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March 3, 2000

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

Attention: Document Control Desk

Subject: Grand Gulf Nuclear Station
Docket No. 50-416
License No. NPF-29
Main Steam Lines Exceeded Leakage Limits
LER 1999-006-01

GNRO-2000/00012

Gentlemen:

Attached is Licensee Event Report (LER) 1999-006-01, which is a final report. The interim report (LER 1999-06-00) was submitted by letter dated December 2, 1999. Revised information is denoted by revision markings in the right-hand margin.

Should you have any questions or require additional information regarding the contents of this report, please contact the licensee's representative listed on the attached LER.

Yours truly,

William A Eaton.

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NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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TITLE (4)
Main Steam Lines Exceeded Leakage Limits

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
									N/A	05000
11	02	1999	1999	-- 006 --	01	03	03	2000	FACILITY NAME N/A	DOCKET NUMBER 05000

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more) (11)							
POWER LEVEL (10)	00		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(1)		20.2203(a)(3)(i)	X	50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		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	TELEPHONE NUMBER (Include Area Code)
Charles E. Brooks / Senior Licensing Specialist	601-437-6555

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
X	SJ	ISV	1038	Y		X				

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)

On November 2 and 13, 1999, with the reactor shutdown, Main Steam Line (MSL) Local Leak Rate Testing data indicated that the as-found leakage through the inboard and outboard Main Steam Isolation Valves (MSIVs) in the A and C MSLs exceeded the acceptance limit. Technical Specification (TS) 3.6.1.3 specifies a total leakage limit of 100 standard cubic feet per hour (scfh) for all four MSL penetrations. The acceptance leakage limit for individual MSIVs is 25 scfh (minumum pathway leakage). The as-found leakage rate through the inboard MSIV on the A MSL was approximately 442 scfh and unquantifiable through the outboard MSIV and both C MSL MSIVs due to excessive leakage beyond the measuring capability of the test equipment. Thus, leakage through the A and C MSLs exceeded the total allowable leakage limit specified in TS.

Since the MSIVs are designed to automatically close following a level 1 reactor water level signal indicative of a LOCA, total leakage would be expected to have been limited to the leakage rate of the valve in each affected MSL penetration with the least amount of leakage (minimum pathway leakage). Additionally, the Main Steam Shutoff Valves (MSSVs) were available to limit radiological releases to the environment. The MSSVs successfully passed leak rate testing. All MSIVs have been reworked and retested satisfactorily.

Although the design basis MSIV leakage limits would have been exceeded given a postulated LOCA, there were no actual safety consequences or compromises to public health and safety as a result of this event.

A. Reportable Occurrence

During Local Leak Rate Testing on November 2 and 13, 1999, the leakage rates of six main steam isolation valves (MSIVs) resulted in exceeding the allowable leakage permitted by Technical Specification 3.6.1.3. These unanticipated MSIV [EIIS Codes: JM, SIV] failures resulted in the A and C main steam line (MSL) penetrations exceeding their allowable leakage as a result of both the inboard and outboard valves failing its Local Leak Rate Testing (LLRT). The two remaining failed valves were in the B and D main steam line penetrations.

Telephone notifications were made to the NRC's Emergency Notification System reporting this condition pursuant to 10CFR50.72(b)(2)(i) - a condition found while the reactor was shutdown, had it been found while the reactor was in operation, would have resulted in the nuclear power plant, including its principle safety barriers, being seriously degraded or in an unanalyzed condition that significantly compromises plant safety.

This condition also meets the following 30-day follow-up reporting criteria:

50.73(a)(2)(v) "Any event or condition that alone could have prevented the fulfillment of the safety function of structures or systems that are needed to: (A) Shut down the reactor and maintain it in a safe shutdown condition; (B) Remove residual heat; (C) Control the release of radioactive material; or (D) Mitigate the consequences of an accident."

B. Initial Conditions

The plant was in Operational Condition 5, Refueling, during performance of the leakage rate tests.

C. Description of Occurrence

Technical Specification 3.6.1.3 requires that the leakage rate through all four main steam line penetrations be limited to a cumulative leakage rate of less than or equal to 100 scfh (47,200 sccm). Following performance of Local Leak Rate Testing of all eight MSIVs, the leakage rates for six of the valves exceeded both the Technical Specification leakage limit for total MSL leakage and the acceptance limit of 11,800 sccm (25 scfh) for each individual MSIV (minimum pathway leakage). Of this population of six MSIVs, the leakage through four MSIVs could not be quantified due to excessive leakage beyond the capability of the test equipment to pressurize the test volume to the required test pressure. Thus, the leakage is considered to have exceeded the total TS allowed MSL penetration leakage of 100 scfh (47,200 sccm). As-found data for each of the eight MSIVs is provided in Section G "Additional Information", of this report. Section G also provides as Figure 1, an information-only schematic of the valve configurations being discussed in this report. The MSSVs are designated as F098A-D.

