

December 9, 2005

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United States Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Byron Station, Unit 1  
Facility Operating License No. NPF-37  
NRC Docket No. STN 50-454

Subject: Fourth Supplemental Report to Licensee Event Report (LER) 454-2002-001-00

Enclosed is the fourth and final supplemental report to an LER involving the March 8, 2002, event involving multiple Main Steam Safety Valves on Unit 1 exceeding acceptance criteria for their Inservice Testing setpoint test.

Should you have any questions concerning this matter, please contact Mr. William Grundmann, Regulatory Assurance Manager, at (815) 406-2800.

Respectfully,

(signed by Stephen E. Kuczynski)

Stephen E. Kuczynski  
Site Vice President  
Byron Nuclear Generating Station

Attachment LER 454-2002-001-04

<b>NRC FORM 366</b> (7-2001)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b>			<b>APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004</b>						
<b>LICENSEE EVENT REPORT (LER)</b>		Estimated burden per response to comply with this mandatory information collection request: 50 hours. 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.									
<b>1 FACILITY NAME</b> Byron Station, Unit 1				<b>2 DOCKET NUMBER</b> 05000454			<b>3 PAGE</b> 1 OF 7				
<b>4. TITLE</b> Multiple Main Steam Safety Valve Relief Tests Exceeded Required Tolerance Due to Disk to Nozzle Metallic Bonding and Setpoint Drift											
<b>5. EVENT DATE</b>			<b>6. LER NUMBER</b>			<b>7. REPORT DATE</b>			<b>8. OTHER FACILITIES INVOLVED</b>		
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER	
03	08	2002	2002	- 001	- 04	12	09	2005		05000	
<b>9. OPERATING MODE</b>		1		<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5:</b> (Check all that apply)							
<b>10. POWER LEVEL</b>		92		20.2201(b)		20.2203(a)(3)(ii)		50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)		
				20.2201(d)		20.2203(a)(4)		50.73(a)(2)(iii)	50.73(a)(2)(x)		
				20.2203(a)(1)		50.36(c)(1)(i)(A)		50.73(a)(2)(iv)(A)	73.71(a)(4)		
				20.2203(a)(2)(i)		50.36(c)(1)(ii)(A)		50.73(a)(2)(v)(A)	73.71(a)(5)		
				20.2203(a)(2)(ii)		50.36(c)(2)		50.73(a)(2)(v)(B)	OTHER		
				20.2203(a)(2)(iii)		50.46(a)(3)(ii)		50.73(a)(2)(v)(C)	Specify in Abstract below or in NRC Form 366A		
				20.2203(a)(2)(iv)		50.73(a)(2)(i)(A)		50.73(a)(2)(v)(D)			
				20.2203(a)(2)(v)	X	50.73(a)(2)(i)(B)		50.73(a)(2)(vii)			
				20.2203(a)(2)(vi)		50.73(a)(2)(i)(C)		50.73(a)(2)(viii)(A)			
				20.2203(a)(3)(i)		50.73(a)(2)(ii)(A)		50.73(a)(2)(viii)(B)			
<b>12. LICENSEE CONTACT FOR THIS LER</b>											
NAME William Grundmann, Regulatory Assurance Manager						TELEPHONE NUMBER (Include Area Code) (815) 406-2800					
<b>13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT</b>											
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	
X	SB	SV	C568	YES							
<b>14. SUPPLEMENTAL REPORT EXPECTED</b>							<b>15. EXPECTED SUBMISSION DATE</b>		MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)							X NO				

