APPENDIX C

PWR Containment Qualification

Report 600456

NUCLEAR POWER STATION

QUALIFICATION TYPE TEST REPORT

LIMITORQUE VALVE ACTUATORS
FOR PWR SERVICE

PROJECT #600456

Tested per IEEE Standard 382-1972

Test Performed 7 June 1974 to 22 November 1974

Prepared by Limitorque Corporation

Test Laboratory

Prepared by Walter L. Sykes
Walter L. Sykes
Test Engineer

Date 12/9/75

Approved W. J. Denkowski
W. J. Denkowski
Chief Engineer

Date Dec 9, 75

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APPENDICES

PWR Qualification

1.0 Introduction

A typical Limitorque Valve Actuator, SMB-0 with a 40 ft-lb motor (SMB-0-40) was submitted for qualification to the type test specified by IEEE std. 382- '72' for service in a Pressurized Water Reactor (PWR) containment chamber in Nuclear Power Station application.

The SMB-0-40 Valve Actuator was subjected to mechanical aging simulation to approximate 40 years service life, radiation exposure (Both Normal Life levels plus accumulative doses) and other environmental conditions all as indicated in IEEE Std. 382-'72'. Additional load cycling was performed after LOCA environmental conditions to determine the post accident abilities of the valve actuator.

2.0 Identification of Sample Valve Actuator

TEST UNIT

A limitorque SMB-0 Nuclear Valve Actuator with a 40 ft-lb nuclear containment motor (RH Insulation Class) was constructed per standard nuclear bill of materials and standard nuclear motor specifications. The following information was taken from the identification tags:

PWR Qualification

Valve Actuator Type/Size SMB-0

Manufacturer .....Limitorque Corporation

Order Number 600456-A

Serial Number 189835

Electric Motor Information:

Size .....40 ft-lb stall
8 ft-lb run

Manufacturer .....Reliance Electric Company

Identification number 2Y267074A1EZ

Full Load Speed .....1735 RPM

Frequency .....60 Hz

Voltage .....460 Volts

Insulation Class .....RH

Type .....P

3.0 Type Test Procedure

The type test plan as described in IEEE Std. 382-'72', paragraph 4, consists of three basic parts:

1. Aging Simulation
2. Seismic Qualification
3. Accident Environmental Simulation

As an added test margin, the test actuator was submitted to additional load cycling after completion of all the required environmental conditions and prior to final inspection. This additional load cycling is not a requirement of IEEE Std. 382-'72'. A base test motor was processed with the Test Unit for additional engineering information.

3.1 Aging Simulation (IEEE Std. 382 para. 4.2)

3.1.1 Thermal Aging

Thermal aging was performed on the motor stators by the motor manufacturer (Reliance Electric Company) in cooperation with Limitorque Corporation.

The motor stator was heat aged for 100 hours at 180 °C. A certificate of compliance was supplied by Reliance Electric Company verifying the thermal aging of the stator (see Appendix A.)

3.1.2 Mechanical Aging

Mechanical Aging was performed on the Test Unit by the Limitorque Test Laboratory. Data on the Aging & Post test Cycling is presented in Appendix B. Although IEEE Std. 382- '72' requires 500 cycles, the unit was cycled thru 1208 cycles,

each cycle consisting of one close stroke and one open stroke at room ambient conditions. The Limitorque Valve Actuator was seated at the end of the close stroke and the seating thrust monitored. The thrust applied was equivalent to the thrust & torque ratings of the SMB-0 actuator. A typical stroke time of 40 sec. was chosen for the actuator operating time.

3.1.3 Radiation Aging (IEEE Std. 382-'72' Part II Section 1)
The Aging dose of 4 Megarads was combined with the accident dose (200 Megarad) per IEEE Std. 382-'72' part III and is discussed in the following section 3.3 of this report.

3.2 Seismic Qualification (IEEE Std. 382 Para. 4.3)
The Seismic Qualification was performed by Lockheed Electronics, Inc. Environmental Laboratory on a Reaction Vibration machine. The Test Unit with motor, was scanned in each of the three major axis over a frequency range of 5 to 35 Hz to search for resonance. No resonance was found.

3.3 Radiation Exposure (IEEE Std. 382 Part II Section 1)

The Limitorque Actuator and motor were subjected to a Gamma Ray Irradiation of 204 Megarads per IEEE Std. 382-'72' requirements.

The Test Unit was placed in a Cobalt-60 and Cesium-137 field of 1 Mrad/hour at an air equivalent dose.

A total radiation dose of 204 Megarads was applied after thermal aging, mechanical aging and seismic qualification.

The radiation exposure was performed by Isomedix Corporation. A Test Certification was supplied by Isomedix Corporation and is presented in Appendix C.

3.4 Accident Simulation (IEEE Std. 382-'72')

3.4.1 Test Description

The test was performed at Limitorques' Environmental Test Facility, see figures 1, 2 and 3 in Appendix E. A schematic of the instrumentation system and a summary of instruments used during the test are presented in Figure 4 and Table I located in Appendix F. The limitorque Actuator was mounted on a thrust tube attached to the side of the test chamber with the stem thrusting against the load cell mounted

externally to the test chamber. (see Figure 1, Appendix E)

Control and power lead connections were made through flexible pressure tight conduit connections run between the units and the access ports of the test chamber. The external wire harness was run to a junction box, where terminal strips provided access to each lead for monitoring insulation resistance. The terminal strips were wired to a control system (see Figure 4, Appendix F). The control panel illustrated in Figure 3,(Appendix E) contains a power monitoring system to monitor line voltage, current in each of the three (3) motor legs and the power consumption of the motor.

Pressure and temperature were monitored on the multipoint temperature recorder and strip chart recorder mounted on the test console (Figure 3, Appendix E). In addition to the automatic monitoring system, the temperature and pressure was monitored by a pressure gauge and two thermometers mounted in the side wall of the test chamber (see Figures 1 and 4.)

During the rapid temperature and pressure transients, the chamber ambient and limit switch compartment internal temperature and pressure were monitored continuously on the strip chart recorder.

Cooling coils mounted inside the chamber provided cooling capacity to reduce the temperature in the chamber to the various temperature plateaus.

