LICENSEE EVENT REPORT (LER)

Facility Name (1)	Docket Number (2)	Page (3)
Dresden Nuclear Power Station, Unit 2	0 5 0 0 0 2 3 7	1 of 1 3

TITLE (4) Main Steam Isolation Valves Failure to Close Due to High Stem Drag Forces Caused by Valve Packing

Event Date (5)			LER Number (6)			Report Date (7)			Other Facilities Involved (8)	
Month	Day	Year	Year	Sequential Number	Revision Number	Month	Day	Year	Facility Names	Docket Number(s)
									N/A	
0 5	1 7	8 8	8 8	0 1 2	0 0	0 6	1 5	8 8	N/A	

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)			
	N	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	0 0 0	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	Other (Specify in Abstract below and in Text)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

Name	TELEPHONE NUMBER
	AREA CODE
Joseph Welch, Technical Staff Engineer (X-666)	8 1 5 9 4 2 - 2 9 2 0

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS
X	S B	I S V	C 6 8 4	N					

SUPPLEMENTAL REPORT EXPECTED (14)		Expected Submission Date (15)	Month	Day	Year
Yes (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e, approximately fifteen single-space typewritten lines) (16)

On May 17, 1988 at 1255 hours with Unit 2 shutdown for a scheduled maintenance outage, during the performance of Special Procedure (SP) 88-3-15 all eight Unit 2 Main Steam Isolation Valves (MSIVs) were declared inoperable due to their failure to fully close on a loss of pneumatic supply. The root cause of the MSIVs failure to fully close has been attributed to high drag forces exerted on the valve stem by the valve packing. Immediate corrective actions included repacking all four inboard MSIVs with a new style packing, adjusting the packing on two of the outboard MSIVs, and replacing the upper six rings of packing on the remaining two outboard MSIVs. In addition, Operator training in regards to this event was performed, Control Room annunciator procedures were revised, and a leak inspection of all Unit 2 MSIVs was performed prior to power operation.

Although testing demonstrated a possibility exists that an MSIV might not fully close during a slow loss of pneumatic supply, transient analyses requiring a main steam isolation assume rapid MSIV closure immediately upon initiation of the transient. Since MSIV closure would occur long before a degraded pneumatic system pressure could be reached, safety significance of this event was minimal.

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PLANT AND SYSTEM IDENTIFICATION

General Electric Boiling Water Reactor - 2527 MWt rated core thermal power. Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

Nuclear Tracking System (NTS) tracking code numbers are identified in the text as (XXX-XXX-XX-XXXXX).

EVENT IDENTIFICATION

Main Steam [SB] Isolation Valves [JM] (MSIVs) Failure to Close Upon Loss of Pneumatic Supply Due to High Stem Drag Forces which were Caused by the Valve Packing.

A. CONDITIONS PRIOR TO EVENT:

Unit: 2 Event Date: May 17, 1988 Event Time: 1255 hours

Reactor Mode: N Mode Name: Shutdown Power Level: 0%

Reactor Coolant System (RCS) Pressure: 0 psig

B. DESCRIPTION OF EVENT:

On December 24, 1987, with Unit 2 operating at 93% rated core thermal power, the 2-203-1B inboard MSIV was observed to have a double position indication as seen on the Control Room 902-3 panel. Reactor steam flow through the B Main Steam Line (MSL) was also indicating approximately 75% flow relative to the other three MSLs. A load drop was initiated and an attempt to cycle the 2-203-1B MSIV was made. However, the 2-203-1B MSIV would not open or close. The 2-203-2B outboard MSIV was then closed and taken out-of-service to isolate the B MSL, in accordance with Technical Specification 3.7.D.2. Subsequent investigation revealed that a pneumatic supply line to the 2-203-1B MSIV had pulled out of the manifold block on the valve operator. The underlying cause of the disconnected pneumatic line fitting was attributed to vibration and reduced thread engagement between the stainless steel pneumatic line fitting and aluminum manifold block. Immediate corrective action was to reconnect the fitting, check for leaks, and cycle and time the 2-203-1B MSIV. Additional special testing was planned for an upcoming maintenance outage.

On April 14, 1988 and again on April 27, 1988 the 2-203-1B MSIV experienced additional pneumatic supply line problems. The first of these events involved a loose pneumatic line coupling while the second event involved the MSIV drifting partially closed due to a disconnected manifold block pneumatic supply line, similar to the December 24, 1987 event. Corrective actions for these events included the necessary repairs followed by normal MSIV surveillance testing.

