CROSBY

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

TEST REPORT NO. 4330, REVISION 2

CYCLE TIME FOR MSIV ACTUATORS
AT
NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT NUCLEAR STATION, UNIT 2

TESTED BY: J. D. MacAFEE

DATE OF REPORT: NOVEMBER 10, 1986

J D MacAfee 10 Nov 86

W. D Greenlaw (for) 10 Nov 86

CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

1. Objectives

The objectives of the test were to locate the cause of excessive cycle time of the modified Gulf & Western Series 600 Actuator designed for use with the 24" MSIV's at Nine Mile Point Nuclear Station, Unit 2 and to bring the cycle time within the 3 to 5 second time frame required.

2. Test Actuator and Background

The testing was performed on the actuator in the possession of Crosby Valve & Gage Company in Wrentham, Massachusetts. This was a full size actuator less the MSIV, mounted in the orientation encountered in service. The actuator design had undergone dynamic operability testing at Wyle Laboratories, documented in Wyle Test Report No. 46912-2 dated November 14, 1983.

As a result of problems encountered during the preliminary and pre-operational testing at the site, a decision was made to modify the actuator by eliminating the mechanical latch and, instead, hold the actuator/valve assembly open with continuous hydraulic pressure. See Figure 4.

3. Description of Problem

The installation of a make-up pump and accumulator in the test actuator was followed by a number of cycles to verify acceptable performance. During those cycles it was observed that the cycle time measured from loss of electrical signal to end of stroke was dependent upon the length of time the system had been held under pressure. The tests showed the actual stroke time remained a constant 3.4 seconds plus or minus 0.3 seconds, but the trip time for the solenoid operated valves in the hydraulic piping system from signal loss to start of actuator stroke varied from less than 1.0 seconds to greater than 4.0 seconds, depending upon the length of time between cycles. Figures 1 and 2 display the results of two such representative tests. Figure 1 is the recorder trace of a cycle after the actuator had been held open for approximately 18 hours. Figure 2 is the trace of the fourth cycle run in approximately 30 minutes. The figures display both the trip time and the ensuing actuator stroke time.

In addition to the extended cycle times, the system's internal leakage resulted in the make-up pump cycling more frequently than was deemed acceptable.

4. Investigation

The main actuating cylinder, produced by Hydro-Line Corporation, was modified by the addition of an adjustable piston stop screw in the end cap and the installation of EPR piston seals in place of the iron piston rings originally installed. The hydraulic fluid discharge ports in the test unit had previously been enlarged to minimize pressure drop during the closing cycle. The make-up pump cycle time went from 15 minutes to 8 days following the installation of the new piston seals.

The solenoid operated valves were disassembled and the sealing face of the discs were remachined to assure that hang-up time was not related to seat wedging. At the same time new EPR O-ring disc seals were installed. Fourteen cycles were run following varying dwell times, testing the valves singly and simultaneously. There was no appreciable effect on the performance.

Two new discs were installed in the valves using solid TFE disc seals. A series of nine tests with pressurization times of up to four (4) days resulted in solenoid operated valve trip times never exceeding 1.3 seconds.

A different set of discs were installed in the valves. This set had Stellite No. 6 faces and seals consisting of EPR O-rings with carbon filled TFE cover rings. The use of Stellite was an attempt to lengthen the useful life of the valve seat. This combination actually prevented the valves from opening until the pressure was dropped substantially. It was suspected that the friction of the disc/seat material combination and not the seal materials caused this behavior.

The previously used discs (which are 17-4PH steel) were machined to accept the combination EPR/TFE seals. After holding pressure for approximately 17 hours, the valves cycled with a trip time of 0.4 seconds. See Figure 3 for a trace of that test.

To assure that nothing unrecognized had changed, the previously installed EPR O-rings were reinstalled in these discs and tested for four (4) cycles. After a four (4) hour dwell time there was a 2.4 second solenoid operated valve trip time.

