

NP-33-03-001-01

Docket No. 50-346

License No. NPF-3

August 18, 2003

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

Ladies and Gentlemen:

LER 2003-001-01
Davis-Besse Nuclear Power Station, Unit No. 1
Date of Occurrence – January 30, 2003

Enclosed please find Supplement 1 to Licensee Event Report 2003-001, which is being submitted to provide written notification of potential inability of air-operated valves to function during design basis conditions. This issue was identified during development and implementation of an Air-Operated Valve Reliability Program as previously committed in Licensee Event Report 2002-004. This Supplement addresses additional valves identified during the Extent of Condition review associated with LER 2003-001. Commitments associated with this LER are listed in the Attachment.

Very truly yours,



Mark B. Bezilla
Vice President

PSJ/s

Enclosures

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

JE22

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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 Affairs (419-321-8450) at Davis-Besse of any questions regarding this document or associated regulatory commitments.

<u>COMMITMENTS</u>	<u>DUE DATE</u>
1. Install sufficiently sized accumulators for valves CC1495, SW1424, SW1429, SW1434, SW1356, SW1357, and SW1358	1. Prior to startup
2. Install a new valve actuator and sufficiently sized high pressure nitrogen bottles capable of closing valve MU3 against the maximum RCS differential pressure.	2. Prior to startup
3. Submit LER Supplement to address risk significance.	3. Target: September 17, 2003

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(See reverse for required number of digits/characters for each block)

Estimated burden per response to comply with this mandatory information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by Internet e-mail to bjs1@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 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.

1. FACILITY NAME Davis-Besse Unit Number 1	2. DOCKET NUMBER 05000346	3. PAGE 1 OF 8
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4. TITLE
Potential Inability of Air-Operated Valves to Function During Design Basis Conditions

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
01	30	2003	2003	-- 001 --	01	08	18	2003	FACILITY NAME	DOCKET NUMBER 05000
									FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE D	10. POWER LEVEL 000	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)								
		<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)					
		<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(x)					
		<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 73.71(a)(4)					
		<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(5)					
		<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)						
		<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)						
		<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(D)						
		<input type="checkbox"/> 20.2203(a)(2)(v)	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)						
		<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)						
		<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)						

12. LICENSEE CONTACT FOR THIS LER

NAME Peter S. Jordan - Regulatory Affairs	TELEPHONE NUMBER (Include Area Code) (419) 321-8260
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13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED

<input checked="" type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE).	<input type="checkbox"/> NO	15. EXPECTED SUBMISSION DATE	MONTH 09	DAY 17	YEAR 2003
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16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On January 30, 2003, with the reactor defueled, it was determined that several air-operated valve (AOV) actuators had negative operating margins. After further review, it has been determined that eight valves in total were not capable of performing their intended safety functions for all required conditions. Valve MU3 would not fully close against maximum Reactor Coolant System pressure to isolate letdown flow. A new actuator and accumulators are being installed. Upon a loss of non-safety instrument air, valves CC1495, SW1356, SW1357, SW1358, SW1424, SW1429, and SW1434 would not have been capable of performing their intended safety functions because they were not provided with sufficiently sized accumulators. Following postulated accidents, CC1495 is to close to isolate Component Cooling Water (CCW) flow to non-essential equipment. SW1356, SW1357, and SW1358 may be remote manually closed to provide containment isolation function for Service Water (SW) return from non-operating Containment Air Coolers. SW1424, SW1429, and SW1434 are to open to ensure adequate SW flow through the CCW heat exchangers. Sufficiently sized accumulators are being installed on these seven valves. These conditions, apparently caused by inadequate design assumptions, are being reported in accordance with 10CFR50.73(a)(2)(i)(B) as operation or condition prohibited by the Technical Specifications.

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Davis-Besse Unit Number 1	05000346	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	2 OF 8
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NARRATIVE (If more space is required, use additional copies of NRC Form 366A) (17)

DESCRIPTION OF OCCURRENCE:

System and component design basis calculations are being performed and reviewed as part of the development and implementation of an AOV Reliability Program as previously committed in Davis-Besse Nuclear Power Station (DBNPS) Licensee Event Report 2002-004. On January 30, 2003, with the reactor defueled, it was determined that four air-operated valve (AOV) actuators had negative operating margins. After initially reporting the four deficient valve actuators, a total of eight valve actuators was determined to be deficient. Upon loss of non-safety related instrument air, valves MU3, CC1495, SW1356, SW1357, SW1358, SW1424, SW1429, and SW1434 would not have been capable of performing their intended safety functions for all required conditions during past plant operation. Therefore, LER 2003-001 is being supplemented to include the valves determined by the AOV Reliability Program to be deficient. A description of each of these valves is given separately below.

