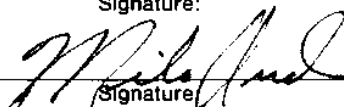

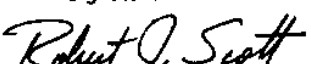
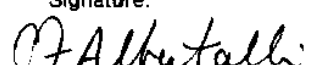


Raychem Energy Division

Report

Title		Pages: 20
PERFORMANCE TEST OF 8 KV, IN-LINE TYPE MOTOR CONNECTION SPLICES, RAYCHEM TYPE NMCK8		Enclosures: 4
Report Number:	Date:	Revision 1 2 3
EDR-5037	January 14, 1982	
Tested by:	Signature:	Date:
MILO D. ANDERSON		1/15/82
Prepared by:	Signature:	Date:
GARETH W. WILL		1/14/82
Approved by:	Signature:	Date:
ROBERT J. SCOTT for Product Management		1/14/82
Approved by:	Signature:	Date:
C.F. ALBERTALLI for Technical Operations		1/14/82
Raychem Corporation Energy Division		

REVISION RECORD

REV.	PAGE	PARAGRAPH	DESCRIPTION	DATE
1			Added Revision Record, page ia and ib	
1	i		Changed page i to page iia and iib	
1	2	item 4	Changed 323°C to 348°F	
1	5	5.1.1	Added "The test results are summarized in Table 2."	
1	8	2	Changed second sentence to read: (Note: This thermal aging condition corresponds to the Okonite Company's equivalent to 40 years life at 90°C for their cable and does not represent aging conditions equivalent to simulate 40 year life for the Raychem splice materials.)	
1	9	7.2	Changed 382°F to 384°F	
1	9	7.2.1 Para. 3	Changed second sentence to read: "This is equivalent to rated operating voltage phase to ground plus 10 percent margin."	
1	11	item 8, Results	Changed 1×10^{10} ohms typical to 8.2×10^{10} ohms min.* and added (see Table 2)	
1	11	item 9, Test Reqmt	Changed 23 PSIG to 28 PSIG and 343°F to 348°F	
1	11		Added note* "Sample number 4 insulation resistance value of 6.0×10^7 was attributed to the motor lead/end cap assembly and not to the test sample itself."	
1	16		RSI Certification of Irradiation added (9) Radiation Source: Cobalt 60	
1	20	Attachment 4	Page 1 of NTS Report 548-9273, para. 2 "Summary" corrected procedure number to NPE-TP-81-02	
1	20	Attachment 4	Page 3 of NTS Report 548-9273 added ohm to meg in table	

REVISION RECORD

REV.	PAGE	PARAGRAPH	DESCRIPTION	DATE
1	20	Attachment 4	Page 3 of NTS Report 548-9273, para. 2 changed 382°F to 384°F, 343°F to 348°F and 28.5 psig to 28 psig.	
1	20	Attachment 4	Page 7 of NTS Report 548-9273, Figure 2, identified test chamber and changed Figure 2 title to HELB Test Setup.	
1	20	Attachment 4	Page 8 of NTS Report 548-9273, Figure 3 changed "LOCA CHAMBER" to read "TEST CHAMBER."	
1	20	Attachment 4	Appendix A, page 8, NTS General Data Sheet changed 343°F to 348°F and 23 PSIG to 28 PSIG.	
1	20	Attachment 4	Appendix A, NTS Report 548-9273, page 11, changed test title to read: POST HELB I.R. and Hypot changed last line to read "cables were at 5000 Va-c during HELB test." NOTE: Revisions to Attachment 4 were made by NTS.	
2	ia	-	Clarification and corrections to revision record description.	
2	11	Note @ bottom of Table 3	Changed 6.7 to 6.0	

APPROVALS

Rev.	Date	N.P. Engrg.	Prod. Mgt.	Q.A.	
Rev. 2	9-10-82	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Corrections
Rev. 1	6-30-82	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Incorporate comments and corrections
Rev.	Date	N.P. Engrg.	Prod. Mgt.	Q.A.	

REVISION RECORD

Rev.	Page	Paragraph	Description	Date
3	14	ALL	Reduced reproduction size of appendices	10/7/87
3	17	ALL	Reduced reproduction size off Attachment 1	10/7/87
3	18	ALL	Reduced reproduction size of Attachment 2	10/7/87
3	19	ALL	Reduced reproduction size of Attachment 3	10/7/87
3	Several		Indicated pages which should remain blank to ensure proper format	10/7/87

APPROVALS

3	10/7/87	NA	Milo Anderson	John Hoffman	Peter Larsson	
			<i>Milo Anderson</i>	<i>John Hoffman</i>	<i>Peter Larsson</i>	
Rev.	Date	Tested By	Prepared By	Prod. Mgt.	Tech. Oper	

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1.0 OBJECTIVE

To evaluate the performance of the Raychem NMCK8⁽¹⁾, 8kV In-Line Motor Connection kit when subjected to accelerated thermal aging, radiation, electrical stress and a simulated high energy line break in accordance with Raychem Energy Division test plans NPE-TP-81-01 and NPE-TP-81-02.

To establish the qualification of the NMCK8 kit for use on Class IE electrical circuits outside the containment area of nuclear generating stations in accordance with the requirements of IEEE Standards 323-1974 and 383-1974.

2.0 SUMMARY

Twelve test samples consisting of bolted in-line connections were subjected to a test program based on the guidelines of IEEE Standards 323-1974 and 383-1974 to determine their suitability for service outside the containment area of a nuclear generating station. The NMCK8 was required to demonstrate functional operability after simulated 40-year aging conditions and maintain rated voltage during a high energy line break exposure.

The test program consisted of:

1. Thermal aging (504 hours at 150°C)

(1) NOTE: NMCK8 is the product name given to the nuclear grade 8kV motor connection kits. Prior to completion of qualification tests this same product configuration was designated MCK-S-1LX or 2LX to distinguish it from Raychem's commercial MCK-S motor connection kit.

2. Radiation exposure (50 Mrads)
3. Electrical tests (insulation resistances at 500 Vd-c and voltage withstand tests at 11.2kV rms a-c).
4. Simulated high energy line break - HELB (steam for 4 hours at 348°F 28 psig; samples energized at 5kVa-c phase to ground).

The splice system demonstrated satisfactory performance in the test programs and no failures were recorded in any of the 12 splices tested. The test sequence and the results are summarized in Table 3.

All samples demonstrated capability to maintain electrical integrity for their installed life with up to 50 Mrads of radiation including an HELB exposure.

3.0 CONCLUSION

The results of the test programs confirm by type testing the adequacy and suitability of the NMCK8 motor connection assemblies under normal and design basis event conditions for use on Class IE systems in a nuclear power generating station where LOCA considerations are not a requirement.

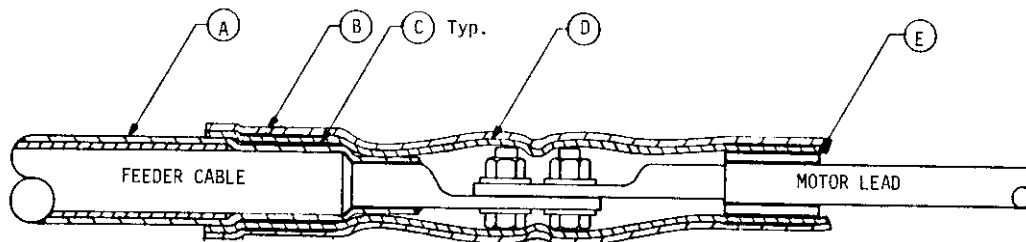
4.0 SAMPLE DESCRIPTION

4.1 Cables and Connections

The feeder cable used was Okonite Company's Okoguarde[®] 4/0 AWG tape shielded cable. Two types of motor cables were used: (1) 6 AWG glass reinforced silicone rubber insulated cable and (2) 2 AWG silicone rubber.

FIGURE 1

SAMPLE CONSTRUCTION



- A - NHVT-I-A-2-00
- B - BBIT - 65/25, 14" Long
- C - S1024 Adhesive Tape
- D - BBIT - 40/16, 14" Long
- E - BBIT - 25/10, 3" Long

SAMPLE TEST CONSTRUCTIONS

CONSTRUCTION 1 - Okonite Okoguard® 8kV, 4/0 AWG tape shield feeder cable connected to a 6 AWG glass reinforced silicone rubber insulated motor lead with shim.

CONSTRUCTION 2 - Okonite Okoguard® 8kV, 4/0 AWG tape shield feeder cable connected to a 2 AWG silicone rubber insulated motor lead without shim.

CONNECTORS - Burndy YA6C-2N, YA1C-2N, YA28-2N

TABLE 1
SAMPLE MATRIX

Sample	Construction	Thermal Aging	Radiation Exposure
1	1	X	X
2	1	X	X
3	1	X	X
4	1		X
5	1		X
6	1		X
7	2	X	X
8	2	X	X
9	2	X	X
10	2		X
11	2		X
12	2		X

insulated cable. The feeder cable was terminated on both ends using a standard Raychem 8kV NHVT termination kit.

The following hardware was used: Compression type terminal lug - 2 hole NEMA, manufactured by the Burndy Corporation; 1/2 inch dia. x 1 inch long bolts.

4.2 Sample Construction

The test samples were assembled in accordance with the Raychem installation instructions (as provided in each kit) and as shown in Figure 1. The BBIT insulating tubing was taken at random from manufacturing stock. The test sample matrix is given in Table 1.

5.0 TESTING PROCEDURES

5.1 Functional Tests

Functional tests were conducted in accordance with Raychem Energy Division Test Plans NPE-TP-81-01 and NPE-81-02.

5.1.1 Insulation Resistance

The insulation resistance was measured in accordance with ASTM D257-78. The insulation resistance measurements were taken after one minute of electrification at 500 Vd-c. The IR requirement for this test was greater than 2.5 megohms (Table 3). The test results are summarized in Table 2.