Next, EPR O-rings with Tefzel cover rings were installed in the same discs. Tefzel was of interest because of its greater resistance to radiation. The valves failed to open under pressure using this seal combination.

4. Investigation (Continued)

The EPR/TFE combination was again installed in the discs. After sixteen (16) hours under pressure the delay was 0.4 seconds. After three (3) days, after five (5) days and after twelve (12) days the solenoid operated valve trip time was 0.3 seconds.

During a test of the valves at the manufacturer's (Target Rock Corporation) laboratory it was demonstrated that the application of a high side load, simulating seismic loads, would result in a slow valve opening. The installation of a spacer in the disc return spring cavity solved the problem at that site. Duplicate spacers were installed in the valves on the test actuator in Wrentham. Following a 6.5 hour dwell time at pressure the solenoid operated valve trip time was less than 0.2 seconds. The actuator is presently undergoing a thirty-eight (38) day test under pressure after which the trip time will again be measured.

Table I summarizes the results of the actuator tests run incorporating the final solenoid operated valve disc seal design. The last run incorporated the spring spacer as well, showing the slight improvement in response time.

5. Conclusions

The primary contributor to the variation in speed of actuation of the solenoid operated valves appears to be the friction of the disc seals.

Tests of the original EPR O-ring disc seal showed that cycle times exceed the required 3 to 5 seconds.

EPR seals on the main cylinder's piston substantially reduce the operating frequency of the make-up pump.

Tests using an EPR O-ring with TFE cover ring in the solenoid operated valve disc results in operating cycle times within the required 3-5 seconds.

Increased spring force on the disc results in equally fast or faster response than the unmodified spring.