The Safety Features Actuation System (SFAS) [JE] at the DBNPS is designed to automatically prevent or limit fission product and energy release from the core, to isolate the containment vessel [NH] and to initiate the operation of the engineered safety features equipment in the event of a loss-of-coolant accident or fuel handling accident inside containment. The SFAS also initiates protective actions in the event of a Main Steam line break. SFAS protective actions include signalling various valves to stroke to their safety position or sending a confirmatory signal for valves to remain in their safety position.

The Component Cooling Water (CCW) System [CC] circulates water through a closed cooling loop to provide cooling water to safety-related equipment and reactor auxiliary equipment within the Auxiliary [NF] and Containment [NH] Buildings, transferring the heat through the CCW heat exchangers [CC-HX] to the ultimate heat sink [BS] (Lake Erie) via the Service Water (SW) System [BI]. The system pressure is set by the CCW Surge Tank [CC-TK] located upstream of the CCW Pumps [CC-P]. During a Design Basis Accident, CCW supply to non-essential components is isolated, and cooling water is supplied only to essential components, including the Emergency Diesel Generator Jacket Cooling Water Heat Exchangers [LB-HX], Decay Heat Pumps [BP-P] and Bearing Housing Coolers [BP-P-CLR], High Pressure Injection Pumps' Bearing Coolers [BQ-P-CLR], the Decay Heat Removal Heat Exchangers [BP-HX], and Containment Gas Analyzer Heat Exchangers.

During normal plant operation, the Service Water (SW) System supplies SW to the CCW heat exchangers, Containment Air Coolers (CACs), Turbine Plant Cooling Water heat exchangers, and Emergency Core Cooling System (ECCS) room coolers for cooling. Operation of the ECCS room coolers is not required during normal plant operation for heat removal, however, SW flow through the room coolers is required to minimize corrosion of the cooling coils. During emergency operation, automatic valve sequencing aligns a redundant supply path of SW to safety-related components which include the CCW heat exchangers, and CACs. A Safety Features Actuation Signal (SFAS) will cause SW pumps to start and realign valves to supply SW to essential equipment and isolate SW flow to non-essential equipment.

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DESCRIPTION OF OCCURRENCE (continued):

Valve CC1495, CCW Auxiliary Building Non-Essential Header Isolation Valve [CC-ISV]

Valve CC1495 is a 16-inch butterfly valve which is normally open to provide cooling water to non-essential components such as the Spent Fuel Pool Heat Exchangers [DA-HX], Reactor Coolant Pump Seal Return Coolers, Reactor Coolant System Sample Cooler, Post-Accident Sample Coolers, Pressurizer Quench Tank Cooler, and various Clean Liquid, Miscellaneous Liquid, and Gaseous Radwaste System [WE] components. On an SFAS Level 3 signal, this valve closes to isolate non-essential loads and ensure that cooling water is available for Engineering Safety Features components and the Makeup pumps' gear and lube oil coolers. This valve also closes on low level in the CCW Surge Tank to ensure sufficient CCW flow is available to essential equipment. However, calculations showed that the safety-grade air accumulator installed at the valve to provide a source of motive power in the event of a loss of non-safety related instrument air is undersized. The available air volume was not sufficient to ensure the valve would fully close in the event of a loss of instrument air on an SFAS Level 3 signal or a low CCW Surge Tank level.

Valves SW1356, SW1357, and SW 1358, Service Water (SW) Return Valves from Containment Air Coolers (CAC) [BK-CLR]

These are 8-inch ball valves which are normally open on operating CACs to provide a flow path of SW from the operating CACs to the SW return header outside containment. The CACs provide a containment atmosphere cooling function during both normal operation and accident conditions. During normal operation, these valves provide temperature control for their respective operating CAC. In the event of a design basis accident, an SFAS Level 2 signal will automatically place the two operating CAC fans in low speed. Fan operation in low speed initiates an electrical signal to stroke the control valves in the SW return lines to full open to allow maximum SW flow through the operating CACs. In the event of loss of instrument air, an actuator spring provides the motive force to open the valves. However, these valves have a dual safety function.

For both normal operation and accident conditions, two of three CACs are in operation. The third CAC is placed in standby. This spare CAC will have its SW outlet valve closed during both normal and emergency operation based on containment isolation considerations. These valves are located outside containment. The valves are held in the closed position by air pressure. Since the design basis accident analysis considers a 30-day accident duration, the SW return valve on the spare CAC must retain its containment isolation function (remain closed) for 30 days. With a loss of instrument air, the air accumulators for these valves did not have sufficient capacity to meet this 30-day closure requirement.