After a review of the solenoid pilot valve block assembly, valve operation, and the electrical schematics for the MSIVs, Special Procedure (SP) 88-3-15, Unit 2 MSIV Failure to Fully Close on Loss of Air, was developed to duplicate events which had occurred on December 24, 1987 and April 27, 1988, in which the pneumatic supply to the 2-203-1B MSIV was lost. This test would also replicate Dresden Operating Surveillance (DOS) 250-3, Main Steam Isolation Fail-Safe Test During Cold Shutdown. With this special procedure, it was believed that all actions and responses of the MSIVs could be properly demonstrated.

On May 15, 1988 at 1000 hours, Unit 2 was shutdown for a scheduled maintenance outage. On May 16, 1988 at 0750 hours, permission was obtained to perform SP 88-3-15. Personnel were positioned in the Primary Containment [NH] in order to perform a visual inspection of the MSIVs and also to observe the valve's operation during the performance of the special procedure.

The first portion (Section A) of the SP 88-3-15 electrically induced a rapid loss of air to the MSIV actuator piston. However, none of the inboard or outboard MSIVs fully closed during this section of the test. Since no closing times could be obtained, a measurement was made to determine approximately how far each MSIV had travelled. The MSIV's stroke distances were as follows:

		1st Attempt	2nd Attempt	3rd Attempt
Inboard MSIVs	203-1A	7-1/4"	-	-
	203-1B	0"	0"	1/8"
	203-1C	6-7/8"	-	-
	203-1D	1-1/4"	1-1/4"	-
Outboard MSIVs	203-2A	0"	3/4"	-
	203-2B	1-5/8"	-	-
	203-2C	5-5/8"	-	-
	203-2D	2-1/2"	-	-

The full stroke of a MSIV is approximately 9-1/2 inches.

Section B of SP 88-3-15 involved manually disconnecting the 1-1/2 inch pneumatic supply to the MSIVs. This test was only performed on the 2-203-1B and 2-203-1D MSIV's. Testing revealed that 2-203-1B MSIV failed to move while the 2-203-1D MSIV only moved one inch. Both couplings were disconnected simultaneously before the stroke measurements were taken.

At this point in the procedure, the testing was suspended in order for an evaluation of the data to be performed. It was postulated that during both portions of the test, air was trapped on the bottom side of the actuator piston by the repositioning of the pneumatic four-way valve thereby not allowing the MSIV to fully close under spring force alone. It was decided that a pressure gauge and a vent valve would be attached to the test port on the bottom side of the aluminum manifold block. This would allow for monitoring of the lower piston volume pneumatic pressure during the original test.

Following the installation of the pressure gauge and vent valve on the 2-203-1A MSIV, SP 88-3-15 was repeated on May 17, 1988 at 1017 hours. When the 2-203-1A MSIV was tested, the pressure gauge for the lower piston depressurized to 0 psig. The vent valve was then opened verifying that the lower piston pressure was fully vented. In this instance the 2-203-1A MSIV closed approximately 5-7/8 inches.

At that time, Sections C and E of SP SP 88-3-15 were performed on the inboard and outboard MSIVs respectively. These portions of the test isolated the pneumatic supply to the Primary Containment [NH] (inboard MSIVs) and MSL tunnel (outboard MSIVs). The closure times of each MSIV was to be recorded from the point at which the valve indicated partial closure to full valve closure. After isolating the pneumatic supply to inboard MSIVs and waiting nine minutes, the pressure on the lower piston of the 2-203-1A MSIV dropped to 0 psig. All of the inboard MSIVs attempted to close, however

none of the valves went fully closed. The instrumentation indicated the 2-203-1A MSIV initiated movement at approximately 21 psig lower piston pressure. The stroke distances of the inboard MSIVs were again measured as an alternative to closure times and the results were as follows:

203-1A	5-7/8 "
203-1B	3/8 "
203-1C	6-1/8 "
203-1D	1 "

When the air supply was isolated to the outboard MSIVs, similar results occurred. None of the MSIVs fully closed. The stroke distances of the outboard MSIVs were as follows:

203-2A	0 "
203-2B	1-5/8 "
203-2C	5-1/4 "
203-2D	2-3/4 "

Following completion of this test on May 17, 1988 at 1255 hours, all eight MSIVs were declared inoperable. An Emergency Notification System (ENS) phone call was made to the Nuclear Regulatory Commission (NRC) at 1526 hours fulfilling the NRC four hour notification requirement.