A double spray system provided a reliable source of chemical spray during the test profile. Flow meters mounted on the panel near the test chamber (see Figure 1, Appendix E) monitored the chemical fluid flow. Spray nozzles mounted on two sets of manifolds (3 nozzles per manifold) with the ability to switch manifold provided the proper spray pattern. The pressure in each active manifold set was monitored to indicate any restriction of the spray nozzle orifice. A back flush system was provided to back flush the spray manifold.

3.4.2 Test Procedure for LOCA Test

The Limitorque Valve Actuator was exposed to steam and chemical spray in accordance with the

criteria listed in Table 1 in the "IEEE Guide for Type Test of Class 1 Electric Valve Operators for Nuclear Power Generating Stations" IEEE Std. 382-'72'. The temperature/pressure profile is illustrated in Figure 5, which also shows the schedule for measuring the insulation resistance of the power and control leads and cycling of the Limitorque Valve Actuators.

During the first four days of the test, the specified temperature and pressures were maintained by the controlled injection of steam into the test chamber. During the remainder of the test, the 200 ^{o}F/10 psig state was maintained by filling the test chamber with air controlled to the proper pressure and using electrical heaters. The atmosphere was kept saturated with water vapor by maintaining condensate in the bottom of the tank and by daily injections of steam.

3.5 Post Test Inspection

A visual inspection of the limit switch compartment and the limit and torque switches was performed at the conclusion of the accident simulation.

Specified Accident Profile

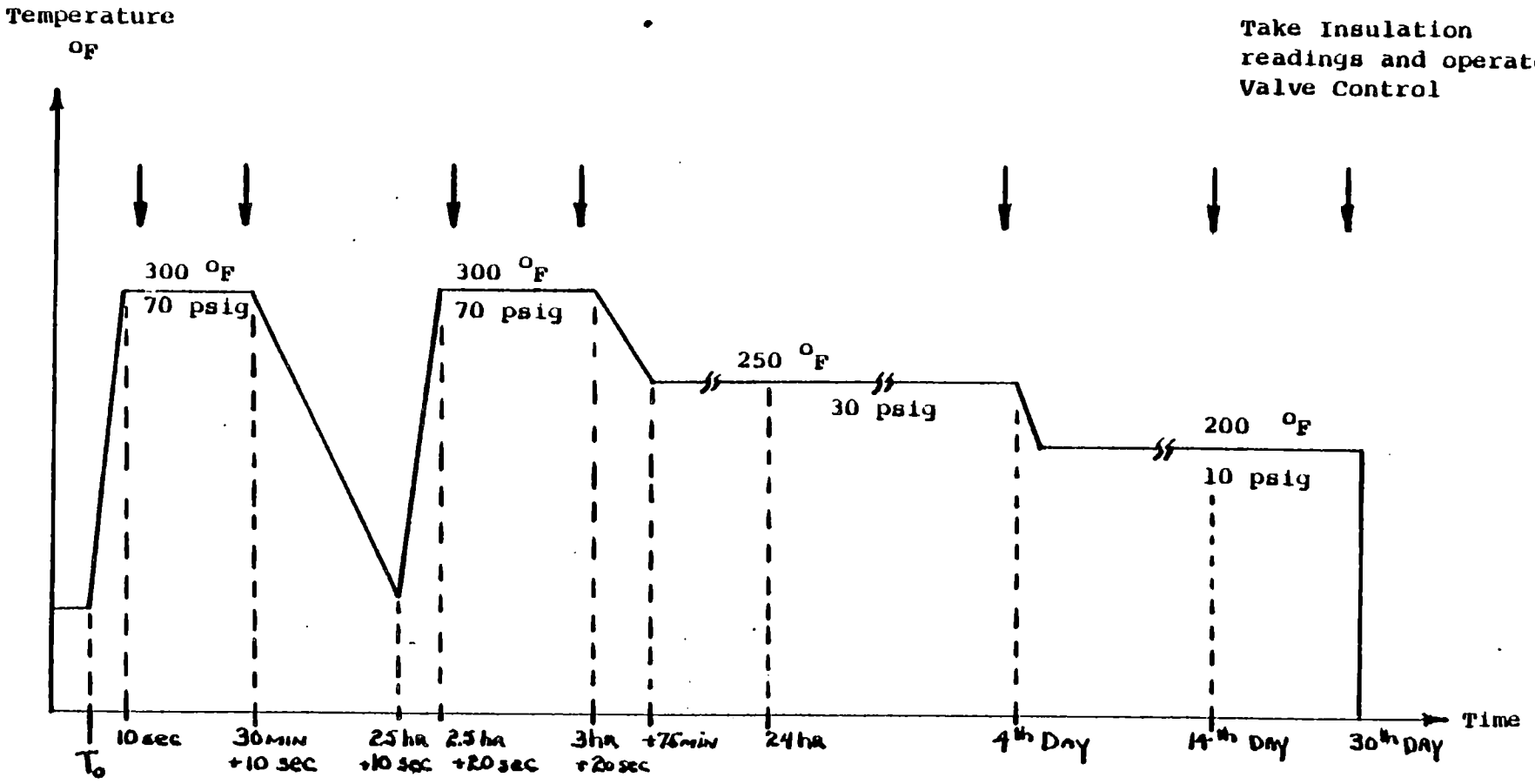


Figure 5

3.6 Post LOCA Load Cycling Test

Similar to that performed at pre-test mechanical aging, the unit was cycled for a total of 794 cycles (one close & one open stroke percycle) at room ambient conditions (data supplied in Appendix B).

3.7 Final Inspection

A complete physical inspection of the test samples was made after the completion of the Post LOCA Load Cycling to observe the conditions of the actuator.

4.0 Test Results

4.1 Mechanical Aging

The unit was initally tested on 7 June 1974 and a thrust output of 20,162 lbs. was obtained at a torgue switch setting of 1-3/4. (This value is an average of 24 readings.) The unit remained on the test stand and was automatically cycled at room ambient conditions.

The cycling test was performed from 7 June 1974 to 10 June 1974 for a total of 1208 cycles consisting of one torque switch closure in each cycle.

The load was measured after the completion of the mechanical aging and an average of 10 readings produced a thrust output of 19,920 lbs.

The test data obtained is presented in Appendix C.