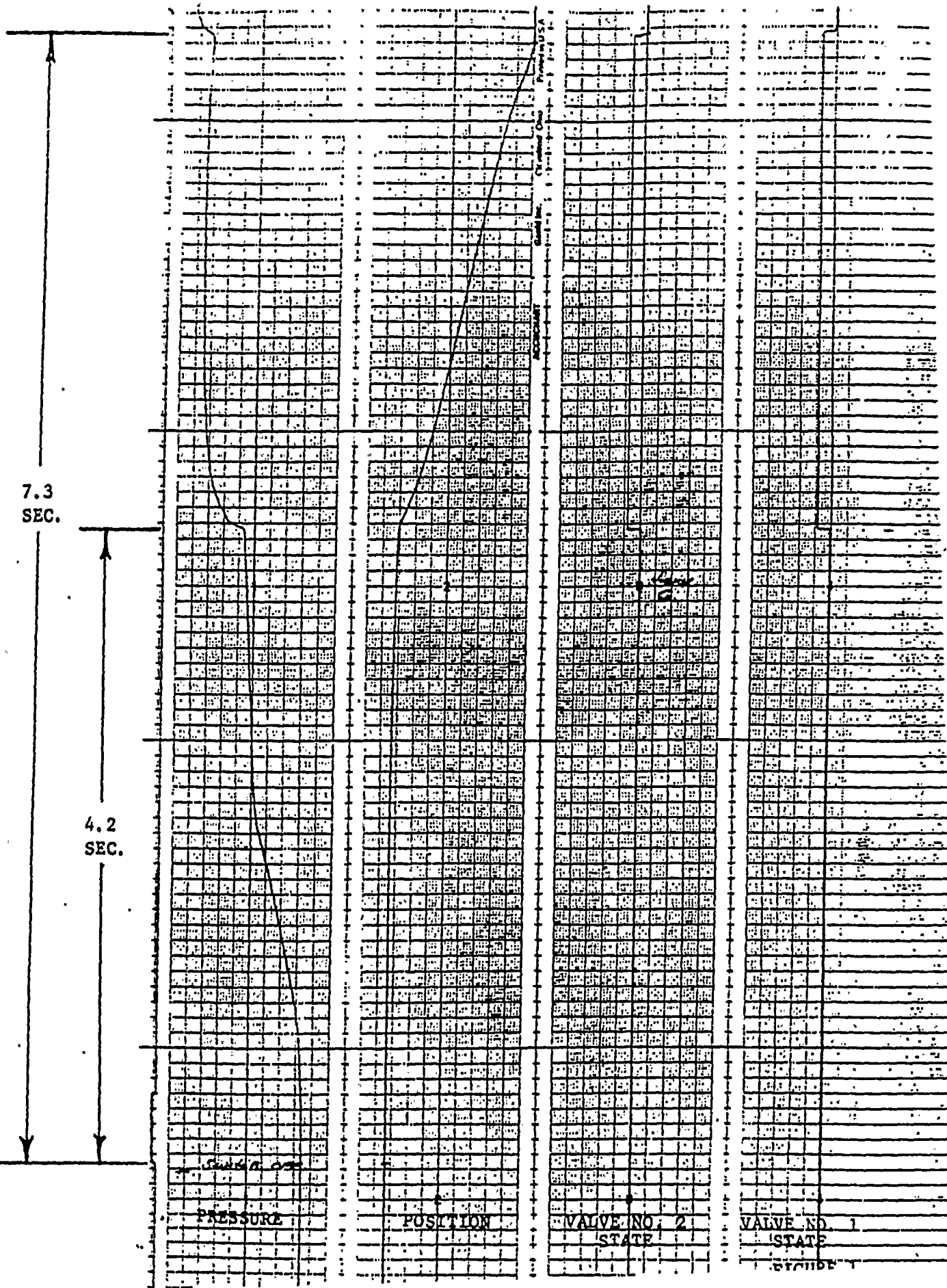

7.3
SEC.
4.2
SEC.
PRESSURE
POSITION
VALVE NO. 2
STATE
