

EXPIRES 04/30/98

LICENSEE EVENT REPORT (LER)

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T 6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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TITLE (4)
Failure of Auxiliary Feed Regulating Valves to Meet Inservice Test Stroke Time

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 NAME	DOCKET NUMBER
01	18	94	94	-- 001 --	01	06	25	97	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9) 1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)									
POWER LEVEL (10) 096	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(ii)		50.73(a)(2)(viii)			
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)			
	20.2203(a)(2)(i)		20.2203(a)(3)(iii)		50.73(a)(2)(iii)		73.71			
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER			
	20.2203(a)(2)(iii)		50.36(c)(1)		X 50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A			
20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)						

LICENSEE CONTACT FOR THIS LER (12)

NAME R. G. Joshi, MP2 Nuclear Licensing	TELEPHONE NUMBER (Include Area Code) (860) 440-2080
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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

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

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

On January 18, 1994 at 1518 hours, during performance of auxiliary feedwater pump monthly surveillance procedure (SP) 2610A "Motor Driven AFPs and Regulating Valves Operability Test", Auxiliary Feedwater Regulating Valve (AFRV) 2-FW-43A and B both failed to open in the In-Service Test required time. At the time of discovery of this event, the unit was in Mode 1 at 96% power.

The original LER submittal concluded that an unidentified blockage of the valve positioners bleed-off port was the cause of this event. Further investigation concluded that the valves were fully capable of performing their safety function at all times. Therefore, this event is not reportable under the requirements of the LER rule.

This report is being submitted to provide additional information regarding the recurrence of the event, actual event cause, discrepancies identified during the investigation of this event, and final corrective actions. This revision is a complete revision of the original LER.

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I. Description of Event

On January 18, 1994 at 1518 hours, during performance of auxiliary feedwater (AFW) pump monthly surveillance procedure (SP) 2610A "Motor Driven AFPs and Regulating Valves Operability Test", Auxiliary Feedwater Regulating Valve (AFRV) 2-FW-43A and B both failed to open in the In-Service Test (IST) required time. At the time of discovery of this event, the unit was in Mode 1 at 96% power.

On January 24, 1994 a report was made pursuant to the requirements of 50.72(b)(2)(iii), "any event or condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident." A follow-up report containing additional information was submitted on January 27, 1994, which determined that the January 18, 1994 event had no safety consequences, since it was believed that the valves would have fulfilled their safety function had a design basis event occurred.

On March 15, 1994, after six weeks of performing monthly surveillance procedure SP2610A on a weekly basis, valve 2-FW-43A again failed its stroke time test with a stroke time to open greater than 4 minutes. The valve was immediately declared inoperable and subsequently disassembled, inspected and overhauled. Computer diagnostic testing on the reassembled valve showed that the valve opened smoothly with no sign of resistance.

On September 20, 1994, also during performance of the AFW pump IST, valve 2-FW-43A once again failed to open within the time period required by the quarterly valve surveillance test. Subsequent investigation identified that the delay in valve opening was due to excessive hydraulic forces across the valve plug which were present immediately after operation of the AFW pump, and not due to an obstructed vent path as originally believed.

Further analysis concluded that the valves were fully capable of performing their safety function at all times. Therefore, this event is not reportable under the requirements of the LER rule. This report is being submitted to provide additional information regarding the recurrence of the event, actual event cause, discrepancies identified during the investigation of this event, and final corrective actions.

A detailed chronological description of events follows:

January 18, 1994 Failed Surveillance Test

As part of SP 2610A, the control room operator secured the AFW pump and cycled one of the two AFRVs (2-FW-43A) in the open direction. The AFRV failed to open for approximately 16 minutes. The operator recognized that the quarterly IST required the valve to open within 60 seconds. The operator re-stroked and timed the valve twice, resulting in normal 45 - 46 second stroke times. The operator then stroked and timed the other AFRV (2-FW-43B) twice. It also failed its IST criteria with stroke times of 60.3 and 60.4 seconds. Approximately two hours and ten minutes after the initial failure, adjustments were made to the air supply pressure for both valves. The valves were retested, resulting in stroke times within their IST criteria. As a precaution to ensure valve operability, the monthly pump and regulator valve operability test was rescheduled for weekly performance.

Following the January 18, 1994 event, technical support and maintenance personnel initiated an investigation to determine the cause of failure. Initially, the cause of the 16 minute delay observed in 2-FW-43A opening could not be determined, since the failure could not be duplicated. The AFRVs are pneumatically operated, fail open valves, which open by spring force upon loss of air. In the absence of outside effects, failure to stroke could be caused by an internal binding problem, a broken spring, or failure of the valve operator to vent. Since subsequent valve operation tended to discount mechanical problems, the initial investigation focused on the valve operator vent path as the cause of the event.

