NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Millstone Nuclear Power Station Unit 3	05000423	1 of 6

TITLE (4)

Potential Air/Gas Intrusion in Chemical and Volume Control System

EVENT DATE (5)			LER NUMBER (6)					REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER		REVISION NUMBER		MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
02	23	98	98	--	016	--	02	10	22	98	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	000	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)	50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.36(c)(2)	X 50.73(a)(2)(vii)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
David A. Smith, Manager, Unit 3 Regulatory Compliance	(860)437-5840

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

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

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

On February 23, 1998, with the unit in Mode 5, it was identified that there had been several Condition Reports (CRs) written since early 1997 describing Boric Acid pump air binding, or gas/air accumulation within the Boric Acid piping system. Gas/air accumulation within the system had resulted in the Boric Acid Pumps (3CHS*P2A and B) cavitating or becoming gas/air bound. Three primary pathways have been identified for gas/air intrusion: air introduced during batching operations, inadequate venting of connecting systems after maintenance, and gas stripping. This gas/air binding phenomenon has affected both trains of the Boric Acid System. The Boric Acid system remains operable with the exception of the gravity boration pathway. The Refueling Water Storage Tank is operable as an alternate boration path.

These conditions are reportable pursuant to 10 CFR 50.73 (a)(2)(vii) as "any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems or two independent trains or channels to become inoperable in a single system designed to: (A) Shut down the reactor and maintain it in a safe shutdown condition; [and] (D) Mitigate the consequences of an accident." This condition is historical.

The cause for air intrusion into the Boric Acid Pumps is inadequate initial design of the Boric Acid system piping configuration. There were no adverse safety consequences from this condition. The unit has not experienced a reactivity event where operation of the Boric Acid System has been needed, nor an event where emergency boration has been necessary.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Millstone Nuclear Power Station Unit 3	05000423	98	--	016	--	02	2 of 6

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

I. Description of Event

On February 23, 1998, with the unit in Mode 5, it was identified that there had been several Condition Reports (CRs) written since early 1997 describing Boric Acid pump air binding, or gas/air accumulation within the Boric Acid piping system. Gas/air accumulation within the system had resulted in the Boric Acid Pumps (3CHS*P2A and B) cavitating or becoming gas/air bound. Three primary pathways have been identified for gas/air intrusion: air introduced during Boric Acid batching operations, inadequate venting of connecting systems after maintenance, and gas stripping. This gas/air binding phenomenon has affected both trains of the Boric Acid System. The system remains operable with the exception of the gravity boration pathway. The Refueling Water Storage Tank (RWST) is operable as an alternate boration path.

During the Nuclear Regulatory Commission (NRC) Inspection [illegible] Section 40500 Inspection, a question was raised regarding the adequacy of the root cause investigation associated with Condition Report (CR) M3-97-0954, dated May 14, 1997, which attempted to determine the causes of the air binding problems with the Boric Acid Pumps. The root cause did not identify all the potential sources of air that could lead to air binding. CR M3-98-0975, dated February 19, 1998, was issued to re-evaluate the root cause.

(See attached figure for the following descriptions.)

The boric acid batching process has led to air intrusion because the air filled space in the vertical section of piping below the Boric Acid Batch Tank is swept into either the "A" or "B" Train when the batch tank drain valve is opened for filling and the respective train's pump is running for mixing during batching operations. Air binding of the Boric Acid Pumps could prevent the flow of boric acid from the system when called upon. Also, both pumps tie into a common header to the charging pumps. Sufficient air within the system could lead to air binding of one or more charging pumps as they take suction from a common header. These conditions are reportable pursuant to 10 CFR 50.73 (a)(2)(vii) as "any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems or two independent trains or channels to become inoperable in a single system designed to: (A) Shut down the reactor and maintain it in a safe shutdown condition; [and] (D) Mitigate the consequences of an accident." This condition is being dispositioned in accordance with the Millstone Corrective Action Program.

The Boric Acid System consists of two separate trains, each containing a Boric Acid Storage Tank (BAST), Boric Acid Pump (to transfer borated water from the storage tank to either the Volume Control Tank (VCT), the RWST, or the suction of the charging pumps), and associated piping and valves. The Boric Acid Batch Tank is located on the floor level above the two trains. There is a long vertical drop in the piping from the batch tank to a connection with each system. During a batching operation a slug of air is trapped in this line and is swept into the operating Boric Acid Pump as it circulates the boric acid solution for mixing. A vent valve was installed on this section of piping during this outage.

The physical configuration of the "A" Boric Acid System Gravity Boration lines contains a high point segment of piping which is at a much higher elevation (51 feet - 6 inches) than the elevation of the line running from the "A" Boric Acid Storage Tank to the suction of the "A" Boric Acid Pump (45 feet - 0 inches). This section of piping is a dead leg (only opened if gravity boration is needed) and provides a large volume to trap gas/air once introduced into the system.

On the "B" Boric Acid System suction piping the vertical line from the Boric Acid Batch Tank contains a short horizontal segment at an elevation of 47 feet - 10 inches, which connects a short vertical segment that leads down to the horizontal suction line between the "B" Boric Acid Storage Tank and the suction of the "B" Boric Acid Pump (elevation of 45 feet - 0 inches). This short horizontal section of piping at elevation 47 feet - 10 inches can also trap air during batching

operations.

