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February 28, 2008

L-08-043

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 2008-001, Pressure Boundary Leak Found During Decay Heat Removal Drop Line Weld Overlay

Enclosed is Licensee Event Report (LER) 2008-001. This LER is being submitted to provide written notification of the discovery of water seeping from a weld on the Decay Heat Removal System during the Fifteenth Refueling Outage while in Mode 6. The water seeping was identified during the installation of a pre-emptive full structural weld overlay on the 12-inch Reactor Coolant System hot leg to Decay Heat Removal System nozzle at the location of the dissimilar metal butt weld region. The leak was determined to be from an axial flaw. The leak was repaired. This event is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A) as a condition that resulted in the condition of the nuclear power plant, including its principal safety barriers, being seriously degraded. Immediate notification of this event was made to the Nuclear Regulatory Commission on January 4, 2008 (Event Number 43880) per 10 CFR 50.72(b)(3)(ii)(A).

There are no regulatory commitments contained in this letter or its enclosure. If there are any questions or if additional information is required, please contact Raymond A. Hruby, Jr., Manager – Site Regulatory Compliance, at 419-321-8000.

Sincerely,

Mark B. Bezilla

TSC

Enclosure: LER 2008-001 (NP-33-08-001-00)

IE22
NRR

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

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 8/31/2010

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 Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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

Pressure Boundary Leak Found During Decay Heat Removal Drop Line Weld Overlay

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
01	04	2008	2008	- 001 -	00	02	28	2008		05000
									FACILITY NAME	DOCKET NUMBER
										05000

9. OPERATING MODE

6

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)*
Tej S. Chowdhary, Staff Nuclear Engineer, Regulatory Compliance	(419) 321-7831

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

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 January 4, 2008, during the Fifteenth Refueling Outage with the plant in Mode 6, while installing a pre-emptive full structural weld overlay of alloy 52M weld material for mitigation of an alloy 600/182/82 weld on the 12-inch decay heat drop line branch connection from the Reactor Coolant System hot leg, the weld machine operator identified reactor coolant water seeping from a small hole. The weld overlay was stopped, and both loops of the decay heat removal system were declared inoperable. Ultrasonic examination and excavation of a repair cavity confirmed a single axial flaw approximately 1.75 inches long in the nozzle-to-elbow dissimilar metal butt weld. The probable cause was attributed to Primary Water Stress Corrosion Cracking (PWSCC). The corrective action consisted of completing the structural weld overlay after a repair to seal the axial flaw.

The overall safety significance of this event is low. Although the welds may be susceptible to PWSCC that can result in small leaks, industry experience with PWSCC shows that complete failure of the weld joints is considered to be very unlikely.

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NARRATIVE

DESCRIPTION OF OCCURRENCE:

System Description:

At the Davis-Besse Nuclear Power Station (DBNPS), the primary function of the 12-inch Hot Leg Decay Heat Removal Nozzle [AB-NZL] and attached piping is to maintain a Nuclear Safety Related Seismic ASME Class 1 Reactor Coolant System (RCS) Pressure Boundary. This piping provides a flowpath from the RCS to the Decay Heat Removal System, which is used to cool the reactor core during plant shutdowns.

DBNPS Technical Specification (TS) Limiting Condition for Operation (LCO) 3.9.8.1 requires at least one Decay Heat Removal Loop in operation when in Mode 6 and the water level above the top of the irradiated fuel assemblies within the reactor vessel is greater than or equal to 23 feet.

TS LCO 3.9.8.2 requires two independent Decay Heat Removal Loops be Operable when in Mode 6 and the water level above the top of the irradiated fuel in the reactor vessel is less than 23 feet. With less than the required Decay Heat Loops Operable, TS LCO 3.9.8.2 Action a requires the immediate initiation of corrective actions to return the required loops to Operable status as soon as possible.

Also, TS LCO 3.4.10.1 requires the structural integrity of ASME Code Class 1, 2 and 3 components to be maintained in all Modes. With the structural integrity of any ASME Code Class 1 component not conforming to the TS-listed requirements, TS LCO 3.4.10.1 Action a requires restoration of the affected component's structural integrity prior to increasing the Reactor Coolant System more than 50 degrees above the minimum temperature required by nil ductility temperature considerations (120 degrees Fahrenheit).

Event Description:

The FirstEnergy Nuclear Operating Company (FENOC) committed to the NRC in letter Serial Number 3304, dated January 25, 2007, to remove the DBNPS from service in December 2007 to support necessary inspection or mitigation activities for specific dissimilar metal welds, in order to satisfy Electric Power Research Institute (EPRI) MRP-139 inspection criteria. The Fifteenth Refueling Outage commenced on December 30, 2007.