Condition Report GGCR 1999-1653 was initiated to document this condition. Additionally, Significant Event Response Team (SERT) Root Cause Analysis Report 99-52 was compiled to assess the cause of these valve failures and recommend corrective actions to prevent recurrence.

D. Root Causes

1. Equipment Specification, Manufacture & Construction – Manufacturer fabrication or construction less than adequate:

   During inspection of valve internals, the vendor's field representative noted rolled metal on the F028D valve seat. The rolled metal was attributed to the main poppet striking the rib guide at the 180-degree position. This was the result of the sharp edge of the main poppet being rolled by repeated striking of the rib. Current proprietary vendor main poppet shop drawings contain a note to chamfer all edges. This applies to the 1B21F028D only.

2. Equipment Specification, Manufacture & Construction - Original design inadequate:

   The valve design allows rotation of the main poppet during operation, causing wear that results in an unstable main poppet.

3. Management Methods, Corrective action – corrective actions for previously identified problems (or previous event cause) were not adequate to prevent recurrence:

   Two distinct issues were identified as part of this root cause:

   a. Failure evaluation was less than adequate: maintenance and deficiency document dispositions accepted "part is broke - normal wear" or "failed in service" as causes without determining why the sub-component failure (sheared spring holder pin) occurred or recurred. Spring holder pin failures occurred without the cause(s) of failures being determined. Other existing GGNS program elements for failure prediction or evaluation (01-S-17-18, Predictive Maintenance Program and 01-S-07-30, Evaluation of Equipment and Component Malfunctions) also failed to prevent this event.

   b. Evaluation of generic implications was less than adequate: Documents examined showed limited examination of generic implications for these failures. The generic implications of spring holder pin failures did not address the pins in other MSIVs.

E. Corrective Actions

1. Immediate Corrective Actions:

1. The six MSIVs that initially failed their LLRT have been refurbished and successfully passed subsequent leak rate testing. Conservatively, the two remaining MSIVs that initially passed their LLRT have also been refurbished.

2. In an effort to determine the causes of the excessive leakage, all eight MSIVs were disassembled to determine their internal conditions for inspection. Based on the inspection results the following corrective actions were taken:

a. Anti-Rotation Pin Modification: Atwood & Morrill's recommended modification was to install a second anti-rotation pin, in addition to the present anti-rotation pin, which joins the pilot poppet upper spring holder to the stem. The new anti-rotation pin has a larger diameter than the present pin and has a tapered shape that makes it easier to insert. In addition, the original pin has been left in the spring holder plate, thereby providing three bearing surfaces to prevent rotation. As an additional precaution, based on an occurrence at another plant, both pins have been welded into the spring holder plate to prevent loss. This modification was applied to all eight MSIVs during RF10.

b. Main poppet Seating chamfered Seat Modification: The main poppet seating surface was chamfered to a 1/32" radius as specified by the manufacturer. This modification was also applied to all eight MSIVs during RF10.

c. Guide rib refurbishment: All of the guide ribs in all eight MSIVs were examined and measured to determine whether or not they met acceptance standards. Deficient guide ribs on F022A and F022B were rebuilt to manufacturer's standards.

d. Guide ring refurbishment: The guide rings on the main poppets of all eight MSIVs were examined. The guide rings appeared unacceptable on the F022A and F022B, and these main poppets were replaced.

e. Pilot poppet refurbishment: The pilot poppets on all eight MSIVs were replaced. Per the vendor's recommendations, the seating surface angles on the replacement pilot poppets were recut so that the pilot seats trailing edge first, which provides a more reliable seating interface.

f. Seating surface refurbishment: All seating surfaces on all eight MSIVs were lapped. This includes all eight replacement pilot poppets following their recutting, as well as the pilot and main seats on the main poppets and the main body seats.

g. Air and Spring Closing Forces Verification: Two sets of installed MSIV main springs, one from an inboard MSIV and one from an outboard MSIV, were tested and found to be within acceptable vendor recommended tolerances. The forces exerted by the air in the piston and by the springs were verified by this testing, together with calculations, and were found to be within vendor recommended tolerances.

All of the above immediate corrective actions have been completed.