5.1.2 Voltage Withstand Test

Voltage withstand tests were conducted in water in accordance with IEEE Standard 383-1974, Section 2.3.3.4, using equipment as described in ASTM

TABLE 2
TEST RESULTS

Insulation Resistance at 500 Vd-c for 1 min. in Water at Ambient Temp.

Measurements are in OHMS

<u>Sample</u>	<u>Baseline Result</u>	<u>Post Thermal Aging and Radiation</u>	<u>Post Radiation Only</u>	<u>Post HELB (Engineering data only; not part of test requirements)</u>
1	1.2×10^{11}	3.0×10^{10}		6.8×10^7
2	6.2×10^{11}	1.4×10^{12}		6.5×10^7
3	6.0×10^{11}	1.4×10^{12}		
4	5.0×10^{11}		6.0×10^7	
5	7.8×10^{11}		8.2×10^{10}	6.6×10^7
6	6.4×10^{11}		1.2×10^{11}	6.6×10^7
7	1.6×10^{12}	1.4×10^{12}		
8	1.7×10^{12}	1.9×10^{12}		6.8×10^7
9	5.0×10^{11}	1.5×10^{12}		6.8×10^7
10	3.0×10^{10}		3.5×10^{11}	
11	1.7×10^{12}		4.0×10^{11}	6.6×10^7
12	1.5×10^{12}		4.5×10^{11}	6.8×10^7

D149-75. The voltage applied was between each sample conductor and the ground plane. The voltage applied was 80 volts per mil of insulation thickness of the feeder cable for five minutes. The actual voltage applied to the samples was 11.2kV rms a-c (80V/mil x 140 mils). Note: 11.2kV rms a-c is the equivalent of 2.25 times the rated voltage phase to ground. The requirement for this test was that there be no breakdown.

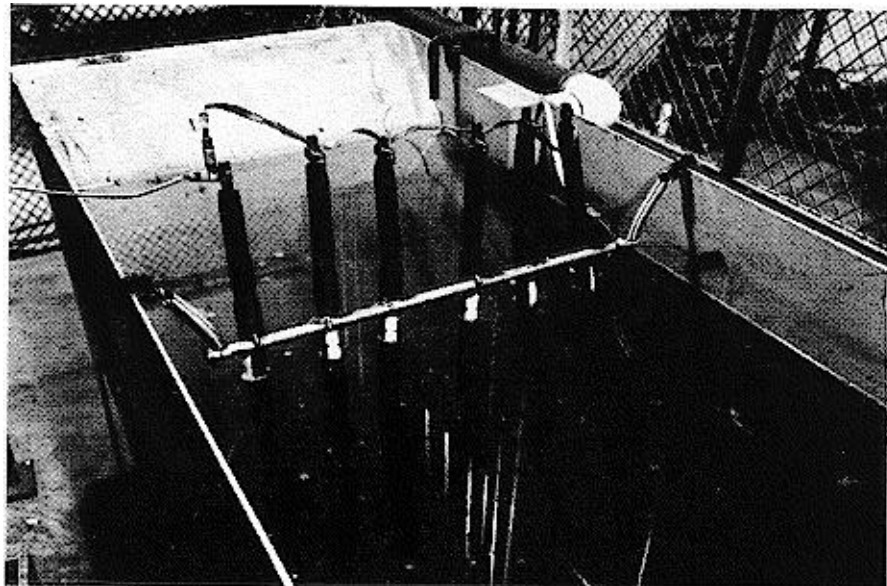
6.0 SAMPLE TESTING

All 12 samples were first subjected to 24 hours water immersion followed by voltage withstand and insulation resistance measurements as described in 5.0 above.

Figure 2 depicts the test set-up.

FIGURE 2

IMMERSION



The samples were then divided into two groups. Group 1 consisted of three samples each of constructions 1 and 2 (Figure 1). Group 1 received both thermal aging and radiation exposure. Group 2 received radiation exposure only.

Sample group 1 received thermal aging for 504 hours at 150°C (302°F) in a circulating air oven (note: This thermal aging condition corresponds to the Okonite Company's equivalent to 40 years life at 90°C for their cable and does not represent aging conditions equivalent to simulate 40 year life for the Raychem splice materials) and radiation exposure of 50 Mrads from a Co⁶⁰ source. Sample group 2 received the same radiation exposure. This sample test matrix was in accordance with Raychem Energy Division Test Plan NPE-TP-81-01. After thermal aging and radiation exposure, the samples were subjected to functional testing as described

After completion of Test Plan NPE-TP-81-01, selected samples from groups

1 and 2 were further subjected to a simulated high energy line break (HELB) in accordance with Raychem Energy Division Test Plan NPE-TP-81-02. This test was conducted at National Technical Services test facility in Chatsworth, California.

7.0 TEST RESULTS

7.1 Results of Test Plan NPE-TP-81-01

All samples met or exceeded the functional test requirements as prescribed in the test plan. The results of these tests are summarized in Table 3. The final functional testing was witnessed and verified by Energy Division Quality Assurance personnel. The results of this test are documented in Raychem laboratory notebook 5750-23.

7.1.1 Inspection

Upon completion of the functional tests, the samples were visually inspected for any abnormalities. None were found.

7.2 Results of Test Plan NPE-TP-81-02, HELB

All samples held rated voltage throughout the course of the HELB environment exposure. At the start-up of the test, the internal chamber temperature was raised from ambient to 384°F as the internal chamber pressure was adjusted to 28 psig within 16 seconds (refer to NTS Report 548-9273 page 6 attached). The chamber temperature then dropped to 280°F for 10 seconds. The temperature and pressure were then adjusted to the requirements of the HELB profile.

The results of this test as performed by National Technical Services are certified in NTS test report 548-9273 attached.

7.2.1 Post HELB Testing

Upon completion of the HELB exposure, the samples were de-energized and the chamber filled with water.

After the chamber was filled with water, insulation resistance measurements were made. IR values ranged from 6.5×10^7 ohms to 6.8×10^7 ohms. Voltage withstand tests were not performed due to test equipment failure at NTS. Voltage withstand tests were completed at Raychem.

The voltage withstand tests were conducted in air at 5.5kVa-c phase to ground. This is equivalent to rated operating voltage phase to ground plus 10 percent margin.

TABLE 3
SUMMARY OF TEST

<u>Test Description</u>	<u>Test Requirement</u>	<u>Results</u>
1. Water Immersion	Samples immersed under 12 inches of water at ambient temp. for 24 hours	N/A
2. AC Withstand (while immersed)	11.2kV rms a-c for 5 minutes	Passed
3. Insulation Resistance (while immersed)	Baseline measurements	3 x 10 ¹⁰ ohms min. (see Table 2)
4. Thermal Aging	504 hours at 150°C (3 samples of each constr.)	No visible defects
5. Radiation Exposure	50 Mrads Co ⁶⁰ Source	No visible defects
6. Water Immersion	Samples immersed under 12 inches of water at ambient temp. for 24 hours	N/A
7. AC Withstand (while immersed)	11.2kV rms a-c for 5 minutes	Passed

TABLE 3 (cont.)

<u>Test Description</u>	<u>Test Requirement</u>	<u>Results</u>
8. Insulation Resistances (while immersed)	> 2.5 megohms after 1 min. at 500 Vd-c	8.2×10^{10} ohms min.* (see Table 2)
9. HELB Exposure	Samples exposed to 28 psig and 348°F for 4 hours while energiz to 5kVa-c phase to ground	Passed

*Sample number 4 insulation resistance value of 6.0×10^7 was attributed to the motor lead/end cap assembly and not to the test sample itself.

The samples were wrapped tightly with copper gauze to constitute a ground plane. All samples maintained 5.5kV phase to ground for five minutes.

Dielectric breakdown tests were conducted in air. The rate of rise was 500 Va-c/second. Breakdown voltages ranged from 18kVa-c to 64kVa-c. Table 4 summarizes the results.

The breakdown tests were conducted for engineering purposes and were not part of the qualification requirements.

TABLE 4
VOLTAGE WITHSTAND AND DIELECTRIC BREAKDOWN
POST HELB

Sample	5.5kVa-c Withstand 5 Minutes	Dielectric Breakdown Voltage, kVa-c 500 Va-c/Sec Rise Time
1	Passed	56
2	Passed ⁽¹⁾	18
3	Passed ⁽¹⁾	40
4	Passed	49
5	Passed ⁽¹⁾	56
6	Passed ⁽¹⁾	58
7	Passed	66
8	Passed ⁽¹⁾	64
9	Passed ⁽¹⁾	42
10	Passed	54
11	Passed ⁽¹⁾⁽²⁾	60
12	Passed ⁽¹⁾	60

(1) Denotes samples subjected to HELB test. (2)
Tested at 8kVa-c phase to ground.

7.2.2 Inspection

Upon completion of the HELB exposure and insulation resistance measurements as described in 7.2.1, the samples were removed from the chamber and examined for any defects. No visible defects were observed. After the inspection, the samples were returned to Raychem.

Upon arriving at Raychem, the samples were again visually examined. This examination revealed cracks in samples 2 and 3 over the bolted area 0.3 inches long. These samples were subjected to the testing described in 7.2.1. Both samples passed the 5.5kVa-c phase to ground voltage withstand for 5 minutes. Further examination of the cracks were conducted after completion of testing to determine the extent of damage. The cracks in the outer sleeves were carefully cut away to determine if the inner sleeves were affected. The area immediately under the cracked outer sleeve showed no signs of damage. Further examination of the inner sleeve was conducted by removing the remainder of the outer sleeve. The inner sleeve was completely intact and no signs of damage were visible.

