NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Perry Nuclear Power Plant, Unit 1	0 5 0 0 0 4 4 0	1 OF 0 4

TITLE (4) Solenoid Air Pilot Valves Stick Due to Excessive Heat Exposure Resulting in Main Steam Isolation Valve Slow Closure and Subsequent Manual Reactor Scram During Shutdown

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)
										0 5 0 0 0
1 0	2 9	8 7	8 7	— 0 7 3	— 0 1	1 0	0 3	8 8		0 5 0 0 0

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
1	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10): 0 8 0	20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	X 50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	X 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
Gregory A. Dunn, Compliance Engineer, Extension 6484	AREA CODE: 2 1 6 — 2 5 9 - 3 7 3 7

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	
C	J M	F S N	A 6 1 0	Y							

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 October 29, 1987 at 1837, 2155 and 2216 three Main Steam Isolation Valves (MSIV) failed to fast close in the time required by Technical Specifications 3.4.7 and 3.6.4. Subsequently, the three MSIVs were stroked with satisfactory closure times. On November 3 at 1157 and 1208 two of the same MSIVs failed to close within the required time. Based on repeat failures a plant shutdown was commenced at 1330. The reactor was manually scrammed at 1819.

The cause of the MSIVs delayed closures has been attributed to the associated fast closure dual solenoid air pilot valves sticking in the normal energized position when deenergized. The dual solenoid valves were sticking due to degradation of the elastomer disc and core assembly seals caused by exposure to excessive heat from previously existing steam leaks.

The elastomer discs and seals for all MSIV dual solenoid pilot valves have been replaced. Other equipment has been evaluated for any adverse affects from known steam leaks. Additional temperature monitoring equipment has been installed and special instructions established specifying actions to be taken upon exceeding baseline temperature values. Subsequent physical, chemical and thermal endurance testing confirmed the failure mechanism of the elastomer.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

On October 29, 1987 at 1837, 2155 and 2216 three Main Steam Isolation Valves (MSIV) [JM] failed to fast close in the time required by Technical Specifications. Subsequently, the three MSIVs were stroked with satisfactory closure times. On November 3 at 1157 and 1208 two of the same MSIV's failed to close within the required time. A reactor shutdown was commenced and the reactor was manually scrammed from approximately 23 percent reactor power at 1819. At the time of the event the plant was in Operational Condition 1 (Power Operation) with reactor power approximately 80 percent of rated and reactor pressure at approximately 960 psig.

On October 29, at 1837 Startup Test Instruction (STI)-B21-025A, "MSIV Functional Test" was being performed on 1B21-F022D, inboard MSIV. The D Main Steam Line (MSL) [SB] inboard MSIV closed in 22.14 seconds, in excess of the required closure time of Technical Specifications 3.4.7 and 3.6.4.. At 2103 the D inboard MSIV was satisfactorily cycled twice with closure times of 3.24 and 2.94 seconds. All other MSIVs were then cycled to verify closure time. The B and D outboard MSIVs closed in 11.9 and 77 seconds respectively, and each was subsequently recycled with satisfactory results. The cause of the slow closures was thought to be a one time deposit of debris in the respective solenoid valves [FSV] causing a delay in their response. Once the valves were cycled and the stroke times passed, the debris was assumed to be blown away. This was consistent with industry experience with slow closing MSIVs. Since initial conditions causing MSIV slow closure could not be repeated, all MSIVs were declared Operable and plant startup testing continued.

On November 3 at 1150, MSIV stroke timing commenced in preparation for performing a full MSIV closure scram as part of the startup test program. At 1157 the D inboard MSIV closed in 18 seconds but subsequently recycled satisfactory at 1159. At 1208 the D outboard MSIV failed to close. A second attempt was satisfactory at 1213 with a closure time of 3.4 seconds. Based on repeat failures a plant shutdown was commenced at 1330. The Reactor Recirculation (RRC) [AD] Pumps were shifted to slow speed at 1630, resulting in reactor power decreasing from 32 percent to 23 percent of rated. With reactor power below the Low Power Set Point (LPSP)(26 percent), the Rod Pattern Controller (RPC) [AA] generated Control Rod insert and withdrawal blocks. Preparations were made and the reactor was manually scrammed by placing the Mode Switch [HS] in "Shutdown" at 1819.