The scope of the Alloy 600 Weld Overlay project for the Fifteenth Refueling Outage consisted of applying pre-emptive weld overlay material (alloy 52M) to areas of the RCS that are susceptible to cracking. Seven weld overlays were applied, grouped as follows: four nozzles at the top of the pressurizer [AB-T], two nozzles for the pressurizer surge line, and one nozzle for the Decay Heat Removal Drop Line. The Decay Heat Removal Drop Line nozzle provides the connection of the Decay Heat Removal System to the RCS hot leg. In order to minimize dose, application of an automated Gas Tungsten Arc Welding (GTAW) process was chosen for the weld overlays.

The 12-inch RCS hot leg to Decay Heat Removal System nozzle was shop fabricated of A105 Grade II carbon steel with Alloy 182 buttering on the weld end and internally clad with a minimum 1/8 inch SA-371 ER 308L stainless steel filler metal. The nozzle is butt welded with Alloy 182/82 filler metal to a 12-inch schedule 140 long radius 90 degree elbow made of SA-403 grade WP-316 stainless steel.

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DESCRIPTION OF OCCURRENCE: (continued)

On January 2, 2008, during the Fifteenth Refueling Outage a dye penetrant examination of the Decay Heat Removal Drop Line nozzle connection from the Reactor Coolant System hot leg was completed resulting in no observed indications. With the RCS partially drained until the water level was about two feet above the RCS hot leg centerline, the first bead on the structural weld overlay for the Decay Heat Removal Drop Line nozzle was started by welding personnel on January 3, 2008. With the plant in Mode 6, on January 4, 2008, at 0250 hours, the weld operator identified water seeping from a small hole in the initial pass of the weld overlay bead. The leak was located in the 19th weld bead of the first layer of the structural weld overlay located directly over the existing butt weld. The weld overlay was stopped and both loops of the Decay Heat Removal System were declared Inoperable, due to a through-wall defect that impaired the structural integrity of the piping. A Problem Solving Plan and an Operational Decision Making Issue (ODMI) were developed for continued operation of the Decay Heat Removal System with the leak based upon an engineering evaluation providing reasonable assurance of the structural integrity for existing conditions.

Based upon an ODMI recommendation, the refueling canal was filled and the core was offloaded as originally scheduled. The leakage was measured as less than one drop per minute with at least 23 feet of borated water covering the top of the irradiated fuel assemblies seated within the reactor pressure vessel. Once the core was offloaded, work proceeded on repair of the weld. The first layer of the overlay was ground smooth to allow ultrasonic examination using the phased array technique. A recently developed manual phased array ultrasonic examination procedure was qualified such that it addressed the configuration of the hot leg to Decay Heat Removal Drop Line nozzle and dissimilar metal butt weld region in order to characterize the flaw. This qualification included detection and depth sizing of flaws in dissimilar metal butt welds and was demonstrated on samples containing implanted cracks. Utilizing an EPRI Performance Demonstration Initiative (PDI) mock-up, a detailed examination plan was developed to minimize the scan restrictions existing on the dissimilar metal weld region. The technique used a 32 x 32 element phased array search capable of generating angles from 0 to 84 degrees in one degree increments for circumferential flaws, and 0 to 69 degrees for axial flaws (limited by physical restraints of the wedge). The search output is raster scanned to the extent that the configuration of the dissimilar metal weld geometry allows. The phased array examination determined that the flaw was an axial flaw approximately 1.75 inches long, wholly contained in the dissimilar metal butt weld and had a profile consistent with other stress corrosion cracking axial flaws in alloy 82/182 weld material that have been confirmed in other plants. No other flaws were noted during this initial ultrasonic examination of the decay heat nozzle weld. Refer to Figure 1 for a diagram of the weld and flaw.

At the completion of the ultrasonic examination, a cavity two inches wide, 2.5 inches long and approximately 0.375 inches deep was ground into the weld and adjacent base material in order to prepare the area for evaluation and repair. The UT Examination of the area and the excavated cavity confirmed that the flaw was axially oriented and allowed the configuration of the dissimilar metal butt weld region to be more accurately depicted.

The leak was repaired satisfactorily prior to the plant's return to power on February 1, 2008, under the scope of NRC approved Relief Request RR-A30, Revision 2, dated December 20, 2007 (TAC No. MD4452).

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APPARENT CAUSE OF OCCURRENCE:

The axial flaw was located in the alloy 82/182 portion of the dissimilar metal weld. The thickness of the alloy 82/182 portion of the dissimilar metal weld is approximately 1.25 inches. The Decay Heat Removal Drop Line had been in service for 19.25 effective full power years (EFPY) at a temperature of 606.4 degrees Fahrenheit.

The probable cause of the axial flaw in the hot leg to decay heat removal nozzle dissimilar metal butt weld was determined to be the result of PWSCC that resulted in the axial flaw progressing through-wall, and resulted with water seeping during the application of the structural weld overlay. The stress corrosion failure mode is supported by ultrasonic examination results which confirm a similar profile and characteristics to stress corrosion cracking at other plants established by metallurgical examination.

ANALYSIS OF OCCURRENCE:

At the time of discovery, the DBNPS was shut down for its Fifteenth Refueling Outage and was in Mode 6 (Refueling). The overall safety significance of this event was very low. Although welds may be susceptible to PWSCC that can result in small leaks, industry experience with PWSCC shows that complete failure of the weld joints is considered to be very unlikely.