APPENDICES

Data Acquisition Instruments

Certification of Radiation

APPENDIX A
LIST OF DATA ACQUISITION INSTRUMENTS¹

The instruments listed below were used to conduct those tests described in Raychem Test Plan NPE-TP-81-01, Rev. 2. Those instruments used to conduct the HELB (Raychem Test Plan NPE-TP-81-02) are listed in National Technical Services report 548-9273 which is attached.

<u>INSTRUMENT</u>	<u>MANUFACTURER</u>	<u>MODEL NO.</u>	<u>SERIAL NO.</u>	<u>LAST CALIBRATED</u>	<u>CALIBRATION FREQUENCY</u>	<u>RANGE</u>
Megohmmeter ⁽¹⁾	General Radio	1864	6571	Before use	6 mos	0 - 1x10 ¹³ ohms
High Voltage Meter ⁽¹⁾	Jennings	J-1005	323	Before use	6 mos	0 - 100kV
Transformer	General Electric	M296710YETB	-----	-----	N/A	0 - 20kV
Multi-Point Recorder ⁽¹⁾	Honeywell	16303846/324- 162-0000-00000- 301-11	D8210735001	Before use	6 mos	0 - 300°C

NOTE: 1

All instruments were calibrated by Viking Laboratories of Santa Clara California. All instruments used were calibrated against standards traceable to the National Bureau of Standards or an acceptable natural physical standard, per MIL-I-45208A and MIL-C-45662A requirements. Calibration records are on file at Raychem Corporation, Menlo Park, California.



CERTIFICATION OF IRRADIATION

CUSTOMER: Raychem Corporation

IRRADIATION RUN DATE: July 10, 1981

IRRADIATION RUN NUMBER: RAY1001-T

LIST AND DESCRIPTION OF MATERIALS PROCESSED:

Lot Number: None

12 Raychem MCK-5 In Line Motor Connection Kit Specimens
#NPE-TP-81-015

Radiation Sterilizers, Incorporated certifies that this material received a gamma radiation air equivalent dose of 50.0 MRads, plus 10 percent, minus 0 percent, within the accuracy of the dosimetry devices utilized.

- (1). Average dose rate 0.2 MRads/hour.
- (2). Total hours of irradiation 250 hours.
- (3). Samples were positioned vertically in the rack supplied by Raychem.
- (4). Halfway through irradiation period the rack was rotated and the inside specimens were rotated to the outside to assure dose uniformity.
- (5). Prior to irradiation twenty four dosimeters were utilized to establish the dose map and dose rates for the radiation field.
- (6). Dosimeters used were radiachromic dye type supplied by Far West Technology Inc., Goleta, Ca.
- (7). Dosimeter calibration is traceable to Standard NBS source. Calibration curve dated November 26, 1980 is attached.
- (8). The overall accuracy of the dosimetry system utilized is approximately $\pm 5\%$.
- (9). Radiation Source: Cobalt 60

Certified By: 

Date: 7-20-81

ATTACHMENT 1

Environmental Test Plan for Raychem
MCK-5 In-Line Motor Connection
NPE-TP-81-01, Rev. 2

R

Raychem Corporation

ENVIRONMENTAL TEST PLAN FOR
Raychem MCK-5 IN-LINE
MOTOR CONNECTION

1.0 Objective

To evaluate the performance of the Raychem MCK-5, 5-8Kv In-Line Motor Connection Kit when subjected to accelerated thermal aging, radiation and electrical stress in accordance with the requirements of Gibbs L Hill, Inc. Specification 2323-ES-100, Append1x 3, page 7, paragraph 1.4.1a.

2.0 Materials and Sample Construction

2.1 Materials

2.1.1 Raychem test materials shall meet the requirements of Raychem Material Specificat10n PPS 3010/4.

2.1.2 The cable shall be supplied by Comanche Peak Steam Electric Station and shall meet all the requirements set forth by the Comanche Peak Steam Electric Station Quality Assurance Program.

2.2 Sample Construction (figure 1)

2.2.1 Samples shall be constructed per the standard installation instructions for the kits used in this test. Figure 1 illustrates the construction and lists the materials to be tested. There shall be six samples each of two constructions. Three samples of each construction shall be given the full test sequence and the other three of each construction shall be tested to all parts of the sequence except thermal aging (Table 1).

Raychem

3.0 Test Sequence

3.1 The test program shall consist of the following sequence:

<u>Sequence</u>	<u>Test</u>	<u>Section</u>
1.	Water immersion	4.0
2.	Functional test	5.0
3.	Thermal aging	6.0
4.	Radiation exposure	7.0
5.	Water immersion	4.0
6.	Functional test	5.0
7.	Inspection	8.0

4.0 Water Immersion

4.1 Test samples shall be immersed in tap water at room temperature for 24 hours. All parts of the motor connection assemblies, excluding leads, shall be at least 12 inches below the surface of the water.

5.0 Functional Tests

5.1 Insulation Resistance (ASTM D257-78)

The insulation resistance shall be measured at 500 volts d.c. in water at room temperature after one minute of electrification time.

Requirement: $R > 2.5$ megohms

5.2 Voltage Withstand Tests

The Voltage Withstand Tests shall be conducted in water per IEEE Std. 383-1974, section 2.3.3.4, using equipment as described in ASTM D149-75. The voltage shall be applied between each sample conductor and the ground plane. The voltage applied shall be 80 volts per mil of insulation thickness of the feeder cable for five minutes.

Requirement: No breakdown

Raychem

6.0 Thermal Aging

Three of each construction shall be thermally aged for 504 hours at $150^{\circ}\text{C} \pm 2^{\circ}\text{C}$ in an air circulating oven (Table 1).

NOTE: This thermal aging condition corresponds to the Okonite Company's equivalent to 40 years of life at 90°C for their cable.

7.0 Radiation Exposure (IEEE 383-1974, 2.3.3.3)

Test samples shall be exposed to an air equivalent dose of 5.0×10^7 rads of gamma radiation from a Co^{60} source at a rate not to exceed 1.0×10^6 rads per hour.

NOTE: This radiation exposure exceeds the Comanche Peak requirement.

8.0 Inspection

Upon completion of the test program, the test samples shall be visually inspected and their condition noted.

9.0 Report

A report shall be issued subsequent to the completion of testing. This report shall contain descriptions of the test samples, test data, a listing of data acquisition instruments, calibration data, radiation certification and conclusions.

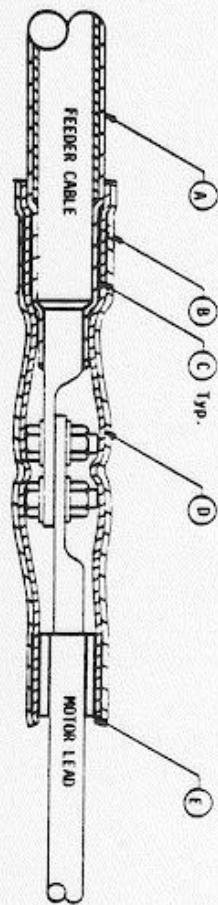
Raychem

Table 1

TEST MATRIX

<u>SAMPLE</u>	<u>CONSTRUCTION</u>	<u>THERMAL AGING</u>	<u>RADIATION EXPOSURE</u>
1	1	X	X
2	1	X	X
3	1	X	X
4	1		X
5	1		X
6	1		X
7	2	X	X
8	2	X	X
9	2	X	X
10	2		X
11	2		X
12	2		X

FIGURE 1
SAMPLE CONSTRUCTION



NOTES:

1. Motor lead to be:
 - A. Construction 1
1/C-#6 AWG glass reinforced silicone rubber insulation with shim.
 - B. Construction 2
1/C-#2 AWG silicone rubber insulation without shim.
2. Connectors
Burndy YA-2N, 2-hole NEMA

KEY

- A - HVT-1-A-2-00
- B - Outer Sleeve, BBIT 65/25, 14" L
- C - S1024 Adhesive Tape
- D - Inner Sleeve, BBIT 40/16, 14" L
- E - Shim, BBIT 25/10, 3" L

PRODUCT APPLICATION DRAWING			
ENGINEER	DATE:	DESCRIPTION:	DCR No.
Raychem ENERGY DIVISION-AMPAC			
POK:		DOCUMENT No.	REV.

ATTACHMENT 2

Radiation Requirements for
The Raychem MCK-5 In-Line
Motor Connection Kit
NPE-TP-81-01S

RADIATION REQUIREMENTS
FOR
THE RAYCHEM MCK-5 IN-LINE
MOTOR CONNECTION KIT

- 1.0 Dose and dose rate
Test samples shall be exposed to an air equivalent dose of 5.0×10^7 rads of gamma radiation from a Co^{60} source at a rate not to exceed 1.0×10^6 rads per hour.
- 2.0 Uniformity
The test samples shall be uniformly irradiated longitudinally and circumferentially to an air equivalent dose of 5.0×10^7 rads, plus 10 percent, minus zero percent.
- 3.0 Number of dosimeters
The number of dosimeters used to monitor the irradiation of the test samples shall be sufficient to ensure the requirements of paragraphs 1.0 and 2.0.
- 4.0 Frequency of data acquisition
Dosimetry readings shall be made at a frequency to ensure the requirements of paragraphs 1.0 and 2.0.
- 5.0 Data acquisition devices
There must be documented measures to assure that data acquisition instruments used for this program are properly controlled, calibrated and adjusted at specified periods to maintain accuracy within established limits. This is in accordance with the requirements of 10CFR50, Appendix B. A record of the calibration dates and accuracies shall be provided with the certification at the conclusion of the program.

(Radiation Requirements for the Raychem MCK-5 In-Line
Motor Connection Kit, contd.)

