FirstEnergy

Davis-Besse Nuclear Power Station
5501 North State Route 2
Oak Harbor, Ohio 43449-9760

NP-33-98-008-00

Docket No. 50-346

License No. NPF-3

October 1, 1998

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

Ladies and Gentlemen:

LER 1998-008
Davis-Besse Nuclear Power Station, Unit No. 1
Date of Occurrence - September 1, 1998

Enclosed please find Licensee Event Report 1998-008, which is being submitted to provide 30 days written notification of the subject occurrence. This LER is being submitted in accordance with 10CFR50.73(a)(2)(v).

Very truly yours,

James H Lash /sr

James H. Lash
Plant Manager
Davis-Besse Nuclear Power Station

DLM/dlc

Enclosure

IE22 1/1

cc: Mr. J. L. Caldwell
Acting Regional Administrator
USNRC Region III

Mr. Stephen J. Campbell
DB-1 NRC Senior Resident Inspector

Utility Radiological Safety Board

NRC FORM 366 (4-1995)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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

APPROVED BY OMB NO. 3150-0104 EXPIRES 04/30/98

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Davis-Besse Unit Number 1	05000346	1 OF 5

TITLE (4)
Post Loss of Coolant Accident Boron Dilution Flow Path Analyses and Procedural Guidance

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
09	01	1998	1998	-- 008 --	00	10	01	1998	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
	20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
	20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
	20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
	20.2203(a)(2)(iii)		50.36(c)(1)	X	50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
	20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Dale L. Miller, Senior Engineer - Licensing	(419) 321-7264

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

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

SUPPLEMENTAL REPORT EXPECTED (14)				EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On September 1, 1998, at 1530 hours, with the Davis-Besse Nuclear Power Station (DBNPS) operating in Mode 1, at 100 percent rated thermal power, a Potential Condition Adverse to Quality Report (PCAQR) was submitted documenting the proceduralized guidance for initiation of the post loss of coolant accident (LOCA) boron dilution flow path. The plant's emergency procedure, DB-OP-02000, allowed initiation of the post-LOCA boron dilution flow path under pressurized, saturated liquid conditions that, for a limited range of small break LOCAs, could cause steam binding and voiding in the suction piping of both operating Low Pressure Injection (LPI) Pumps. The cause of this condition was that the potential for operation of the flow path with pressurized, saturated liquid was not identified in the analyses for initiation of an active boron dilution flow path following a small break LOCA. The plant emergency procedure allowed initiation of long term boron dilution if both LPI pumps were available and Reactor Coolant System (RCS) pressure was less than 200 psig. To correct the condition, emergency procedure changes were completed to provide additional guidance on the initiation of the active boron dilution flow path. Formation of a steam void in the suctions of both running LPI pumps after a LOCA could prevent the fulfillment of the safety function of a system needed to maintain the reactor in a safe shutdown condition. This condition is reportable in accordance with 10 CFR 50.72(b)(2)(iii)(A) and the Nuclear Regulatory Commission was notified via the Emergency Notification System at 1549 hours on September 1, 1998. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(v)(A).

Description of Occurrence:

On September 1, 1998, at 1530 hours, with the Davis-Besse Nuclear Power Station (DBNPS) operating in Mode 1, at 100 percent rated thermal power, a Potential Condition Adverse to Quality Report (PCAQR) was initiated with regard to the proceduralized guidance for initiation of the post loss of coolant accident (LOCA) boron dilution flow path. The DBNPS Updated Safety Analysis Report (USAR) credits one active and one passive method for post LOCA boron dilution that are effective from any initial power level. The active method is the initiation of a dilution flow through the normal Decay Heat (DH) system drop line. Passive boron dilution has been shown, by analysis, to occur following a large break LOCA due to the existence of small gaps between the hot leg outlet nozzles and the core barrel, to the downcomer region of the reactor vessel. The flow which would pass through these gaps is sufficient to prevent precipitation of boron without the initiation of any active method of dilution.

During a review of a plant modification being processed to resolve all issues relative to boron dilution flow paths, Engineering personnel identified that step 10.14.1 of the plant's emergency procedure, DB-OP-02000, allowed initiation of the post-LOCA boron dilution flow path under pressurized, saturated liquid conditions. At the DBNPS the decay heat and low pressure injection functions are performed by the same system. Each Decay Heat / Low Pressure Injection (LPI) Pump suction isolation valve [Energy Industry Identification System - Function Code: BP-ISV] from the Reactor Coolant System (RCS) has an open bypass line for the purpose of providing an active boron dilution flow path. Each bypass line includes an isolation valve, DH10 or DH26 [BP-ISV], followed by a flow element orifice, FE4908 or FE4909 [BP-OR]. After a large break LOCA, flow is intended to be induced by gravity across the flow element orifices FE4908 and FE4909, by opening the normal DH drop line isolation valves DH11 and DH12 [BP-ISV]. Step 10.14.1 of DB-OP-02000 allowed initiation of the post-LOCA boron dilution flow path through the normally open DH system valves DH10 and DH26, if both LPI pumps are available and Reactor Coolant System (RCS) pressure is less than 200 psig. As pressurized, saturated liquid flows past FE4908 or FE4909, the liquid would flash to steam, which would cause voiding in the suction piping of both operating LPI pumps.