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

During setpoint testing of the Unit 1 Main Steam Safety Valves (MSSVs) on March 7 and 8, 2002, three of the 20 MSSVs (i.e., 1MS014D, 1MS015C, and 1MS014C) failed to meet Technical Specification (TS) required lift setpoint tolerances. Operations personnel entered the applicable TS Action Condition until each valve was tested satisfactorily. Because the MSSVs were tested sequentially, only one valve was known to be inoperable at any one time. The cause of the 1MS014C and 1MS015C test failures is attributed to metallic bonding between the disk and the nozzle. This phenomenon is characterized by MSSVs experiencing a high initial lift setting followed by a significant drop in the lift setpoint, with no intervening adjustments. The 1MS015C had the new Inconel X-750 disk material, which is believed to be less susceptible to metallic bonding. The evaluation for this valve failure continues and a supplemental report will be issued. The cause of the third valve's test failure is attributed to setpoint drift. Corrective actions include replacing the 1MS014C and 1MS014D valves' disks with the X-750 Inconel material. An engineering analysis concluded that the design basis analyses bounded the out-of-tolerance MSSV condition. The condition of multiple MSSVs being outside of their required lift setting tolerance band is reportable in accordance with 10 CFR 50.73(a)(2)(i)(b), "Any operation or condition prohibited by the plants Technical Specifications."

Byron Station will continue to monitor the performance of the MSSVs through the 2004 and 2005 refuel outages and issue a supplemental report in late 2005.

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**A. Plant Conditions Prior to Event:**

Event Date / Time: March 8, 2002 / 1129 hours

Unit 1 – Mode 1 – Power Operations, Reactor Power – 92%

Reactor Coolant System [AB]: Normal operating temperature and pressure

No structures, systems or components were inoperable at the start of the event that contributed to the event.

**B. Description of Event:**

On March 7, 2002, with Unit 1 at 92% power and 510 days of continuous power operation, the setpoint testing of the Unit 1 Main Steam Safety Valves (MSSVs) was initiated in preparation for the upcoming refueling outage (i.e., B1R11) scheduled to begin on March 9, 2002. The MSSVs are tested each cycle to meet the In-Service Testing (IST) program. Specifically, the IST program requires testing a minimum of four valves (20%) out of the 20 total MSSVs on the four steam generator loops, with all 20 valves being tested at least once every five years. Normally, an initial sample of six or seven valves are selected to ensure all 20 valves are tested every five years. For the most recent refuel outage (i.e., B1R11), the initial plan was to test nine valves to meet the code requirement of testing all 20 valves in five years, including an additional selection of valves experiencing performance concerns and valves previously refurbished with Inconel X-750 disk material. However, due to the test failures incurred, the testing sample was expanded to include all 20 valves. These MSSV tests verify that the actual MSSV lift settings are in accordance with Technical Specification (TS) 3.7.1, "Main Steam Safety Valves." The Technical Specification allows a 3% tolerance on the as-found lift setting and requires all tested valves to be set to a 1% as-left tolerance. The test determines each valve's actual lift setting using normal system pressure with assistance from a hydraulic testing device. The MSSV testing is performed in accordance with Byron Station Maintenance Procedure (BMP) 3114-15, "Main Steam Safety Valve Verification of Lift Point Using Furmanite's Trevitest Equipment." The procedure's as-left acceptance criteria require two consecutive lift tests within 1% of the valve's required lift setpoint with no adjustments performed between these tests.

The MSSV tests were initiated on March 7, 2002, and completed on March 9, 2002. The MSSV tests, and any required valve adjustments, were performed on only one valve at a time. Valves not meeting acceptance criteria were adjusted (if required) and satisfactorily tested before proceeding to the next valve.

The initial lift tests performed on three of the 20 MSSV valves exceeded the 3% Technical Specification as-found limit. However, the final two lift tests performed on two (i.e., 1MS014C and 1MS015C) of the three valves, before any adjustments, were within the 1% TS as-left limit.

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**B. Description of Event (continued):**

These two MSSV's did not require any setpoint adjustment to leave them within the 1% as-left criteria. Maintenance personnel had to adjust the remaining valve (i.e., 1MS014D) to put it within the 1% as-left tolerance.

