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May 31, 2016

L-16-145

10 CFR 50.73

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

Subject:
Davis-Besse Nuclear Power Station, Unit 1
Docket Number 50-346, License Number NPF-3
Licensee Event Report 2016-003

Enclosed is Licensee Event Report (LER) 2016-003, "Leak from Reactor Coolant Pump Seal Piping Flexible Hose due to Undetected Manufacture Weld Defect." This LER is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) and 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,

Brian D. Boles

JCS

Enclosure: LER 2016-003

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

IE22
NRR

NRC FORM 366 (11-2015) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (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 Page 2 for required number of digits/characters for each block)

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Davis-Besse Nuclear Power Station, Unit 1	05000346	1 OF 4

4. TITLE

Leak from Reactor Coolant Pump Seal Piping Flexible Hose due to Undetected Manufacture Weld Defect

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
										05000
03	30	2016	2016	003	00	05	31	2016	FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
6	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☒ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
000	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
Joseph C. Sturdavant, Staff Engineering Specialist, Nuclear Compliance	(419) 321-8199

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	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO				

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

On March 30, 2016, with the Davis-Besse Nuclear Power Station shutdown for a scheduled refueling outage in Mode 6 with the Reactor Coolant System depressurized, approximately one half teaspoon of dry boric acid was identified on the Reactor Coolant Pump (RCP) 1-1 first stage seal cavity vent line flexible braided piping connection, which was determined to be reactor coolant pressure boundary leakage. This leak was from the welded end connection of the small bore ASME Section III Class 2 flexible braided piping assembly between the RCP seal and the first isolation valve.

The most probable cause of this leak was a weld solidification through-wall crack at the flange to hose / bellows tube pressure boundary weld that occurred during manufacture. The post manufacture testing was not adequate to detect this extremely small pressure boundary defect. Corrective actions include inspecting the other RCP seal vent line flexible hoses, replacement of RCP 1-1 seal vent line flexible piping assembly with one that passed a more stringent leak test, and revising procurement requirements to incorporate this more stringent leak test.

This event is being reported pursuant to 10 CFR 50.73(a)(2)(ii)(A) as degradation of a principal safety barrier and 10 CFR 50.73(a)(2)(i)(B) as operation or condition prohibited by Technical Specifications.

NRC FORM 366A (11-2015) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

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LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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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 March 26, 2016, the DBNPS shutdown for scheduled refueling and maintenance activities. On March 30, 2016, with the station in Mode 6 and the RCS depressurized, a scheduled engineering inspection identified leakage from the RCP 1-1 seal injection flexible hose assembly and the leakage was determined to be an unisolable leak from the reactor coolant pressure boundary. This leakage was characterized as one half teaspoon of dry boric acid crystals, no active leak was identified and there was no indication of boric acid on the rest of the RCP seal package. 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 located on the RCP 1-1 first stage seal cavity vent line flexible hose assembly (at the flange to hose / bellows attachment), which is classified as small bore American Society of Mechanical Engineers (ASME) Section III Class 2 piping (3/4 inch pipe) between the RCP and the first isolation valve [AB-PSF] in the RCP vent piping.

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DESCRIPTION OF EVENT: (continued)

The flexible hose assemblies, manufactured by Senior Flexonics Pathway, had been installed (12 assemblies, 3 per RCP) in April 2014 during the 18th Refueling Outage as corrective action for DBNPS LER 2013-002, "Leak from Reactor Coolant Pump Seal Piping Socket Weld due to High Cycle Fatigue," therefore, the hoses had been pressurized for a twenty-four month operating cycle.

CAUSE OF EVENT:

A laboratory failure examination was unable to confirm the pressure boundary leak path, but a partial depth weld solidification crack was observed in the Alloy 625 pressure boundary material at the hose / bellows tube to socket end. A similar through-wall weld solidification crack at the flange to hose / bellows tube pressure boundary weld was likely the source for the boric acid leakage for the RCP 1-1 first stage seal cavity vent line. Therefore, the direct cause of the RCP 1-1 first stage seal cavity vent line pressure boundary leakage was likely a weld solidification crack during manufacture. Each of the other identified failure modes from operation, installation, manufacture, and design were refuted.

The DBNPS had three (3) uninstalled spare flexible hose assemblies also supplied in the same batch as the leaking hose for the RCP 1-1 first stage seal cavity vent line. These spare hose assemblies were subsequently bubble tested (30 psig air pressure for 10 minutes) and helium tracer probe leak tested. All three (3) uninstalled spare flexible hose assemblies passed the bubble test, but one (1) failed the helium tracer probe leak test acceptance criteria. Helium tracer probe leak testing of the uninstalled spare hose assemblies permits increased sensitivity for detection of extremely small leaks. Helium tracer probe leak testing was proven an effective barrier that could have mitigated or prevented shipment of the flexible hose assembly with pressure boundary leakage. Therefore, the root cause of the pressure boundary leak path (weld solidification crack) not being detected during manufacture was less than adequate quality control inspection after manufacture of the flexible hose assemblies such that an extremely small pressure boundary defect was not detected by liquid penetrant and hydrostatic testing at 1.5 times design pressure (3750 psig) for 10 minutes.

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 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 at 0014 hours on March 31, 2016, via Event Number 51837. This issue is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A) as degradation of a principal safety barrier. Additionally, as this is RCS Pressure Boundary leakage and it potentially could have existed with the plant in operation, contrary to TS LCO 3.4.13, which does not allow any Pressure Boundary leakage, this issue is also being reported pursuant to 10 CFR 50.73(a)(2)(i)(B) as operation or condition prohibited by Technical Specifications. No safety functions were lost as a result of this issue and all TS required actions

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Reportability Discussion: (continued)

were met at the time of discovery. The flexible hose assembly manufacturer determined no 10 CFR 21 reportable condition existed since there was no failure in the design, materials, inspection, or testing per code requirements, and no evidence of a systemic (repeatable) issue.

CORRECTIVE ACTIONS:

Extent of condition walkdowns / engineering inspections were performed on the other eleven (11) installed RCP seal cavity vent line flexible hose assemblies, and no other leaks were identified. There were no other flexible hose assemblies identified in the nuclear piping system specification.

The RCP 1-1 first stage seal cavity vent line flexible hose assembly was replaced with one (1) of the spare hose assemblies that passed the helium tracer probe test to resolve the reactor coolant pressure boundary leakage and the operational mode restraint was closed on April 22, 2016.

The procurement requirements for the RCP seal cavity vent line flexible hose assemblies will be revised to add a new required helium tracer probe leak test with acceptance criteria of at least 1 E-5 Standard cubic centimeters/second, or other equivalent helium leak test method. Also, the procurement requirements will be revised to reference to this event's Condition Report so that this preventive action will be retained. Additionally, the flexible hose assemblies had the material status changed to Hold pending the change to the procurement requirements to add that the helium tracer probe leak test be completed.

PREVIOUS SIMILAR EVENTS:

Licensee Event Report (LER) 2012-002 and LER 2013-002 reported the discovery of a leaking elbow socket weld in the RCP 1-2 first stage seal vent line resulting from high cycle fatigue. In response to LER 2013-002, the DBNPS RCPs first, second, and third stage seal cavity vent lines were replaced with flexible hoses in April 2014 during the 18th Refueling Outage. There have been no similar LERs at the DBNPS involving flexible hose defects in the past three years.