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February 28, 2008
L-08-041

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 2007-002, Decay Heat Removal Discharge Piping Void Due to Inadequate Procedure for Venting Following Maintenance

Enclosed is Licensee Event Report (LER) 2007-002. This LER is being submitted to provide written notification of the discovery of a void in Decay Heat Removal Train 1 Discharge Piping while realigning the train during the Fifteenth Refueling Outage. This piping void, which was formed during on-line maintenance approximately two months prior to discovery, was due to inadequate procedure guidance for venting the train following on-line maintenance. This issue is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as an operation or condition prohibited by the Technical Specifications. Evaluations concluded Decay Heat Removal Train 1 remained capable of performing all required safety functions with the void in the discharge piping.

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

Enclosure: LER 2007-002 (NP-33-07-002-00)

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

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 8/31/2010
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	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.

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4. TITLE
Decay Heat Removal Discharge Piping Void Due to Inadequate Procedure for Venting Following Maintenance

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
12	30	2007	2007	- 002 -	00	02	28	2008	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE: 5

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 or in NRC Form 366A
☐ 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		15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete EXPECTED SUBMISSION DATE).*	☒ NO				

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

On December 30, 2007, with the plant in Mode 5, a step decrease of approximately six inches in the Reactor Coolant System Pressurizer was observed when aligning Decay Heat Removal (DHR) Pump 1 suction from Low Pressure Injection mode to DHR mode. The alignment was suspended, and a piping void was discovered in the discharge piping of DHR Pump 1. The void was vented from the high point vent valve inside Containment to restore train operability. It was determined that this void was formed during on-line maintenance on October 31, 2007, due to an inadequate procedure for recovering the DHR train following on-line maintenance. This void rendered DHR Train 1 inoperable for approximately 59 days due to the inability to successfully meet Technical Specification Surveillance Requirement 4.5.2.b, which requires the train to be full of water while in Modes 1 through 3.

An evaluation determined DHR Train 1 remained capable of performing all required safety functions as a result of the estimated 17 cubic feet of voided piping that existed while the plant was operating. This issue is being reported in accordance with 10 CFR 50.73(a)(2)(i)(B) as an operation or condition prohibited by the Technical Specifications. The procedure will be revised to properly vent the system following maintenance, and procedures for other standby safety systems will be reviewed for similar issues.

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NARRATIVE

DESCRIPTION OF OCCURRENCE:

System Description:

The Decay Heat Removal System [BP] at the Davis-Besse Nuclear Power Station (DBNPS) has two main functions which are dependent on the plant's mode of operation. During Power Operation through Hot Standby Conditions (Modes 1 through 3), both trains of the Decay Heat Removal System are aligned for Low Pressure Injection (LPI), in which the function is to provide water from the Borated Water Storage Tank (BWST) [BP-T] to the reactor pressure vessel [AB-T] for Emergency Core Cooling following a Loss of Coolant Accident (LOCA). In this alignment, the Decay Heat Removal Pumps [BP-P] can also act as a booster pump ("piggyback" mode) to the High Pressure Injection Pumps [BQ-P] to increase the outlet pressure of the High Pressure Injection Pumps for certain small-break LOCA scenarios. Following depletion of the BWST volume, the suction of the Decay Heat Removal Pumps is transferred to the Containment Emergency Sump [BP-V] for long-term recirculation cooling of the reactor pressure vessel following a LOCA. The Decay Heat Removal Pumps may also be used for Boric Acid Precipitation Control during the post-accident cooling period.

During plant shutdowns, the suctions of the Decay Heat Removal Pumps are aligned to the Reactor Coolant System to provide for a controlled cooldown during the latter stages of plant shutdown and to maintain the Reactor Coolant System temperature during shutdown/refueling operations.

DBNPS Technical Specification (TS) Limiting Condition for Operation (LCO) 3.5.2, "Emergency Core Cooling Systems," requires two independent ECCS subsystems be Operable while the plant is operating in Modes 1, 2, and 3. Each ECCS subsystem is comprised of one Operable High Pressure Injection (HPI) Pump, one Operable Low Pressure Injection (LPI) Pump, one Operable Decay Heat Removal Cooler, and an Operable suction flow path from the BWST that can be manually transferred to the Containment Emergency Sump during the recirculation phase of operation. With one HPI Train inoperable, TS LCO 3.5.2 Action a requires the inoperable train be restored to Operable status within 3 days or a plant shutdown initiated. With one LPI Train inoperable, TS LCO 3.5.2 Action b requires the inoperable train be restored to Operable status within 7 days or a plant shutdown initiated. TS LCO 3.5.3 requires only one of the above ECCS subsystems be Operable while in Mode 4 (Hot Shutdown), and there are no ECCS subsystem operability requirements in Mode 5 (Cold Shutdown).

Surveillance Requirement (SR) 4.5.2.b requires each ECCS subsystem be demonstrated Operable by verifying that the ECCS piping is full of water by venting the ECCS pump casings and discharge piping high points at least once each refueling interval or prior to operation after the ECCS piping has been drained.