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Operations personnel had noted that the AFRVs utilize a different vent path under accident conditions than the path tested during the IST. During normal operation and as tested during the IST, the valve vents air pressure from the actuator dome through the positioner. However, during an accident condition, venting is accomplished through a solenoid dump valve. This latter vent path was not tested by either the monthly AFW pump TS surveillance or the quarterly AFRV IST. Operations considered this information in their original operability assessment and believed that since the venting followed a different path during actual accident conditions, then the potentially obstructed vent path observed during the IST would not affect the valves safety function.

It was also noted that the pneumatic pressure on both valve operators was significantly higher than normal. The inlet air supply regulators for 2-FW-43A and 2-FW-43B were found to be set at 95 and 100 psig, respectively. Discussion with the valve vendor confirmed that no more than 70 psig should be required to obtain a seal against an AFW design pressure of 1250 psig, and that this value was inclusive of 15 psig to overcome opening spring pressure and 3 psig to compensate for packing friction. A review of AFRV maintenance history revealed that the regulated supply pressure on both the valves had been increased approximately one year prior to the event to provide higher closing force against suspected seat leakage. The investigation found that prior to increasing the regulator pressure, an adequate review had not been performed to document the change and identify any potential impact on the AFRV design function or testing criteria. As a result, the IST stroke time acceptance criteria was never updated to reflect the increased regulator pressure. Subsequent review of the regulator pressure increase verified that the increased pressure, while remaining within the design capability of the operator, resulted in a decrease in the margin between normal stroke time and IST acceptance criteria.

The increase in stroke time resulting from the increased regulator pressure could not account for the 16 minute delay in the opening of 2-FW-43A. The investigation into the delayed stroke time was complicated by the inability to replicate the event such that a detailed analysis of the failure could not be completed. Based on the information available during the first event, it was believed that the most probable cause was a transient obstruction in the positioner bleed-off path.

On February 24, 1994 follow-up diagnostic testing of the AFRVs was performed. This testing identified a slight increase in the opening resistance for 2-FW-43A. However, it was determined that both valves remained within their design parameters and that the sticking forces identified could not account for prolonged stroke time. Based on the best available information, it was still believed that the delayed stroke problem was related to the positioner pilot valve.

March 15, 1994 Failed IST

On March 15, 1994, after six weeks of performing SP2610A, a second delayed opening of AFRV 2-FW-43A occurred. The affected AFRV was immediately determined to be inoperable and an investigation was initiated. Noting that some sticking had been previously identified, the valve was disassembled, inspected and overhauled. Upon reassembly, diagnostic testing was employed to verify that the valve operated smoothly and none of the sticking identified on February 24, 1994 was observed. In addition, the positioner bleed-off valve was inspected and found to be clean and functioning properly. The investigation discounted the original belief that the positioner vent path was blocked.

September 20, 1994 Failed IST

On September 20, 1994 a repeat of the delayed AFRV opening event occurred during AFW pump IST. The AFRV was immediately declared inoperable and an investigation was initiated. A design review identified the potential for pressure locking to develop under the conditions associated with pump surveillance testing. Troubleshooting activities following this event included more extensive monitoring, including performance of the

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pump surveillance test while diagnostic monitoring equipment was installed on the AFRV, monitoring downstream pressure. These activities helped identify that the delayed valve opening was due to residual hydraulic forces across the valve plug generated during AFW pump operation. These forces develop during pump testing when the AFRV and the bypass valve seat allow leak-by, pressurizing the piping downstream of the AFRVs. When the pump is shutoff, the upstream pressure dissipates (backflow through the pump) quicker than the pressure downstream of the AFRVs. The resulting hydraulic force holds the plug in a closed position. If an attempt is made to stroke the AFRV shortly after securing the pump, the hydraulic force is greater than the operator opening force and the valve remains closed until sufficient equalization can occur. Once the valve begins to stroke, the pressure immediately equalizes and the valve opens normally.

In the current piping configuration, the maximum pressure that can develop on the downstream side of the AFRV plug is equivalent to feed header pressure (approximately 905 psi). Pump pressure above this pressure is relieved through the Auxiliary Feed Water check valve to the feed system. During postulated accident conditions, automatic initiation of the AFW pump would immediately pressurize the upstream side of the plug to the higher pump discharge pressure. The pressure downstream of the AFRVs (steam generator side) cannot be higher than that upstream (AFW pump side), therefore, pressure locking would not be induced, since higher pressure on the upstream side of the plug would help the valves to open, thus allowing the AFRVs to fulfill their safety function. The pressure locking that results from AFW pump testing will not affect the safety function of the AFRVs during postulated accident scenarios.

