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Exelon Nuclear

10 CFR 50.73

July 19, 2006
BW060072

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Braidwood Station, Unit 1
Facility Operating License No. NPF-72
NRC Docket No. STN 50-456

Subject: Submittal of Supplemental Licensee Event Report Number 2006-001-01, Braidwood Unit 1 – "Unit 1 Reactor Coolant System Pressure Boundary Leakage Due To Inter-Granular Stress Corrosion Cracking of a Pressurizer Heater Sleeve"

The enclosed Licensee Event Report (LER) is being submitted in accordance with 10 CFR 50.73, "Licensee event report system," paragraph (a)(2)(i)(B) and paragraph (a)(2)(ii)(A). This LER is a supplement to LER 2006-001-00 which was submitted on June 26, 2006. This supplement clarifies the applicability of Technical Specification 3.4.13, "RCS Operational Leakage," Limiting Condition for Operation to the identification of leakage from the Unit 1 Pressurizer Heater Sleeve number 52.

There are no commitments contained in the attached report. Should you have any questions concerning this submittal, please contact Mr. Dale Ambler, Regulatory Assurance Manager, at (815) 417-2800.

Respectfully,

for

Keith J. Polson
Site Vice President
Braidwood Station

Enclosure: LER Number 2006-001-01

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory 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 and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 an 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.

LICENSEE EVENT REPORT (LER)

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

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4. TITLE

Unit 1 Reactor Coolant System Pressure Boundary Leakage Due To Inter-Granular Stress Corrosion Cracking of a Pressurizer Heater Sleeve

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	N/A
04	25	2006	2006	- 001 -	01	07	18	2006	FACILITY NAME: N/A	DOCKET NUMBER: N/A

9. OPERATING MODE

6

10. POWER LEVEL

0.0

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☒ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☒ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☐ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Michael Smith, Engineering Director	(815) 417-3800

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	AB	PZR	W120	Y	N/A	N/A	N/A	N/A	N/A

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On April 19, 2006, while removing insulation from the surge line of the Unit 1 pressurizer, an insulation contractor discovered boric acid on the insulation. On April 25, 2006, the leakage was identified as originating from the number 52 pressurizer heater near the upper weld between the pressurizer heater sleeve and heater coupling. Technical Requirements Manual Limiting Condition for Operation (TLCO) 3.4.f Condition A was entered for one or more ASME components not in conformance due to pressure boundary leakage. The heater coupling and a portion of the sleeve was cut out of the system and the remaining portion of the heater sleeve was plugged and welded using an engineered ASME section III repair detail. On April 28, 2006, following the repair of the pressurizer, TLCO 3.4.f Condition A was exited.

Analysis of the boric acid found on the pressurizer and the pressurizer insulation determined a leak existed during the past operating cycle which is not in compliance with Technical Specification 3.4.13, "RCS Operational Leakage," that states there will be no pressure boundary leakage in Modes 1, 2, 3 and 4. This leak was identified through refueling outage inspection activities, not during plant operation.

The root cause of the observed boric acid leakage was intergranular stress corrosion cracking of the number 52 pressurizer heater sleeve through a locally sensitized section of the Type 316 stainless steel base material. The corrective action to prevent recurrence will be the implementation of long-term recommendations provided by the Exelon Generation Company, LLC, Asset Management Group to prevent future leakage, and implementation of actions required to comply with industry guidance to accept visual examinations for evidence of leakage.

There were no safety consequences impacting plant or public safety as a result of this event. This event is being reported pursuant to 10 CFR 50.73(a)(2)(i)(B) and 10 CFR 50.73(a)(2)(ii)(A).

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

A. Plant Operating Conditions Before The Event:

Event Date: April 25, 2006 Event Time: 0030

Unit: 1 MODE: 6 Reactor Power: 0.0 percent

Unit 1 Reactor Coolant System (RCS) [AB] Temperature: 92 degrees F, Pressure: N/A

B. Description of Event:

There were no additional structures, systems or components inoperable at the beginning of the event that contributed to the severity of the event.

On April 19, 2006, at 0300, while removing insulation from the surge line of the Unit 1 pressurizer, an insulation contractor discovered boric acid on the insulation.

On April 25, 2006, at 0030, following an extensive investigation, Exelon Generation Company, LLC (EGC) identified rouging on the insulation penetration for pressurizer [AB] heater number 52. Rouging is the development of surface deposits or staining, and is an indication of possible high temperature steam impingement on stainless steel. The leakage was identified as originating from the number 52 heater near the upper weld between the pressurizer heater sleeve and heater coupling. Technical Requirements Manual Limiting Condition for Operation (TLCO) 3.4.f Condition A was entered for one or more ASME components not in conformance due to pressure boundary leakage.