6.0 Certification

Upon completion of the irradiation, a letter of certification shall be issued to Raychem Corporation and shall contain the following information:

1. Total dose and dose rate
2. Actual total hours of irradiation
3. Sample positioning
4. How the radiation was measured
5. The types of dosimeters used and calibration information
6. Signature and title of the person issuing the certification

ATTACHMENT 3

Test Plan for HELB Qualification Test of
Raychem MCK-5 In-Line Motor Connection Kit
NPE-TP-81-02

August 12, 1981

TEST PLAN FOR HELB QUALIFICATION TEST OF RAYCHEM MCK-5 IN-LINE MOTOR CONNECTION KIT.

1.0 Objective

To evaluate the performance of the Raychem MCK-5, 5-8kV In-Line Motor Connection Kit when subjected to simulated high energy line break (HELB) environmental conditions, in accordance with the requirements of Comanche Peak Steam Electric Station.

2.0 Sample Construction

Eight samples shall be chosen from the test matrix described in Test Plan NPE-TP-81-01 at the conclusion of the testing. Four samples shall have been exposed to both thermal aging and radiation. Four samples shall have been exposed to radiation only. These samples are representative of the worst case conditions of the product over its installed life. A detailed description of the sample construction is contained in NPE-TP-81-01 Revision 1 and will be documented in the test report. The samples consist of an MCK-5 In-line Motor Connection Kit installed onto an unshielded motor lead and a shielded field cable (terminated with a Raychem N-HVT), both representative of cable used at the Comanche Peak Steam Electric Station.

3.0 Test Program

3.1 General

Following completion of the qualification test program detailed in Test Plan NPE-TP-81-01 Revision 1, eight samples shall be selected -- four of each aging condition. In each group of four, two samples shall be of each construction as outlined in Test Plan NPE-TP-81-01 -- for further testing to the HELB environmental conditions of the Comanche Peak Steam Electric Station.

Test Program, General.(contd.)

Successful completion of the previous test qualifies the MCK-5, 5-8kV In-Line Motor Connection Kit for use on Class IE circuits under normal operating conditions. The samples chosen for this test represent two possible end of life conditions. A completely unaged (virgin) sample, representing beginning of life, need not be tested. The testing of conditioned samples is a worst case condition for the Raychem materials.

The required HELB environmental conditions as specified for the Comanche Peak Steam Electric Station are:

Temperature: 328°F
Pressure: 23 psig
Humidity: 100%
Duration: 4 hours

The test sequence shall be as follows:

1. Visual inspection
2. HELB exposure
3. Functional test

- 3.2 Visual Inspection - a visual inspection shall be performed by Raychem upon receipt of the test samples at the test site location to detect any in-transit damage. Splice and cable shall be inspected for cuts, cracks, scrapes or other signs of physical abuse. Samples revealing indeterminate damage shall be given a voltage withstand test at 11.2kV to ground to determine suitability for further testing.
- 3.3 HELB Exposure - samples shall be mounted in a pressure vessel capable of exposing the samples to steam at the required temperatures and pressure plus margin. The samples shall be energized

Test Program (HELB Exposure, contd.)

to 5kV a-c phase to ground throughout the test. The required test profile is as follows:

<u>TIME</u>	<u>TEMPERATURE OF (°C)</u>	<u>PRESSURE</u>
0-	Ambient	Ambient
0 to 4 hours	Ambient to 343°F (173°C)	23 psig (minimum)
4 hours +	Cool down to ambient	Ambient

- 3.4 Acceptance Criteria - the samples shall be capable of maintaining rated voltage throughout the HELB exposure to verify functional operability. In the event that rated voltage is not maintained throughout the HELB exposure, the source of the failure shall be identified. If the failure is not attributed to the splice insulating kit itself, further testing of the splice wrapped with a copper gauze ground plane shall be conducted to determine its functional operability. Subsequent ability of the splice sample itself to pass a voltage withstand test at rated voltage and demonstrate insulation resistances greater than one megohm shall be considered acceptable performance verification.
- 3.5 Post HELB Electrical Tests - the insulation resistance of each sample shall be measured at 500 V. d-c at ambient temperature after being energized for one minute. Equipment shall conform to ASTM D 257-78. Each sample shall also be given a voltage withstand test at 5.5kV. a-c to ground for five minutes, using equipment in accordance with ASTM D 149-75. Both tests shall be conducted in water. These tests are intended to provide engineering information only on the performance of the splice. They are not required to demonstrate functional operability.

4.0 Report

A report shall be written subsequent to completion of the testing. The report shall include descriptions of the test samples and test set-up, test data, a list of data acquisition instruments with calibration records, and conclusions.

ATTACHMENT 4

HELB Test Certification
National Technical Services
Report No. 548-9273



RAYCHEM CORPORATION
300 Constitution Drive
Menlo Park, CA 94025

Report No. 548-9273

Date: 14 October 1981

TEST SPECIMENS

Eight (8) MCK-5 In-Line Motor Connection Kits; Sample Numbers MCK-5-2, MCK-5-3, MCK-5-5, MCK-5-6, MCK-5-8, MCK-5-9, MCK-5-11, MCK-5-12.

SUMMARY

This report certifies that the Specimens identified above have been subjected to High Energy Line Break (HELB) Testing in accordance with Raychem Test Procedure Number NPE-TP-81-02. An anomaly was reported and is fully documented | 1 in the body of this report.

TEST EQUIPMENT

<u>NTS No.</u>	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Calibration</u>	
				<u>Cycle</u>	<u>Due Date</u>
ENV672V	Boiler	Parker	16869	--	N/A
--	Super Heater	NTS	--	--	N/A
--	Auto-clave	Kaiser	585 @ 450°	--	N/A
E1219V	Bridge Balance	NTS	--	Before Use	--
E1193V	X-Y Plotter	Linear Inst	285MM	Before Use	--
P1030V	Compound Gauge	Ashcroft	AMP8346	Ind. Only	N/A
P623V	Press Gauge	Ashcroft	AMP7317	Ind. Only	N/A
P456V	Press Gauge	Ashcroft	0-160	Ind. Only	N/A
1062	Press Gauge	Ashcroft	AMP8236	Ind. Only	N/A
P536V	Press Gauge	Ashcroft	0-100	--	11-19-81
P547V	Press Gauge	Ashcroft	AMP7321	Ind. Only	N/A
P582V	Press Gauge	Ashcroft	0-300	Ind. Only	N/A
P561V	Press Gauge	Ashcroft	0-200	Ind. Only	N/A
P1093V	Press Gauge	Helicoid	6W-150-1	Ind. Only	N/A
P1126V	Press Gauge	U.S. Gauge	19042	Ind. Only	N/A

TEST EQUIPMENT (continued)

<u>NTS No.</u>	<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Calibration</u>	
				<u>Cycle</u>	<u>Due Date</u>
ENV475V	LED Thermometer	Analogic	AN2572	Ind. Only	N/A
ENV1107V	Transducer	Statham	0-100	Before Use	--
ENV527V	Recorder	Honeywell	Temp	--	3-28-82
G642V	Recorder	Honeywell	Press	Before Use	--
ENV856S	Controller	Honeywell	Temp	Ind. Only	N/A
E698V	Megometer	Gen.Radio	1862C	6 months	2-18-82
P858V	Press Gauge	Ashcroft	0-100	3 months	10-14-81
P846V	Press Gauge	Ashcroft	0-60	3 months	1-6-82
P851V	Press Gauge	Ashcroft	0-200	3 months	12-2-81
E1185V	Variac	Gen.Radio	0-140 ACV	--	N/A
E740V	VOM	Simpson	630NA	6 months	4-7-82
E1192	Transformer	Maloney Elec	7650047	6 months	N/A

NOTE: The equipment specified above was calibrated, as required, in accordance with MIL-C-45662A and is traceable to the National Bureau of Standards (NBS). The NBS traceability records are maintained on file in the NTS Quality Control Office.

TEST PROCEDURES AND TEST RESULTS

HIGH ENERGY LINE BREAK (HELB) TEST

Date Performed: 8 October 1981

The Specimens were mounted to a NTS-adaptable flange and installed in a test chamber of the High Energy Line Break (HELB) system, as shown in Photograph 1. The Specimens were then energized to 5000 Vac and this condition was maintained throughout the test (refer to Figure 2).

The internal chamber temperature was adjusted from ambient to +384°F as the internal chamber pressure was adjusted from ambient to 28 psig within 16 seconds (refer to Figure 1 and Notice of Deviation 1). The chamber temperature was then adjusted to +348°F and the chamber pressure to 28.0 psig. These conditions were maintained for a period of 4 hours. No other anomalies were reported.

The chamber environmental conditions were returned to ambient and the Specimens were deenergized. The chamber was filled with water and the Specimens were subjected to insulation resistance (IR) tests. The results of these tests are listed below:

<u>Samples</u>	<u>Reading (meg ohm)</u>
MCK-5-2	68
MCK-5-3	65
MCK-5-5	66
MCK-5-6	66
MCK-5-8	68
MCK-5-9	68
MCK-5-11	66
MCK-5-12	68

The IR test was completed at 500 Vdc and the readings were recorded after 1 minute of energization. A voltage withstanding test was not done due to equipment failure. Per customer instruction, the test shall be completed by the customer at his facility. Following the IR tests, the chamber was drained of water and the Specimens were removed from the chamber. No signs of physical damage were noted following a visual examination. This concluded testing and the Specimens were returned to Raychem Corporation.


 DAVID P. BAME Project Manager


 HOWARD E. CLARK, Quality Assurance Manager



AETL

APPROVED ENGINEERING TEST LABORATORIES

A NATIONAL TECHNICAL SERVICES CO.