VALVE NO. 1
STATE

FIGURE 1

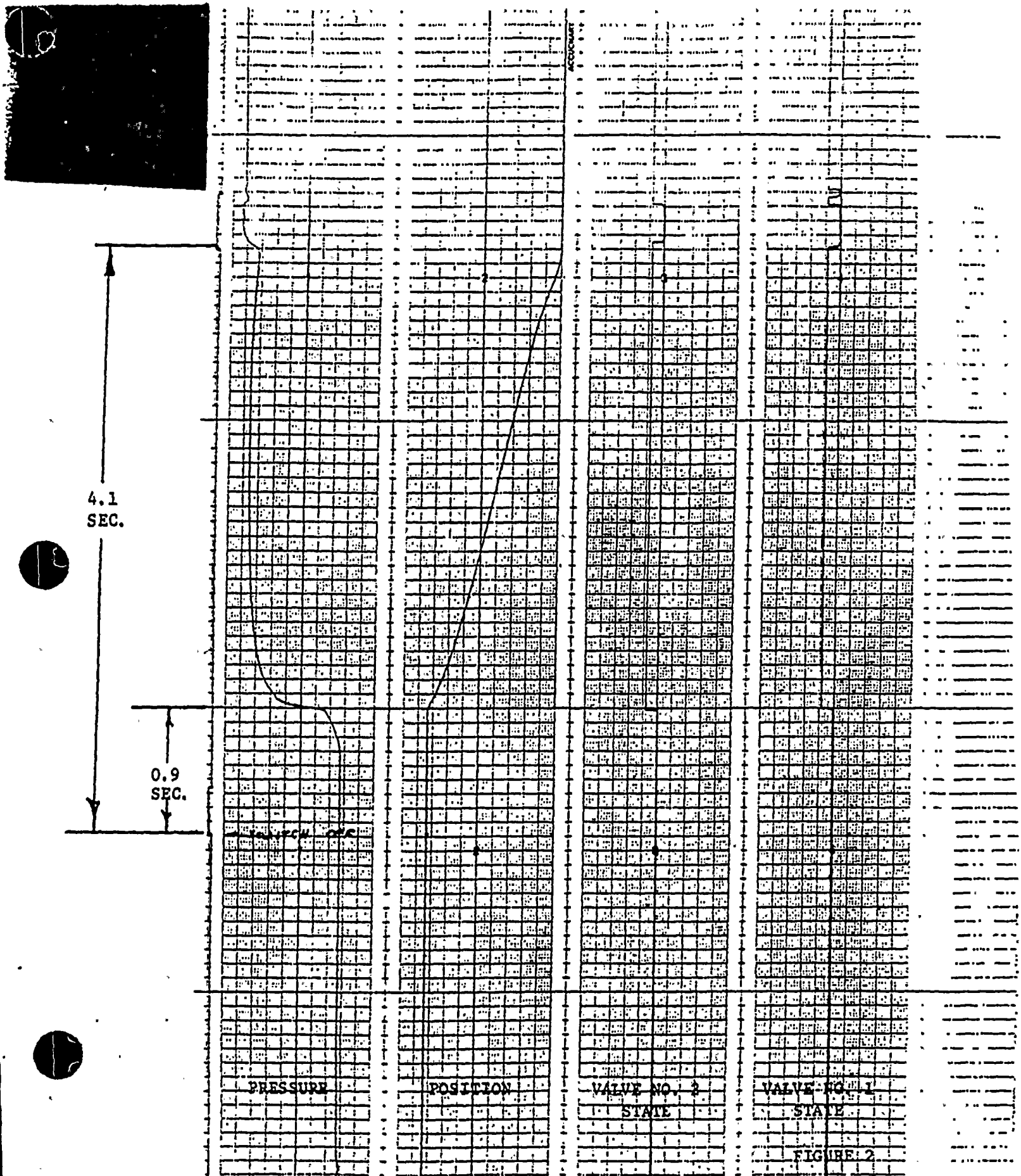

4.1
SEC.
0.9
SEC.