Analysis of the boric acid found on the pressurizer and the pressurizer insulation determined a leak existed during the past operating cycle which is not in compliance with Technical Specification (TS) 3.4.13, "RCS Operational Leakage," that states there will be no pressure boundary leakage in Modes 1, 2, 3 and 4. This leak was identified through refueling outage inspection activities, not during plant operation.

The heater coupling and a portion of the sleeve was cut out of the system and the remaining portion of the heater sleeve was plugged and welded using an engineered ASME Section III repair detail. A complete visual inspection of all 78 pressurizer heaters was performed to determine the initial extent of condition. Heater number 52 was identified as the only source of boric acid leakage from the pressurizer.

On April 28, 2006, at 0143, following the repair of the pressurizer, TLCO 3.4.f Condition A was exited.

C. Cause of Event

The coupling and portion of the heater sleeve removed were shipped to a testing facility to determine the cause of the observed leak.

The failure analysis of the removed heater sleeve identified a through-wall crack located in the heat affected zone of the heater sleeve near the upper coupling weld. The failure was caused by circumferentially oriented intergranular stress corrosion cracking (IGSCC). The crack propagated through the heater sleeve heat affected zone appearing to be heavily sensitized during fabrication welding. Typically, the material used for the sleeve, Type 316 stainless steel, is not susceptible to IGSCC in a pressurized water reactor (PWR) environment. However, sensitized 316 stainless steel can be susceptible to IGSCC in stagnant PWR environments containing oxygen. With the heater

element inserted into the sleeve, a long, cylindrical, crevice, approximately 0.015" wide by 12" long, is created between the heater element and the sleeve.

Analysis of the boric acid found on the pressurizer and the pressurizer insulation determined a leak existed during the past operating cycle which is not in compliance with TS 3.4.13, "RCS Operational Leakage," that states there will be no pressure boundary leakage in Modes 1, 2, 3 and 4. This leak was identified through refueling outage inspection activities, not during plant operation.

The root cause of the observed boric acid leakage was IGSCC of the number 52 pressurizer heater sleeve though a locally sensitized section of the Type 316 stainless steel base material. The heater sleeve was sensitized through minor cold working of the inner diameter bore and by the heat generated by multiple weld passes on the coupling to heater sleeve weld.

D. Safety Consequences:

There were no safety consequences impacting plant or public safety as a result of this event.

All 78 PZR heater sleeves and couplings were visually inspected in the refueling outage. Heater 52 was confirmed to be the only leakage source. Based on the amount of boric acid present, the leak size was determined to be extremely small and the associated leak rate would be too small to be captured by normal surveillance methods. If leakage had increased, the normal charging system would be used to compensate for the leakage. The leak was identified through refueling outage inspection activities, not during plant operation. Had the pressure boundary leakage condition been identified in Modes 1, 2, 3 or 4, TS 3.4.13, "RCS Operational Leakage," would have required a Unit 1 shutdown to identify the leakage source and to perform the necessary repairs prior to resuming operation.

Operating experience for this design of stainless steel heater sleeve indicates that the heater at location 52 of Braidwood Unit 1 represents the only occurrence of IGSCC-induced circumferential cracking in the industry. With no other occurrences of leakage occurring in this large population of stainless steel heater sleeves, this data suggests an extremely low probability of occurrence of cracking in another heater sleeve.

A postulated severance or ejection of a heater sleeve due to circumferential cracking was evaluated. Ejection of a heater sleeve was found to be equivalent to a small break loss of coolant accident (SBLOCA). The consequences of such an event are bounded by the results of existing SBLOCA emergency core cooling system performance analysis.

Therefore, the impact on normal plant operation was insignificant.

This event did not result in a safety system functional failure.

E. Corrective Actions:

The corrective actions include:

- Cut out the failed heater sleeve portion, plug, and seal weld the sleeve to prevent further leakage. This action has been completed.
- Visually inspect all of the pressurizer heater sleeves for signs of boric acid leakage every refueling outage on Unit 1 and Unit 2, beginning with the next Unit 2 refueling outage, as the first inspection has already been completed on Unit 1. Inspections will be performed at every refueling outage, pending more definitive industry

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

guidance. Inspections are to be bare metal inspections conducted by opening the convection shields or by removal of the mirror insulation.

The corrective action to prevent recurrence will be the implementation of long-term recommendations provided by the EGC Asset Management Group to prevent future leakage, and implementation of actions required to comply with industry guidance to accept visual examinations for evidence of leakage.

F. Previous Occurrences:

There have been no previous similar events at Braidwood Station.

G. Component Failure Data:

Manufacturer	Nomenclature	Model	Mfg. Part Number
Westinghouse	Pressurizer	1100J48	N/A