4.2 Seismic Qualification

The Seismic Qualification was performed at Lockheed Electronics Environmental Laboratory on 12 June 1974. The data recorded is presented in Lockheed test Report No. 3521-4811. (Appendix D.) The thrust load was not monitored during seismic testing; however, thrust readings taken after seismic and radiation, 19,350, average of three readings, was within three (3) percent of the post mechanical aging value. The output characteristics did not change during seismic testing or irradiation. The valve actuator and its limit and torque switch functioned during seismic testing.

4.3 Radiation Aging & Accident Exposure

The exposure to radiation of the Test Unit was performed on 18 July 1974 at Isomedix Corporation. A total dose of 204 Megarads was used. A Test Certification may be found in Appendix C.

4.4 Accident Environmental Simulation Test Results

The LOCA Test was performed at Limitorques' Enviromental Test Facility. The environmental test was started 22 August 1974 and completed 21 September 1974.

4.4.1 Temperature and Pressure Profile

The profile specified in paragraph 3.2.5 of this report was closely followed as evidenced in Figure 6. The transient data was obtained by means of the strip chart recorder. At the transient time of ten (10) seconds, the temperature was a temperature within 91% of the specified temperature (300°F.) A temperature of 300°F was reached in 15.2 seconds. The second transient closely approximated the first reaching a temperature of 300°F in 13.8 seconds. Copies of the actual strip chart data are presented in Figures 7 & 8.

After the transient and a dwell of 30 minutes at 300°F, the test ambient was brought to a stable condition of 250°F and 30 psig. The actual temperature conditions were within minus 2% and plus 6% of specified temperature and the pressure conditions were within plus or minus 3.5%. These conditions were maintained for the balance of four (4) days.

At a test time of 96.1 hours (approx. 4 days) the test ambient was lowered to 200°F and 10 psig. The chamber was maintained at these conditions by means

