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June 22, 2005

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Subject: McGuire Nuclear Station, Unit 2
Docket No. 50-370
Licensee Event Report 370/2005-05, Revision 0
Problem Investigation Process (PIP) M-05-00841

Pursuant to 10 CFR 50.73, Sections (a)(1) and (d), attached is Licensee Event Report (LER) 370/2005-05, Revision 0, concerning failure of Main Steam Isolation Valve (MSIV) 2SM-1 to close on McGuire Unit 2.

This report is being submitted in accordance with 10 CFR 50.73 (a) (2) (i) (B) as an operation prohibited by Technical Specifications.

This event is determined to be of no significance to the health and safety of the public. There are no regulatory commitments contained in the LER.

JP Harrall /for

G. R. Peterson

Attachment

IE22

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NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06-30-2007

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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4. TITLE

Failure of Main Steam Line Isolation Valve (MSIV) to close.

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	02	2005	2005	- 005 -	00	06	22	2005	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE	3
10. POWER LEVEL	000

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

	20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)		50.73(a)(2)(ix)(A)
	20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)		50.73(a)(2)(x)
	20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)		73.71(a)(4)
	20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)		73.71(a)(5)
	20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)		
	20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)		
	20.2203(a)(2)(v)	x	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)		
	20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)		
	20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)		

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Reza Djali, Regulatory Compliance	704-875-4228

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	SB	ISV	A585	YES					

14. SUPPLEMENTAL REPORT EXPECTED				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete 15.EXPECTED SUBMISSION DATE).	X	NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

Unit Status: At the time of the event, Unit 1 was in Mode 1 (Power Operation) at 100 percent power and Unit 2 was in Mode 3 (Hot Standby) at 0 percent power.

Event Description: On March 2, 2005, 2SM-1, 2D Steam Generator Main Steam Isolation Valve (MSIV), failed to stroke closed during testing. This event, which constitutes a condition prohibited by Technical Specifications, was determined to be of no significance to the health and safety of the public.

Event Cause: The cause of this event is attributed to binding caused by insufficient clearance between the valve stem and cover bushing.

Corrective Action: 2SM-1 was repaired by improving its packing configuration, installing stronger actuator springs, and increasing the inside diameter of the cover bushing. The MSIVs will be repacked with packing material which will not induce a corrosive environment. An air assist closure feature that was previously removed will be restored to all MSIVs. Until that feature is restored, shutdown stroke testing will be performed for all MSIVs.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

BACKGROUND

Applicable Energy Industry Identification (EIIS) system and component codes are enclosed within brackets. McGuire unique system and component identifiers are contained within parentheses.

Main Steam Isolation Valves [ISV] (MSIV):

The Unit 2 Main Steam System [SB] (SM) contains four MSIVs manufactured by Atwood and Morrill Company (Model MSI-002). Each valve is located downstream of its respective Steam Generator [SG] (SG) and remains open during normal power operation. The MSIVs are designed to automatically close upon receipt of a Main Steam Line Isolation Signal (Engineered Safety Feature). The safety functions performed by these valves include the following:

- Close to isolate all four SGs to ensure that no more than one SG is affected in the event of a steam line break. This minimizes the positive reactivity effects of the break by ensuring that the Reactor Coolant System [AB] (NC) does not experience excessive cool down as a result of the increased steam flow.

- Close to isolate all four SGs to ensure that no more than one SG is affected in the event of a steam line break inside containment. This minimizes the containment temperature and pressure increase.

- Isolation of the containment atmosphere from the environment in the event of a release of fission product radioactivity to the containment atmosphere as the result of a design basis accident

McGuire Technical Specification (TS) 3.6.3 - Containment Isolation Valves:

TS 3.6.3 specifies that each containment isolation valve shall be operable in Modes 1, 2, 3, and 4. TS Surveillance Requirement (SR) 3.6.3.5 and associated test acceptance criteria indicate that an MSIV is operable when it is capable of closing in less than or equal to 8 seconds upon receipt of an isolation signal. As per TS 3.6.3, Condition C, if one or more MSIVs are inoperable, each affected penetration flow path shall be isolated by the use of at least one closed and de-activated automatic valve, closed manual valve, or blind flange within 72 hours and each affected penetration flow path shall be verified to be isolated once per 31 days. If the required action and associated completion time of Condition C are not met, then TS 3.6.3, Condition F, states that the respective Unit must be in MODE 3 within 6 hours and in MODE 5 within 36 hours.

