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**D. F. Packer**

General Manager  
Plant Operations  
Waterford 3

W3F1-94-0186

A4.05

PR

November 4, 1994

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, D.C. 20555

Subject: Waterford 3 SES  
Docket No. 50-382  
License No. NPF-38  
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report Number LER-94-013-00 for Waterford Steam Electric Station Unit 3. This report is submitted as a voluntary Licensee Event Report.

Very truly yours,

D.F. Packer  
General Manager  
Plant Operations

DFP/DFL/tjs  
Attachment

cc: L.J. Callan, NRC Region IV  
G.L. Florreich  
J.T. Wheelock - INPO Records Center  
R.B. McGehee  
N.S. Reynolds  
NRC Resident Inspectors Office  
Administrator - LRPD

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## LICENSEE EVENT REPORT (LER)

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

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.

FACILITY NAME (1)

Waterford Steam Electric Station Unit 3

DOCKET NUMBER (2)

05000 382

PAGE (3)

1 OF 08

TITLE (4)

Boron Dilution While Rinsing CVC Ion Exchanger

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)		
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER	
08	19	94	94	013	00	11	04	94	N/A	05000	
									N/A	05000	
OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)									
1		20.402(b)			20.405(c)			50.73(a)(2)(iv)			73.71(b)
POWER LEVEL (10)		100			20.405(a)(1)(i)			50.73(a)(2)(v)			73.71(c)
		20.405(a)(1)(ii)			50.73(a)(2)(ii)			50.73(a)(2)(vii)			X OTHER
		20.405(a)(1)(iii)			50.73(a)(2)(i)			50.73(a)(2)(viii)(A)			(Specify in Abstract below and in Text, NRC Form 365A)
		20.405(a)(1)(iv)			50.73(a)(2)(ii)			50.73(a)(2)(viii)(B)			
		20.405(a)(1)(v)			50.73(a)(2)(iii)			50.73(a)(2)(x)			

## LICENSEE CONTACT FOR THIS LER (12)

NAME: D.C. Matheny, Operations Superintendent  
TELEPHONE NUMBER (include Area Code): (504) 464-3178

## 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)

YES (If yes, complete EXPECTED SUBMISSION DATE)	X	NO	EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
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## ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On August 19, 1994, an undesired boron dilution of the Reactor Coolant System (RCS) occurred while performing blended makeups to the Volume Control Tank (VCT) during the rinsing of a CVC Ion Exchanger. During this process, boric acid flow to the VCT decreased significantly, due to erratic behavior of the boric acid makeup header check valve (BAM-146).

The most probable cause of this event was the failure of BAM-146 to function properly. Unconservative decision making by Control Room personnel is considered a contributing factor. Corrective actions include replacing BAM-146 and increasing Operator awareness on reactivity management significance.

This event did not compromise the health and safety of the public and plant personnel in that no Technical Specification limits were exceeded and reactor power remained within the acceptable band. Two other boron dilution events have been reported as voluntary LER's by Waterford 3 this year, but neither was similar in cause. This report is being submitted as a voluntary LER.

REQUIRED NUMBER OF DIGITS/CHARACTERS  
FOR EACH BLOCK

BLOCK NUMBER	NUMBER OF DIGITS/CHARACTERS	TITLE
1	UP TO 46	FACILITY NAME
2	8 TOTAL 3 IN ADDITION TO 05000	DOCKET NUMBER
3	VARIES	PAGE NUMBER
4	UP TO 76	TITLE
5	6 TOTAL 2 PER BLOCK	EVENT DATE
6	7 TOTAL 2 FOR YEAR 3 FOR SEQUENTIAL NUMBER 2 FOR REVISION NUMBER	LER NUMBER
7	6 TOTAL 2 PER BLOCK	REPORT DATE
8	UP TO 18 -- FACILITY NAME 8 TOTAL -- DOCKET NUMBER 3 IN ADDITION TO 05000	OTHER FACILITIES INVOLVED
9	1	OPERATING MODE
10	3	POWER LEVEL
11	1 CHECK BOX THAT APPLIES	REQUIREMENTS OF 10 CFR
12	UP TO 50 FOR NAME 14 FOR TELEPHONE	LICENSEE CONTACT
13	CAUSE VARIES 2 FOR SYSTEM 4 FOR COMPONENT 4 FOR MANUFACTURER NPRDS VARIES	EACH COMPONENT FAILURE
14	1 CHECK BOX THAT APPLIES	SUPPLEMENTAL REPORT EXPECTED
15	6 TOTAL 2 PER BLOCK	EXPECTED SUBMISSION DATE

**LICENSEE EVENT REPORT (LER)**  
**TEXT CONTINUATION**

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FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)	PAGE (3)
		YEAR      SEQUENTIAL NUMBER      REVISION NUMBER	
Waterford Steam Electric Station Unit 3	05000 382	94      --      013      --      00	02 OF 08

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

**REPORTABLE OCCURRENCE**

On August 19, 1994 an inadvertent dilution of the RCS (EIIS Identifier AB) occurred at Waterford 3, resulting in several minor reactor power excursions. During this event, no Technical Specification safety limits were exceeded, nor did the event result in the plant being in a degraded or unanalyzed condition. At no time during the event was the allowable reactor power limit exceeded. Therefore, it has been determined that this event does not meet the reporting threshold of 10CFR50.73. However, Waterford 3 feels that this issue may be of generic concern and this report is being provided as a voluntary LER.