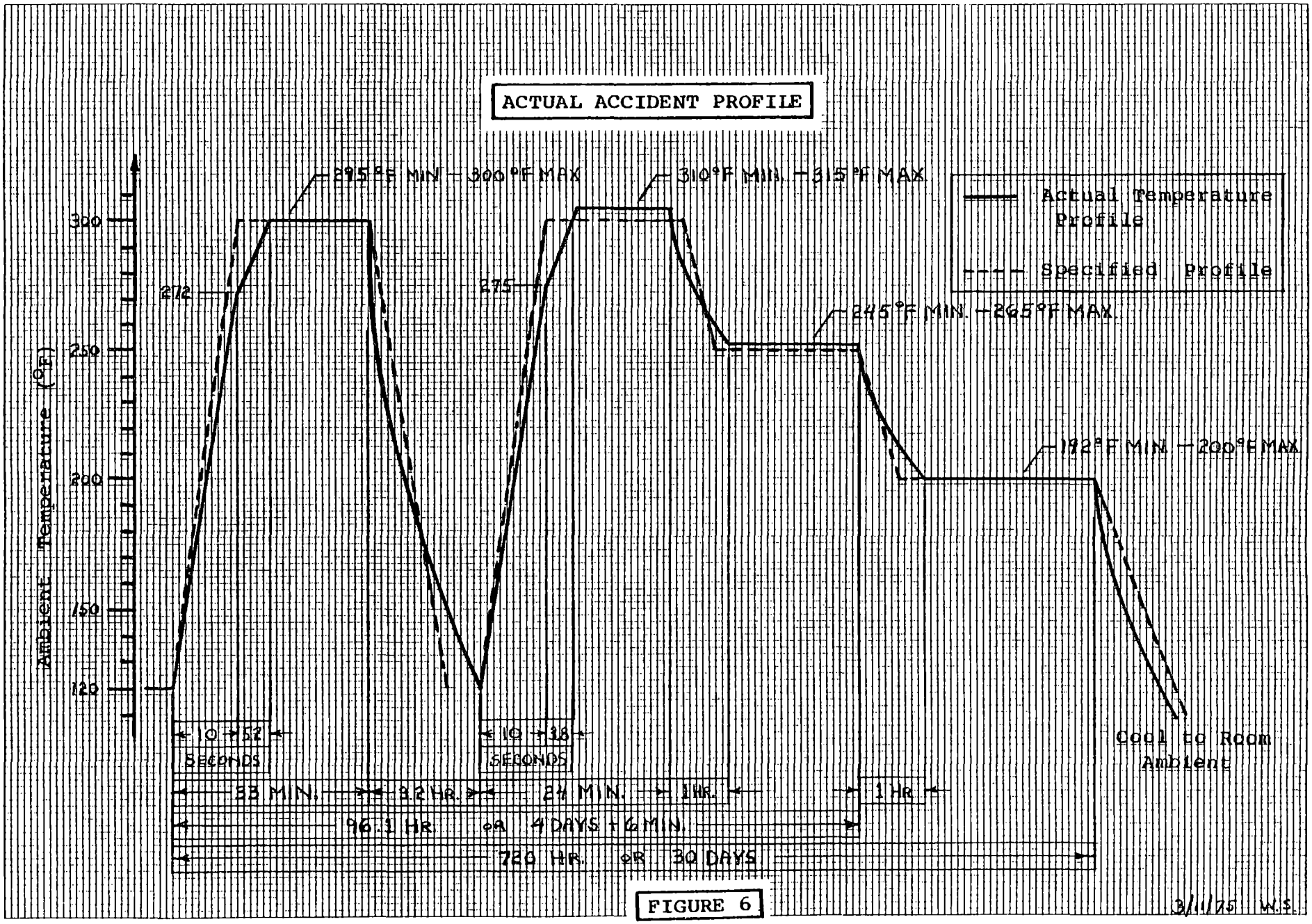


FIGURE 6

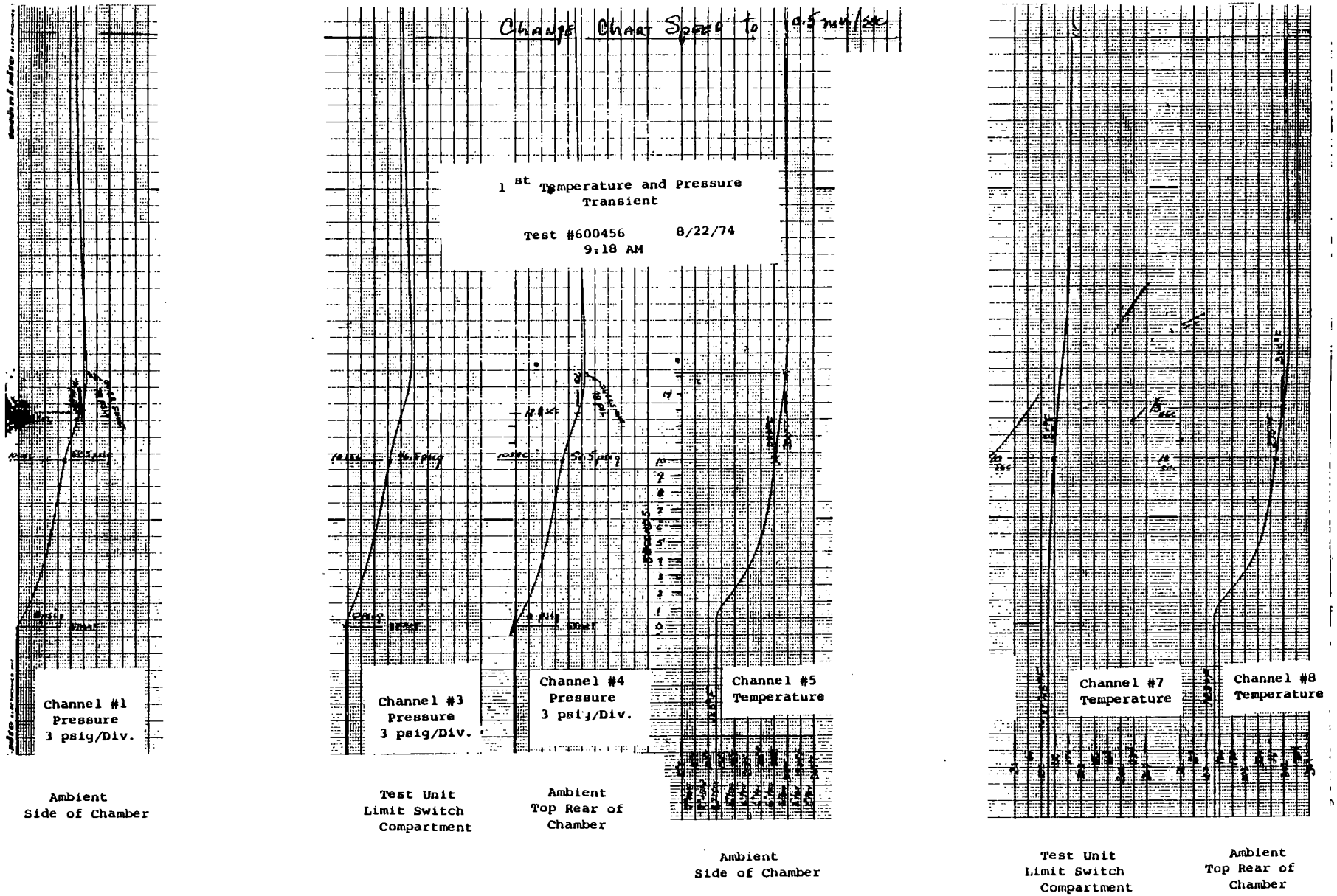
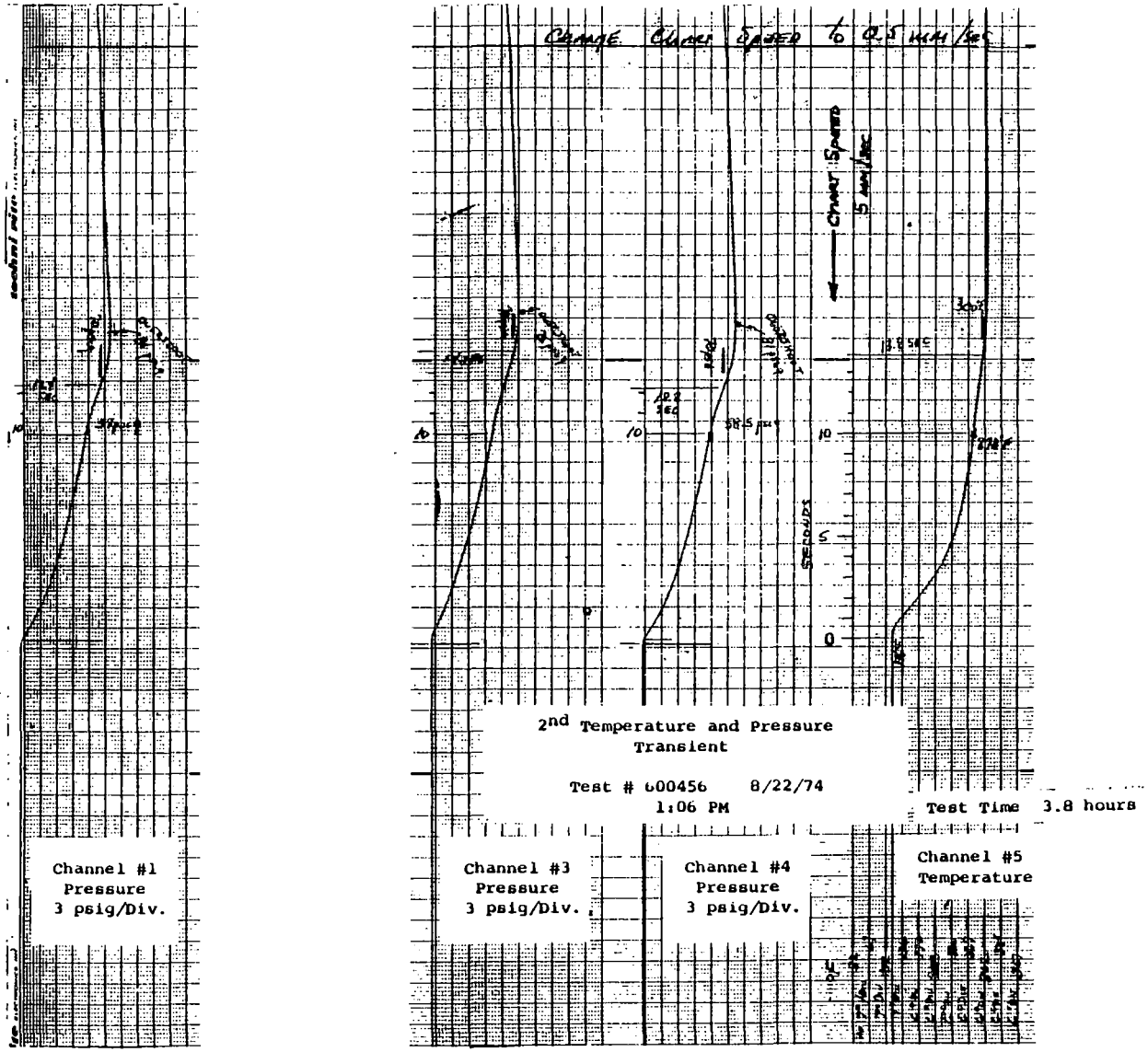