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DESCRIPTION OF OCCURRENCE (continued):

Valves SW1424, SW1429, and SW1434, CCW Heat Exchanger SW Outlet Valves

These are 12-inch ball valves located on the SW return piping from the CCW heat exchangers. During normal operation, they serve as temperature control valves by throttling SW flow. During emergency operation, the outlet control valves for both the operating and standby CCW heat exchangers go to their full open position upon receipt of an SFAS Level 2 signal in order to maximize SW flow through the CCW heat exchangers. The valves are also to fail open upon loss of instrument air. These valves have a double-acting with spring assist cylinder actuator which requires the presence of air to stroke to its safety position. These valves are not provided with an air accumulator to assist in valve stroking. Based upon the results of a dynamic differential pressure test performed on SW1434, this spring force, alone, has been determined to be inadequate to stroke the valves to their full open position.

Valve MU3, Reactor Coolant System (RCS) Letdown Isolation Valve [CB-ISV]

This 2.5-inch gate valve is normally open to allow letdown flow to pass from the Letdown Coolers [CB-CLR] to the purification demineralizers [CB-DM]. A small portion of reactor coolant is letdown for purification, chemical control, and degasification purposes during normal plant operation. This isolation valve closes on an SFAS Level 2 signal to isolate letdown flow as well as to provide for (outside) containment isolation. This valve is also designed to fail closed upon a loss of instrument air. An internal actuator spring will take this valve to its failed position. Calculations performed showed that the isolation valve would not fully close against a maximum Reactor Coolant System pressure of 2500 psig.

APPARENT CAUSE OF OCCURRENCE:

Lessons learned from the nuclear power industry's motor-operated and air-operated valve programs indicate that AOV performance can be enhanced by improvements in valve and actuator sizing, setting, testing, and maintenance. It was found that during the original procurement cycle, many AOV actuators were undersized. This was a result of vendors being provided with inaccurate system conditions in combination with less than conservative sizing methodology used at the time, and a lack of formal calculations supporting the design basis and appropriate settings for AOV actuators. There was also the practice of sizing AOV actuators with minimum built-in margin. Similar analytical deficiencies resulted in the design of the air accumulators, used to provide a source of motive power in the event of a loss of non-safety related instrument air, not being sufficient to ensure the valves would perform their intended safety function under all design conditions. This apparent cause applies to valve CC1495.

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APPARENT CAUSE OF OCCURRENCE (continued):

Valves SW1424, SW1429, and SW1434 were originally designed with air accumulators to assist in valve stroking. Plant modification 87-1315 replaced the valve assemblies in 1991 which included removal of the accumulators. These valves currently have a double-acting with spring assist actuator. The modification that installed these actuators stated that these valves are taken to their safety position by a mechanical spring. It was therefore concluded that the valves' accumulators were not needed and were removed. The apparent cause of this condition was an incorrect engineering assumption.

As noted in the Description of Occurrence, valves SW1356, SW1357, and SW1358 have a safety function to provide containment isolation for non-operating CAC(s) following a LOCA. The accumulators for these valves were determined to have insufficient air capacity to keep the valves closed for a 30-day period, consistent with accident analysis assumptions. The apparent cause of this condition was an apparent lack of understanding at the time of plant's construction of the design and licensing basis and to correlate this information into the design of the accumulators for these valves and lack of design evaluation for the sizing of the accumulators.

As noted in the Description of Occurrence, the actuator for MU3 was designed with an internal actuator spring to stroke the valve to its fail closed position upon loss of instrument air. During normal plant operation when this valve is open, the spring is in a state of compression. Over time, this led to the degraded condition of "spring relaxation," a reduction in spring length caused by creep of the spring material under load. This spring relaxation reduced the free length of the spring which resulted in a degraded capability to close MU3 against the force of its higher range of design operating pressure. This spring relaxation phenomenon, which is caused by normal equipment operation over time, was not recognized for purposes of preventive maintenance.

ANALYSIS OF OCCURRENCE:

At the time of discovery there were no applicable Technical Specification operability requirements for the affected systems with the reactor defueled. However, the plant operated in this condition when the CCW System was required to be operable per TS 3.7.3.1, the SW System was required to be operable per TS 3.7.4.1, and Containment Isolation Valves were required to be operable per TS 3.6.3.1. Therefore, this issue represents a condition prohibited by the Technical Specifications, and is reportable in accordance with 10CFR50.73 (a) (2) (i) (B).

While the reactor coolant Letdown Outlet Isolation Valve (MU3) would not have closed against a maximum RCS pressure of 2500 psig, a preliminary engineering evaluation determined that the valve would have closed against a differential pressure of 2030 psi. If a leak in the RCS caused pressure to decrease to the SFAS Level 2 actuation setpoint of 1600 psig, MU3 would have closed to perform its safety function of isolating containment and reactor coolant Letdown flow.

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ANALYSIS OF OCCURRENCE (continued):

Additionally, valve MU2A is located inside of containment in compliance with General Design Criteria 55 to isolate letdown flow upon receipt of the same SFAS Level 2 signal. This motor-operated valve remained fully capable of isolating letdown flow at full RCS pressure. Therefore, containment isolation capability of Letdown flow was degraded but maintained.