For a large break LOCA, the RCS temperature and pressure quickly decreases to saturation conditions at containment pressure, which will not cause flashing at the LPI pump suction to occur. For smaller LOCAs, where RCS pressure remains higher than containment pressure, initiation of this flow path can cause pressurized, saturated liquid to be forced across orifices FE4908 and FE4909 with a higher pressure drop. This would result in flashing across the orifices and introduction of a steam void in the suction piping of both running LPI pumps. For this to occur, the LOCA would need to be of a smaller size so that RCS pressure is maintained greater than containment pressure. Although this limited break size, in conjunction with the procedure step, would probably cause vapor binding of the running LPI pumps, it is not known whether pump damage would result without operator action.

The following design considerations can effect post-LOCA boric acid dilution control.

The flow path through DH10 and DH26 was designed to drain coolant from the RCS hot leg following a large break LOCA on the RCS cold leg. No other break locations require this flow path. Inducing some forward flow through the core was deemed necessary to control boric acid concentration increases which could occur due to core boiling in the absence of any forward core liquid flow.

Description of Occurrence: (Continued)

In the large break LOCA scenario, the RCS would be depressurized to approximately containment pressure before the flow path through DH10 and DH26 would be manually initiated. With the RCS at approximately containment pressure, the pressure drop across the DH10 and DH26 piping would be very small, and flashing of reactor coolant would not be expected. Thus, the system would function as designed for large break LOCA scenarios.

For small break LOCAs where the system does not depressurize below approximately 92 psia, analysis provided by Framatome Technologies, Inc. (FTI) indicates that core temperature will remain high enough that boric acid solubility limits will not be exceeded.

A number of passive flow paths exist within the reactor vessel which should serve to provide passive dilution below 92 psia. The flow path through the Reactor Vessel Vent Valves (RVVVs), was credited in the original design basis analysis, but has been refined by more recent FTI analysis. For breaks which allow refilling or maintenance of level in the reactor vessel above the cold leg nozzles, RVVVs provide a passive dilution flow path which will allow the potentially concentrated core mixture to flow into the relatively dilute coolant in the reactor downcomer. This concentrated mixture outflow is replaced in the core by lower concentration coolant from the downcomer. At pressures below 92 psia, temperature is sufficiently low that clearance gaps between the hot leg nozzles on the internal diameter of the reactor vessel and the core barrel should open. These gaps allow spillover or leakage of the potentially concentrated core mixture into the relatively dilute coolant in the reactor downcomer. This flow path is credited in the DBNPS USAR. However, analysis supporting its use was focused primarily on large break LOCA. Another potential flow path should become effective at pressures below 20-30 psia. This flow path is driven by density differences. It induces flow downward along the baffle plates at the perimeter of the fuel assemblies, outward through drilled holes at the bottom of the core barrel, and upward into the reactor downcomer through the annular region between the core barrel and the thermal shield. This flow path can be effective, but is not currently credited in the design basis. It is currently believed that the combined effect of the above passive mechanisms are adequate to prevent post LOCA boric acid precipitation.

The flow path through DH10 and DH26 presently provides redundancy and an active flow path only for large break LOCA. As a small break LOCA progresses, it is desirable to transition from the containment sump/LPI cooling to the decay heat removal (DHR) system. For a small break on the RCS cold leg, sufficient water level should exist to allow initiation of the DHR system via the DHR drop line. Initiation of normal DHR would provide forward core flow and abundant dilution flow. In the case of a large or small break on the hot leg, the break would induce forward core flow and measures to control boric acid concentration would not be required.

Engineering judgment, based on studies which have been completed to date, indicates that current boric acid concentration control measures are sufficient. For small break LOCAs, the rate of boric acid concentration buildup is slow and a variety of anticipated operator actions, feasible for small break LOCAs, would preclude exceeding the boric acid solubility limit.