Both trains of the Decay Heat Removal System were declared Inoperable due to this leak on the dissimilar metal butt weld, but both trains of the Decay Heat Removal System remained functional with one train in service providing core cooling and the second train aligned in standby for decay heat removal.

The EPRI safety assessment of alloy 82/182 pipe butt welds for Babcock & Wilcox design plants (MRP-112) concluded that axial PWSCC flaws that propagate through-wall will produce leakage that can be detected in service before exceeding available structural margins. For the case of axial-through-wall flaws, the calculated critical flaw length is much greater than the maximum length of any axial flaw, which is limited to the width of the weld metal. Therefore, there is no safety concern relative to rupture from an axial flaw and the plant's leakage detection system will be capable of identifying a through-wall axial flaw.

These axial cracks would be detected prior to reaching critical flaw size either by non-destructive examination prior to leakage occurring, or by visual inspections or leak detection after leakage has started. Therefore, it is concluded the overall safety significance of the axial flaw discovered at the DBNPS was very low because no failures occurred, and the structural integrity of the RCS pressure boundary was not significantly compromised.

An extent of condition evaluation was also performed. All Alloy 600 dissimilar metal butt welds subjected to Hot Leg or greater temperatures received a pre-emptive full structural weld overlay in 15RFO as recommended by EPRI MRP-139. The other dissimilar metal butt welds in the RCS (the 14-inch core flood nozzles (2), the 28-inch reactor coolant pump inlet (4) and discharge nozzles (4), the high pressure injection line nozzles (4), and the cold leg drain lines (4)) are less susceptible to stress corrosion cracking due to their lower operating temperature in the cold legs. These welds are subjected to the inspection/mitigation requirements of EPRI MRP-139. One cold leg drain line nozzle was mitigated by weld overlay in 14RFO. The remaining reactor coolant pressure boundary alloy 600/82/182 dissimilar metal welds were either shop fabricated in vessels / piping assemblies or involve j-groove welds. These welds received a base metal visual examination at the frequencies recommended by EPRI MRP-139 for butt welds subject to similar operating temperatures.

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ANALYSIS OF OCCURRENCE: (continued)

The core flood tanks operate at ambient temperatures and are not considered prone to PWSCC. Therefore, the condition is not likely present in other identical or similar equipment.

This report is being made in accordance with 10 CFR 50.73(a)(2)(ii)(A) which requires reporting of any event or condition that resulted in the plant, including its principal safety barriers, being seriously degraded. A non-emergency eight hour degraded condition notification per 10 CFR 50.72 (b)(3)(ii)(A) was submitted to the NRC as Event Number 43880 on January 4, 2008.

CORRECTIVE ACTIONS:

Corrective actions taken to repair the leak included excavation of a cavity, peening the area of the flaw, seal welding, completion of the planned full structural weld overlay, and an acceptable ultrasonic examination. The implementation of the structural weld overlay provided a new RCS pressure boundary, an acceptable method of preventing future PWSCC, and an acceptable contour for ultrasonic examination.

DBNPS has ongoing Alloy 600/690 Material Management Program in order to satisfy the EPRI MRP-139 inspection criteria. Additionally, as part of an Alloy 600 Mitigation Plan structural weld overlays of the pressurizer relief and spray nozzles, pressurizer surge nozzle, and surge line to hot leg nozzle were completed during the Fifteenth Refueling Outage (2008). The remaining alloy 600 butt welds will be inspected or mitigated in accordance with EPRI MRP-139 and Nuclear Energy Institute NEI 03-08, Guideline for the Management of Materials Issues.

FAILURE DATA:

PWSCC of Alloy 600 material has been a recurring problem in PWR plants primary system pressure boundaries since the mid 1980's as noted in MRP-139. As a result pre-emptive structural weld overlays of susceptible piping were initiated in accordance with MRP-139 recommendations. This condition was discovered as a result of this pre-emptive action.

Past occurrences at the DBNPS include an axial indication on a dissimilar metal butt weld on the reactor coolant pump 1-1 cold leg drain line (DBNPS LER Number 2006-002) and extensive pressure boundary leakage from J-groove welds on alloy 600 control rod drive mechanism nozzles. Industry operating experience has demonstrated a generic or broader issue that alloy 600/82/182 materials exposed to primary coolant water (or steam) at the normal operating conditions of nuclear plants have been susceptible to stress corrosion cracking. LER 2006-002 stated that the length of the indication could not be determined and there was no evidence of through-wall leakage during bare metal examination of the piping which differentiates it from this event. The overall safety significance of this cold leg drain line nozzle-to-elbow dissimilar metal axial flaw indication discovered in 2006 was considered minimal because no failures or leakage occurred.

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

NP-33-08-001-00 CR 08-32521

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Figure 1: 12 Inch Decay Heat Drop Line Branch Connection Weld