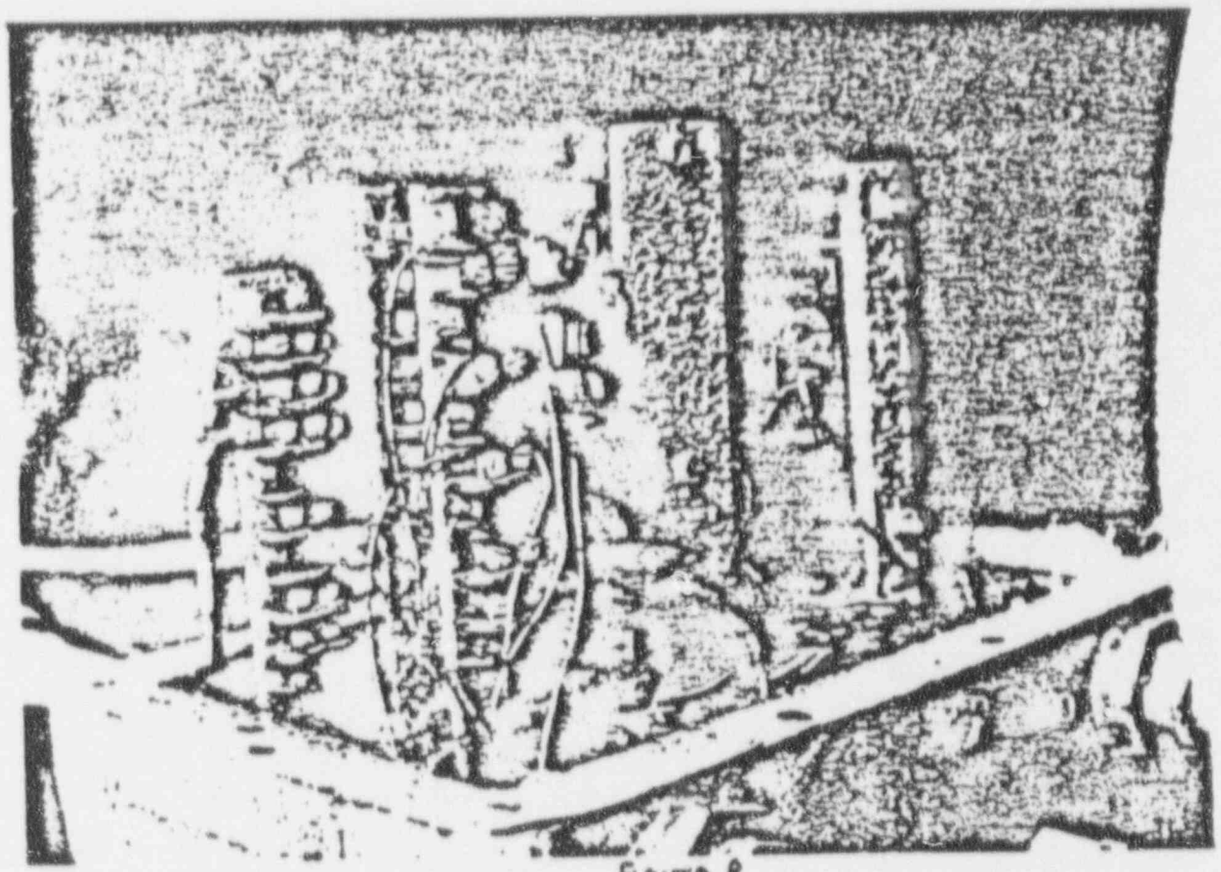


Figure 8