An evaluation of gas stripping/accumulation has been completed. This evaluation determined that the stripped gas originates in the common line from the mini-flow orifices and the Reactor Coolant Pump number 1 seal leakoff. The most likely source of this gas is the orifices in the minimum flow line. The gas is then transported to the Charging pump suction header via the seal water return path. Due to the piping configurations, any gas accumulation migrates to the high points. Vent valves have been installed on these sections of piping.

II. Cause of Event

This condition is historical. The cause for air intrusion into the Boric Acid Pumps is inadequate initial design of the Boric Acid system piping configuration. Inadequacies in the design of the piping layouts and the lack of vents in some locations resulted in trapped air in the system. Contributing factors were inadequate batching and venting procedures. The boric acid batching process used introduced air into the System. The large amount of maintenance performed during this outage on portions of the Chemical and Volume Control and the Boric Acid Systems could have introduced air pockets into the Boric Acid System which may not have been adequately vented.

It has been determined that the stripped gas originates in the common lines from the mini-flow orifices and in the Reactor Coolant Pump number 1 seal leakoff. The most likely source of this gas is the orifices. The gas is then transported to the Charging pump suction header via the seal water return path. Due to the piping configurations, any gas accumulation would migrate to the high points.

III. Analysis of Event

The operability of the boric acid transfer portion of the Chemical and Volume Control System (Boron Injection System) ensures that sufficient negative reactivity control is available during each mode of operation. Failure to maintain the Boric Acid System lines full of borated water could result in portions of the piping containing voids and/or entrained gas pockets which could adversely affect the ability of the boric acid or charging pumps to function properly. The Boric Acid System and the Gravity Boration lines to the charging pumps are redundant to the Refueling Water Storage Tank. This condition is significant in that if these trains were inoperable when the RWST was inoperable this could have resulted in the unit operating in a condition that was outside the units design basis.

There were no adverse safety consequences from this condition, in that the unit has not experienced a reactivity event where operation of the Boric Acid System has failed, nor a Design Basis Event where operation of the emergency boration function has been necessary

IV. Corrective Action

There was no immediate impact on equipment operability and immediate corrective actions were not required because the unit was in full compliance with Technical Specification 3.1.2.1, "Boration Systems Flow Path - Shutdown," as both flow paths from the Refueling Water Storage Tank were OPERABLE.

The following corrective actions have been completed:

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Millstone Nuclear Power Station Unit 3	05000423	98	--	016	--	02	4 of 6

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

1. Troubleshooting of the Boric Acid System to determine the source(s) of air intrusion into the system and corrective actions have been identified.

2. Procedures have been revised to incorporate lessons learned from the troubleshooting effort to avoid air entrainment during Boric Acid batching operation to address deficiencies in the design of the system.

3. Vent valves have been added to the high points in the gravity boration pathways.

4. The effectiveness of Boric Acid batching procedure was validated and the procedure was revised as a result

5. An investigation of the potential sources of gas was performed.

6. A surveillance program was developed to periodically monitor the affected piping, to establish a gas accumulation rate and the required periodicity for venting gas to ensure charging pump operability.

7. A maximum allowed volume of gas was established for the boric acid gravity boration piping to ensure pump operability. Additionally, a procedure was developed to specify venting requirements and methodology.

The following corrective action remain to be completed:

1. Evaluate potential system modifications to minimize gas stripping and eliminate locations which promote gas accumulation. (Prior to Refueling Outage 6)

V. Additional Information

None

Similar Events

Listed below are other historical LERs which reported conditions resulting from inadequate design. A majority of these events were identified as a result of the Configuration Management Review Process.

LER 96-007-00	Containment Recirculation Spray, Quench Spray, and Safety Injection System Outside Design Basis Due to Design Errors
LER 96-009-02	Inoperable Shutdown Margin Monitors from Low Count Rate, Due to Inadequate Design Control
LER 96-013-00	Residual Heat Removal System Design Deficiency Due to Non-conservative Original Design Assumption
LER 96-026-02	Non-Conservative Primary Grade Water Flow Rates Used in Boron Dilution Safety Analysis
LER 97-003-00	Potential For Recirculation Spray System (RSS) Piping Failure Due To RSS Pump Stopping And Restarting During Accident Conditions
LER 97-015-00	Potential Vortexing of Recirculation Spray System Pumps
LER 97-021-00	Defective Design of RSS Expansion Joint Tie Rod Assembly
LER 97-028-00	Potential Loss of Net Positive Suction Head for Recirculation Spray System Pumps

LER 97-029-00	Design Basis Concern on SGTR Analysis for MSPRBV
LER 97-031-00	RHR Valve Low Pressure Open Permissive Bistable Setting Set Non-Conservatively
LER 97-035-00	Potential Nonconservatism for Steam Generator Water Level Low-Low Trip Setpoint Due to PMA Term Uncertainties
LER 97-041-00	Voluntary Report: Operation of Service Water System With Only One Pump Operable
LER 97-046-00	Containment Recirculation Spray System Cubicle Flood Potential
LER 97-048-00	Oversized PGS Impeller Could Potentially Result in Non-Conservative Boron Dilution Event
LER 97-051-00	Design Deficiency for 4.16kV Feeder Fault Clearing Times

Manufacturer Data

EIIS System Code

Reactor Coolant System	AB
Chemical and Volume Control System	CB

EIIS Component Code

Pump	P
Tank	TK
Valve	V

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
		YEAR	SEQUENTIAL NUMBER			REVISION NUMBER	
Millstone Nuclear Power Station Unit 3	05000423	98	--	016	--	02	6 of 6

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

BORIC ACID BATCHING SYSTEM
GRAVITY FEED SYSTEM
(Not to Scale)