The cause of the MSIVs delayed closures has been attributed to failure of the respective fast closure dual solenoid air pilot valve (Automatic Switch Company (ASCO) model NP-8323A20E). The dual solenoid valve is one of the components which make up the air pack for controlling instrument air to open or close each of the MSIVs. Both solenoids of the dual solenoid valve must deenergize to allow the valve to reposition and vent the air from the bottom side of the MSIV actuator piston and supply instrument air to the top side of the piston for the fast closure operation. Exposure to elevated temperatures resulting from steam leaks caused the Ethylene Propylene Diene Monomer (EPDM) elastomer discs and core assembly seals to degrade causing the solenoid valves to stick in the normal energized position when deenergized.

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Localized high temperature conditions existed during the plant cycle due to steam leakage. Steam leakage is known to have resulted from an MSIV 1B21-F022B packing leak and MSIV Leakage Control System [BD] isolation valves body to bonnet leakage. This leakage was in the direct vicinity of those MSIV's which exhibited slow closure. Based upon the degradation of the EPDM, and rust contamination on one of the solenoids, steam in excess of 300 degrees F is suspected of leaking in the direction of the MSIV air packs.

Primary Containment [NH] integrity ensures that the release of radioactive materials from the containment atmosphere will restrict the site boundary radiation dose to within the limits of 10 CFR 100. Additionally, the design bases assumes the MSLs will isolate within 5.5 seconds. Based on as found conditions of the MSIVs a safety evaluation was conducted with assistance from General Electric Company and Gilbert Commonwealth, Inc. The results of the analysis for the most limiting accident, indicates the plant would have 79 seconds or more to isolate the MSL prior to exceeding 10 CFR 100 site boundary dose limits. Therefore, the 18 second closure of the D MSL penetration has been shown to be within the bounds of accident guidelines. Therefore, this event is considered to be of potential safety significance. No previous similar events have been identified.

The following evaluations and actions have been or will be completed to verify the root cause conclusion and minimize the potential for future MSIV failures.

1. The total air pack was replaced for 1B21-F028D, the dual solenoid was replaced for 1B21-F022D and 1B21-F022A. All of the other MSIV dual solenoids have been rebuilt.

2. Evaluations have been performed for other ASCO solenoid Class 1E applications in the plant and other equipment in the vicinity of all known steam leaks to determine if there has been any affect on their qualified life. These evaluations revealed that there were eight valve actuators in the vicinity of known steam leaks. These actuators were inspected and no heat degradation was observed.

3. A baseline for drywell and steam tunnel temperature elements in the vicinity of the MSIVs has been established. Additional steam tunnel temporary temperature monitoring has been installed in the MSIV area. A procedure has been established specifying necessary actions to be taken upon exceeding the baseline temperature values.

4. Until the first refueling outage, the dual solenoids will be checked for proper operation during the monthly slow closure check and the MSIVs will be cycled individually on a quarterly basis verifying the fast closure time.

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5. Subsequent to the solenoid valve failures physical, chemical and thermal endurance testing re-substantiated the conclusion that heat degradation of the EPDM material caused the MSIV solenoids to stick. The existing qualified lifetime of the EPDM solenoid valves was not affected by the results of these tests.

6. As part of a followup action, one MSIV solenoid (for 1B21-F028A) was replaced on May 26, 1988 in order to subject it to physical and chemical analysis. This solenoid experienced the highest temperature profile since complete MSIV solenoid replacement in December 1987.

The post scram evaluation has identified the cause for the RPC control rod blocks to be attributed to two contributing characteristics. First, the normal control rod pattern deviates from the RPC sequence. In order to achieve a 100 percent rod pattern, it is necessary to deviate from the RPC banked position withdrawal sequence. During plant startup deviation from the RPC sequence occurred at approximately 55 percent reactor power. When shutting down, reactor power was much lower, due to power history and xenon build-up, prior to reaching the step at which RPC sequence constraints would be met. To ensure the operators are aware of the step of the control rod movement sequences which deviates from the RPC sequence, a note has been added to the top of the control rod movement cover sheet. Integrated Operating Instruction (IOI) 3 "Power Changes", has been changed to give the operators more specific instructions for verifying the control rod pattern is consistent with the RPC sequence and requires down shifting RRC pumps at a higher reactor power. Secondly, the LPSP setting of 26 percent was higher than necessary and will be lowered to 22 percent.

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