An additional concern, identified as a result of the initial event, was the failure to declare both valves as inoperable. A non-conservative philosophy led the operations department to consider the valves operable despite the fact that: (1) operations recognized that the valves did not meet IST criteria, (2) there was no evidence to support the conclusion that the AFRVs would function properly during an accident condition, and (3) although the TS Limiting Condition for Operation only specifies verification of auxiliary feed pump operability, the surveillance requirements for the auxiliary feed pump require testing of components that make up the flow path. Therefore, it should have been apparent that a verification of an AFW flow path was necessary.

II. Cause of Event

The original LER submittal concluded that an unidentified blockage of the valve positioners bleed-off port was the likely cause of these events. Investigation of subsequent events concluded that the cause was the presence of hydraulic forces across the valve plug. These forces develop as a result of AFW pump operation, and dissipate approximately 10 minutes after the pump has been shutoff. This condition is caused by minute leakage through the control and associated bypass valve, and was not accounted for during the development of the surveillance procedure. This condition occurs only during testing of the AFRVs and is not expected to occur during design basis conditions.

III. Analysis of Event

The Auxiliary Feedwater System provides water for the removal of sensible and decay heat, and to cool the primary system to 300° F in case the main condensate and Steam Generator Feed Pumps are inoperable. The AFRVs regulate the flow of auxiliary feedwater to the steam generators.

AFRVs 2-FW-43A and 2-FW-43B are globe type valves designed to regulate AFW flow. These valves are controlled by an air operator designed to maintain the valves in a closed position against the maximum pressure developed by the AFW pumps. When air pressure is vented from the actuator pressure dome, the valve is opened by a spring that develops approximately 15 pounds of opening force.

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The original LER submittal indicated that AFRVs 2-FW-43A and 2-FW-43B were unable to perform their safety function, as demonstrated by their failure to meet IST requirements. Subsequent investigation concluded that the original cause for the delayed stroke time was incorrect. The delayed valve opening was found to occur only when the valves were stroked immediately (less than 10 minutes) after the AFW pumps had been shutoff. In this configuration hydraulic forces are generated against the valve plug on the steam generator side, with no hydraulic forces present on the AFW pump side of the plug. If a pressure as small as 90 psi is present on the steam generator side when the auxiliary feed pump is not operating (i.e., no pressure on the pump side), then the spring is not capable of providing sufficient opening force.

During design basis conditions, automatic initiation of the AFW pump would pressurize the upstream side of the plug to the higher pump discharge pressure. The pressure downstream of the AFRVs (steam generator side) cannot be higher than the upstream (AFW pump side). Therefore, pressure locking would not be induced since the higher pressure on the upstream side of the plug would help the valves to open. The pressure locking that results from AFW pump testing would not affect the safety function of the AFRVs during postulated accident scenarios.

The actual safety significance of this event is low, since there has never been an event that has challenged the AFRVs safety function. The potential safety significance is also low since the investigation concluded that the delayed opening of the valves was the result of hydraulic forces across the valve plug, which are not present during postulated accident scenarios.

IV. Corrective Action

Immediate corrective actions after the January 18, 1994 event included verification of the correct pneumatic supply pressure to the AFRVs and resetting the regulators to that pressure. In addition, a diagnostic test was developed to investigate other possible causes for the delay in valve opening. The testing frequency was also increased to provide additional assurance of continued AFRV performance.

Corrective actions following the March 15, 1994 event included 1) disassembly, inspection and overhaul of 2-FW-43A; 2) disassembly and inspection of the positioner; and 3) post-maintenance diagnostic testing of the valve to verify the resistance to opening had been eliminated.

Subsequent to the September 20, 1994 delayed stroke time event, a test package was developed that included a design review and an extensive test of the AFW System. The pressure locking phenomenon was identified during these activities.

A TS clarification was issued to ensure the AFW system safety function was assessed during the AFW pump TS surveillance.

The surveillances associated with the AFRVs were consolidated into one new surveillance procedure.

Programmatic corrective actions included a review of air operated valve applications to identify dual function valves similar to the AFRVs. As a result of this review, four other safety related valve test procedures were revised so that the appropriate vent path was used during testing. These deficiencies were reported under LER 95-020-00. IST acceptance criteria were also revised so that degrading conditions could be identified prior to reaching operability limits.

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V. Additional Information

Similar Events

Previous LERs that involve insufficient valve testing:

- 95-020: Automatic Actuation of an Engineered Safety Feature During Maintenance
- 96-023: Failure to Perform Technical Specifications Surveillances on Certain Containment Isolation Valves
- 96-026: Incomplete Technical Specification Required Surveillance - Valve Lineups Inside Containment

EIIS Codes

- SJ - Feedwater System
- BA - Auxiliary/Emergency Feedwater System