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LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Perry Nuclear Power Plant, Unit 1	05000 440	1 OF 8

TITLE (4)
Failure to Meet Technical Specification Limits for Main Steam Line Leakage Rates

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
05	24	94	94	-- 014 --	01	11	17	94	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9): 5
POWER LEVEL (10): 000

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.402(b)		20.405(c)		50.73(a)(2)(iv)		73.71(b)
	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
	20.405(a)(1)(iii)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)(A)		(Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iv)		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 (Include Area Code)
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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
X	SB	ISV	A585	Y					
X	BD	ISV	R340	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 15 single-spaced typewritten lines) (16)

During the investigation of local leak rate testing (LLRT) results on the main steam line (MSL) containment penetrations, it was determined that the testing methodology utilized was not representative of design basis accident conditions. Therefore, the LLRT testing did not satisfy the surveillance requirements of Technical Specifications. Additionally, the as found leakage from MSLs B, C, and D exceeded the limit of Technical Specification 3.6.1.2.

The root cause of the nonrepresentative testing of the MSLs has been attributed to inadequate procedures. The procedures for the LLRTs performed on the MSLs allowed nonconservative testing of the main steam isolation valves (MSIV) in that additional seating force was allowed to be applied to the MSIVs by non-safety related instrument air. The cause of the excessive leakage of the MSLs was valve seat misalignment on three MSIVs and excessive packing leakage on a MSIV leakage control system valve due to a bent stem.

As a result of this event, a design change was implemented during the refueling outage to provide a safety related air supply to the actuators for the outboard MSIVs. Additionally, the MSIVs with identified excessive seat leakage and the identified packing leaks were reworked. LLRT testing of the MSLs was performed satisfactorily prior to restarting from the refueling outage.

I. Introduction

During the investigation of local leak rate testing (LLRT) results on the main steam line (MSL) containment penetrations, it was determined that the testing methodology utilized was not representative of design basis accident conditions. LLRTs of the MSLs were performed with instrument air applied to the main steam isolation valve (MSIV) actuators; however, instrument air cannot be assumed to be available following a design basis accident (refer to NRC Information Notice 89-26). Therefore, LLRT testing for the MSLs did not satisfy the surveillance requirements of Technical Specification 3.6.1.2. Additionally, the as found leakage from MSLs B, C, and D exceeded the limit of Technical Specification 3.6.1.2. At the time of discovery of this event, the plant was in Operational Condition 5 (Refueling) during the fourth refueling outage.

This condition is being reported pursuant to the requirement of 10CFR50.73(a)(2)(i)(B), Operation Prohibited by Technical Specifications. Courtesy notifications to the NRC Operations Center following initial LLRT test results were made on February 14 and 15, 1994.

II. Description of Event

System Description

The main steam system [SB] conveys steam from the reactor vessel [AD] through four MSLs denoted A, B, C, and D. Each MSL contains two MSIVs [ISV] which serve as containment isolation valves. The inboard MSIVs are located inside the primary containment barrier (drywell). The outboard MSIVs are located outside the primary containment barrier in the steam tunnel. The containment penetration boundary for the MSLs also includes valves for the MSL drains and the MSIV leakage control system [BD].

The combination of two MSIVs in each steam line provides a highly reliable means of isolating the reactor vessel to minimize the loss of reactor coolant inventory and to limit the release of radioactive materials. The basic design of all eight MSIVs is identical. The valves are 26-inch angled globe valves of the Y configuration manufactured by Atwood and Morrill Co., Inc. (Manufacturer code A585). The cup-shaped poppet of the main disc moves on a centerline that is 45 degrees upward from the horizontal centerline of the piping run.

Attached to the upper end of the stem is an air actuator that opens and closes the valve. The MSIV closing motive force is a combination of springs and instrument air [LD]. In the case of a loss of the non-safety related instrument air, an air accumulator for each MSIV supplies air to assist spring force in closing the valve. The accumulator is sized and utilizes check valves to ensure sufficient volume to close each MSIV.

Testing Methodology

LLRTs of the MSL containment penetrations are usually accomplished once every 18 months during refueling outages. This testing consists of pressurizing the volume between the isolation valves on each main steam line to peak accident pressure (P_a) and measuring the leakage out of this volume. This method combines the leakage paths for the main steam line (MSIVs, drain line isolation valves, and MSIV leakage control system isolation valves).

By applying the test pressure between the MSIVs during LLRTs, the inboard MSIVs are tested in the reverse flow direction. This testing methodology results in the test pressure being applied to the bottom side of the poppets on the inboard MSIVs which opposes some of the the closing forces for the valve.

