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August 6, 2012
L-12-299

10 CFR 50.73

ATTN: Document Control Desk
United States Nuclear Regulatory Commission
Washington, D.C. 20555-0001

SUBJECT:
Davis-Besse Nuclear Power Station
Docket Number 50-346, License Number NPF-3
Licensee Event Report 2012-002

Enclosed is Licensee Event Report (LER) 2012-002, "Leak from Reactor Coolant Pump Seal Piping Socket Weld due to High Cycle Fatigue." This LER is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A).

There are no regulatory commitments contained in this letter or its enclosure. The actions described represent intended or planned actions and are described for information only. If there are any questions or if additional information is required, please contact Mr. Patrick J. McCloskey, Manager, Site Regulatory Compliance, at (419) 321-7274.

Sincerely,

Barry S. Allen

GMW

Enclosure: LER 2012-002

cc: NRC Region III Administrator
NRC Resident Inspector
NRR Project Manager
Utility Radiological Safety Board

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO 3150-0104 EXPIRES 10/31/2013

Estimated burden per response to comply with this mandatory collection request: 80 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects.resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

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

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4. TITLE

Leak from Reactor Coolant Pump Seal Piping Socket Weld due to High Cycle Fatigue

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	06	2012	2012	- 002	- 00	08	06	2012		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

3

10. POWER LEVEL

000

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☒ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
Gerald M. Wolf, Supervisor, Nuclear Compliance	(419) 321-8001

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	AB	PSF	X999	N					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete EXPECTED SUBMISSION DATE). ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On June 6, 2012, with the Davis-Besse Nuclear Power Station in Mode 3 and the Reactor Coolant System at normal operating temperature and pressure, a scheduled walkdown identified a leak from Reactor Coolant Pump (RCP) 1-2 first stage seal vent cavity line. The 0.1 gallon per minute leak was from a socket weld of the small bore ASME Section III Class 2 piping between the RCP seal and the first isolation valve. The station cooled down to Mode 5 and repaired the leaking socket weld.

The most probable cause of this leak was determined to be high cycle fatigue of the seal cavity vent line at the elbow socket weld in combination with a discontinuity in the socket weld root. The high cycle fatigue was due to a less than adequate design modification to minimize vibration of the line. Planned corrective actions include replacement of this and similar seal piping for all four RCPs with flexible hoses, and review of other socket welded piping for similar potential failure modes.

This event is being reported pursuant to 10 CFR 50.73(a)(2)(ii)(A) as degradation of a principal safety barrier based on existing NRC precedence.

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NARRATIVE

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

System Description:

The Davis-Besse Nuclear Power Station (DBNPS) Reactor Coolant System (RCS) [AB] uses four Reactor Coolant Pumps (RCPs) [AB-P] to circulate the reactor coolant. Each RCP is a single-stage centrifugal pump designed to produce a flow of approximately 90,000 gallons per minute (gpm) and driven at 1200 revolutions per minute by a 13,200 volt motor [AB-MO]. The RCPs are shaft-sealed with a seal cartridge assembly [AB-SEAL] that consists of three mechanical face-type sealing stages. The design flow rate for each seal staging flow coil is 1.5 gpm at a differential pressure of 750 pounds per square inch (psi). Approximately 8 to 10 gpm of seal injection water from the Makeup and Purification System [CB] is injected below the first stage mechanical seal for lubricating and cooling the seals. Most of the injection water passes into the pump case through the close-running, spiral grooved shaft and cover restriction bushing into the RCS, and the remainder (1.5 gpm) flows upward through the three mechanical seals. Flow from the three pressure break-down devices leaves the RCP through the seal return connection to return to the Makeup and Purification System. Leakage across the third seal face passes up the shaft and into a standpipe that drains to the containment normal sump.

Technical Specification(s):

Technical Specification (TS) Limiting Condition for Operation (LCO) 3.4.13 requires RCS operation leakage be limited to no Pressure Boundary leakage, 1 gpm unidentified leakage, 10 gpm identified leakage, and 150 gallons per day primary to secondary leakage through any one steam generator while the plant is in Modes 1 through 4. With operational leakage not within these limits for reasons other than pressure boundary leakage or primary to secondary leakage, TS LCO 3.4.13 Condition A requires the leakage to be reduced to within limits within 4 hours. If Condition A cannot be met within the required completion time, or if Pressure Boundary leakage exists, or primary to secondary leakage is not within limits, Condition B requires the plant be placed in Mode 3 in 6 hours and in Mode 5 in 36 hours.