Change Chart Speed to 0.5 inch/sec
1st Temperature and Pressure Transient
Test #600456 8/22/74
9:18 AM
Channel #1 Pressure 3 psig/Div.
Channel #3 Pressure 3 psig/Div.
Channel #4 Pressure 3 psi/Div.
Channel #5 Temperature
Channel #7 Temperature
Channel #8 Temperature
Ambient Side of Chamber
Test Unit Limit Switch Compartment
Ambient Top Rear of Chamber
Ambient Side of Chamber
Test Unit Limit Switch Compartment
Ambient Top Rear of Chamber

Figure #7



2nd Temperature and Pressure Transient

Test # 600456 8/22/74
1:06 PM

Test Time 3.8 hours

Figure #8

of strip heaters and air injection through a pressure controlled solenoid valve. Once stability was reached, the ambient was maintained within plus 0% and minus 4% of specified temperature and plus 10% and minus 0% of specified pressure.

4.4.2 Chemical Spray Delivery

The chemical mixture (per Table 1 of IEEE Std. 382-page 12) was prepared prior to start of the LOCA test and pH values measured. Tank No. 1 had a pH of 10.9 after initial mixing. Tank No. 2 had a pH of 10.5 after initial mixing. The pH was monitored on a sample taken from Tank No. 1 at a test time of 0.1 hours (pH=11.1) and after 4.4 hours (pH=11.1). A sample of Tank No. 2 taken at 24 hours had a pH reading of 10.5.

The chemical flow was maintained at 0.6 gal/min in each spray manifold or an overall flow rate of 1.2 gal/min. A check was made of the average flow rate by recording the total amount of chemical solution used in a given period of time. These average flow rates agreed with the recorded instantaneous flow rates.

4.4.3 Chamber Humidity

The relative humidity of the chamber was maintained at 100 percent by the periodic injection of steam and by maintaining the vapor condensate at the bottom of the chamber at the same temperature as the air/vapor mixture. The content of air in the air vapor mixture was minimized by venting the chamber during the thermal transients.

4.4.4 Insulation Resistance Measurements

Insulation resistance measurements to ground were made periodically on the power and control leads of the Test Unit prior to operating the valve actuator (see Table II.)

4.4.5 Operator Cycling Data

The test unit functioned without problems throughout the entire test. It is worthy to mention that during the final operational cycle (719.1 hours) the close indicating light exhibited a very dim glow when it should have been extinquished. This phenomena was noticed only on the "close" light circuit and no other indicating lights or circuits

TABLE II

Insulation Resistance of Power and Control Leads

(All resistances are in Megohms except where a K indicates Kilo-ohms)

(all measurements made to ground)

Time After Start Test (hr.)	MOTOR LEADS			CONTROL CIRCUIT LEADS														
	T-1	T-2	T-3	CL-1	61	71	41	43A	43B	43C	45A	45B	51	53A	53B	53C	55A	55B
*0	400	400	400	180	180	180	2000	180	180	180	180	180	180	190	180	180	180	180
0.15	160K	160K	160K	300K	400K	400K	40.0	400K	400K	400K	400K	400K	400K	400K	400K	400K	400K	400K
0.5	120K	120K	120K	280K	280K	280K	5.0	280K	280K	280K	280K	280K	280K	280K	280K	280K	280K	280K
3.9	100K	100K	100K	2.0	2.0	2.0	6.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
4.2	50K	50K	50K	400K	400K	400K	2.4	400K	400K	400K	400K	400K	400K	400K	400K	400K	400K	400K
95.5	80K	80K	80K	2.0K	2.0K	3.0K	40K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K	2.0K
334.9	60K	60K	60K	1.5K	1.5K	2.0K	5.0K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K	1.5K
719.1	60K	60K	60K	2.0K	2.0K	3.0K	5.0K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K	1.7K

*Check prior to start of test.

exhibited these characteristics. Subsequent investigation concluded that the current flow through this light to duplicate the dim glow was insignificant and coupled with its occurrence in the final hour of a 30 day test did not constitute a malfunction.

The megger readings diminished during the environmental test and the current & power requirements did increase slightly as the test in the environmental chamber continued; however, this had no effect on the actuator performance. The stroke time remained constant throughout the test.

Also a slight variation in the measured output thrust was noted and was attributed to a change in stem efficiency rather than actuator output torque change. It was noted that during periods of non-operation, the thrust tended to become lower, whereas during periods of frequent operations, the thrust increased. Probably, the ambient temperature & moisture effected the lubricity of the lubricant used on the stem.

A summary of the cycling data is presented in Table III.

TABLE III

VALVE ACTUATOR CYCLING DATA

Time After Start of Test (hr.)	Potential (volts)			OPEN STROKE					CLOSE STROKE							
				Run Current (Amps)			Power (Watts)	Stroke Time (Secs)	Run Current (Amps)			Peak Current * (Amps) (T-3)	Power (Watts)		Stroke Time (Secs)	Seating Thrust (lbs)
	T-1 T-3	T-1 T-2	T-2 T-3	T-1	T-2	T-3			T-1	T-2	T-3		Run	*Peak		
** 0	490	495	490	4.6	4.8	4.6	620	42	4.6	4.8	4.4	5.0	620	1350	42	19,375
.3	475	480	480	4.5	4.6	4.5	620	42	4.3	4.3	4.2	5.1	600	1300	43	19,425
.6	485	490	485	4.7	4.8	4.6	680	42	4.8	4.9	4.5	5.1	680	1320	43	20,825
4.1	485	490	485	4.8	4.9	4.6	620	42	4.8	5.0	4.6	5.1	610	1300	43	21,600
4.3	490	490	480	4.8	5.0	4.7	650	42	4.8	5.0	4.6	5.1	640	1350	43	22,150
95.5	495	500	495	5.1	5.2	5.0	725	42	5.2	5.3	4.9	5.3	750	1500	43	22,650
335.4	485	490	485	4.8	4.9	4.6	650	41	4.9	5.0	4.6	5.0	650	1400	42	21,600
719.1	495	500	490	4.9	5.2	4.9	675	42	5.0	5.2	4.7	5.0	675	1500	42	18,550
719.5	495	500	490	5.0	5.2	4.9	700	42	5.0	5.2	4.7	5.6	675	1900	42	21,350

* Due to rapid rise of current and power, considering the slow meter response times, these values to be considered as approximation of actual peak.