PRESSURE
POSITION
VALVE NO. 2
STATE
VALVE NO. 1
STATE

FIGURE 2

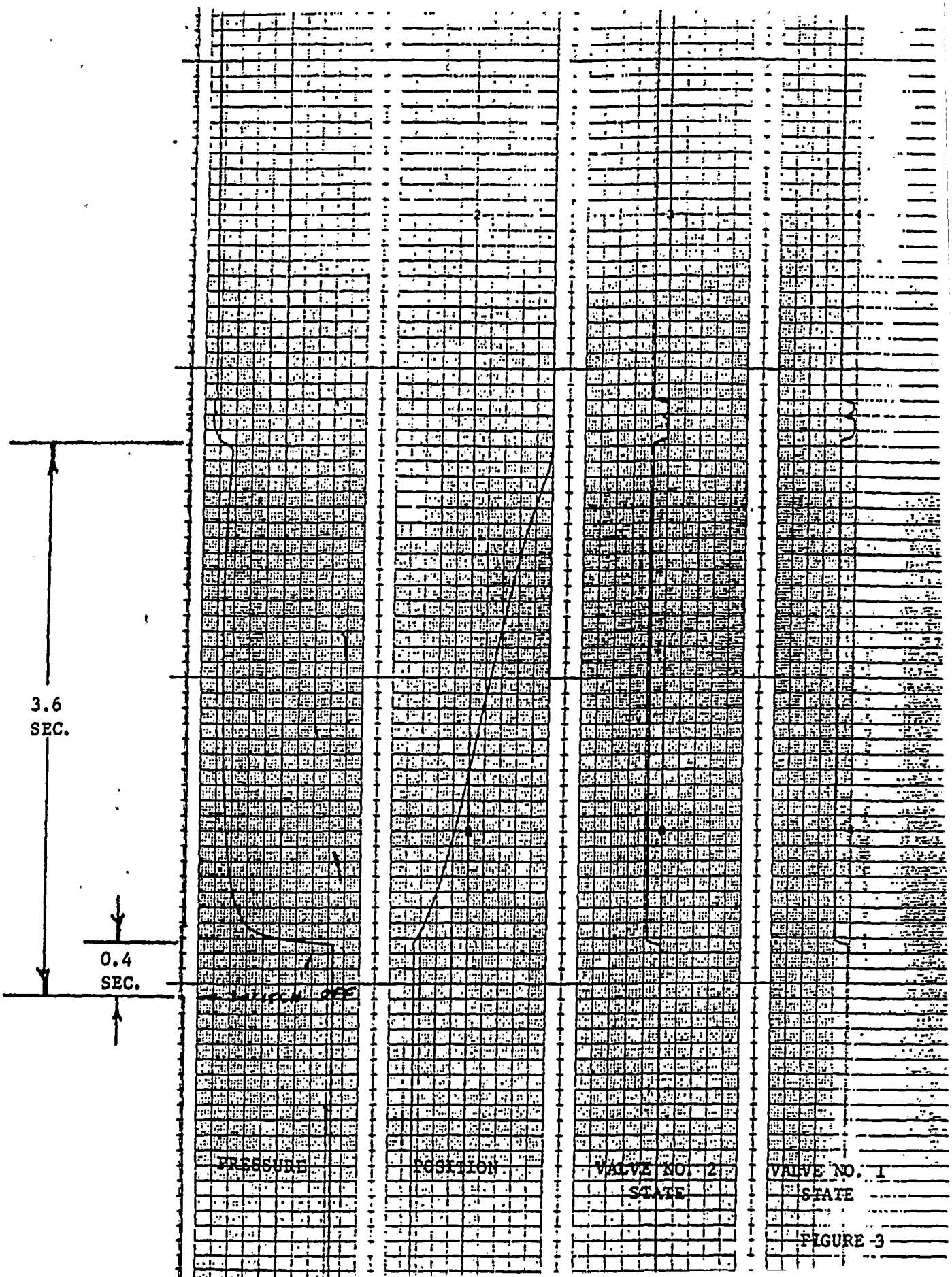
