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Docket Number 50-346

NP-33-06-002-00
10 CFR 50.73

License Number NPF-3

May 22, 2006

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

Ladies and Gentlemen:

Licensee Event Report 2006-002-00
Ultrasonic Examination Identifies Axial Flaw Indication in
Reactor Coolant Pump Drain Line Weld
Davis-Besse Nuclear Power Station, Unit No. 1
Date of Occurrence – March 18, 2006

Enclosed is Licensee Event Report (LER) 2006-002-00, which is being submitted to provide written notification of the discovery of an axial flaw indication on the Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow dissimilar metal butt weld. The ultrasonic examination that discovered this indication was performed in response to operating experience of leakage identified at other similar plants. No through-wall leakage was detected. Because the indication could not be found acceptable under American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME) Code Section XI, a full structural weld overlay was performed to repair the piping. This event is being reported in accordance with 10 CFR 50.73(a)(2)(ii)(A). Immediate notification of this event was made to the Nuclear Regulatory Commission on March 21, 2006 (Event Number 42437) per 10CFR50.72(b)(3)(ii)(A). There are no commitments associated with this LER.

Very truly yours,

GMW

Attachment
Enclosure

cc: Regional Administrator, USNRC Region III
DB-1 Project Manager, USNRC
DB-1 NRC Senior Resident Inspector
Utility Radiological Safety Board

IE22
A047

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COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station in this document. Any other actions discussed in the submittal represent intended or planned actions by Davis-Besse. They are described only as information and are not regulatory commitments. Please notify the Manager – Regulatory Compliance (419-321-8585) at Davis-Besse of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
None	N/A

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 6/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 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

Ultrasonic Examination Identifies Axial Flaw Indication in Reactor Coolant Pump Drain Line Weld

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
03	18	2006	2006	- 002	- 00	05	22	2006		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 Specify in Abstract below
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Gerald M. Wolf, Staff Engineer, Regulatory 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

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 March 18, 2006, with the plant shut down for refueling, ultrasonic examination of the Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow dissimilar metal weld detected an axial flaw indication. This ultrasonic inspection was performed in response to operating experience of leakage identified at other similar plants. Due to the configuration of the weld joint and lack of qualified depth sizing procedures for dissimilar metal welds, the length of the indication could not be accurately determined, but was estimated to be at least 0.25 inches in length. No evidence of through-wall leakage was observed during bare metal examination of the piping. This indication, caused by an inadequate welding process during initial plant construction, could not be found acceptable under American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME) Code Section XI, so a repair consisting of a full structural weld overlay was performed. ASME Code relief was requested from the Nuclear Regulatory Commission for this repair method, which was verbally granted prior to plant restart.

The overall safety significance of this axial flaw indication was minimal because no failures or leakage occurred, and the structural integrity of the Reactor Coolant System pressure boundary was not compromised. No unacceptable indications were found on other similar nozzles inspected as part of the extent of condition review.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

DESCRIPTION OF OCCURRENCE:

On March 18, 2006, with the Davis-Besse Nuclear Power Station (DBNPS) shut down for the fourteenth refueling outage and in Mode 6 (Refueling), ultrasonic examination of the 2-1/2 inch diameter Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow dissimilar metal butt weld [AB-NZL] detected an axial flaw indication at least 0.25 inches in length. Due to the configuration of the weld joint and lack of qualified depth sizing procedures for dissimilar metal welds, the length of the indication could not be accurately determined. Ultrasonic examination of the base material on both the elbow and nozzle sides of the weld showed no evidence of propagation, so the axial flaw indication was believed to reside solely in the Alloy 182 buttering and potentially the weld of the nozzle-to-elbow dissimilar metal in close proximity to the inside surface. No evidence of through-wall leakage was observed on the previous day when an Alloy 600 bare metal examination of the piping was conducted.

The four Reactor Coolant Pump cold leg drain lines are nuclear safety related, seismic class 1 piping, and are part of the Reactor Coolant System pressure boundary. These cold leg drain lines, located in the low point of the piping from the Steam Generator [AB-HX] to the suction of the Reactor Coolant Pumps [AB-P], provide a flow path to allow draining the cold leg to the Reactor Coolant Drain Tank [CA-TK] header. The Reactor Coolant Pump 1-1 cold leg drain line is unique in that it also provides a flow path to the Makeup System [CB] to accommodate temporary changes in Reactor Coolant System inventory and allow purification of Reactor Coolant while providing boric acid concentration control. The normal service condition temperature of the four cold leg drain lines is approximately 560 degrees Fahrenheit and 2155 pounds per square inch pressure.