C. APPARENT CAUSE OF EVENT:

The failure of the MSIVs to fully close on loss of pneumatic supply is being reported per 10 CFR 50.73(a)(2)(ii) which requires the reporting of any condition outside the design basis of the plant.

After the MSIVs had been declared inoperable, an investigation was initiated to determine the root cause of the MSIV failure. Four possible root causes were postulated: 1) failure of the accumulator check valve to seat properly; 2) relaxed tension in the MSIV springs; 3) failure of the MSIV manifold assembly; and 4) excessive binding of the MSIV stem due to packing adjustment or improper lubrication. In order to determine the exact root cause, special test procedures were developed to investigate the four postulated failure mechanisms. The results of the special testing are discussed below.

1. Accumulator Check Valve Leakage Testing

Failure of the MSIV accumulator check valve to fully seat was suspected as a possible root cause for the MSIV failure. If an accumulator check valve failed to seat properly, it was postulated that a sufficient quantity of air could have leaked out of the accumulator through the check valve, and into the atmosphere through piping leaks (See Figure 1). In this postulated failure mechanism, insufficient pneumatic pressure would be left in the accumulator to close the MSIV when the pneumatic four-way valve eventually repositioned on low pressure. To verify whether this failure mechanism was the actual root cause, Special Procedure (SP) 88-5-56, Leak Rate Test of the MSIV Reserve Air Accumulator Check Valves, was written to provide a qualitative assessment of the check valve's leak tightness. All eight MSIV accumulator check valves were tested. In order to obtain accurate results, the pneumatic supply to the accumulator was isolated, and the upstream side of the check valve was vented to atmosphere. Since the exact volume of the accumulator and attached check

valve piping was unknown, the flow make-up method was used to determine the check valve through leakage. In order to simulate operating conditions, the test volume was pressurized to 90 psig. The flow rate necessary to maintain the test volume at 90 psig was then observed. The flow rates measured in Standard Cubic Feet Per Hour (SCFH) are listed below:

	MSIV Accumulator Check Valves	Flow Rate (Leakage)
Inboard MSIVs	2-203-1A	2.86
	2-203-1B	4.42
	2-203-1C	2.32
	2-203-1D	8.55
Outboard MSIVs	2-203-2A	12.13
	2-203-2B	8.29
	2-203-2C	33.19
	2-203-2D	7.02

According to the Commonwealth Edison Boiling Water Reactor Engineering Department (BWRED), the allowable leakage was determined to be 5 to 25 SCFH. Since the check valve for the 2-203-2C MSIV had a leakage rate of 33.19, it was replaced prior to Unit start up.

Although one check valve was found to leak in excess of the recommended 25 SCFH limit, seven of the eight MSIV accumulator check valves demonstrated acceptable leakage rates, therefore MSIV accumulator check valve leakage was ruled out as a potential root cause for the MSIV failure.

2. MSIV Spring Tension Testing

The purpose of this testing was to demonstrate that the MSIV closing springs had not significantly degraded from their original specified force. To accomplish this testing the springs were removed from the 2-203-1C MSIV actuator. A bench test was performed on each of the individual springs to determine the force required to achieve a compression of six inches (in one inch increments.) From this data, the individual spring constants were determined. A spring constant for each set of two springs was determined and the total force resulting from all sets of springs at the MSIV closed and open positions was calculated. These calculated forces for the valves were then compared to original startup test data collected on an identical MSIV. This comparison is shown below.

	Original Startup Testing	Dresden 1988 Results
Total Spring Constant	650 lbs/in	643 lbs/in
Close Preload (Valve closed)	4,300 lbs	4,334 lbs
Open Force (Valve open)	10,280 lbs	10,121 lbs

These test results, when compared to original design numbers, confirmed the current capability of the springs and demonstrates that significant spring degradation has not occurred. Therefore, spring relaxation was ruled out as a potential root cause for MSIV failure.

3. MSIV Manifold Assembly Testing

In order to determine whether the root cause of the MSIV failure could be attributed to the MSIV manifold assembly, Special Procedure (SP) 88-5-57, MSIV Manifold Assembly Testing, was written. An MSIV manifold assembly consists of an aluminum manifold block, a three-way solenoid valve, a pneumatic four-way valve, and a pilot solenoid assembly (see Figure 1). The purpose of the test was to determine the response of the pneumatic four-way valve on a simulated slow and rapid loss of pneumatic supply to the pilot solenoid assembly.