NOTICE OF DEVIATION

DATE: 10-8-81

- LOS ANGELES DIVISION / 5320 WEST 104TH STREET / LOS ANGELES, CALIFORNIA 90045 / (213) 776-3202
- VALLEY DIVISION / 9551 CANOGA AVENUE / CHATSWORTH, CALIFORNIA 91311 / (213) 341-0830
- SAUGUS DIVISION / 20988 W. GOLDEN TRIANGLE RD. / SAUGUS, CALIFORNIA 91350 / (805) 259-8184
- EL MONTE DIVISION / 1431 POTRERO AVENUE / SO. EL MONTE, CALIFORNIA 91733 / (213) 444-9511
- FULLERTON DIVISION / 1536 EAST VALENCIA / FULLERTON, CALIFORNIA 92631 / (714) 879-6110

CUSTOMER: RAY CHEM MJO NO.: 548-9273

PART NO.: _____ N.O.D. NO.: 1

SAMPLE SERIAL NO.: MCK-S-2,3,5,6,8,9,11,12 P.O. NO.: A05271-1

TEST PROCEDURE: 4-5412 PARAGRAPH: 6.1.2.3 Figs

REQUIREMENT: MAINTAIN SIMULATED ENVIRONMENTAL CONDITION OF 343°F @ 23 PSIG FOR 4 HOURS

DEVIATION: SOON AFTER SPIKE TEMP DROPPED TO 280°F FOR 10 SEC.

DISPOSITION: CONTINUE TESTING

APPROVAL _____
(Customer Representative)

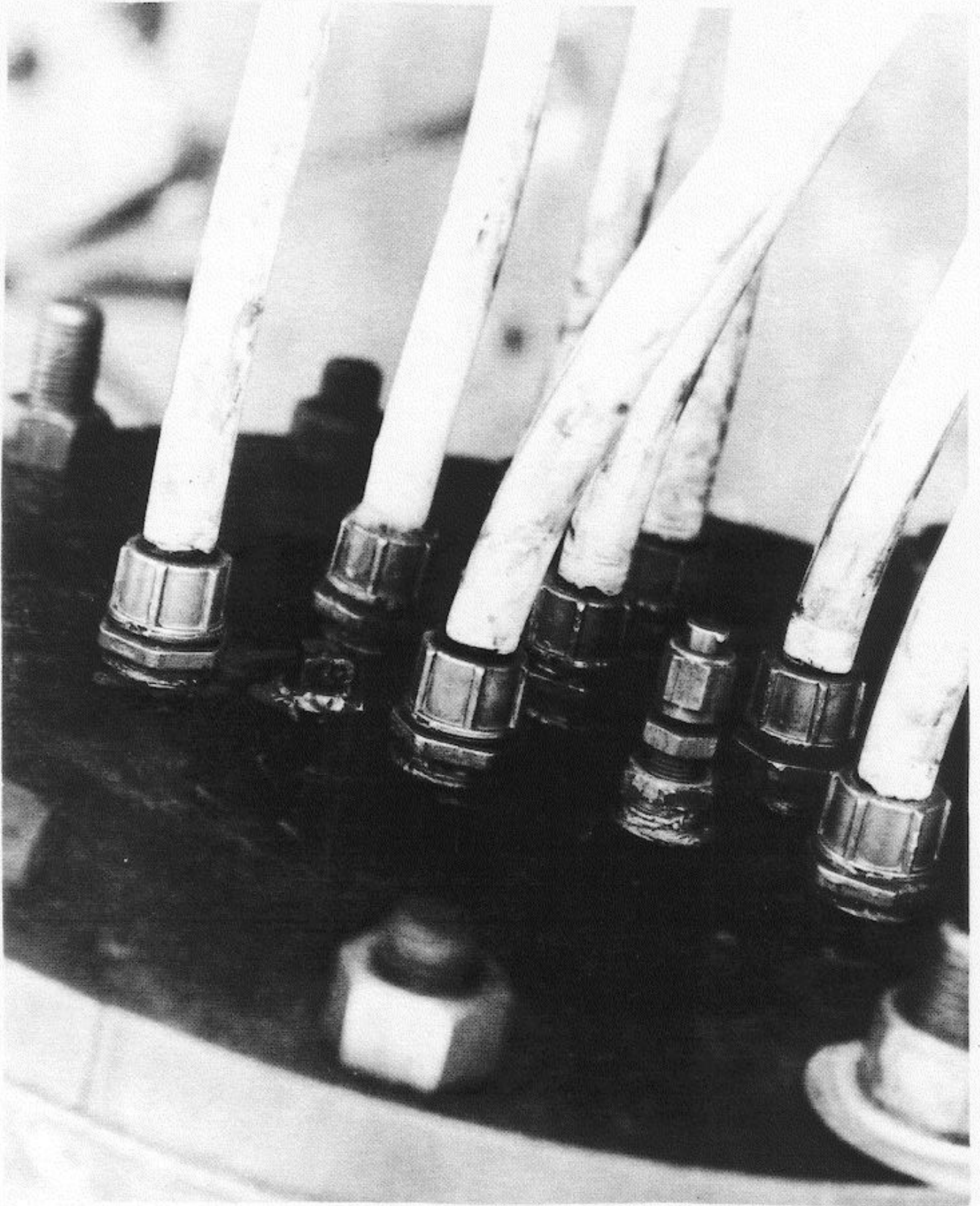
CUSTOMER NOTIFICATION:

Made to: GARY WILL How: VERBAL

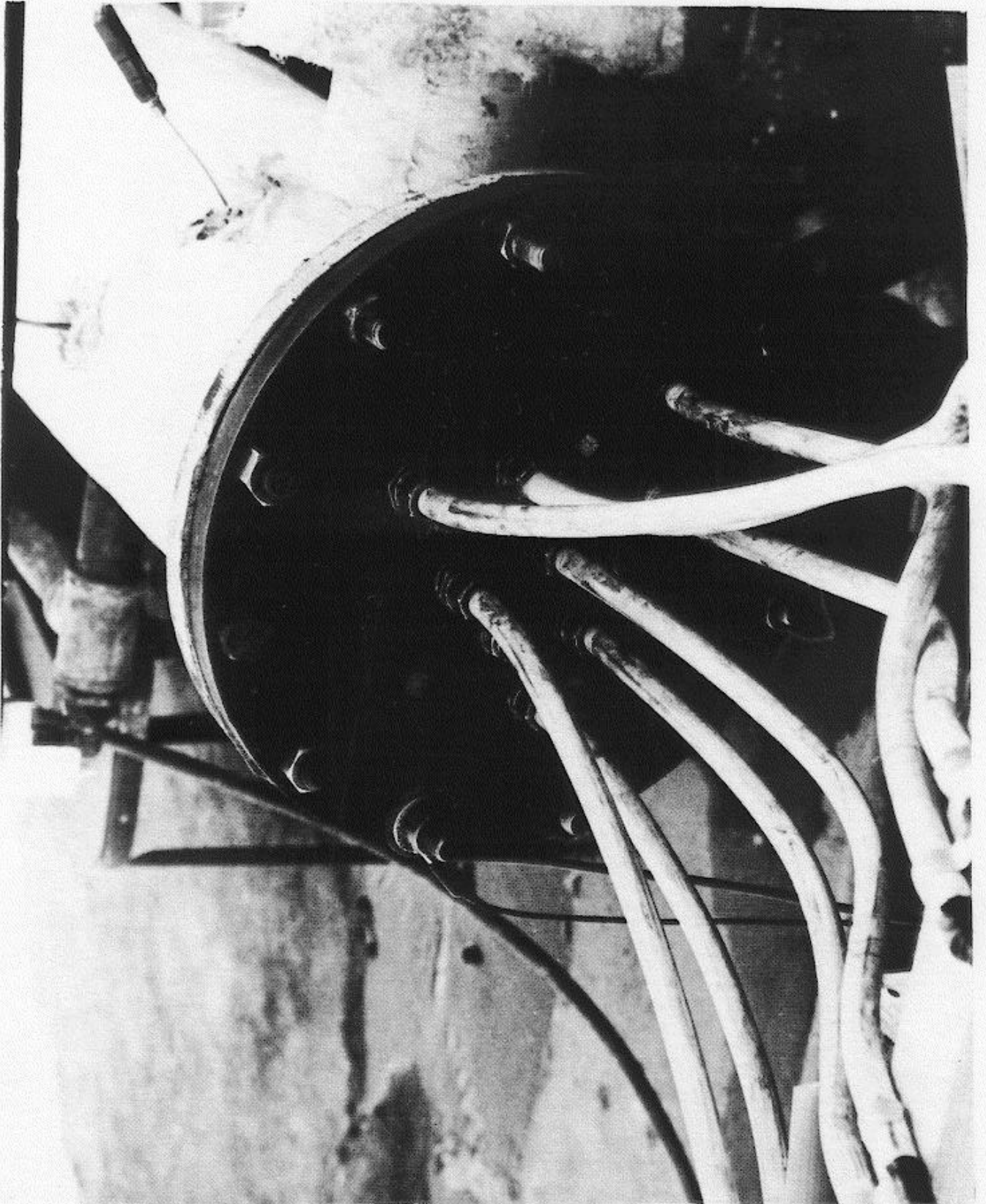
Date & Time: _____ By: D.P. BAME

DCAS Notified: YES NO _____ DATE _____
A.E.T.L. Dept. Supervisor

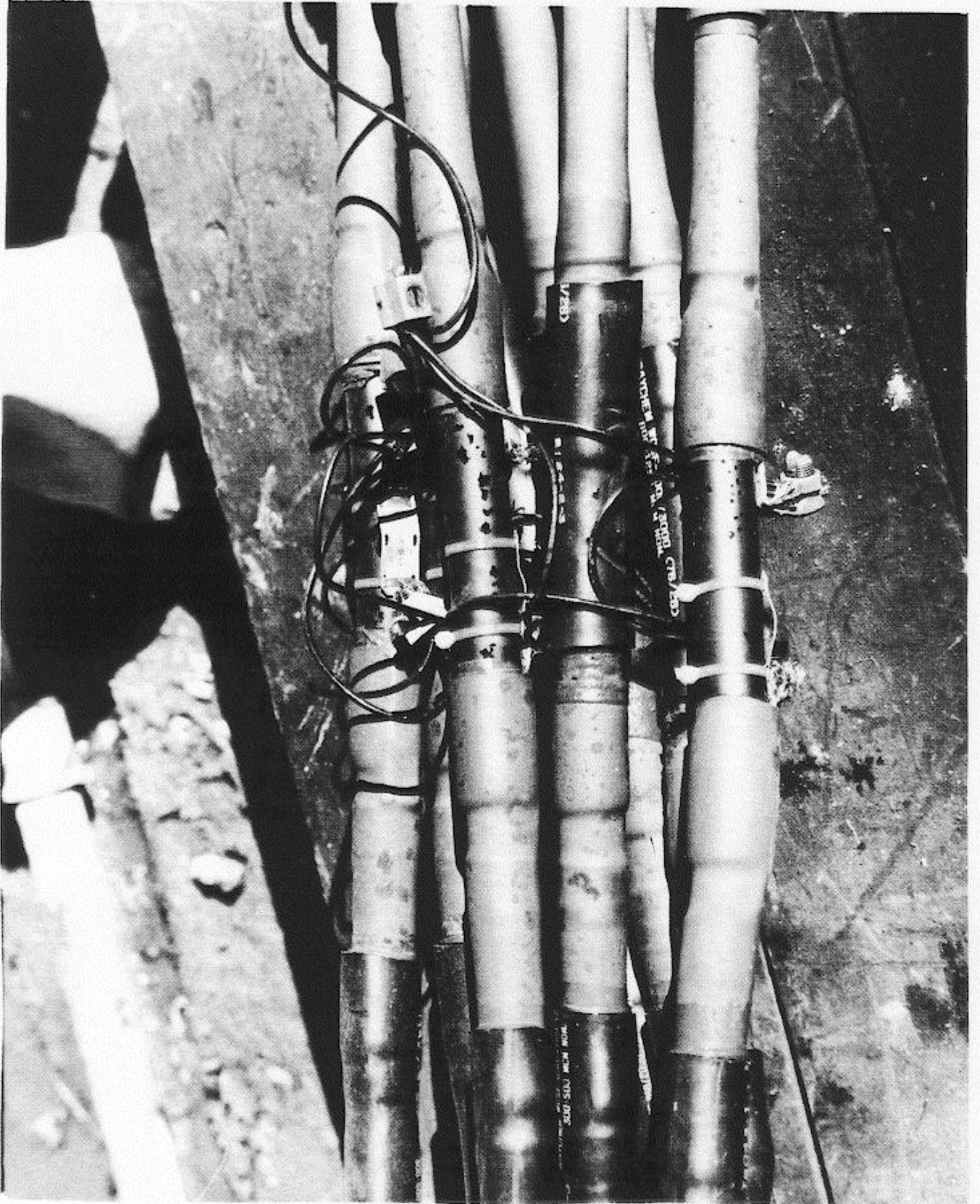
NTS



NTS

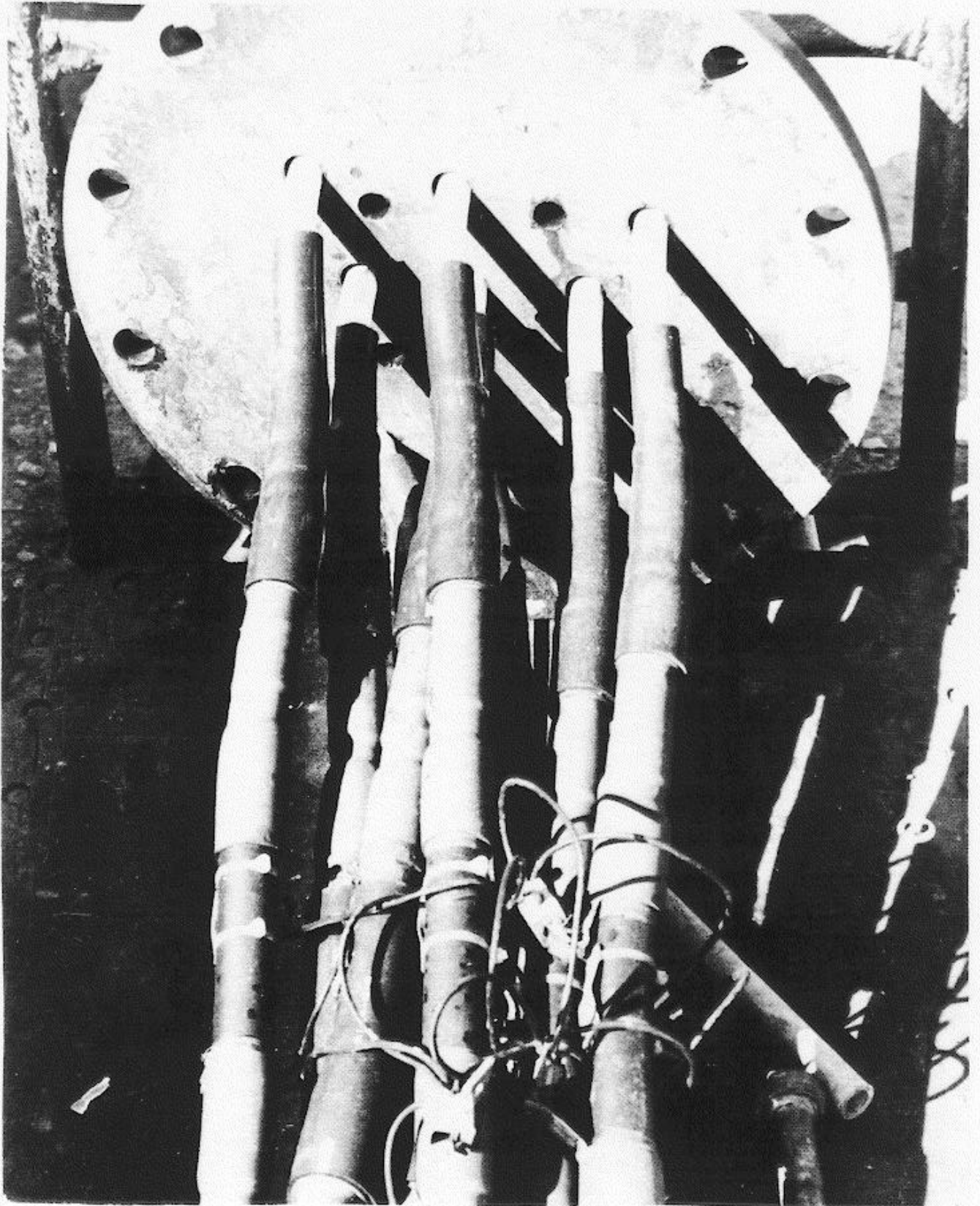


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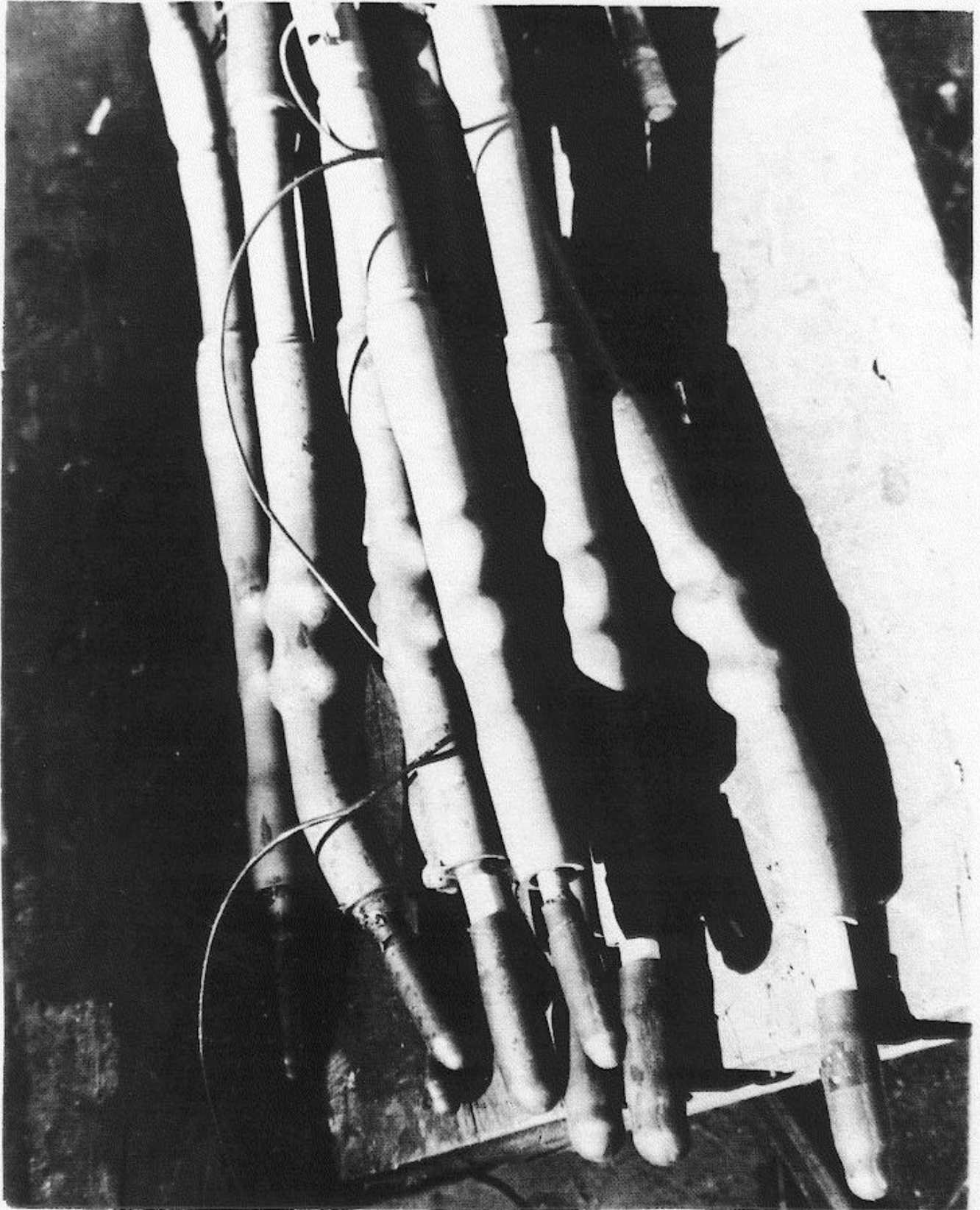