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McGuire Technical Specification (TS) 3.7.2 - Main Steam Isolation Valves:

TS 3.7.2 specifies that four MSIVs shall be operable in Mode 1. This LCO also states that they shall be operable in MODES 2 and 3, except when the MSIVs are closed and de-activated. TSSR 3.7.2.1 and the TS 3.7.2 BASES indicate that an MSIV is operable when it is capable of closing in less than or equal to 8 seconds upon receipt of an isolation signal. Compliance with these operability criteria can be verified by the performance of hot stroke testing. As per TS 3.7.2, Condition A, if one MSIV is inoperable in MODE 1, the affected MSIV shall be restored to operable status within 8 hours. If the required action and associated completion time of Condition A are not met, then TS 3.7.2, Condition B, states that the respective Unit must be in MODE 2 within 6 hours. As per TS 3.7.2, Condition C, if one or more MSIVs are inoperable in MODE 2 or 3, the affected MSIV shall be closed within 8 hours and verified closed once per 7 days. If the required action and associated completion time of Condition C are not met, then TS 3.7.2, Condition D, states that the respective Unit must be in MODE 3 within 6 hours and in MODE 4 within 12 hours.

Changes in the original design of the MSIVs since 1992:

- The air assist closure which was originally supplied by the vendor was removed after vendor analysis showed adequate closure margin. This analysis was later found to contain errors.
- The packing configuration was changed from a Graphite type to a Teflon type. Later the carbon bushing was moved from the bottom of the packing stack to the top.
- The stem material was changed from 17-4PH to SA638 grade 660. The difference in thermal expansion for SA638 and 17-4PH resulted in less clearance between the stem and the cover bushing.

EVENT DESCRIPTION

Note: All events are shown in the approximate sequence in which they occurred. All times are approximate.

- In 1992 Air assist feature was removed from 2SM-1.
- In 2000 the 2SM-1 packing configuration was altered, the stem material was changed, and a new cover bushing was installed. The valve was successfully stroke tested.
- At 1537 on October 3, 2003, Unit 2 entered Mode 3 following Refueling Outage 2EOC15.
- At 1745 on October 4, 2003, 2SM-1 was successfully stroked.
- At 1125 on March 2, 2005, 2SM-1 failed to close during hot stroke testing. The other three MSIVs were tested successfully.

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- At 1130 on March 2, 2005, 2SM-1 was declared inoperable.

On April 26, 2005, the 2SM-1 Root Cause Failure Analysis report was completed. This report conservatively determined that 2SM-1 was inoperable from its last successful stroke test at 1745 on October 4, 2003 until the valve was restored to operable status on April 9, 2005.

During the above period, 2SM-1 was inoperable longer than permitted by plant Technical Specifications. This constitutes an operation prohibited by Technical Specifications and is reportable per 10CFR 50.73 (a) (2) (i) (B). No other MSIVs on Unit 2 were inoperable during the same period.

CAUSAL FACTORS

The cause of this event is attributed to binding caused by insufficient clearance between the valve stem and cover bushing. The contributors to the elevated binding between the stem and the cover bushing were excessive corrosion growth, thermal binding as a result of differential expansion, and extrusion of the packing into the clearance gap between the stem and the cover bushing.

2SM-1 failed to close because the stem was bound in the lower portion of the stuffing box at the cover bushing. Binding occurred because of a combination of tight clearance and abnormally thick corrosion.

The minimal diametric design clearance between the stem and cover bushing is reduced at hot conditions due to differential thermal expansion of the stem, cover bushing, and valve bonnet.

The corrosion layer grew on the stem and cover bushing as a result of chemical corrosion. These layers eventually grew together at the top of the cover bushing and contributed to binding of the valve. The corrosion was caused by the breakdown of Teflon in the extruded packing material which released fluoride and created a highly corrosive environment. The lower packing ring was examined by the packing vendor representative. Some portions of this packing were unexpectedly found to be dry and devoid of Teflon. Further tests by the packing manufacturer showed a significantly higher leachable fluoride than from new packing samples.