The manifold assembly was removed from the 2-203-1C MSIV and bench tested in the Mechanical Maintenance Department (MMD) hot shop. The test rig consisted of separate regulated pneumatic supplies to the pilot solenoid assembly and to the manifold block assembly. The manifold block assembly and pneumatic supply pressures were initially set up to simulate an open MSIV condition. During the tests that were performed, pneumatic pressure to the pilot solenoid assembly was slowly decreased and the pneumatic four-way valve was monitored to determine the pressure at which the valve would change position. Air was expected to rapidly exhaust from the lower exhaust port of the valve upon repositioning.

As the pneumatic pressure was slowly decreased from 90 psig to approximately 45 psig, air began exhausting from the upper port of the pneumatic four-way valve rather than the expected lower port. As the supply pressure to the pilot solenoid was further decreased, the quantity of air porting from the pneumatic four-way valve increased. The test result indicated that the pneumatic four-way valve had moved to a mid-position, thereby porting air to atmosphere rather than to the MSIV operator.

Believing that the test rig did not properly simulate the normal pneumatic supply condition provided by an accumulator and a 1-1/2 inch supply line, a new test rig was fabricated which included a 1-1/2 inch supply line and accumulator. Pneumatic pressure was again slowly decreased from 90 psig to approximately 45 psig at which point the pneumatic four-way valve appeared to move once again to a mid-position, allowing air to exhaust from the pneumatic four-way valve upper port.

Testing continued; however, this time the pneumatic supply was isolated to the accumulator while the pressure to the pilot solenoid was slowly decreased. As pressure decreased to approximately 45 psig, air began to exhaust from the upper exhaust port as in the previous tests. As the accumulator and pilot solenoid pneumatic supply pressures reached approximately six psig, the pneumatic four-way valve fully repositioned and air remaining in the accumulator exhausted through the lower port (closing direction). The manifold block assembly and pneumatic supply pressures were set up once again to simulate an open MSIV condition. This time, the pneumatic supply to the pilot solenoid was isolated and then rapidly vented. This resulted in immediate full repositioning of the pneumatic four-way valve.

Upon reviewing the results of this testing, the solenoid valve manufacturer verified that this was the expected operation of the pilot solenoid assembly. The results of this testing demonstrated that with a degraded pneumatic situation, pneumatic supply from an MSIV accumulator could exhaust through the upper port (vent) of the pneumatic four-way valve into the atmosphere rather than to the MSIV operator. Under this condition, an MSIV would have to close on spring pressure alone.

Test results also showed that on rapid loss of pneumatic supply, accumulator supply pressure would be available to assist the MSIV springs in closing the MSIV. A rebuilt pneumatic four-way valve was placed on the manifold assembly and was slow leak tested. The test results were the same. Although this testing had discovered a situation in which the pneumatic supply might not be available to close an MSIV, the manifold block assembly was ruled out as the root cause of the MSIV failure since the pneumatic four-way valve responded as designed during a rapid loss of air which is the design basis for valve operation.

4. MSIV Stem Binding Tests

In order to determine if the root cause of the MSIV failure to close could be attributed to valve stem binding, a series of timing tests, packing adjustments, and valve stem lubrications were performed. Testing began on the 2-203-1A MSIV by performing Dresden Operating Surveillance (DOS) 250-2, Quarterly Timing of Main Steam Isolation Valves. The purpose of the timing test was to demonstrate that the MSIV would close properly with pneumatic and spring pressure combined. The quarterly valve timing resulted in a closure time of 4.71 seconds. The stem packing on the 2-203-1A MSIV was loosened and Special Procedure (SP) 88-3-15, Unit 2 MSIV Failure to Fully Close on Loss of Air, was performed. The purpose of performing this procedure was to determine if the valve would close on spring pressure alone. The 2-203-1A MSIV fully closed in 15.48 seconds. The MSIV was then cycled closed twice and timed again per DOS 250-2. The resultant closure times of 4.56 and 4.35 seconds showed improvement. The stem on 2-203-1A MSIV was then lubricated and again valve closure was timed by performing DOS 250-2 and SP 88-3-15. In each case, the MSIV closure times improved. Finally, the guidepost of the 2-203-1A MSIV was lubricated and valve closure was timed by once again performing DOS 250-2 and SP 88-3-15. The closure time for spring pressure testing improved slightly, but no significant change was noted while performing the normal quarterly valve timing surveillance.

After packing adjustments had been shown to improve the 2-203-1A MSIV closure times and had allowed the MSIV to close on spring pressure only, additional tests were performed on both the 2-203-2A and 2-203-2C MSIVs. On both of these MSIVs, loosening of the stem packing allowed the MSIVs to close on spring pressure alone during the performance of SP 88-3-15.