NTS

Report No. 548-9273 pg 5-3
Photograph 4
Post HELB Examination



NTS



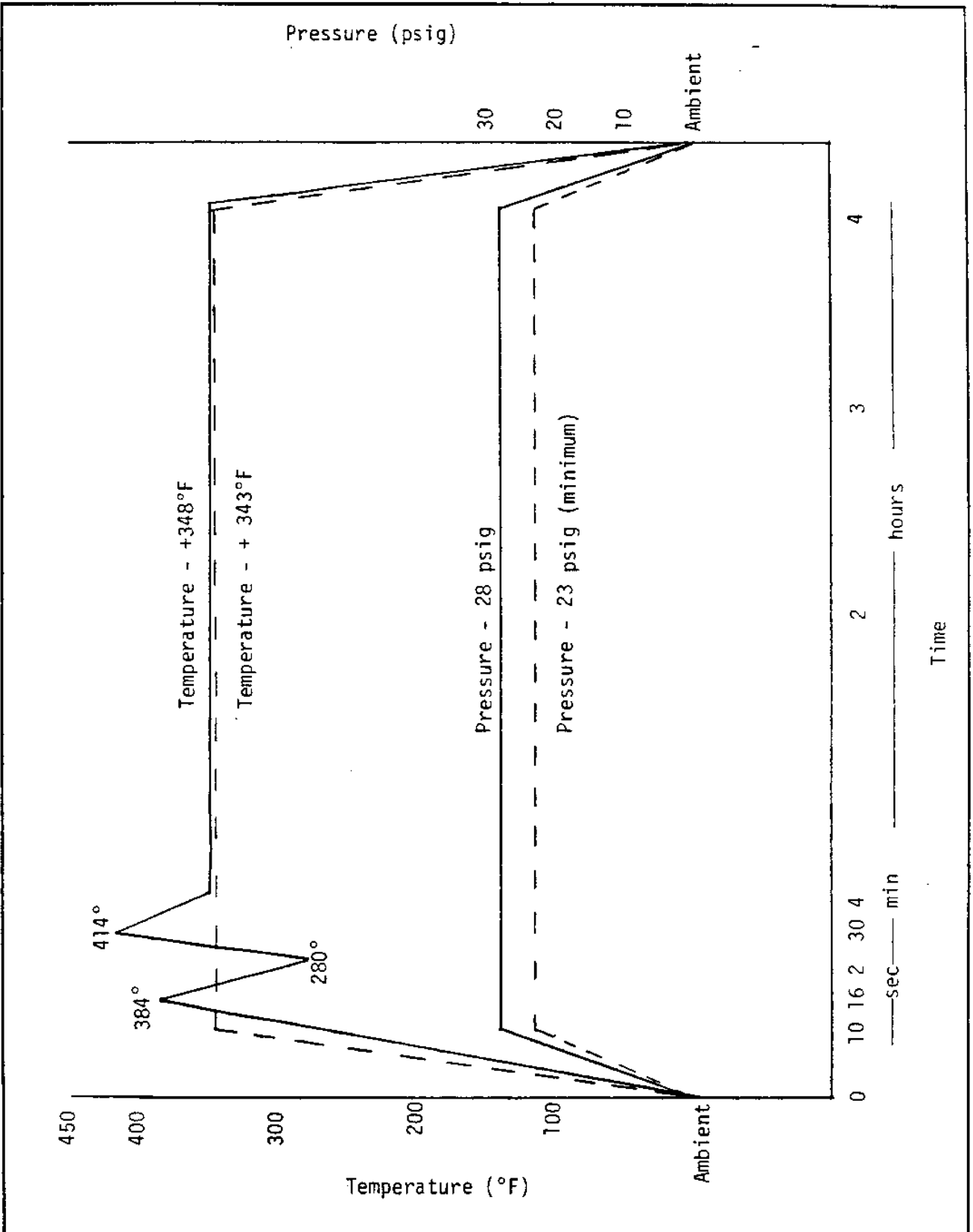
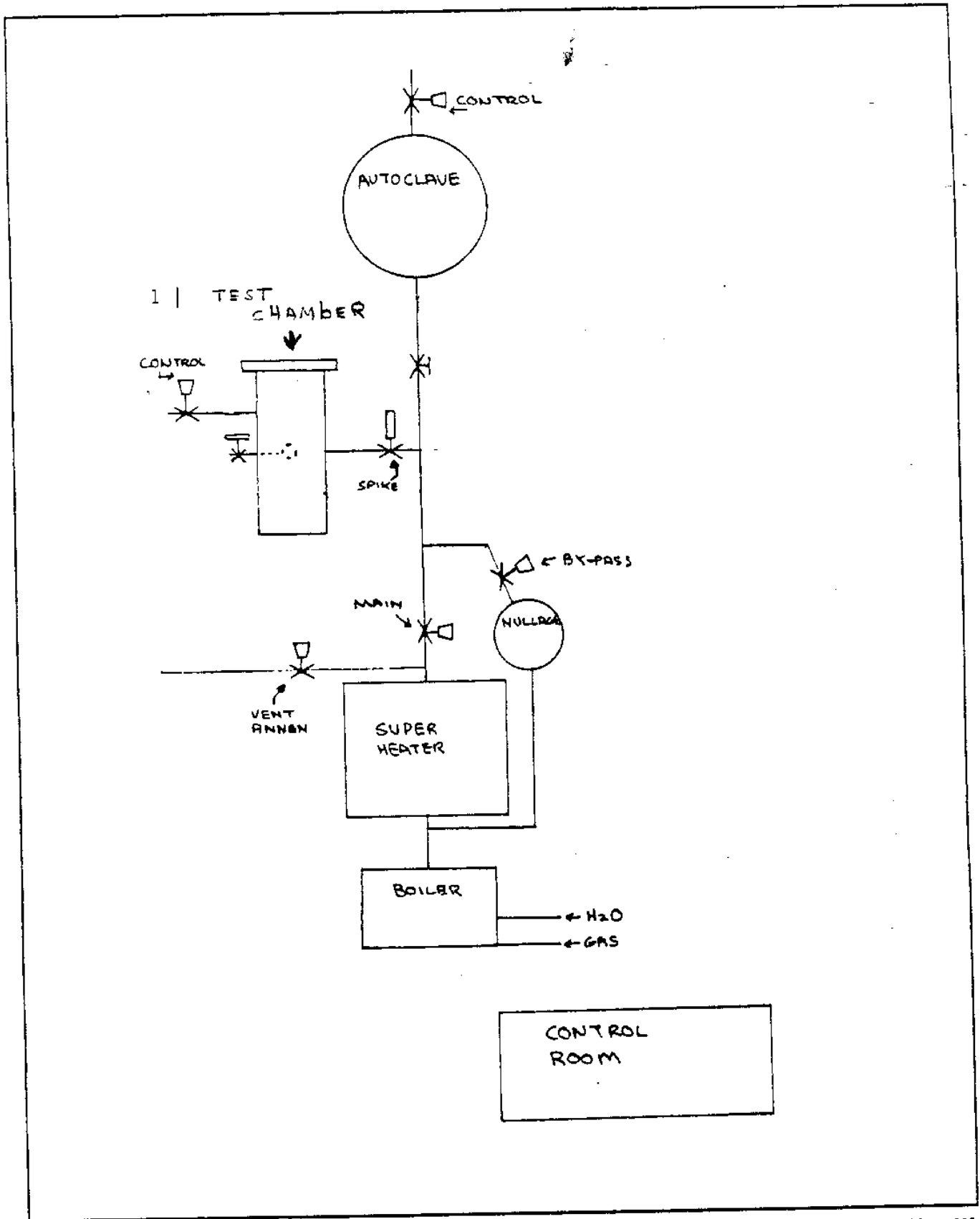