Event Description:

On December 30, 2007, a planned plant shutdown was in progress to start the Fifteenth Refueling Outage. On December 30, 2007, at approximately 1723 hours, the plant entered Mode 4 with Reactor Coolant System temperature less than 280 degrees Fahrenheit. This permitted one train of Decay Heat Removal to be realigned from the Low Pressure Injection to the Decay Heat Removal mode of operation. Decay Heat Removal Pump 2 was started at approximately 1827 hours in the Decay Heat Removal mode, and at approximately 2025 hours the plant entered Mode 5 with Reactor Coolant System temperature less than 200 degrees Fahrenheit.

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DESCRIPTION OF OCCURRENCE: (continued)

Following entry into Mode 5, Decay Heat Removal Train 1 was realigned from the Low Pressure Injection mode of operation to the standby Decay Heat Removal mode of operation per procedures DB-OP-06903 Revision 27, Plant Shutdown, and DB-OP-06012 Revision 30, Decay Heat and Low Pressure Injection System Operating Procedure. During this alignment with the pump not operating, the suction source for the Decay Heat Removal Pump 1 was transferred by closing valve DH2733, Decay Heat Removal Pump 1 Suction from BWST or Emergency Sump, and then opening valve DH1517, Decay Heat Removal Pump 1 Suction from the Reactor Coolant System (a simplified elevation drawing is included as Figure 1). On December 30, 2007, at approximately 2225 hours, when DH1517 was opened, there was a step decrease of approximately six inches in the Reactor Coolant System Pressurizer [AB-PRZ] level. A void was suspected and DH1517 was immediately closed. The train was vented from the discharge side of the Decay Heat Removal System utilizing the high point vent valve located inside Containment for approximately five minutes until a solid stream of water was observed. A small quantity of gas was also noted when the suction piping from the Reactor Coolant System to the Decay Heat Removal Pump was vented.

APPARENT CAUSE OF OCCURRENCE:

On October 29, 2007, with the plant in Mode 1 at approximately 100 percent power, Decay Heat Removal Train 1 was declared inoperable in order to perform scheduled maintenance. The train was safety tagged and the piping drained under a clearance per procedure NOP-OP-1001, Clearance and Tagging Program. The piping downstream of valve DH1B, Decay Heat Removal Pump 1 Discharge to the Reactor Coolant System (a Containment Isolation Valve), did not need to be drained for the maintenance activities and was kept full of water by closing DH1B prior to draining the system.

Following work completion and removal of the safety clearance, the train was filled and vented on October 31, 2007, in accordance with the system operating procedure (DB-OP-06012 Revision 29) and an Operations Evolution Order developed to provide instructions for pump restoration. Venting from valves DH177/DH177A, Decay Heat Removal Pump 1 Discharge to Reactor Coolant System Vent, was marked as being not applicable in the system operating procedure because Containment was inaccessible, and because DH1B was closed prior to the start of Decay Heat Removal Train 1 draining.

Neither the system operating procedure section for filling and venting Decay Heat Removal Train 1 following maintenance in Modes 1 to 3 nor the Operations Evolution Order contained instructions to vent from DH73, Decay Heat Pump 1 Discharge Line Leak Test Connection Valve, which was the high point of piping drained during the train outage. DH73 is located at elevation 567'-0" and venting from this location would have ensured the train was water solid to the upstream side of DH1B.

The cause of this event was determined to be inadequate procedural guidance for recovering the Decay Heat Removal System following on-line maintenance. The system operating procedure DB-OP-06012 contains sections for starting, operating and recovering the system in all phases of system operation. Included are sections 4.39 and 4.40 for filling and venting the Decay Heat Removal Trains following maintenance during Modes 1 to 3. The guidance of these two sections is focused on recovering from maintenance to the Decay Heat Removal Pump and Cooler, and they do not take into account that maintenance may have been performed on some system piping sections downstream of the cooler, and that these piping sections need to be vented prior to returning the system to operable status.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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ANALYSIS OF OCCURRENCE:

The initial size of the void was estimated to be approximately 15 cubic feet. This is based on the fact that when the void was created on October 31, 2007, valve DH1B (elevation 567' 0") was closed and the pipe was vented through valve DH166 (elevation 560' 3"), and there is approximately 26 feet of 10-inch pipe between these two elevations. Upon opening valve DH1B following maintenance, the void migrated to the true high point of the system, and expanded slightly (to approximately 17.4 cubic feet) due to the change in elevation. The void was well down stream of the branch connection for the HPI piggy back line and the connection for LPI recirculation to the BWST; therefore, no potential for voiding in the High Pressure Injection (HPI) piping existed. The quarterly LPI pump flow surveillance test, which utilized the recirculation line to the BWST, was performed without issue on November 1, 2007.

The DBNPS LOCA analysis assumes that the LPI pump achieves full discharge pressure at 40 seconds after the break. The LPI Pump 1 startup time, including instrument delay and Emergency Diesel Generator startup delay, is approximately 23 seconds. Therefore, the system is fully pressurized to near shutoff head of the LPI pump well before injection is assumed to occur. Since the Core Flood Tanks [BP-T] and the LPI system have a common injection line, the Core Flood Tank pressure controls the LPI system pressure until the Core Flood Tank empties. LPI flow is not expected to occur until approximately 40 seconds after the break occurs, when in the large break LOCA scenario, the Reactor Coolant System is at approximately 35-40 psia and the Core Flood Tank pressure is at 75-160 psia.