2. Long-Term Corrective Actions:

Long-term corrective actions to address root cause number 1 are:

1. Include the requirement for chamfering of MSIV main poppets in inspection/installation procedure (07-S-34-B21-4).

2. Include the requirement for chamfering of MSIV main poppets in the MSIV vendor manual.

Long-term corrective actions to address root cause number 2 are:

1. Establish a Project Management Team consisting of an executive sponsor and, at a minimum, representatives from Maintenance (familiar with MSIVs), Design Engineering, Programs & Components, and an independent technical expert) to review the SERT report and determine required actions for the following issues:

   a. Main poppet rotation & instability
   b. Consistent seating performance of main & pilot poppet
   c. Inspection frequency for valve internals
   d. Suitable diagnostic test methods for determining MSIV internal wear and actuator performance.
   e. Limited margin for alignment deviations
   f. Guide Rib Wear

Long-term corrective actions to address root cause number 3 are:

1. Perform an assessment of the utilization & the effectiveness of Predictive Maintenance Program (01-S-17-18) and equipment trending providing input into the Corrective Action Program.

2. Review the above assessment results with station personnel (e.g. all-hands meeting, stand-down, etc.).

3. Evaluate whether to document all as-found LLRT failures in a nonconformance document.

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F. Safety Assessment

The LOCA dose calculation is the only dose calculation that explicitly considers the MSIV leakage rate. Other events, such as the main steam line break outside containment, credit the MSIV isolation only since the calculated doses are not particularly sensitive to small leakage rates compared to the initial large release. The LOCA dose analysis assumes a single active failure in association with the recirculation line break which is currently assumed to be the failure of an MSIV to close.

Using design basis assumptions, an unquantifiable leakage rate on the B21F028A, B21F022C, B21F028C and the failure of the inboard MSL A MSIV, B21F022A, would constitute an unacceptable leakage path from the reactor vessel (where the source term release is occurring) to the Turbine Building, which is then released unfiltered to the environment since the Turbine Building is not part of Secondary Containment. This would have challenged compliance with 10 CFR Part 100 and GDC-19 limits. Explicit calculations have not been performed, but it is expected that this bypass release path would result in offsite doses greater than the limits in 10CFR100 and control room doses greater than the limits in 10CFR50, Appendix A, Criterion 19.

Realistically, it is not expected that this condition would have resulted in a large release given a postulated radiological accident since the MSLs can be isolated by the Main Steam Shutoff Valves (MSSVs), designated in Figure 1 as F098A-D. The MSSVs were verified to be leaktight by testing and confirmed to have been capable of mitigating the magnitude of any postulated offsite releases. If during a LOCA, adequate core cooling cannot be maintained, then entry into the Severe Accident Procedures (SAPs) would occur. The SAPs direct operators to initiate the MSIV Leakage Control (MSIV-LCS), if required. Procedure 04-1-01-E32-1 states that the outboard MSIV-LCS is the preferred system to initiate, which directs closure of the MSSVs. While these valves do not meet the redundant power supply requirement (i. e., all MSSVs are powered by ESF Div. II), their effectiveness in isolating the steam lines and thus substantially mitigating any postulated steam line releases would be assured for all but the very low probability event of a severe accident coincident with both a loss of offsite power and a Div. II failure.

G. Additional Information

Valve Vendor Data:
Manufacturer: Atwood & Morrill

Main Steam Line Isolation Valve As-Found Leak Rate Testing Results
Units are Standard Cubic Centimeters Per Minute (sccm)

Valve Description		Test Result	As-Found Leakage (sccm)
B21F022A	MSL A Inboard	Failed	208,602
B21F022B	MSL B Inboard	Failed	15,300
B21F022C	MSL C Inboard	Failed	Unquantifiable
B21F022D	MSL D Inboard	Passed	11,300
B21F028A	MSL A Outboard	Failed	Unquantifiable
B21F028B	MSL B Outboard	Passed	200
B21F028C	MSL C Outboard	Failed	Unquantifiable
B21F028D	MSL D Outboard	Failed	Unquantifiable

As discussed in the safety assessment (Section F), the Main Steam Shutoff Valves were also leak rate tested. The as-found leakage rate data is as follows:

B21F098A – 1497 sccm
B21F098B – 251 sccm
B21F098C – 2254 sccm
B21F098D – 2002 sccm

Research of plant records for the past 2 years did not identify any cases where as-found LLRT data indicated that a main steam line penetration failed as a result of both the inboard and outboard MSIV failing its LLRT.

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

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G. (Continued)

Figure 1