The 2-1/2 inch cold leg drain line nozzles were shop fabricated of A105 grade II carbon steel with Alloy 182 buttering on the weld end and internally clad with a minimum of 1/8 inch stainless steel filler material. The nozzle was butt welded with Alloy 82/182 filler metal to a 2-1/2 inch schedule 160 long radius 90 degree elbow made of SA-403 grade WP-316 stainless steel. Refer to Figure 1 at the end of this report for a diagram of this piping. During the fourteenth refueling outage, the Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow weld was examined by personnel and equipment qualified to the Performance Demonstration Initiative (PDI) generic procedure for manual ultrasonic examination of dissimilar metal piping welds. The axial flaw indication discovered on March 18, 2006, was located in the Alloy 182 buttering of the dissimilar metal weld. Alloy 600 and its associated Alloy 82/182 weld filler materials are used in nuclear power plants due to a thermal expansion coefficient that is intermediate between low alloy and stainless steels. The related weld filler materials are used to join Alloy 600 parts to the ferritic steel components and also as a bi-metallic weld joining ferritic base materials to austenitic stainless steel base materials. Alloy 82 is used in the automatic welding process and Alloy 182 is used in the manual welding process.

The DBNPS In-Service Inspection program was augmented to include ultrasonic examinations of the Reactor Coolant Pump cold leg drain lines in response to operating experience of thermal fatigue leakage at plants similar to the DBNPS. Ultrasonic examinations were performed on the opposite side cold leg drain line welds for Reactor Coolant Pumps 2-1 and 2-2 in the previous (thirteenth) refueling outage and no unacceptable indications were identified, although these inspections were not performed to the qualified procedures used during the fourteenth refueling outage. Ultrasonic inspection of the Reactor Coolant Pump 1-2 cold leg drain line weld during the fourteenth refueling outage revealed no unacceptable indications. No ultrasonic examinations had been conducted on the Reactor Coolant Pump cold leg drain lines prior to these inspections.

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17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)*

APPARENT CAUSE OF OCCURRENCE:

The probable cause of this axial flaw indication on the 2-1/2 inch diameter Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow dissimilar metal butt weld is less than adequate welding process during initial plant construction in 1975. Residual stresses from extensive localized grinding and repair of a crack, slag, and a lack of penetration resulted in a flaw in this weld. There are two possibilities for the resultant axial flaw indication. Either a latent construction flaw remained from several localized weld repairs and was hidden in the weld butter by the radiograph penetrameter, or the weld repairs resulted in a crack initiation site. The residual stresses from the construction weld repairs when combined with the conducive environment of the Reactor Coolant System, plus the susceptibility of Alloy 600 material established the presence of the three key elements for the development of primary water stress corrosion cracking in spite of the low susceptibility (lower operating temperature) of the cold leg drain lines. None of the other three cold leg drain lines required a localized repair of the nozzle-to-elbow butt weld involving repetitive grinding like the Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow butt weld during initial plant construction.

The welding process is identified as only a probable cause since metallurgical examination of the axial flaw indication was not performed to provide validation of the cause.

ANALYSIS OF OCCURRENCE:

10CFR50.73(a)(2)(ii)(A) requires reporting of any event or condition that resulted in the plant, including its principal safety barriers, being seriously degraded. NUREG-1022, "Event Reporting Guidelines - 10CFR50.72 and 10CFR50.73" lists as an example of such degradation "Welding or material defects in the primary coolant system which cannot be found acceptable under ASME Section XI, IWB-3600, 'Analytical Evaluation of Flaws' or ASME Section XI, Table IWB-3410-1, 'Acceptance Standards.'" After further evaluation of the Reactor Coolant Pump 1-1 cold leg drain line nozzle-to-elbow butt weld axial flaw indication, on March 21, 2006, it was determined that the indication could not be found acceptable under ASME Section XI, and therefore required repair prior to plant restart. A non-emergency eight hour notification per 10CFR50.72(b)(3)(ii)(A) was provided to the NRC as Event Number 42437 on March 21, 2006.