At the expected pressure when LPI injection would begin to occur, the void would have been compressed to between 3.9 to 8.5 cubic feet. The LPI system flows into the Reactor Coolant System at approximately 2450 gpm at 120 psia, so the void would have delayed LPI flow by at most approximately 1.6 seconds. At lower Reactor Coolant System pressures, the delay would have been even shorter as the flow rate would increase. With the actual LPI start up time of less than 24 seconds, flow delivery would have been assured within the 40 seconds assumed in the analysis.

The presence of the additional non-condensable gas in the reactor pressure vessel would be of little consequence when compared to the nitrogen volume injected by the Core Flood Tank discharge. The non-condensable gases reaching the reactor pressure vessel would rise to the upper head region where they would be vented to the top of Reactor Coolant System Loop 2 by the connecting Continuous Vent Line. From that point, they would be slowly removed from the Reactor Coolant System through the High Point Vent at the top of Reactor Coolant System Loop 2. Should the break be a small break, natural circulation would not be interfered with by the gas, since two phase natural circulation, although slowed by the non-condensable gas, would still occur. Small break LOCAs are mitigated in the short term by flow from High Pressure Injection and the Core Flood Tanks. By the time LPI flow is beginning for these smaller breaks, the cladding temperatures would have already peaked and would be decreasing. Therefore, the time to vent the void is not critical to the successful mitigation of smaller breaks.

The structural impact of starting the LPI Train with the void was evaluated, and it was concluded that the pressure wave that would have resulted from starting the system with the void present would not have challenged the integrity of the system. Based on the above, it is concluded that the safety function of LPI System Train 1 to provide emergency core cooling to the core would have been met. There would not have been significant impact on the other functions of the LPI system such as supporting long term recirculation or providing boric acid precipitation control, since the void would migrate to the atmosphere of the Containment and not impact sump level or long term flow paths. Therefore this event had very low safety significance.

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ANALYSIS OF OCCURRENCE: (Continued)

Reportability Discussion

Decay Heat Removal Train 1 was removed from service on October 29, 2007, and the subsystem was drained for maintenance. The system was refilled on October 31, 2007 and returned to service on November 1, 2007, at 1720 hours. Based upon the evaluation performed, it was determined the plant operated with a void in the discharge piping of Decay Heat Removal/LPI Train 1 from November 1, 2007, until the plant was shutdown on December 30, 2007 (59 days). Because LPI Train 1 would not have been able to pass TS SR 4.5.2.b in this condition, the requirements of TS LCO 3.5.2 Action b were not met for more than 7 days without the plant shutting down, which resulted in the plant operating in a condition prohibited by the Technical Specifications.

This issue represents a condition that is reportable per 10 CFR 50.73(a)(2)(i)(B) as a Licensee Event Report within 60 days of discovery. Investigation into this issue determined that no voiding existed in LPI Train 2; therefore, no loss of safety function occurred as a result of this issue.

CORRECTIVE ACTIONS:

Upon discovery of the void on December 31, 2007, the Decay Heat Removal Pump 1 discharge piping was vented until a solid stream of water was observed to ensure the piping was full of water.

DB-OP-06012, Decay Heat and Low Pressure Injection System Operating Procedure, will be revised by adding the requirement to vent from valves DH73 for train 1 and DH72 for train 2 to the procedure sections for filling and venting Decay Heat Removal Trains following maintenance in Modes 1 to 3.

System operating procedures for Emergency Core Cooling Systems as well as other standby safety systems will be reviewed for potential deficiencies that would allow for gas intrusion to the piping system. The review shall be performed using system isometric drawings. System operating procedures to be reviewed include the Decay Heat Removal and Low Pressure Injection System, the High Pressure Injection System, the Containment Spray System [BE], the Reactor Coolant Makeup System [CB], and the Motor Driven Feedwater and Auxiliary Feedwater Systems [BA].

The actions described above represent intended or planned actions, and completion of these actions is being tracked through the DBNPS corrective action program. These actions are described for the NRC's information and are not regulatory commitments.

FAILURE DATA:

There have been no Licensee Event Reports submitted for the DBNPS in the past three years regarding inoperability of Emergency Core Cooling Systems due to piping voids. Instances of gas accumulation in these systems have occurred throughout the industry, and the FirstEnergy Nuclear Operating Company (FENOC) has maintained an awareness of industry events and implemented industry suggested improvements to reduce vulnerability to these types of events. The system operating procedure sections for filling and venting the Decay Heat Removal Trains following maintenance in Modes 1 to 3 were added to the procedure in April 2006 (Revision 26 of DB-OP-06012) in response to industry operating experience. However, these added sections did not include venting from valve DH73. Therefore, DB-OP-06012 Revision 26 did not provide adequate guidance for venting the system following maintenance.

NARRATIVE

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

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Figure 1

Decay Heat Removal System Simplified Elevation Diagram