** Check prior to start of test.

4.5 Post LOCA Inspection

The post LOCA Inspection was performed 21 September 1974 after opening the test chamber. Photographs were taken of the test unit with the limit switch compartment cover in place (see Figure9). Externally, the Test Unit was clean looking with no unusual deposits. The limit switch compartment had approximately one-eighth (1/8) of an inch of condensate in the bottom of the compartment.

Both the limit and torque switches were clean and functioned without mechanical difficulties. The motor lead protective sleeving was split in several areas; however, no damage was noted to the motor lead insulation.

4.6 Post LOCA Load Cycling

The post LOCA Load Cycling was performed by the Limitorque Test Laboratory from 30 September 1974 to 4 October 1974.

The thrust output of the Test Unit was measured prior to the start of the load cycling. The thrust output was found to be 16,392 (an average of 6 readings). This was accomplished at the same torque

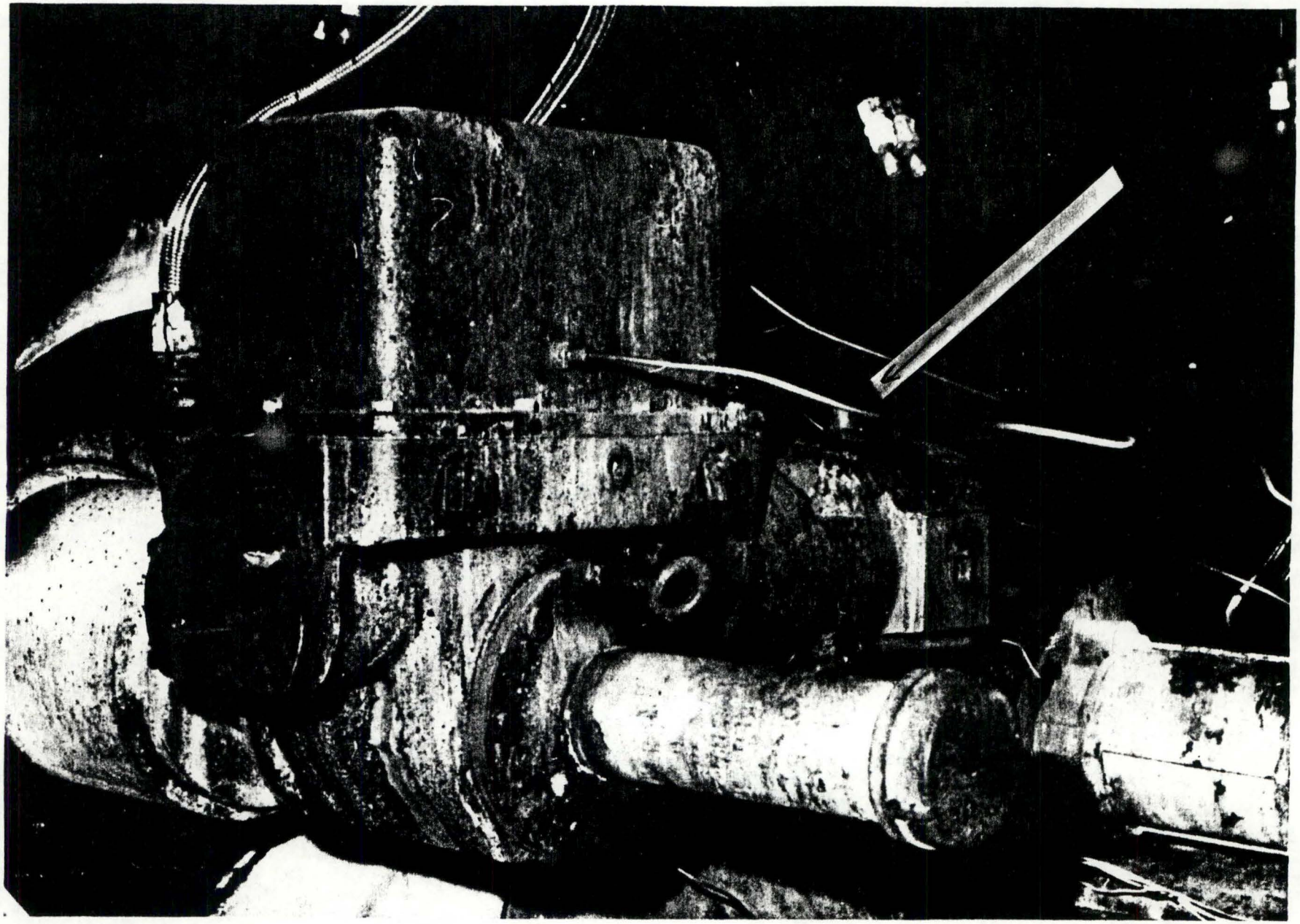


Figure 9 Post LOCA Conditions

switch setting (1-3/4) as that used throughout the test.

The torque output of the actuator as controlled by the torque switch remains constant with the same torque switch setting, however, the thrust monitor in the test stem depends upon several factors including the efficiency of the acme threads. The lower thrust output monitored after the unit was brought to room temperature was attributed to a degredation of stem efficiency as a result of corrosion of the steel stem and deposition of foreign materials from the exposure to the steam and chemical spray and not attributable to changes in the torque switch operating train or reduction in the torque output of the actuator.

The effect of the corrosion was most noticeable after the stem was exposed to room ambient conditions for several hours. After the completion of the 794 cycles, the thrust monitored returned to its original value indicating the repeated cycling had removed the corrosive deposits in the stem thread area. The cycling data and thrust reading are presented in Appendix B.