Industry analyses have documented the low safety significance of primary water stress corrosion cracking (PWSCC) in piping similar to these Reactor Coolant System drain lines. When axial flaws occur in this type of weld, the flaws are limited to the width of the Alloy 82/182 weld metal since PWSCC will not occur in the low-alloy steel and stainless steel materials. Flaws can only grow into the adjoining PWSCC resistant materials at a slow rate by fatigue. Axial cracks that arrest when they reach low-alloy steel and stainless steel materials are limited to the length of the weld and do not pose a risk of rupture. These axial cracks would be detected prior to reaching critical flaw size either by non-destructive examination prior to leakage occurring (as in the case of this event at the DBNPS), or by visual inspections or leak detection after leakage has started. Therefore, it is concluded the overall safety significance of the axial flaw indication discovered at the DBNPS was minimal because no failures or leakage occurred, and the structural integrity of the Reactor Coolant System pressure boundary was not compromised.

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CORRECTIVE ACTIONS:

A repair consisting of a full structural weld overlay of the affected area was performed to mitigate any potential stress corrosion cracking. The finished weld overlay completely covered the indication with Alloy 52 based weld material that is highly resistant to primary water stress corrosion cracking. The weld overlay also induces compressive stress in the weld, thus impeding growth of any reasonably shallow cracks. Furthermore, the weld overlay was sized to meet all structural requirements independent of the existing weld, and to facilitate ultrasonic examination. An acceptable ultrasonic examination with no recordable indications was obtained for the weld overlay repair to the Reactor Coolant Pump 1-1 cold leg drain line. No remnants of the axial flaw indication were observed after the weld overlay; however, the intent of the ultrasonic examination after the repair was not to validate previous observations.

The ASME Code Section XI, In-Service Inspection Appendix Q and Code Case N-504-2 allow a flaw to be reduced to an acceptable size by deposition of weld reinforcement (weld overlay) on the outside of the pipe, without flaw removal. Relief from the DBNPS In-Service Inspection Requirements was requested from the Nuclear Regulatory Commission (NRC) via letter Serial Number 3248 dated March 29, 2006, and supplemented by letter Serial Number 3249 dated March 31, 2006. Verbal approval of this relief request was granted by the NRC on April 5, 2006, prior to plant heat up above 120 degrees Fahrenheit, the limiting temperature imposed by Technical Specification 3.4.10.1 Action a.

The four High-Pressure Injection System [BQ-NZL] nozzle and the three Pressurizer relief [AB-NZL] nozzle dissimilar metal butt welds are of similar size and physical configuration to the Reactor Coolant Pump cold leg drain lines, except for having stainless steel safe ends. The High Pressure Injection System nozzles also have a stainless steel thermal sleeve that is intended to protect the piping and dissimilar metal weld from thermal variations and fatigue. Ultrasonic inspections were performed on all seven of these welds during the fourteenth refueling outage, as well as the 1-2 cold leg drain line, to determine the extent of condition; no unacceptable indications were noted, including the 2-1 High Pressure Injection nozzle that had multiple weld repairs like the 1-1 cold leg drain line in the past.

While not a regulatory requirement or commitment, the DBNPS Alloy 600/690 Material Management Program directs performance of an ultrasonic inspection of either a Pressurizer relief nozzle or the Pressurizer spray nozzle each refueling outage, due to their higher susceptibility to stress corrosion cracking. An ultrasonic examination of another Reactor Coolant Pump cold leg drain line and another High Pressure Injection cold leg interface with the Reactor Coolant System is currently planned for the sixteenth refueling outage commencing in 2010. Additionally, as part of an Alloy 600 Mitigation Plan and in accordance with the DBNPS Corrective Action Program, a project is being pursued to perform structural weld overlays of the Pressurizer relief and spray nozzles during the fifteenth refueling outage (2008), and a structural weld overlay or replacement of the cold leg drain lines in the sixteenth refueling outage (2010).

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FAILURE DATA:

There have been no Licensee Event Reports submitted by FENOC for the DBNPS in the last three years reporting an event similar to the axial flaw indication on the dissimilar metal butt weld of the Reactor Coolant Pump 1-1 cold leg drain line. Likewise, there have been no similar events documented in the DBNPS Corrective Action Program. This condition was self-identified as a result of similar, but more severe conditions discovered elsewhere within the U.S. nuclear power industry. The pre-emptive ultrasonic examinations were effective in preventing similar, more consequential conditions of leaks experienced elsewhere in the industry.

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

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Figure 1: Reactor Coolant Pump 1-1 Cold Leg Drain Line Nozzle-to-Elbow Weld Arrangement Prior to Weld Overlay