Operations personnel were notified. TS 3.7.1 Action Condition entry and exit times were as follows:

Valve	Date/Time of TS Action Condition Entry	Date/Time of TS Action Condition Exit
1MS014D	03/07/02 @ 14:20	03/07/02 @ 15:15
1MS015C	03/08/02 @ 09:33	03/08/02 @ 09:57
1MS014C	03/08/02 @ 10:58	03/08/02 @ 11:29

The specified lift, initial, second, and as-left settings for each of the failed valves, the 1% and 3% Technical Specification limits, and the initial high lift tolerance % were as follows:

Valve	Tech Spec Setpoint (psi)	3% Tech Spec Limits (psi)	Initial Lift (psi)	% Diff.	Second Lift (psi)	As-Left Lift (psi)	1% Acc Crit Limits (psi)
1MS014C	1220	1183-1257	1266	+3.8%	1234	1218	1208-1232
1MS014D	1220	1183-1257	1264	+3.6%	1251	1218	1208-1232
1MS015C	1205	1169-1241	1255	+4.1%	1207	1211	1193-1217

The condition of multiple MSSVs being outside of their required lift setting tolerance band is reportable in accordance with 10 CFR 50.73 (a)(2)(i)(b), "Any operation or condition prohibited by the plants Technical Specifications."

**C. Cause of Event:**

The cause of the 1MS014C MSSV lifting in excess of the 3% TS as-found acceptance criteria is attributed to metallic bonding between the 400 series stainless steel disk and the nozzle resulting in an increase in the valve's lift setpoint. Industry experience has shown that Dresser MSSVs, model 3707R, can experience oxide bonding between the disk and the nozzle resulting in an increase in the valve's lift setpoint.

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**C. Cause of Event (continued)**

The cause of the 1MS015C MSSV failure lifting in excess of the 3% TS as-found acceptance criteria is also believed to be oxide bonding between the X-750 Inconel disk and the nozzle resulting in an increase in the valve's lift setpoint. This valve had the X-750 disk installed during the previous refuel outage due to previous disk bonding performance. This is the first occurrence of oxide bonding at Byron Station of a MSSV with the X-750 disk material. Braidwood Station also experienced failures of MSSV's with the X-750 material installed during their last refueling outage. Byron and Braidwood Stations are the only two sites in the country to have substantiated X-750 disk bonding events. Braidwood Station recently completed a root cause evaluation and has concluded the reason as to why the X-750 disks showed signs of sticking/oxide bonding is indeterminant. However, two factors will continue to be evaluated by Exelon Corporate Engineering as possible contributing causes.

The affect from long continuous runs:

Both Byron and Braidwood Stations had continuous runs on the affected units for greater than 500 days. The lack of thermal cycles on the MSSVs may be conducive to providing optimum disk bonding conditions over time.

The thickness of the oxide layer:

The thickness of the oxide layer of a X-750 disk removed from Diablo Canyon which did not experience bonding was approximately three times thicker than the layer on a Braidwood Station X-750 disk that did experience the bonding phenomenon.

The cause of the 1MS014D MSSV lifting in excess of the 3% TS as-found acceptance criteria is attributed to setpoint drift. It required adjustment to return to within the as-left tolerance of 1%, but did not exhibit the greater than 2% drop between the first and second lifts which would be indicative of disk bonding. 1MS014D was disassembled and no internal abnormalities were noted that would have explained the initial high out-of-tolerance as-found setpoint.

**D. Safety Analysis:**

The primary purpose of the MSSVs is to provide overpressure protection for the secondary system. These valves also provide protection against over-pressurizing the reactor coolant pressure boundary by providing a heat sink for the removal of energy from the reactor coolant if the preferred heat sink provided by the condenser (SD) is not available. The MSSVs also serve as containment isolation valves.

An engineering evaluation was conducted to determine the impact of the MSSV out of tolerance condition on the Chapter 15, "Accident Analyses," transients in the Updated Safety Analysis Report.

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**D. Safety Analysis (continued):**

This analysis concluded that considering the as-found MSSV setpoints, the conclusions of the Chapter 15 analyses still remain valid. Therefore, the overall impact on plant safety due to the identified condition was minimal.