Technical Specification 3.6.1.2 requires that the leakage through the isolation valves of each main steam line be limited to less than 25 standard cubic feet per hour (scfh). If the LLRT on a main steam line fails to meet this requirement, additional testing can be performed to identify which leakage path(s) is excessive.

Sequence of Events

During the fourth refueling outage (RFO4), the initial as-found LLRTs for MSL containment penetrations indicated that all four MSLs exceeded the 25 scfh limit of Technical Specification 3.6.1.2. During troubleshooting to identify the leakage paths on the MSLs, it was identified that the instrument air to the actuators of the MSIVs had been inadvertently isolated during the initial as-found LLRTs.

The instrument air to the actuators for the MSIVs was restored and the as-found LLRTs for the MSLs were reperformed. The results of the LLRTs showed a decrease in the leakage rates for each MSL. Packing leaks on several MSL boundary valves (non-MSIV) were identified during the LLRTs. These packing leaks were repaired, and additional testing was performed to quantify leakage attributed to isolation valve seat leakages. Only one packing leak was

identified as significant. This leak was on a MSIV leakage control system valve (1E32-F0001J) for MSL C. Repair of this packing leak reduced the leakage for MSL C to within Technical Specification limits.

The results of the as-found LLRTs (in scfh) were as follows:

MSL	LLRT with Air Isolated	LLRT with Air Applied	LLRT with Air & Packing Repairs
A	51	16	15
B	1038	102	102
C	1271	517	14
D	404	70	70

During the initial as-found LLRTs and troubleshooting testing, a NRC inspector raised a concern regarding the application of a non-safety related air supply during the LLRTs. As a result of this concern, an investigation of the requirements for testing of the MSIVs was initiated.

MSIV Seat Leakage

Troubleshooting of the leakage paths for the MSLs identified that both MSIVs on MSL B (1B21-F0022B & 1B21-F0028B) and the inboard MSIV on line D (1B21-F0022D) exhibited excessive seat leakage. These MSIVs were reworked during RFO4 to improve their leak tightness.

Additionally, modifications to enhance proper seating of both the MSIVs in MSL C (1B21-F0022C & 1B21-F0028C) were completed during RFO4. These modifications had been planned for RFO4 and provide enhancements that were performed earlier on the other MSIVs (see Similar Events).

Investigation of Instrument Air Use

Investigation of the MSIV LLRT requirements determined that the design of the MSIVs and instrument air would not ensure that additional seating force from the instrument air would be available throughout a design basis event. The accumulators for the MSIVs are safety related and designed to provide the motive force to initially close the MSIVs as required. However, the instrument air supply to the accumulators is not safety related and credit cannot be taken for this supply being available during design basis events. Therefore, the LLRTs which had been performed did not ensure that the design

basis MSL leakage was determined. Past LLRTs for the MSLs have also been performed with instrument air providing additional seating force for the MSIVs. On May 24, 1994, this condition was reported to the NRC resident inspector.

Design documentation from General Electric (GE), the Nuclear Steam Supply System designer, indicates that the spring force alone is not enough to ensure the leak tightness of the MSIVs. However, the original design criteria of the instrument air supply did not require a safety related instrument air supply that would be available during design basis events. Additional testing performed during RFO4 indicated that the MSIV leakage rates increase without the added seating force provided by instrument air.

During RFO4, a design change was implemented to provide a safety related air supply to the outboard MSIVs. Technical Specification surveillance requirement limits will be met by only taking credit for a safety related air supply on the outboard MSIVs.

Investigation of MSL Boundary Leakage

During the inspection of the MSIVs exhibiting excessive leakage, machining errors were identified which had been made the last time these valves had been reworked. These errors had been introduced by calibration errors in the Welding Services Incorporated (WSI) Circular Coordinate Measurement Machine (CCMM) equipment which had been used to determine valve centerline for machining purposes.

WSI identified that a software error had existed with the equipment that was used to modify the MSIV in MSLs A, B, and D during refueling outage 3 (RFO3). WSI CCMM utilizes a software package that determines a theoretical valve centerline. This error still existed with the equipment during the mid-cycle outage in January 1993 when both MSIVs in MSL B were reworked. This software error had been corrected by WSI prior to RFO4.

Because of this error, an evaluation of the MSIVs not reworked during RFO4 (1B21-F0022A, 1B21-F0028A, & 1B21-F0028D) was conducted. This evaluation included a reanalysis of RFO3 as left data and LLRT results for these MSIVs. Based on this evaluation, it was determined that no additional rework was needed to ensure the leak tightness of these MSIVs.