Stem lubrication also significantly improved the closure times of the 2-203-2A and 2-203-2C MSIVs. The guideposts were then lubricated on both MSIVs and valve closure testing was performed. However, lubrication of the 2-203-2A and 2-203-2C MSIV guideposts did not improve the closure times significantly. The outboard MSIVs were then tested per DOS 250-3, MSIV Fail-Safe Testing During Cold Shutdown. The 2-203-2A and 2-203-2C MSIVs closed on the eventual loss of air during the performance of DOS 250-3. The 2-203-2B and 2-203-2D MSIVs (for which packing had not been adjusted and stem and guidepost lubrication had not been performed) would not close.

Finally, the stem and guideposts for the 2-203-2B MSIV were lubricated and quarterly valve timing per DOS 250-2 was performed. Also, quarterly valve timing was performed on the 2-203-2D MSIV. At this time, DOS 250-3 was performed again on the outboard MSIVs. The results were similar to the previous time that DOS 250-3 had been performed. The 2-203-2A and 2-203-2C MSIVs went full closed and the 2-203-2B and 2-203-2D MSIVs failed to close.

5. Final Root Cause Determination

Excessive leakage of the MSIV accumulator check valves was ruled out as a contributing cause of the MSIV failure since seven of the eight local leak rate test results demonstrated acceptable leakages. All eight check valves would have had to fail in order for check valve leakage to be the root cause of the problem. Testing of the MSIV manifold assembly revealed a situation in which the pneumatic four-way valve could move to a mid-position allowing the accumulator pressure to port out to the atmosphere on a degraded pneumatic condition rather than the MSIV actuator. However, the manifold assembly was ruled out as a contributing cause of the MSIV failure since the MSIVs are designed for closure on a rapid loss of pneumatic supply. Also spring relaxation was ruled out as a contributing cause of MSIV failure, since spring testing demonstrated that the springs had not lost any of their closing force.

The root cause of the MSIV's failure to fully close on loss of pneumatic supply has been attributed to the high drag forces exerted on the valve stem due to the valve packing. Although lubrication of the stem increased the velocity at which the valve closes on spring force alone, the limiting factor of valve movement has been determined to be the valve packing.

This high drag force on the MSIV stem has been attributed to the packing material installed on Dresden Unit 2. An investigation of the MSIV packing history revealed that both Dresden Units 2 and 3 MSIVs had been originally supplied with QP self setting packing. The original packing design utilized two sets of packing, one set on each side of the lantern ring. The packing type was a chevron design made of woven asbestos and the packing design was that of packing-gland leak-off packing. After several years of maintenance experience, it was noted that the original design did not allow full compression of the bottom packing. Thus, the bottom set of packing served little function. For this reason, the lantern ring was removed and replaced with additional packing. The final design incorporated 17 rings of packing inside the stuffing box.

In early 1986, the original packing material became unavailable as asbestos was removed from the market and the company went out of business. A substitute packing was bought from John Crane Packing which was of the same shape and size as the original packing but fabricated with a 287I material. The substitute material was installed on the Unit 2 MSIVs during the last refueling outage. The Unit 2 MSIVs are the only valves at the Station utilizing the chevron design packing with the 287I material. The QP self setting packing remains installed on Unit 3. To further verify that the 287I packing was the root cause of the high drag force, DOS 250-3, MSIV Fail-Safe Testing During Cold Shutdown, was performed on Dresden Unit 3. All inboard and outboard MSIVs closed upon slow loss of pneumatic supply without any packing adjustments.

The root cause of the pneumatic supply line disconnecting from the aluminum manifold block during the December 24, 1987 event has been attributed to two factors. First, the structural support of the pneumatic supply lines located in the Primary Containment are inadequate between the accumulator and the aluminum manifold block. Due to the long length of these lines, the normal system vibrations are amplified. This resulted in the weakest point of the piping system to degrade (i.e., manifold block connection and coupling). Inspection of the inboard pneumatic supply line piping revealed a damaged pipe support on the 2-203-1B MSIV pneumatic supply line. This damaged support may have contributed to amplified vibrations in the line and eventual failure.

The second cause of the pneumatic supply line disconnecting can be attributed to the threaded connection between the supply line and the aluminum manifold block. The manifold block is made of aluminum whereas the connecting supply line is made of stainless steel. These dissimilar metals expand at different rates and could lead to a loosening of the connection. In addition, this connection is threaded resulting in all the load exerted on the pneumatic supply piping system being centralized on the threads.