The CCW Auxiliary Building Non-Essential Header Isolation Valve CC1495 would not have fully closed in the event of a loss of non-safety related instrument air in conjunction with either an SFAS Level 3 signal or a low CCW Surge Tank level. This latter event would likely be mitigated by automatic actions. In the event of a leak in non-essential equipment, a low level in the CCW Surge Tank would signal motor-operated valves CC5096 and CC5097, which are upstream of CC1495, to close. These two valves would then isolate the non-essential header regardless of the capability CC1495 to fully close in the event of a leak in non-essential equipment. In the event of an SFAS Level 3 signal in conjunction with a loss of non-safety related instrument air, the valve's safety grade air accumulator would not have had sufficient capacity to fully close the valve. However, motor-operated valves CC5096 and CC5097, noted above, are available to provide remote manual isolation of the non-essential CCW header.

As discussed in Description of Occurrence, the respective SW return valves from the operating CACs, SW1356, SW1357, and SW1358, would not have been capable of maintaining containment isolation capability consistent with accident analysis assumptions. However, this SW piping is a closed fluid system inside containment (not connected to the Reactor Coolant Pressure Boundary nor connected directly to the containment atmosphere). Therefore, failure to maintain the containment isolation function would not create a release pathway for post-accident radioactive material.

As discussed in the Description of Occurrence, the SW return valves from the CCW heat exchangers, SW1424, SW1429, and SW1434, would not have been capable of stroking to their full open position upon receipt of an SFAS Level 2 signal. Based on the results of a dynamic differential pressure test, it was concluded that the valves would only be able to stroke about 28 degrees from the closed position. Air accumulators which served to assist the safety function of the valves were removed in 1991 on the assumption that the actuator internal spring was sufficient to stroke the valves full open. The vendor information provided at the time of this modification suggested that the spring was strong enough to provide adequate torque. This assumption was incorrect and resulted from a lack of design bases for the valves and lack of calculations to support valve orientation, set-up, and sizing for risk significant AOVs.

LER 2003-001-00 had additionally identified valves CC1467 and CC1469, Decay Heat heat exchanger isolation valves [BP-HX-ISV], as potentially incapable of performing their intended safety function. Engineering calculation C-ME-016.04-035, Rev. 0, determined that the actuators for these two valves had positive

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ANALYSIS OF OCCURRENCE (continued):

margin for proper valve operation. Therefore, these valves would have been capable of performing their intended safety function under all postulated plant conditions.

An overall evaluation of the safety significance of valve deficiencies is ongoing. The results of the overall evaluation will be reported in a revision to this Licensee Event Report.

CORRECTIVE ACTIONS:

An AOV Reliability Program is being implemented, in part, to ensure that AOV actuator sizing and setpoints are reviewed to verify and document their adequacy. As previously committed in DBNPS LER 2002-004, for all Category 1 and 2 AOVs and their associated components, the design basis requirements, including the correct installed orientation, will be established in accordance with the AOV Reliability Program Manual. The requisite engineering documents will be developed to implement any required changes for category 1 and 2 AOVs. Any modifications needed to restore these components to their design requirements will be completed prior to plant restart. Post-modification testing will be performed to verify compliance with design bases. Identification of the AOV conditions presented in this LER are the direct result of implementation of the AOV Reliability Program which is intended to preclude recurrence of these conditions in the future. In addition, it is identified that the 1991 modification to valves SW1356, SW1357, and SW1358 removed the air accumulators for these valves based upon an incorrect design/licensing assumption. The recently instituted Design Interface Evaluation process is intended to preclude future occurrence of similar conditions that can result from inadequate communications among organizations affected by a plant modification.

For valves CC1495, SW1424, SW1429, and SW1434, modifications are being implemented to install properly sized safety-related air accumulators. For valves SW1356, SW1357, and SW1358, modifications are being implemented to install properly sized safety-related high pressure nitrogen air bottles. For valve MU3, a modification is being implemented to install a new valve actuator (which does not utilize spring force) and two safety-related air accumulators capable of closing the valve against maximum RCS differential pressure. The modifications to these eight valves will be implemented prior to plant startup.

FAILURE DATA:

DBNPS LER 2002-004 documents similar problems discovered with air-operated valves for which the actuators did not have the capability to properly position the associated valve for all postulated conditions. It was during the performance of the corrective actions as stated in LER 2002-004 that the problems associated with the eight valves described above were discovered.

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

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PCAQR 97-1082
CR 02-07781
CR 03-01253
CR 03-05628

CR 99-2111
CR 03-00830
CR 03-04158

CR 02-07750
CR 03-01040,
CR 03-04878