All machining performed during RF04 (including the design change for both MSIVs in MSL C) was based on physical measurements from a boring bar. The WSI CCMM equipment was utilized as an analytical tool to perform internal valve mapping for as-found/as-left values.

Results of the inspections for excessive MSL boundary leakage are provided below for the individual valves reworked during RF04.

Main Steam Line B:

Excessive leakage in this MSL was due to seat leakage from both the inboard (1B21-F0022B) and outboard (1B21-F0028B) MSIVs. Inspection of the inboard valve identified a light seating line on the valve and poppet seating surfaces at two locations, scuffing on the poppet upper guide band, two guide ribs slightly outside design tolerance, and high spots on the upper bore. Rework of this valve was performed which included remachining of the guide ribs and seat, machining of the guide bands, and grinding of the upper bore high spots.

Inspection of the outboard valve identified valve seat misalignment with respect to the upper bore/flange face (i.e., excessive eccentricity). Also identified was scuffing on the pilot poppet external surface and lack of radial clearance on one guide rib. Rework of this valve was performed including machining of a poppet to match the final lower bore dimensions.

Main Steam Line C:

Excessive leakage in this MSL was due to a packing leak on 1E32-F0001J (MSIV leakage control system). MOVATs testing of this valve identified a bent stem that is believed to have resulted in the excessive packing leakage for this valve. This stem was replaced and retesting was performed satisfactorily.

Main Steam Line D:

Excessive leakage in this MSL was due to seat leakage from the inboard MSIV (1B21-F0022D). Inspection of the valve identified excessive eccentricity. Additionally, scuffing on the pilot poppet external surface was identified and one valve body guide rib was outside vendor specifications. Rework of this valve was performed including machining of a new poppet to match the final lower bore dimensions.

III. Cause of Event

The root cause of the nonrepresentative testing of the MSIVs has been attributed to inadequate procedures. The procedures for the LLRTs performed on the MSLs allowed nonconservative testing of the MSIVs in that additional seating force was allowed to be applied to the MSIVs by non-safety related instrument air.

The cause of the excessive leakage of the MSLs was valve seat misalignment on three MSIVs and excessive packing leakage on a MSIV leakage control system valve due to a bent stem.

IV. Safety Analysis

Primary containment integrity ensures that the release of radioactive materials from the containment atmosphere will be restricted to those leakage paths and associated leakage rates at the peak pressure (P_a) assumed in the Updated Safety Analysis Report accident analyses, thereby limiting the site boundary radiation doses to within the limits of 10CFR100.

All previous cycle LLRT results have been based on the added seating force applied by the non-safety related instrument air to the MSIV actuators. The amount by which MSIV leakage rates are affected by removing the additional seating force applied by the instrument air system on the MSIV actuator cannot be quantified, although it is likely that the leakage rates would increase. This condition would result in non-conservative results in previous LLRTs and, thus, non-conservative assumptions in the accident analyses. Due to the possibility that 10CFR100 limits could have been exceeded during a postulated accident, this event is considered to be safety significant.

V. Similar Events

Six previous LERs have been submitted to report MSL penetration leak rate test failures. These events were reported in LERs 87-051, 87-067, 89-006, 90-025, 92-006, and 93-003. In the first five instances, seat leakage from the MSIVs or leakage from other MSL boundary isolation valves was determined to be the cause. Prior to the third refueling outage (RFO3) the majority of the corrective maintenance performed involved the lapping of seating surfaces. A modification was performed during RFO3 for the six MSIVs in MSLs A, B, and D

which had exhibited excessive seat leakage during testing. The respective MSIVs were successfully tested following modification and repair. Similar modifications for the MSIVs in MSL C were performed during RF04.

LLRTs were performed during a mid-cycle outage in January 1993 (see LER 93-003). These LLRTs identified excessive leakage on MSLs A, B, and D. It was determined that the six MSIVs which were modified during the third refueling outage had indications of leakage around the body to bonnet flanges. The leakage was determined to result from a combination of factors which included incorrect gasket dimensional sizing, an inadequate tensioning procedure used during previous valve reassembly, and a lack of metal to metal contact on the valve body to cover plate gap.

VI. Corrective Actions

As a result of this event, a design change was implemented during the refueling outage to provide a safety related air supply to the actuators for the outboard MSIVs. Additionally, the MSIVs with identified excessive seat leakage and the identified packing leaks were reworked. LLRT testing of the MSLs was performed satisfactorily prior to restarting from the refueling outage.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].