D. SAFETY ANALYSIS OF EVENT:

Dresden Station Units 2 and 3 utilize four Main Steam Lines (MSLs) to conduct steam from the reactor vessel through the containment to the turbine [TA]-generator [TB]. Each MSL is equipped with two MSIVs. One located inside the Primary Containment (inboard) and the second located outside the Primary Containment (outboard). The safety function of an MSIV is to isolate the MSL upon receipt of a closure signal. MSIV closure must occur within three to five seconds and assure Primary Containment isolation. The three to five second time range was selected to ensure that a fast closure would not induce a severe reactivity transient in the reactor, and a slow closure would not allow excessive off-site radiation release through the MSLs.

The MSIVs were designed by the manufacturer to close by spring force alone, stored pneumatic pressure alone, or by the combination of spring force and stored pneumatic pressure. However, MSIV closure by spring force only was not included in the design basis of the MSIVs by General Electric. Closure of an MSIV by a rapid loss of pneumatic pressure was the only method of valve closure considered by General Electric when performing the original transient analysis. Spring closure was included as an additional engineering feature of the valve and was never considered as a safety feature. Each MSIV is provided with an accumulator to store the air which is supplied by the appropriate pneumatic supply system. A check valve is installed between the pneumatic supply and the accumulator in the event that the pneumatic supply becomes unavailable.

The pneumatic supply for the inboard MSIVs is provided by the drywell nitrogen pumpback [LK] system while the pneumatic supply for the outboard MSIV's is provided by the instrument air [LP] system. Both the drywell nitrogen pumpback system and the instrument air system are independent and isolated from each other. Because of the independent pneumatic supply systems and the redundant Primary Containment isolation circuitry, two MSIVs on a single MSL meet the required single failure criteria.

Testing of the MSIV's demonstrated the possibility that an MSIV may not fully close during a slow loss of pneumatic supply to an MSIV if the valve packing were too tight. However, all transient analysis performed by General Electric requiring MSL isolation also requires rapid MSIV closure immediately upon initiation of the transient. MSIV closure would occur long before a degraded pneumatic system pressure could be reached. Since the design basis did not include spring force closure and the MSIVs close immediately during transient events where main steam line isolation is required, failure of the MSIV to close by spring force only is not a safety issue.

Both the drywell nitrogen pumpback system and the instrument air system would have to fail simultaneously in order to prevent the MSIVs from closing. This could only be accomplished through a seismic event or a loss of off-site power. During a postulated seismic event, both the drywell nitrogen pumpback system piping and the instrument air piping would have to become unavailable simultaneously. Since the pneumatic system piping is seismically constrained from the accumulator check valve to the MSIV, this failure method is outside the bounds of the required single failure criteria. During a loss of off-site power event, both the drywell nitrogen pumpback compressors and the instrument air compressors would become unavailable. However, leak rate testing of the MSIV

accumulators and check valves demonstrated that a backup emergency pneumatic supply was available to isolate the MSIVs if required. Furthermore, the MSIV's close immediately during transient events that require isolation of the MSLs. The MSIVs would already be closed long before pressure in the accumulators was lost through slow pressure decay. For these reasons, the safety significance of this event has been considered minimal.

E. CORRECTIVE ACTIONS:

As short term corrective action, all the inboard MSIVs were repacked using a Chesterton grafoil type packing. This packing arrangement consists of a wiper ring of Style 1-C1 followed by three rings of GTPI-5300, followed by one ring of Style 1-C1. The Style 1-C1 is an interbraid graphite and the GTPI-5300 is preformed grafoil. The space created from the removal of the other 12 rings of packing will be taken up with a graphite spacer. The advantage of the grafoil type packing is to lessen stem friction, while providing a leak-free valve stem. Grafoil packing also is a self-lubricating type packing; in other words, as the packing wears it exposes "new" graphite lubrication. The inboard MSIVs are being repacked in order to gather operating experience with this new grafoil style packing.

The upper six rings of packing were removed from the 2-203-2B and 2-2303-2D MSIVs and were replaced with John Crane 1630 Packing, a graphite yarn type.

In addition to the partial repacking of the 2-203-2B and 2-203-2D MSIVs, the 2-203-2A and 2-203-2C outboard MSIVs had their packing readjusted. Also, the valve stem and spring guideposts of all inboard and outboard MSIVs were lubricated with N-5000 type lubricant. As a functional test following the lubrication, packing adjustments/packing replacement of the MSIVs, testing was performed to verify that all the MSIVs would go fully closed utilizing spring force alone. As a final functional test on spring closure alone, SP 88-3-15, specifically Sections C and E, and DOS 250-3, Main Steam Isolation Valve Fail-Safe Test During Cold Shutdown, were successfully completed. Prior to declaring all of the MSIVs operable, DOS 250-1, 10% Closure Test of MSIVs and DOS 250-2, Quarterly Timing of MSIVs, were also successfully completed.