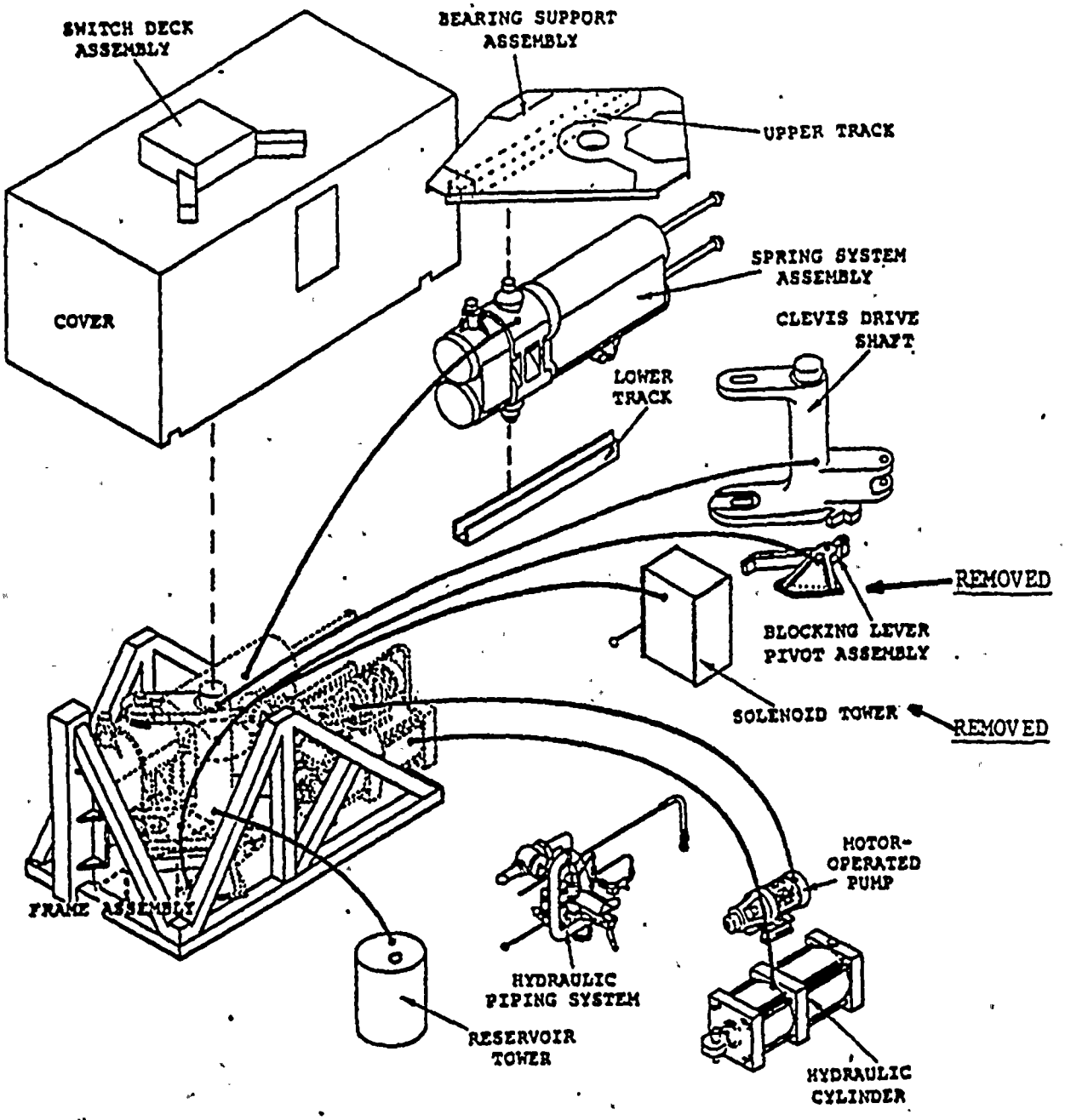
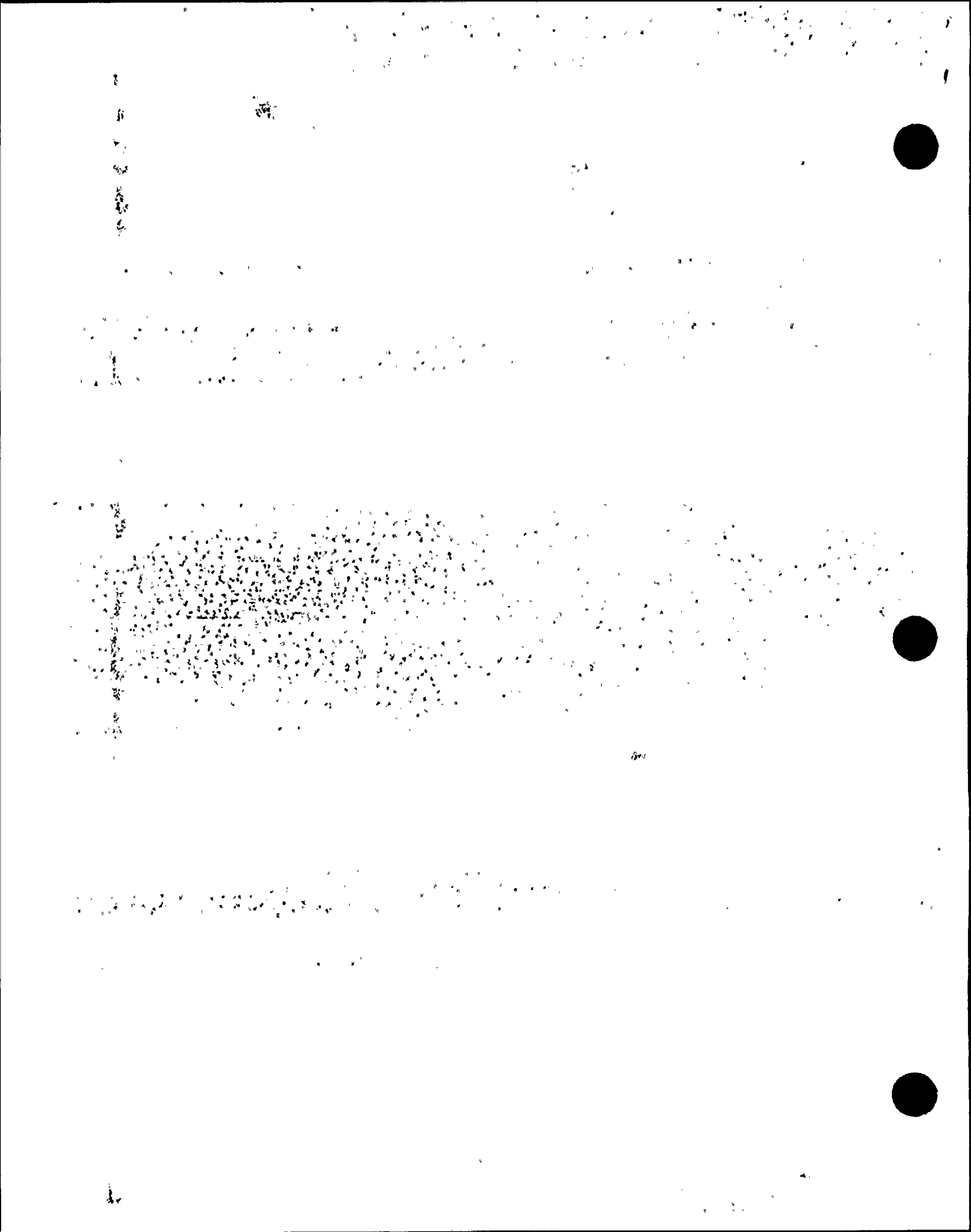