DESCRIPTION OF EVENT:

On May 6, 2012, the DBNPS shutdown for scheduled refueling and maintenance activities. On June 6, 2012, with the station in Mode 3 and at normal operating temperature and pressure (RCS pressure approximately 2150 psi and temperature approximately 530 degrees Fahrenheit), a walkdown was performed as part of scheduled activities to return the station to normal operation. During this walkdown, at approximately 2000 hours personnel noted an active leak from a weld on the first stage seal vent cavity line for RCP 1-2. The seal cavity vent lines for the first, second, and third stage seals are opened during RCS fill evolutions to vent non-condensable gases to the containment vent header. The leak was estimated to be 0.1 gpm, and was located in the upstream weld of the small bore American Society of Mechanical Engineers (ASME) Section III Class 2 pipe socket (3/4 inch pipe, Schedule 160, 0.219 inch wall thickness) at the 90 degree elbow between the RCP and the first isolation valve [AB-PSF]. Because of this leakage, the station entered TS LCO 3.4.13 Condition B, and cooled down to Mode 5 (RCS temperature less than 200 degrees F) on June 7, 2012 at 1300 hours to comply with LCO 3.4.13 Required Action B.2.

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CAUSE OF EVENT:

The most probable cause of the seal cavity vent line to elbow socket weld failure was high cycle fatigue. This high cycle fatigue was believed to be due to a less than adequate design modification to minimize vibration in combination with a discontinuity in the socket weld root. Metallurgical testing and examination is required to confirm or disprove this cause of the weld failure. However, repair of the weld involved grinding out the weld indication and performing a weld repair of the removed material. As such, metallurgical testing and evaluation of the failed weld was not possible to confirm this failure mode. Industry operating experience indicates the majority of socket weld failures occur due to high cycle fatigue, and piping vibrations were measured during RCP operation to support this most probable cause.

The existing seal line vent configuration for RCP 1-2 has existed since 1990, when the piping was lengthened by approximately five inches to accept a new style of RCP seal. The piping modification performed at that time did not appear to consider the impact of changing the vent line piping to accommodate the new seals would have on the socket-welded pipe. Small changes to small bore piping can affect the piping resonance frequency, resulting in higher amplitude vibrations, potentially resulting in a high-cycle fatigue failure.

ANALYSIS OF EVENT:

Because the piping is classified as ASME Section III Class 2 piping, in the event of a postulated failure, per design the reactor can be shut down and cooled down in an orderly manner assuming seal injection is maintained by the Makeup System. The estimated leak rate (0.1 gpm) at the time of discovery in Mode 3 was well within the capability of the Makeup System's capability. Therefore this event was of very low safety significance.

Reportability Discussion:

Initial evaluation of this condition determined that this leak was reportable per 10 CFR 50.72(b)(3)(ii)(A) as degradation of a principal safety barrier; namely, the RCS, due to the material degradation (weld leak). The NRC was verbally notified of this event per 10 CFR 50.72(b)(3)(ii)(A) at 0239 hours on June 7, 2012, via Event Number 48000. Evaluation of this issue was performed to determine if this unisolable leak from the ASME Section III Class 2 seal injection piping constituted RCS pressure boundary leakage; however, based on existing NRC precedence, this issue is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A) as degradation of a principal safety barrier. No safety functions were lost as a result of this issue, and all TS required actions were met.

CORRECTIVE ACTIONS:

Extent of condition walkdowns were performed on similar piping (first, second, and third stage seal cavity vent lines, seal injection, and seal return piping) for all four RCPs with the station at normal operating pressure and temperature. No other weld leaks were identified.

On June 11, 2012, the weld defect was removed and the weld reworked to original weld design. A freeze seal was used to isolate the socket welded elbow for repair.

LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET

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CORRECTIVE ACTIONS: (continued)

A modification is being developed to replace the existing piping for the RCP first, second, and third stage seal cavity vent lines along with the seal injection and controlled bleed off lines with flexible hoses to minimize high cycle vibration fatigue.

Changes will be made to design process documents to account for potential vibration fatigue failures in susceptible socket welded piping, and a review of existing risk significant socket welded piping susceptible to these vibration fatigue failures will be performed utilizing the criteria from these revised documents. Any susceptible socket welded piping identified will be addressed via the Corrective Action Program.

PREVIOUS SIMILAR EVENTS:

There have been no Licensee Event Reports submitted for the DBNPS in the past three years related to a socket weld leak on plant system piping.