**INITIAL CONDITIONS**

Plant Power: 100%

Mode: 1

Procedures Being Performed Specific to this Event:  
OP-002-005, "Chemical and Volume Control"

Technical Specification LCO's in Effect Specific to this Event: None

Major Equipment Out of Service Specific to this Event: None

**EVENT SEQUENCE**

On August 19, 1994, in preparation for a scheduled downpower on August 20, 1994 for turbine valve testing, a rinse of Chemical and Volume Control (CVC) Ion Exchanger C (EIIS Identifier CB-IX) was performed. Ion Exchanger C was to be placed in service in series with Ion Exchanger A in an effort to increase iodine removal capabilities for the expected iodine spike as a result of the downpower. Additionally, a second charging pump was started to reduce iodine levels in the RCS in anticipation of the spike. In preparation for the rinse, a series of blended makeups to the VCT (EIIS Identifier CB-TK) were performed, raising the VCT level to 75%.

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

At 1030 hours the Primary Nuclear Plant Operator (PNPO) commenced rinsing CVC Ion Exchanger C to Holdup Tank B (EIIS Identifier CA-TK). At the same time, a blended makeup was initiated to attempt to maintain VCT level during the evolution. After several makeup additions, boric acid flow began to decrease due to valve BAM-146 (EIIS Identifier CB-V) restricting flow. By 1050 hours boric acid flow to the VCT dropped to less than 10 gpm (from previous rates of 15 gpm to 20 gpm), and by 1120 hours it was down to approximately 6 gpm. Operations personnel in the control room decided to compensate for this reduced flow by directly borating to the suction of the charging pumps, eventually abandoning boron injection to the VCT altogether.

At 1130 hours, letdown flow to the ion exchanger was bypassed directly to the VCT in an attempt to increase VCT level, which was dropping rapidly. Bypassing the ion exchanger was performed several times over the next two hours, maintaining VCT level at about 50%. During this time direct boration to the RCS was continued to maintain reactor power and temperature. At 1255 hours reactor power began to rise, and direct boration was increased. PPS Channel A High Linear Power Pretrip (EIIS Identifier JC-JA) was activated but cleared only minutes later. Several power transients took place within the next hour, reaching a maximum reactor power of approximately 100.4%, before the VCT boron concentration equalized with the RCS. At 1311 hours, PPS Channels A & D High Linear Power Pretrips were actuated and then cleared minutes later. At this time, letdown flow to the ion exchanger was secured. Reactor power was stabilized below 100% by 1350 hours.

**CAUSAL FACTORS**

It has been determined that the most probable cause of this event is the failure of valve BAM-146 to function properly. Although there is no obvious, detectable deficiency with the valve, the maintenance history along with recent observations and testing indicate that the current boric acid flow problems are being caused by BAM-146 performance.

A Condition Identification (CI#256808) was written for BAM-146 in June of

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1988 because the valve appeared to be sticking and was limiting boric acid flow to about 7 gpm. No work could be done on the valve because the threads of the cap galled when maintenance personnel attempted to remove it. It was recommended to use the valve as is and to replace it at a later date. Once the threads were galled, no further problems with that valve were documented. On March 10, 1994, during Refuel 6, BAM-146 was replaced (Work Authorization (WA) #01056973) with an almost identical valve.

A special test was performed on September 14, 1994 on the section of piping containing BAM-146. Pressure and flow measurements were made for several injections of boric acid to the VCT, each performed within minutes of the other. The problem of increasingly limited flow with consecutive injections was reproduced by this test. The test attempted to push 30 gpm of boric acid through the 1 inch line, which should produce a  $\Delta P$  of about 5 psi across the valve. On the first attempt, a flow of 21.4 gpm was achieved with a  $\Delta P$  of 47.5 psi. On the following attempts, flow decreased as had previously been experienced, and pressure increased respectively. The fourth attempt produced a flow of only 12.75 gpm and a  $\Delta P$  of 62.5 psi. These results indicate that flow is being restricted by BAM-146, resulting in a significantly large pressure drop across the valve.

Although the mechanical performance of BAM-146 cannot be viewed externally, there are other indications, in addition to the special test, that the valve is responsible for the flow problems. Primary Makeup Water (PMU; EIIIS Identifier KC) flow just downstream of BAM-146 has not been restricted in any way, and boric acid flow through BAM-143, which branches off just upstream of BAM-146, has not been restricted. Given that BAM-146 is the only component in the subject line, and that flow problems began to recur after the current valve was installed, it is believed that a mechanical deficiency exists within the valve.

Prior to this event, on July 20, 1994, a Condition Report (CR-94-692) was written against BAM-146 regarding inconsistent and decreased boric acid flow rates during repetitive makeups to the VCT. The CR states that flow rates of at least 15 gpm can be achieved when initially making up to the VCT, but in subsequent makeups, flow rates of only 7 gpm can be achieved. The CR also mentions that BAM-146 was replaced during Refuel 6 because of



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similar problems, and that the problems continue to exist.