Figure 1 HELB Profile

----- = Required Levels - 207
————— = Test Levels



1 | FIGURE 2 - HELB Test Setup



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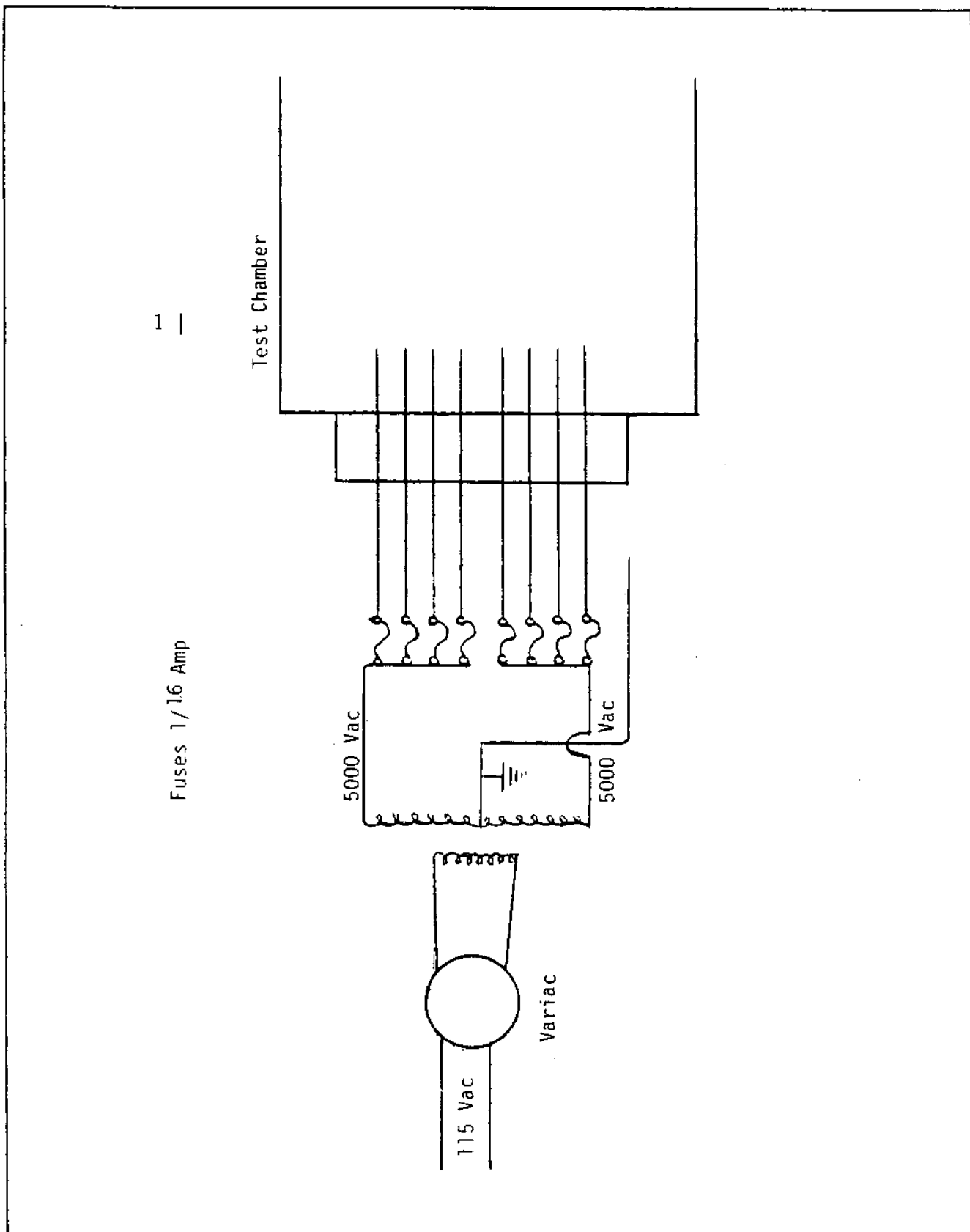


FIGURE 3 - Energizing Circuitry Schematic

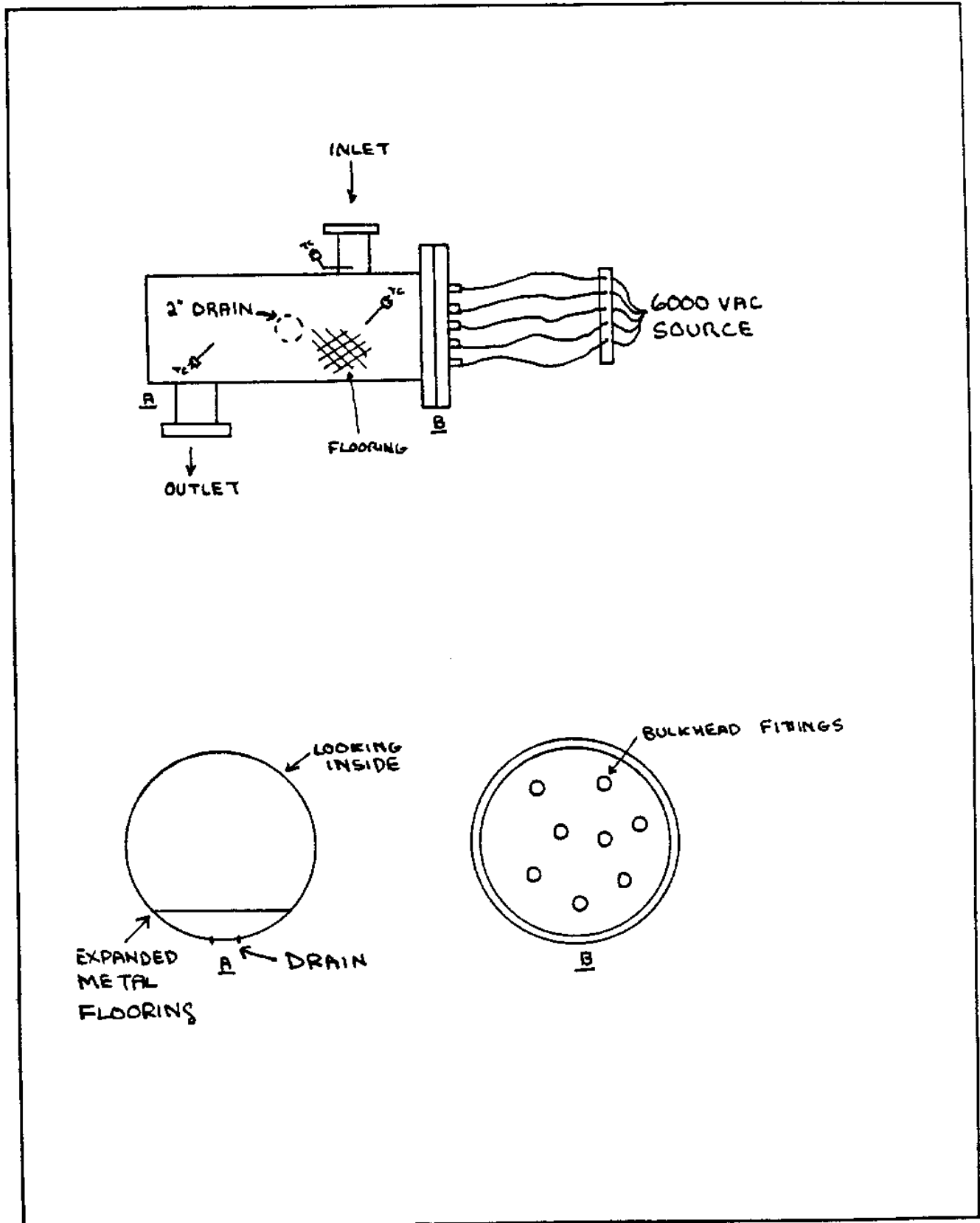


FIGURE 4: Test Chamber Setup

APPENDIX A

Test Data



APPROVED ENGINEERING TEST LABORATORIES
A NATIONAL TECHNICAL SERVICES CO.

GENERAL DATA SHEET

TEST HELB DATE 10-8-81 MJO 548-9273
 CUSTOMER RAYCHEM
 TEST ITEM MOTOR CONN. KITS P/N _____ S/N _____
 SPECIFICATION 4-5412 PAR 6.0

TEST DESCRIPTION

THE SPECIMENS WERE MOUNTED TO A FLANGE THAT ADAPTED THE MOTOR CONNECTION KITS TO THE NTS LOCA SYSTEM. THEY WERE ENERGIZED TO 5 KVAC AS PER FIG 2 OF SPEC. THE SPECIMENS WERE THEN SUBJECTED TO A SIMULATED ENVIRONMENTAL HIGH ENERGY LINE BREAK TO THE CONDITIONS OF FIG 3 (343°F AT 28 PSIG). AFTER 4 HOURS OF SIMULATED HELB THE CHAMBER WAS RETURNED TO AMBIENT AND FILLED WITH WATER PER PARA 6.1.3.1, AND AN INSULATION RESISTANCE TEST WAS CONDUCTED. ALL 8 (EIGHT) TEST SPECIMENS PASSED INSULATION RESISTANCE TESTING. THE SPECIMENS WERE THEN REMOVED FROM THE CHAMBER AND VISUALLY INSPECTED. NO VISUAL DAMAGE WAS NOTED. THE SAMPLES WERE REMOVED FROM THE TEST FLANGE AND REBOXED

AETL ID	CALIB DUE DATE	AETL ID	CALIB DUE DATE	AETL ID	CALIB DUE DATE

PAGE _____ OF _____ TEST BY R. Thurt DATE 10-8-81
 ENGR. [Signature] GOV'T QAR. _____



APPROVED ENGINEERING TEST LABORATORIES
A NATIONAL TECHNICAL SERVICES CO.

GENERAL LOG SHEET

TEST POST HELB I.R. & HYPOT MJO 548-9273
 CUSTOMER RAYCHEM
 TEST ITEM MCK CONNECTIONS P/N _____ S/N _____
 SPECIFICATION 548-9273 PAR 6.1.3

DATE	TIME	LOG ENTRIES	INITIAL
10/8/81	14:00 pm	SPECS CALL FOR AN INSULATION RESISTANCE TEST AT 500 VOL. RECORD VALUES AFTER 1 MIN EXCITATION	RWB
		CABLE A READ 68 MEG.Ω	
		CABLE B 65 MEG.Ω	
		CABLE C 66 MEG.Ω	
		CABLE D 66 MEG.Ω	
		CABLE E 68 MEG.Ω	
		CABLE F 68 MEG.Ω	
		CABLE G 66 MEG.Ω	
		CABLE H 68 MEG.Ω	
10/8/81	14:15	COMPLETED	RWB
		SPECS ALSO CALLED FOR A HYPOT TEST AT 5.5KVAC OR 5000V. TEST WAS WAIVED BECAUSE CABLES WERE AT 5000 VOL DURING HELB TEST.	
		TEST EQUIPMENT	
		GENERAL RADIO MODEL # 1862-C	
		ID # E698V CALIBRATION DUE 2/18/82	

PAGE _____ OF _____
 TEST BY Randy Baker DATE 10/8/81
 ENGR. [Signature] GOV'T QAR _____