Three procedures were revised to provide the necessary guidance needed to allow manual or actuator control of the outboard MSIVs. In the event that a degraded pneumatic condition were to occur, Dresden Operating Abnormal (DOA) procedure 4700-1, Instrument Air System Failure, was revised to require manually scramming the reactor if the instrument air system pressure degrades to 55 psig. The next operator action added was the requirement to manually close the MSIVs. This will preclude the stored energy of the accumulator from being ported out the exhaust manifold should the pneumatic four-way valves start to reposition. Similar steps were added to Dresden Operating Annunciator procedures (DOA) 923-1 (F-4), Low Pressure in Instrument Air Receiver 2A-4701, and DOA 923-1 (F-6), Instrument Air Dryer Trouble Unit 3A, 3B, 3C or Low Pressure in Instrument-Air Receiver 3A-4701, to require closing the outboard MSIV on degraded instrument air pressure.

Operator training was given to all licensed on shift operators in order to give a brief description of the event, testing that was performed to verify MSIV operability, and the rpot cause of the MSIVs failure to close on loss of pneumatic supply. Also in the training, the intent of the procedure changes and the failure analysis as it relates to the design intent of the MSIVs and the accumulator piping system were discussed to further inform the licensed operators as to the response of the MSIVs under a degraded pneumatic supply condition.

Following the startup of Unit 2 when the reactor vessel pressure reached 500 psig, a leak inspection of all MSIVs was performed. One by one all of the MSIVs were closed and a visual inspection of the valve made to determine if any packing leaks existed. No leakage was observed on any of the MSIVs. Each MSIV was required to be in the closed position to verify the seal integrity of the valve packing under system pressure. Also during the Unit 2 startup, all of the MSIVs closure times were checked and verified to be within the Technical Specification limit of three to five seconds, by performing DOS 250-2, Quarterly Timing of MSIVs.

As stated previously in this report, Unit 3 MSIVs were also tested satisfactorily for proper closure upon loss of pneumatic supply, with no packing adjustments required.

Four long term corrective actions have been initiated as a result of this event. These actions are listed below:

1) The accumulator check valves shall be leak tested each refueling outage to verify their airtight integrity (237-200-88-06501).

2) Procedure DOS 250-3, MSIV Fail-Safe Test in Cold Shutdown, will be performed whenever the reactor is in cold shutdown in accordance with the In-Service Testing (IST) Program (237-200-88-06502).

3) The pneumatic supply piping for the MSIVs is being analyzed by the Commonwealth Edison Boiling Water Reactor Engineering Department (BWRED) in order to improve the system's structural support and connection integrity (237-200-88-06503).

4) A study will be performed by BWRED to evaluate alternatives to meet the slow loss of pneumatic supply fail-safe objective. This evaluation will consider valve packing, procedural changes, pneumatic four-way valve improvements, spring closure enhancements, and control logic changes (237-200-88-06504).

F. PREVIOUS EVENTS:

This was a first reportable event in which the MSIVs failed to fully close on a loss of pneumatic supply. Three previous non-reportable events that involved a failure of an pneumatic supply line connection on the 2-203-1B inboard MSIV are as follows.

DVR Number	Title
12-2-87-166	Main Steam Isolation Valve 2-203-1B Drifting Partially Closed Due to a Loose Air Line on the Manifold Block.
12-2-88-45	Unit 2 Main Steam Isolation Valve Air Leak Due to Loose Air Line Coupling.
12-2-88-51	Main Steam Isolation Valve 2-203-1B Drifted Partially Closed Due to Disconnected Manifold Block Air Line.

All three of the above listed events involved leakage from a pneumatic supply line on the 2-203-1B inboard MSIV. At no time during these events was the pneumatic supply to the other MSIVs degraded. Corrective actions included required repairs and surveillance testing.