3.6
SEC.
0.4
SEC.
PRESSURE
POSITION
VALVE NO. 2
STATE
VALVE NO. 1
STATE

FIGURE -3



ACTUATOR ASSEMBLY - EXPLODED VIEW
IDENTIFYING LATCH COMPONENTS
REMOVED IN MODIFICATION

FIGURE 4



CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

TABLE I

SUMMARY OF RESULTS FOR ACTUATOR TESTING USING FINAL SOV DISC SEAL

		Test Results (Seconds)			
Date	Time At Pressure	SOV Trip Time	Actuator Stroke Time	Total Time	Remarks
9/23/86	<30 Min.	0.4	3.2	3.6	No Spring Spacer
9/24/86	15 Hrs.	0.4	3.2	3.6	No Spring Spacer
9/24/86	<30 Min.	0.5	3.3	3.8	No Spring Spacer
9/29/86	<30 Min.	0.4	3.1	3.5	No Spring Spacer
9/30/86	16 Hrs.	0.4	3.2	3.6	No Spring Spacer
10/8/86	3 Days	0.3	3.2	3.5	No Spring Spacer
10/10/86	15 Hrs.	0.5	3.2	3.7	No Spring Spacer
10/10/86	<30 Min.	0.4	3.3	3.7	No Spring Spacer
10/15/86	5 Days	0.3	3.3	3.6	No Spring Spacer
10/27/86	12 Days	0.4	3.3	3.7	No Spring Spacer
10/27/86	6.5 Hrs.	0.2	3.1	3.3	Spring Spacer Installed

1. Preoperational Testing

In response to the NRC request for MSIV preoperational test requirements, attached is a draft copy of POT-1-2. This testing will verify that the actuator and all acutator components function properly in the normal, test, and emergency operation modes. Individual fast closure of each MSIV will be performed to determine closure times.

2. Functional Testing during Power Ascension

Additionally, as requested by the NRC, attached is an exerpt of the NMP2 FSAR describing functional testing of the MSIV which will be performed during power ascension.