**E. Corrective Actions:**

Maintenance immediately notified Operations after each of the initial MSSV lifts that exceeded the 3% TS limit and the appropriate TS Limiting Condition for Operations Action Condition was entered. Following additional lifts on the 1MS014C, 1MS014D, and 1MS015C valves, the valves were re-tested satisfactorily (i.e., within the 1% as-left tolerance limits), and the Action Condition exited.

The 1MS014C and 1MS014D valves were rebuilt with the X-750 Inconel disk material.

BMP 3114-15 will be revised to bias the as-left setpoints for valves refurbished with X750 disks to the low side of the 1% tolerance. This is not a corrective action to prevent bonding of MSSV's, but will allow additional margin to failure should the X-750 disk material exhibit disk bonding during future testing.

Test all six Unit 2 MSSV's with X-750 disk material during the upcoming fall 2002 outage. This will allow for more information concerning the extent of X-750 disk bonding and how it is affected by the plant operating conditions.

**Results of Fall 2002 Unit 2 MSSV Testing**

All six Unit 2 MSSVs with X-750 material were tested in the recent fall outage. All six MSSVs passed with no disc bonding noted. However, this testing occurred after only a 76 day continuous run following a Unit shutdown in June 2002 to repair a steam generator tube leak. This information will be factored into the ongoing engineering evaluation.

**August 2003 Update**

Byron Station plans to continue with the refurbishment of the MSSVs with the inconel X-750 material and also will continue to review the performance of this material through the two fall 2003 and one spring 2004 refuel outages at Byron and Braidwood Stations. The two suspected causes of long continuous steady state runs and the thickness of the oxide layer are still being explored. Actions that are currently in-progress or planned include the mid-cycle lift testing of a sampling of the MSSVs with the new disc material and oxidation treatments of the newly refurbished valves. Mid-cycle testing was conducted in February 2003 on 6 unit 1 valves with the new material. None of these MSSVs tested exhibited the disc bonding phenomena. An update will be reported in a supplemental to this LER in June 2004.

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### July 2004 Update

Byron Station has continued to refurbish MSSVs with the inconel X-750 material and has continued to review the testing performance of this material through the two fall 2003 refuel outages, a spring 2004 refuel outage at Byron Station and a spring 2004 mid-cycle test at Braidwood Station. The following summarizes the MSSVs performance:

September 2003, Byron Station Unit 1 tested all 20 MSSVs and none exhibited the disc bonding phenomena. 16 of the 20 valves have the X-750 material.

October 2003, Braidwood Station Unit 2 tested 13 MSSVs and only one valve exhibited minor disc binding. This valve had not been refurbished with the X-750 material. 4 of the 13 valves have the X-750 material.

March 2004, Byron Station Unit 2 tested 9 MSSVs and none exhibited the disc binding phenomena. 4 of the 9 valves have the X-750 material.

April 2004, Braidwood Station Unit 1 performed mid-cycle test of 3 MSSVs and none exhibited disc binding. All 3 valves have the X-750 material.

Based on the recent testing results, we believe the new X-750 material in conjunction with vendor oxidation treatment is the appropriate corrective action to eliminate the disc bonding phenomena at Byron Station. We will continue to monitor the performance of the MSSVs through the 2004 and 2005 refuel outages at Byron and Braidwood Stations and an update will be reported in a supplement to this LER if any disc bonding is noted in the new X-750 material.

### December 2005 Update - Final

The MSSV testing during the recent 2005 refuel outages at Byron and Braidwood Stations resulted in no additional MSSV failures due to disc binding. The X-750 material in conjunction with vendor oxidation treatment has eliminated the disc binding phenomena.

#### **F. Previous Occurrences:**

- 1) LER 455-1999-001-00, "Six of 20 Main Steam Safety Valve Relief Tests Exceeded Required Tolerance Due to Disk to Nozzle Metallic Bonding"
- 2) LER 455-2001-001-00, "Multiple Main Steam Safety Valve Relief Tests Exceeded Required Tolerance Due to Disk to Nozzle Metallic Bonding"

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**G. Component Failure Data:**

Manufacturer

Nomenclature

Model Number

Dresser

Main Steam Safety Valves

3707R