

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20545, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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TEXT (If more space is required, use additional NRC Form 386A's) (17)

On September 7, 1990 at 0625 and at 0626 hours respectively, Main Steam Isolation Valves (MSIV's) 1B21-F022C and F028B failed to remain closed following successful slow closures of these valves and the positioning of their control switches to "close". At the time of these events, the plant was in Operational Condition 3 (Hot Shutdown), with all control rods inserted. Reactor pressure was approximately 450 psig with the reactor coolant at saturated conditions.

Following shutdown of the Perry Nuclear Power Plant, Unit 1, directions were given to the operators to close the MSIV's in order to maintain control of the reactor cooldown rate. At 0625 hours on September 7, the operators placed the control switch for 1B21-F022C (inboard MSIV in the C Main Steam Line) in the "test" position and depressed the "test" push button. This resulted in a successful slow closure of the MSIV. Following this, with F022C still closed, the operator repositioned the control switch to the "close" position, at which time air should have been applied to the closing side of the MSIV air actuator and an additional exhaust path opened from its opening side, thus allowing the MSIV to remain closed. The valve however, reopened, indicating that the fast closure sequence had not operated properly. The control switch was left in the "close" position and F022C eventually closed, sometime between 1500 and 1913 hours on September 8, 1990. Emergency Response Information System (ERIS) data was not obtained for this closure and thus, the exact time of closure and the actual closing stroke time were not obtained.

Similarly, the control switch for 1B21-F028B (outboard MSIV in the B Main Steam Line) was placed in the "test" position and the "test" push button depressed at 0626 hours on September 7. Once again the MSIV slow closed properly; however, it failed to remain closed when its control switch was placed in "close". This valve closed approximately fourteen minutes later, at 0640 hours on September 7, with its control switch remaining in the "close" position. ERIS data was obtained for this closure and it showed that the MSIV fast closed in approximately 3 seconds.

The other six MSIV's closed properly on September 7, using the sequence of slow (test) close followed by fast close. The last time these valves were satisfactorily fast closed from a full open position was during surveillance testing activities on January 8, 1990.

Based upon the successful slow closure of both of these MSIV's and their subsequent failure to fast close, the problem was suspected to be associated with the air pack and not with the MSIV internals. Therefore, the air packs from both failed valves along with a third from a non-failed valve (1B21-F028C) as a control, were removed from the MSIV's, functionally tested, visually inspected and electrically checked. All three of the air packs cycled properly on the bench. Due to air leakage, the air pack for 1B21-F022C required retightening of several bolts which had been inadvertently loosened during air pack removal before it was functionally tested. Several components of the air packs contained traces of a foreign material adhering to their internal surfaces. With this

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FACILITY NAME (1) Perry Nuclear Power Plant, Unit 1	DOCKET NUMBER (2) 05000440910-021-0103 OF 04	LER NUMBER (6)			PAGE (3)	
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TEXT (If more space is required, use additional NRC Form 308A's) (17)

exception, they appeared to be generally clean inside and the elastomer seals (Viton) appeared to have not degraded. Nothing obvious was observed that could have explained the failures. Electrical testing showed that the solenoid coils had not degraded significantly from their new condition nor was there indication that a high current situation existed. Results of these inspections and tests have been recorded and evaluated.

Root cause analysis of these events was performed using Kepner Tregoe techniques. This analysis led to the conclusion that the cause of these events was failure of the disc holder seat elastomer to shift from the exhaust port in the 3-way dual coil solenoid valve (ASCO Model NP-8323-A20V) preventing this valve from shifting to the "close" position upon deenergization of the solenoids. Failure of this valve to shift position prevented both the 2 and the 4-way Norgren air shuttle valves from changing positions which resulted in the MSIVs being reopened and held open by air pressure, following the successful slow closures and attempted fast closures on September 7, 1990.

Analytical attempts were made to determine the failure mechanism. Beyond our own inspections, an independent laboratory was contracted to perform various inspections and analyses of the valve components and foreign material found within the valves. Optical and electron microscopy were utilized to examine all critical surfaces. Infrared spectroscopy was used to detect the presence of organic foreign material on the elastomers. Physical testing of the solenoid valve components included Shore hardness testing of the o-rings, and spring force measurements. The seating impression depth in the elastomer valve seats was measured and compared.

No definitive cause for the valve failing to release was identified. Remnants of lubricants and other foreign material were identified on the valve internals but no adhesive qualities could be proven. A correlation does appear to exist however, between the seating impression depth in the seat elastomer and the severity of the failures.

The purpose of the MSIV's is to provide protection against the release of radioactive materials from the containment to the environment and to provide a means of isolating the RPV to minimize the loss of coolant inventory during an accident. There are two MSIV's in each Main Steam line. These valves are automatically closed upon a signal from the Nuclear Steam Supply Shutoff System when critical parameters are exceeded. One MSIV in each Main Steam line is sufficient to prevent the release of radioactive material provided that the other penetration isolation valves function properly. The September 7, 1990 event was not safety significant because the plant was shutdown and at least one MSIV in each Main Steam line closed properly. This event however, could potentially have been safety significant because of the possibility of a common mode failure occurring in both the inboard and outboard MSIV's in the same Main Steam line.

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Prior failures of this type occurred on October 29, 1987, November 3, 1987 and November 29, 1987 (NRC Inspection Report 50-440/87027, dated February 10, 1988). These events were caused by degraded Ethylene Propylene Diene Monomer (EPDM) material inside the solenoid valves (10/29/87 and 11/3/87), and by a sliver of EPDM material inside a solenoid causing it to stick (11/29/87). Corrective actions taken for these events included periodic cycling of the valves, local temperature monitoring, an air quality check, and rebuilding of the 3-way dual solenoid valves. The 3-way dual solenoid valves were replaced with new valves containing Viton rather than EPDM during the first refueling outage.

Corrective actions for the September 7, 1990 failures include replacing the ASCO 3-way dual coil solenoid valves (ASCO Model NP-8323-A20V) on the air packs of the outboard MSIV's with a pair of ASCO single coil solenoid valves (ASCO Model NP-8320-A185V) and cycling the solenoid valves quarterly. The single coil solenoids benefit from a superior pressure rating, superior flow and therefore, faster shift times, lower operating temperatures and the absence of a core assembly in the cylinder to exhaust path which is susceptible to foreign material contamination. This design change is being limited to the outboard MSIV's to allow evaluation of the modification while retaining the existing design on the redundant valves in the Main Steam lines. The operating reliability of the remaining dual coil solenoid valves on the inboard MSIV's should be improved by the decision to cycle these valves quarterly. Plants using the dual coil solenoid valves have experienced fast close failures following extended plant runs in which no MSIV closures had occurred during the run. Fast close failures have not occurred following runs in which MSIV closures had been frequently experienced. Finally, the air pack vendor and the NSSS vendor are in the process of redesigning these air packs. Redesigned air packs are not expected to be available for about 2 years. Perry will continue to monitor their development.

Energy Industry Identification System Codes are identified in the text as [XX].