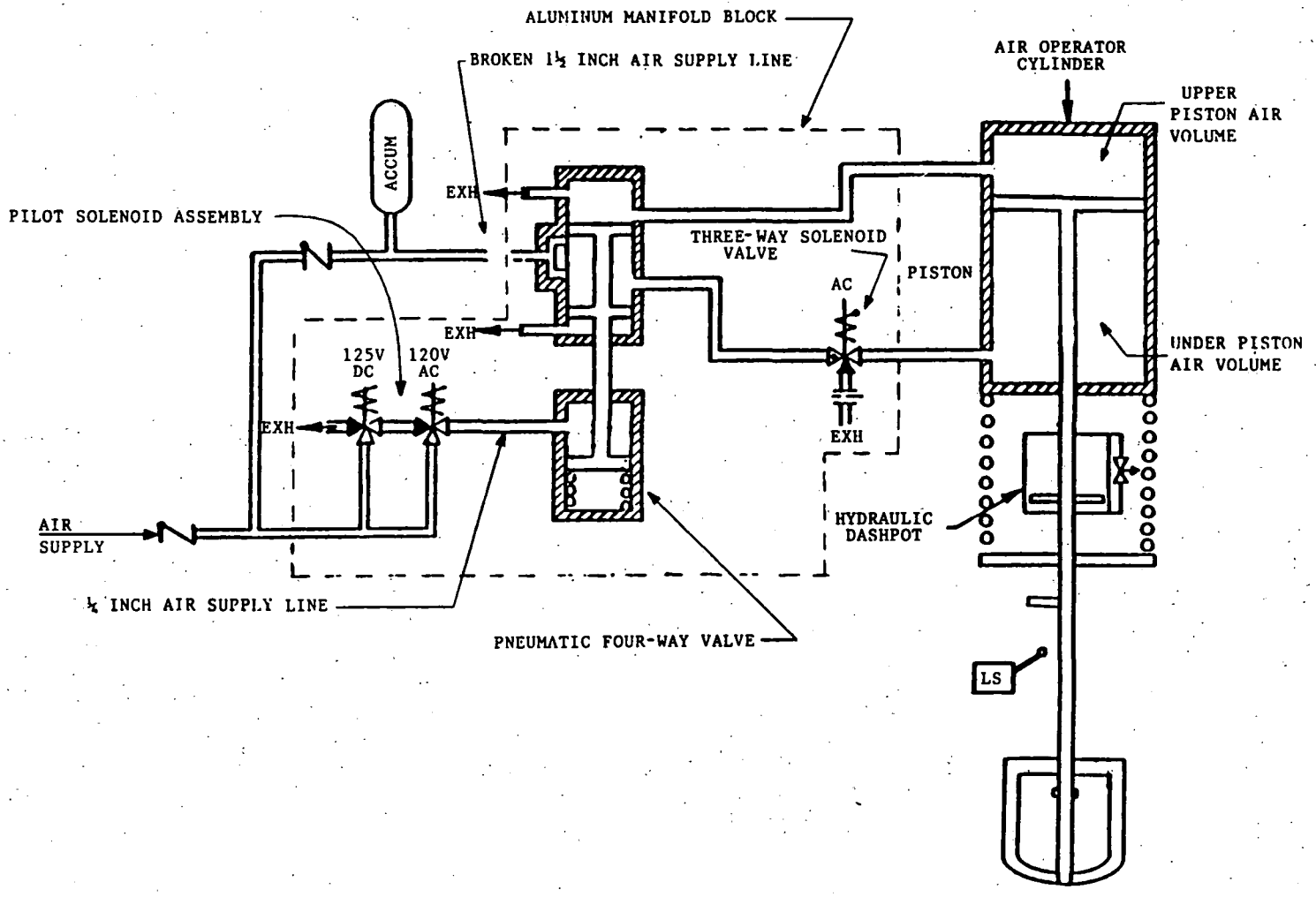
G. COMPONENT FAILURE DATA:

Manufacturer: Crane Co.

Nomenclature: 20" - "Y" Pattern Globe Valve

Model Number: DR-34289

An industry-wide search of the NPRDS data base revealed that there are no reports of excessively tight packing preventing Crane type valves from fully closing.



MSIV AIR SUPPLY SYSTEM SCHEMATIC

(MSIV SHOWN IN OPEN POSITION)

FIGURE 1

Commonwealth Edison
Dresden Nuclear Power Station
R.R. #1
Morris, Illinois 60450
Telephone 815/942-2920

June 15, 1988

EDE LTR #88-459

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Licensee Event Report #88-012-0, Docket #050237 is being submitted as required by Technical Specification 6.6, NUREG 1022 and 10 CFR 50.73(a)(2)(ii)(B).

E.D. Eenigenburg
Station Manager
Dresden Nuclear Power Station

EDE/jmt

Enclosure

cc: A. Bert Davis, Regional Administrator, Region III
File/NRC
File/Numerical
310k

IE22
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