A Base Test motor which experienced all the environmental conditions was installed on the test actuator after the planned post LOCA cycling to obtain cyclic information on the base motor and provide additional load cycling on the test unit. The SMB-0 Actuator (with the base test motor) was cycled for an additional 2184 cycles.

The SMB-0 Actuator functioned without difficulty throughout the additional 2184 cycles.

A summary of the load cycles accumulated on the test unit is as follows:

PreTest Mechanical Aging	1208 cycles
LOCA Testing cycles	9 cycles
Post LOCA Load cycling	794 cycles
Base Test Motor cycling	2184 cycles
TOTAL	4195 cycles

4.7 Final Inspection and Dismantling

4.7.1 Motor Inspection and Dismantling

The motor (used with the test unit during LOCA test) mounted on the Test Unit was removed from the SMB valve actuator and dismantled for inspection. The inspection was performed on 21 November 1974 with representatives from Reliance Electric Company in attendance.

The rotor turned freely prior to dismantling the motor. The stator and rotor showed little evidence of corrosive build-up and no evidence of physical damage. The end bell was particularly clean with little evidence of water. The bearing lubricant was moist and the bearing turned freely.

4.7.2 Valve Control Inspection and Dismantling

The SMB-0-40 Valve Actuator was completely dismantled for inspection on 22 November 1974. Photographs of the valve actuator components are presented in Figure 10.

The torque switch and limit switch were removed from the SMB-0 Valve Actuator and the

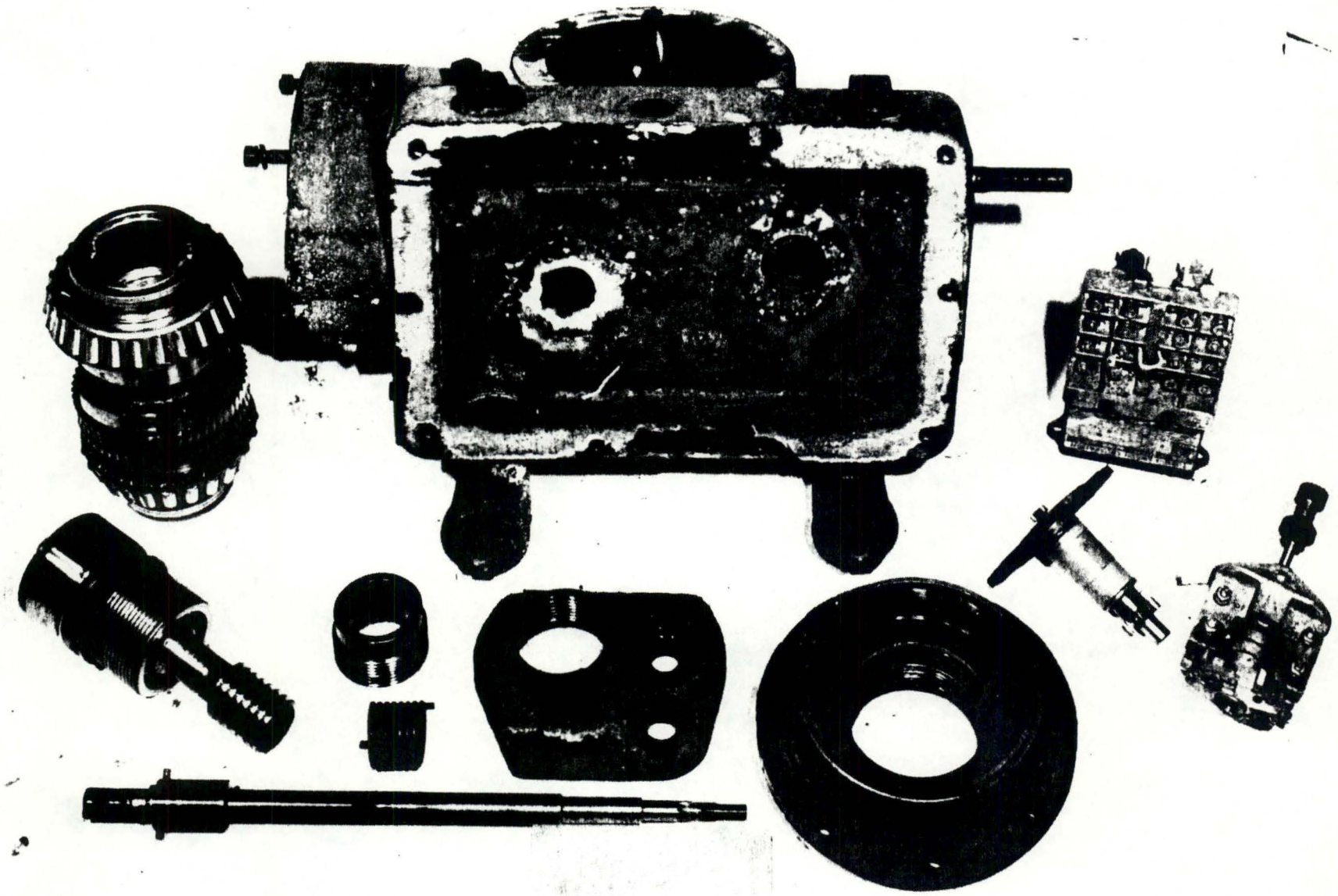


Figure 10
Test Unit Final Inspection

following observations were made:

a.) The torque switch and limit switches worked freely.

b.) The torque switch and limit switch pinions both showed signs of lubrication.

The grease in the main housing and the handwheel clutch compartment was dark in color but maintained its lubricity. A slight amount of separation of the grease was noted. The O-Ring and bearings seemed in good condition with no wear noted.

5.0 Conclusion

The Limitorque Valve Actuator SMB-0-40 was subjected to a qualification test consisting of a 30-day exposure to a steam chemical environment, including two temperature & pressure transients from 120 degrees F to 300 degrees F in approximately 10 seconds. Prior to environmental testing, the motor was heat aged, the unit was mechanically tested and subjected to gamma ray irradiation. The unit was cycled with simulated valve seating loads during environmental testing at elevated temperatures and pressures and after environmental test was additionally cycled with a simulated valve seating load.