A MSIV Failure Transportability Analysis was performed to examine the potential similar binding on other MSIVs for both Unit 1 and Unit 2. This analysis determined that the 2SM-1 failure mode was transportable to the other Unit 1 and Unit 2 MSIVs. Further engineering analysis was performed based on as-left data and it was concluded that adequate clearance margin exists between valve stem and cover bushing (assuming accelerated corrosion rate and service time). During this analysis, two valves, 2SM-3 (2C Steam Generator MSIV) and 2SM-5 (2B Steam Generator MSIV) were identified as having clearances and service times approaching the estimated limit. In response,

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these two valves were repacked during Refueling Outage 2EOC16. Physical inspection of these valves also demonstrated that the calculated accelerated corrosion rate is conservative.

CORRECTIVE ACTIONS

Immediate:

- 2SM-1 was repaired by improving its packing configuration, installing stronger actuator springs, and increasing the inside diameter of the cover bushing. This increased the clearance between the stem and the cover bushing. This was a planned outage activity based on existing corrective actions stemming from previous MSIV failures which occurred during the prior Unit 1 Refueling outage.

Subsequent:

- Evaluated the susceptibility of the remaining MSIVs to the corrosion effects of Teflon and other corrosive chemicals in the packing. Evaluation results indicate positive clearance margin exists for continued operability of the remaining MSIVs. However, valves 2SM-3 and 2SM-5 were repacked to enhance clearance margin.

Planned:

- Packing removed from 2SM-1 will be tested and characterized to determine if it is defective, abnormal, or normal. Similar test will be performed on new and removed packing from valves in similar applications and durations of service.
- Mode 3 Shutdown tests will be performed on each MSIV until the air assist feature is restored.
- The MSIVs will be repacked with packing material which will not induce a corrosive environment which could later degrade valve performance.
- The air assist closure will be restored to all MSIVs. This will allow additional closing thrust.

SAFETY ANALYSIS

Failure of 2SM-1 would have prevented isolation of the D SG. During the inoperable period, there was no identified SG tube leakage.

A risk assessment of this event determined that the increase in the estimated Core Damage Frequency (CDF) or Large Early Release Frequency (LERF) was insignificant. Therefore, the event described in this LER was not significant with respect to the health and safety of the public.

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ADDITIONAL INFORMATION

A review of the McGuire Nuclear Station corrective action database identified three instances, within the past three years, involving the failure of MSIVs 1SM-1 (1D SG MSIV), 1SM-3 (1C SG MSIV), and 1SM-7 (1A SG MSIV) to perform as designed during stroke testing.

The failure of 1SM-1 (reference LER 369/2005-02) was attributed to main poppet binding and the failure of 1SM-3 (reference LER 369/2004-02) was attributed to improper reassembly during maintenance. The failure of 2SM-1 is not considered a recurring event of these failures. However, the failure of 2SM-1 to close is considered to be a recurring event of the 1SM-7 failure. Note that the 1SM-7 failure was not deemed reportable under 10 CFR 50.73.

In April 2004, while performing hot stroke testing, 1SM-7 failed to fully close when the main poppet closed but the pilot poppet failed to fully seat. The failure of 1SM-7 was due to binding in the stuffing box under certain thermal conditions and is similar to the failure of 2SM-1; however, the failure symptoms and physical evidence were much different on 2SM-1. The root cause for 1SM-7 was related to thermal expansion causing a small increase in friction because of rubbing in the stuffing box (no indication of corrosion). 1SM-7 failed to fully close when the small increase in friction in the stuffing box exceeded the spring capability and the valve stopped. For comparison, 2SM-1's stem showed a 360 degree bonding zone as a result of a thick corrosion layer which caused a large increase in friction and the valve did not move from open position.

The Root cause analysis performed following the failure of 1SM-7 identified a need to perform a packing area modification and a new stem guiding modification for 2SM-1. This was allotted for the end of cycle 16 refueling outage (2EOC16). It also identified checking MSIV's travel stroke for low margin valves. 2SM-1 was not a part of this list because it lacked typical scoring marks on its stem and had passed the hot stroke length verification. Therefore, it was concluded that 2SM-1's performance was not affected.

After failure of 1SM-1 in October 2004 and following completion of its root cause analysis, it was decided to develop and implement a comprehensive work scope for all Unit 2 MSIVs, including 2SM-1. Shutdown stroke testing of 2SM-1 was a part of this work scope. The first opportunity to perform this task was in March 2005, during the 2EOC16 Refueling Outage. It was during the performance of this test that 2SM-1 failed to close.

The corrective actions implemented to address the failures of 1SM-1 and 1SM-7 did not identify the failure mechanism for 2SM-1 because the effect of corrosion on MSIV closure was unknown at the time.