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August 27, 2013

L-13-262

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 2013-002

Enclosed is Licensee Event Report (LER) 2013-002, "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,

Raymond A. Lieb

GMW

Enclosure: LER 2013-002

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

IE22
NRR

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
07	01	2013	2013	- 002 -	00	08	27	2013		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 July 1, 2013, with the Davis-Besse Nuclear Power Station in Mode 3 and the Reactor Coolant System at normal operating temperature and pressure, a leak from Reactor Coolant Pump (RCP) 1-2 first stage seal vent cavity line was identified. The 8 to 9 drops per minute leak was from a flange 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 replaced the spool piece containing the weld.

Laboratory failure analysis concluded the cause of this leak to be high cycle fatigue of the seal cavity vent line socket weld. The high cycle fatigue was due to a less than adequate design modification to minimize vibration of the line. Planned corrective actions, based upon a weld leak identified in 2012 on the same line, include either replacement of this and similar seal piping for all four RCPs with flexible hoses or increasing the socket weld size during the next refueling outage, and performing walkdowns of risk significant socket welded piping susceptible to vibration fatigue failures.

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

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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 approximately 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 June 29, 2013, the DBNPS experienced an unplanned reactor trip from approximately 100 percent power due to a trip of RCP Motor 1-2 on actuation of a differential trip relay. Further details of the trip may be found in DBNPS Licensee Event Report 2013-001. Upon entering the containment building to investigate the trip of RCP Motor 1-2, it was identified that the RCP had boric acid deposits covering much of its seal area surfaces, components, and pipes. Upon further investigation and cleaning of the boric acid deposits, it was identified on July 1, 2013, that the leakage was originating from a flange socket weld on the small bore American Society of Mechanical Engineers (ASME) Section III Class 2 piping (3/4 inch pipe, Schedule 160, 0.219 inch wall thickness) for the RCP 1-2 first stage seal cavity vent. With the station in Mode 3 and at normal operating temperature and pressure (RCS pressure approximately 2150 psi and temperature approximately 530 degrees Fahrenheit), the observed leak rate was approximately 8 to 9 drops per minute. The leakage was upstream of the first isolation valve [AB-PSF] in the RCP vent piping and could not be isolated from the RCS. Therefore, the station entered TS LCO 3.4.13 Condition B, and cooled down to Mode 5 (RCS temperature less than 200 degrees F) on July 2, 2013, at 1446 hours to comply with LCO 3.4.13 Required Action B.2.

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DESCRIPTION OF EVENT: (continued)

The RCP 1-2 first stage seal vent line from the leaking flange at the pump seal to the next flanged connection was removed and replaced. The new spool piece welded connections were made with socket welds meeting the industry recommended 2x1 weld leg configuration (weld leg along the pipe side of the weld is equal to twice the Code-required weld leg dimension), which reduces the effects of high cycle vibration fatigue. All weldments and fittings associated with the removed spool piece were sent to a laboratory for failure analysis. This removed spool piece also included the elbow socket weld that was repaired as a result of leakage discovered on June 6, 2012 as documented in DBNPS LER 2012-002.

CAUSE OF EVENT:

The laboratory failure analysis concluded that the cause of the RCP 1-2 seal cavity vent line flange socket weld failure was high cycle fatigue. This high cycle fatigue was due to a less than adequate consideration of piping vibration during a previous modification. 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 RCP first stage seal cavity vent 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 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:

Based on existing precedence, this leak was determined to be 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 1527 hours on July 1, 2013, via Event Number 49163. 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:

The RCP 1-2 first stage seal vent line from the leaking flange at the pump seal to the next flanged connection was removed and replaced with socket welds meeting the industry recommended 2x1 weld leg configuration.

Extent of condition walkdowns were performed on similar small bore piping (first, second, and third stage seal cavity vent lines, seal injection, and seal return piping) for all four RCPs. No other weld leaks were identified.

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NARRATIVE

CORRECTIVE ACTIONS: (continued)

Vibration readings were taken with all four RCPs in operation to verify the seal injection lines, the seal return lines, and the three seal cavity vent lines for each RCP (besides the RCP 1-2 first stage seal vent line) were below the ASME Code screening vibration criteria.

As a result of the RCP 1-2 first stage seal vent line leakage discovered on June 6, 2012 as documented in DBNPS LER 2012-002, an engineering change is planned to replace the existing piping for the RCP first, second, and third stage seal cavity vent lines with flexible hoses to minimize high cycle vibration fatigue. Additionally, the socket weld size for portions of the seal injection and seal return lines will be increased to the industry recommended 2x1 weld leg configuration. Based upon this most recent failure, the engineering change will be revised to include replacing the entire line associated with RCP 1-2 first stage seal cavity vent line back to the first isolation valve. This increase in scope will ensure the remaining socket welds in this previously susceptible line are replaced with new material and socket welded connections to meet the industry recommended 2x1 weld leg configuration. This engineering change is planned to be implemented during the next refueling outage scheduled for 2014.

Based upon the 2012 event, changes were made to design process documents to account for potential vibration fatigue failures in susceptible socket welded piping. Plant walkdowns will be performed to identify risk significant socket welded piping susceptible to vibration fatigue failures.

PREVIOUS SIMILAR EVENTS:

DBNPS LER 2012-002 documents the discovery of a leaking elbow socket weld in the same RCP 1-2 first stage seal vent line as this leaking flange socket weld. The corrective action for the 2012 event of an engineering change to install flexible hoses for the RCP seal cavity vent lines and to increase the socket weld size on portions of the seal injection and controlled bleed off lines was planned to be implemented during the next refueling outage, which is scheduled for Spring 2014.