PWR Qualification

Since the unit performed satisfactorily, throughout the test, it is concluded this test qualifies similar Limitorque Valve Actuators for use in a PWR containment chamber where environmental conditions depicted by Table I in IEEE Std. 382-'72' are encountered.

APPENDIX A

Reliance Electric Company - Certificate of Compliance

RELIANCE ELECTRIC COMPANY

CERTIFICATE OF COMPLIANCE

Limitorque Corporation
5114 Woodall Road
Lynchburg, Virginia 24502

EQUIPMENT: Electric Motor

REFERENCE: Purchase Order No. 600426-C

FILE: Sales Order No. 2Y-267074A1

We certify that the equipment identified above has been designed, manufactured, inspected, and/or tested in accordance with the requirements established by the following specifications: RCP-242, Limitorque D/S 21-49-001-1 We further certify that the stator was heat aged 100 hours at 180°C.

B. L. Hoskins

Quality Control Department

3548 Printed in USA

4200 BENEFIT ROAD / ASHTABULA, OHIO 44004 / TELEPHONE 216-992-2175

GENERAL OFFICES / CLEVELAND, OHIO

APPENDIX B

INITIAL TORQUE SWITCH SETTING

MECHANICAL AGING

POST MECHANICAL AGING THRUST MEASUREMENT

POST SEISMIC QUALIFICATION AND RADIATION THRUST MEASUREMENT

POST ENVIRONMENTAL THRUST MEASUREMENT

POST ENVIRONMENTAL LOAD CYCLING

POST LOAD CYCLING THRUST MEASUREMENT

SUMMARY OF LOAD CYCLING DATA

Specimen: TEST UNIT

Limtorque Valve Actuator
Type: SMB
Size: O
Serial No. 189835
Motor size 40 ft-lb
I. D. #2Y267074A1EZ

Instrumentation:

Load Cell: Capacity 20, 000 pounds
Manufacturer BLH
Serial No. 2512

Strain Indicator:

Manufacturer BLH
Type N
Serial No. 443604

INITIAL TORQUE SWITCH SETTING Date: 6/7/74

No. of Readings	Torque Switch Setting	Thrust Output * (pounds)
5	"1"	11,070
5	"1½"	16,010
24	"1 3/4"	20,162

*Average of all readings

MECHANICAL AGING Date: 6/7/74 to 6/10/74

Definition: One (1) cycle
Open Limit actuation to close torque
Switch actuation to open limit
actuation. Two (2) strokes per cycle.
Stroke Time: 54 sec *
Cycle Time: 1 min. 53 sec
Duty Cycle: 'RUN' 7 cycles - 'OFF' 10 min.
Load (Thrust): 20,162 pounds
Total No. of Cycles: 1208

* The unit was cycled for mechanical aging on a different load stand than was used in the test and since the stroke was longer in this stand, a longer stroke time was obtained.

POST MECHANICAL AGING THRUST MEASUREMENT Date: 6/10/74

No. of Readings	Torque Switch Setting	Thrust Output * (pounds)
10	"1 3/4"	19,920

POST SEISMIC QUALIFICATION AND RADIATION THRUST MEASUREMENT Date: 8/19/74

No. of Readings	Torque Switch Setting	Thrust Output * (pounds)
3	"1 3/4"	19,250

* Average of all readings

POST ENVIRONMENTAL TEST THRUST MEASUREMENT Date: 9/30/74

No. of Readings	Torque Switch Setting	Thrust Output * (pounds)
6	"1 3/4"	16,392

Note: The low output thrust readings are a result of poor stem efficiency as a result of accumulated deposits on the acme threads of the stem. The thrust measured during the last test point of the environmental test was 21,350 pounds.

POST ENVIRONMENTAL LOAD CYCLING Date: 9/30/74 - 10/4/74

Definition: One (1) cycle
Open limit to close torque switch actuation to open limit. Two (2) strokes per cycle.
Stroke Time: 40 sec
Duty Cycle: 'RUN' 7 cylces - 'OFF' 10 minutes
Load (Thrust): 16,392 at start
19,667 at finish
Total No. of Cycles: 794

Note: The increase in thrust output is due to improved stem efficiency. The repeated cycling removed the corrosion in the threaded area of the stem.

The load cycling was discontinued during the night and ran during the first shift.

POST LOAD CYCLING THRUST MEASUREMENT Date: 10/4/74

No. of Readings	Torque Switch Setting	Thrust Output (pounds)
3	"1 3/4"	19,667

Note: The output thrust returned to the value recorded after the pre-test mechanical aging.

APPENDIX C

Radiation Exposure - Isomedix Certificate of Performance

ISOMEDIX

July 19, 1974

Mr. W. J. Denkowksi
Chief Engineer
Limitorque Corporation
181 South Gulph Road
King of Prussia, Pa. 19406

Dear Mr. Denkowski:

This will summarize the perimeters pertinent to the irradiation of one valve operator and motor assembly. Identification on the valve operator and motor assembly was:

SMB 0 Valve Control
s/n 189835
Reliance 40 lb-ft motor
I.D. 2Y267074AlEZ

Units were placed in a co-60 field of $1x10^6$ rad per hour, at an air equivalent dose. They were rotated several times during the exposure to achieve a more uniform dose distribution. Total dose received to the centerline of the unit was 204 mrad (air equivalent) with an overdose factor on the edges of the units of 1.2. Irradiation was in air and ambient temperature in a slight negative pressure. The temperature of the samples during irradiation did not exceed 100°F.

Dosimetry was performed using a Victoreen Model 555 Integrating Dose Rate Meter and Probe. The unit was calibrated on January 15, 1974 by the Victoreen Instrument Company, using Cobalt-60 and Cesium-137 sources whose calibrations are traceable to the U.S. National Bureau of Standards. A copy of the calibration certificate is available.

Confirming dosimetry utilizing a Red Perspex system was also completed.

Isomedix Inc. • 25 Eastmans Road, Parsippany, New Jersey (201) 887-4700
Mailing Address: Post Office Box 177, Parsippany, New Jersey 07054

CHICAGO DIVISION • 7828 Nagle Ave., Morton Grove, Illinois 60053 (312) 966-1160

Irradiation was completed July 18, 1974 and the units returned to you under separate cover.

Very truly yours,

George R Dietz

George R Dietz
Manager, Radiation Services

GRD:km

APPENDIX D

Seismic Qualification - Lockheed Test Report