Description of Occurrence: (Continued)

Formation of a steam void in the suctions of both running LPI pumps after a LOCA could prevent the fulfillment of the safety function of a system needed to maintain the reactor in a safe shutdown condition. This condition is reportable in accordance with 10 CFR 50.72(b)(2)(iii)(A) and the Nuclear Regulatory Commission (NRC) was notified via the Emergency Notification System at 1549 hours on September 1, 1998.

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(v)(A) as a condition that alone could have prevented the fulfillment of a safety function of a system needed to shutdown the reactor and maintain it in a safe shutdown condition.

Apparent Cause of Occurrence:

Three potential methods of post-LOCA boric acid concentration control were described in Babcock and Wilcox Topical Report BAW-10105, rev. 1, "ECCS Evaluation of B&W's 177-FA Raised-Loop NSS," dated July, 1975. The first method involved shutting down one LPI pump, and restarting it in the DHR mode. The second involved shutdown of an LPI pump, and then backflowing around the shutdown pump through its recirculation line into the DH drop line. The third method utilized a hot leg injection method via the pressurizer auxiliary spray. Due to questions and answers with the NRC, the first and second methods were abandoned. The revised method, draining at least 40 gpm from the hot leg and combining it with the LPI pump emergency sump suction flow, was endorsed by the NRC in the Davis-Besse Safety Evaluation Report supplement, section 6.3.3.4, issued in April, 1977. These methods were clearly designed primarily for a large-break LOCA. Difficulties in the use of the system for small break LOCAs were not recognized. Subsequent system and procedural review also did not reveal the issue. Therefore, the cause of this condition is a design analysis oversight which led to inadequate procedural guidance.

Analysis of Occurrence:

Initiation of boron dilution following a LOCA is a supplementary action in the plant emergency procedure. There would be no effect on the initiation of LPI system after a LOCA and the LPI system would have performed its initial safety function as required by the DBNPS plant design basis. Alignment of the LPI system to provide a boron dilution flow path is controlled by the DBNPS plant emergency procedure, DB-OP-02000. This alignment of valves could have caused a loss of suction for some limited range of break sizes as discussed above. If a loss of suction of an LPI pump had occurred upon initiation of the long term boron dilution flow path, instrumentation is available to the plant operators to diagnose the condition. Technical Support Center personnel would also be available to assist the operators. Based on this, the operators should have been able to recognize and correct the condition without resulting in unrecoverable loss of LPI capability, or loss of adequate core cooling.

LICENSEE EVENT REPORT (LER)
TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Davis-Besse Unit Number 1	05000346	1998	-- 008 --	00	5 OF 5

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

Corrective Actions:

As interim corrective action, the DBNPS plant emergency procedure, DB-OP-02000 was revised to require Technical Support Center concurrence prior to initiation of long term boron dilution flow. This is to ensure the active boron dilution flow path is initiated only when RCS pressure drops to approximately equal to the containment pressure. Guidance on the differentiation of a true large break LOCA, from a small break LOCA that may have initial characteristics similar to a large break LOCA, was placed in the Technical Support Center on September 3, 1998. Key Technical Support Center supervisors were notified of this condition. Required reading was distributed to the appropriate Technical Support Center Engineering personnel on recognition of the conditions necessary for initiation of the long term boron dilution flow path. These actions were completed on October 1, 1998.

Additional procedural guidance will be developed for differentiation of a true large break LOCA from a small break LOCA that may have initial characteristics similar to a large break LOCA. This procedural guidance will be included in the plant emergency procedure, DB-OP-02000, or the appropriate plant emergency response organization implementing procedures. These procedure revisions will be completed by January 22, 1999.

An engineering evaluation will be conducted to assess the possibility of closing either DH10 or DH 26. Adequate dilution capability may be available through one boric acid dilution flow path. This engineering evaluation will be completed by February 5, 1999.

A plant modification (97-0074) was previously initiated to address all issues related to long term boron dilution following a LOCA. This plant modification will be completed by the end of the twelfth refueling outage.

Failure Data:

Licensee Event Report 91-006, "Analysis of Post Large Break LOCA Boron Concentration Was Potentially Non-Conservative," was submitted to the NRC on December 5,1991, and was revised on February 5, 1993. This LER was initiated as a result of a Babcock and Wilcox (B&W) Preliminary Safety Concern over a discrepancy in the analysis of two phase mixing through the reactor vessel vent valves. This concern was resolved in January, 1992, with the submittal of B&W Report 51-1206351-00 which justified the role of the internal leakage gaps as a method of passive boron dilution control. There have been no other LERs since then that address issues relative to boron dilution control following a LOCA.

There have been no other LERs in the last three years that potentially could have prevented the fulfillment of the safety function of a system needed to maintain the reactor in a safe shutdown condition as a result of a design analysis oversight.

NP-33-98-008-0 PCAQR 98-1641