Operations personnel in the control room on August 19 were not aware that this CR had been written. No caution tags were placed to indicate the existing condition and there was no formal communication of the condition to the operating staff. The PNPO and Secondary Nuclear Plant Operator (SNPO) were aware of the past problems with BAM-146. Blended makeups to the VCT are performed routinely, but most are single evolutions and have no flow rate restrictions. In addition, the preliminary makeups performed to fill the VCT before the ion exchanger rinsing achieved full boric acid flow (>15 gpm).

Operations personnel on another shift were questioned as to their knowledge of the problems with boric acid flow. They responded that they were conscious of the problems and were aware that a CR had been written.

As boric acid flow decreased and plant operators were unable to get more acid flow through BAM-146, they decided to directly borate to the RCS to maintain reactor power and temperature, and continued to do so throughout the remainder of the evolution. This decision was made in order to balance acid with PMU flow. This exercise was exacerbated by the fact that two charging pumps were draining the VCT at a high rate. It appears, however, that the operating crew placed too much emphasis on continuing the evolution given the problems that were encountered. A preferable decision would have been to secure the rinse, once acid flow problems were discovered, to avoid RCS dilution.

**IMMEDIATE CORRECTIVE MEASURES**

When the operating crew realized that power transients could not be controlled by direct boration alone, Letdown flow to the ion exchanger was secured and reactor power was stabilized below 100%.

A warning that BAM-146 is not operating properly and can restrict acid flow to the VCT was incorporated into the Daily Instructions for Operations personnel. The instructions state that blends to the VCT must be slow and deliberate.

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A description of the current problems with BAM-146 was also documented on an Operations Workaround Input Form to assure that Control Room personnel are aware of the existing condition.

An event review team was formally established to investigate the event.

X-rays of BAM-146 were taken to ensure proper configuration of the valve (i.e. ensure it is not spring-loaded).

#### ACTIONS TO PREVENT RECURRENCE

Waterford 3 has implemented or will implement the following corrective actions to prevent recurrence:

BAM-146 will be removed and replaced no later than the end of the next refueling outage (Refuel 7) with an equivalent swing check valve per Substitute Part Equivalency Evaluation Request (SPEER) # 9401321.

Testing and/or disassembly of the valve will be performed in order to determine any deficiencies which may have caused the valve to fail to function properly.

Any deficiencies discovered with BAM-146 will be addressed regarding the possibility of generic concern with similar type valves at Waterford 3.

Operations Procedure OP-002-005, "Chemical and Volume Control," was reviewed in light of this event. This procedure has been changed to require only one charging pump to be used when rinsing ion exchangers in a series lineup.

The Operations Superintendent will discuss reactivity management and conservative actions with all Operations Personnel.

Specific Instructions concerning blended makeups, borations and dilutions to the RCS were entered into the Daily Instructions for Nuclear Plant Operators (NPO's) and Control Room Supervisors (CRS's) on August 25, 1994.



<b>NRC FORM 366A</b> <small>(5-92)</small>		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>		<b>APPROVED BY OMB NO. 3150-0104</b> <b>EXPIRES 5/31/95</b>	
<b>LICENSEE EVENT REPORT (LER)</b> <b>TEXT CONTINUATION</b>				ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 60.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), 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.	
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The instructions include actions to take if NPO's and Nuclear Auxiliary Operators (NAO's) experience difficulty in performing an intended task. They also instruct NPO's to verify their techniques for reactivity control are in compliance with approved plant procedures. Review of these instructions by Operations Personnel has been completed.

The Control Room Shift involved with this event was observed as an operating shift crew in the Simulator on August 22, 1994. Two approved practice Simulator scenarios were observed by the Assistant Operations Superintendent and two Operations Training Instructors. The shift's performance was satisfactory.

The Operations Superintendent monitored the operational performance on the Simulator of the Control Room Shift involved with this event on 08/30/94 to ensure an acceptable performance level.

The Training Department will conduct training with all Licensed Operators and Shift Technical Advisors on "Reactivity Management" with emphasis on system response to boric acid and makeup additions.

The Vice President Nuclear has conducted talks on reactivity management with all Shift Supervisors.

**SAFETY SIGNIFICANCE**

This event did not compromise the health and safety of the public. Other than problems with BAM-146, no equipment failures were observed during this event, and all other systems functioned as designed. The operating crew responded to the increasing reactor power and temperature and maintained the plant in a safe condition. At no time during the event did the plant exceed the allowable reactor core power limit.

**SIMILAR EVENTS**

Two other boron dilution events at Waterford have recently been reported as voluntary LER's (LER-94-010 and LER-94-011), but neither was similar in cause. The first event, which occurred on June 7, was caused by an

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inadequate review of the design package which installed the Letdown Radiation Monitor (EIIIS Identifier CB-MON-RA). The second event, which occurred on July 20, was caused by operator personnel error. In neither case was the plant's allowable reactor power limit exceeded.