Dominion Nuclear Connecticut, Inc.
Millstone Power Station
Rope Ferry Road
Waterford, CT 06385

Dominion

DEC 3 2003

Docket No. 50-336
B19016

RE: 10 CFR 50.73(a)(2)(i)(B)

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Millstone Power Station, Unit No. 2
Licensee Event Report 2003-004-00
Reactor Coolant System Pressure Boundary Leakage Event

This letter forwards Licensee Event Report (LER) 2003-004-00, documenting a condition that was discovered at Millstone Unit No. 2, on October 11, 2003. This LER is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B).

There are no regulatory commitments contained within this letter.

Should you have any questions regarding this submittal, please contact Mr. David W. Dodson at (860) 447-1791, extension 2346.

Very truly yours,

DOMINION NUCLEAR CONNECTICUT, INC.

Stephen P. Sarver, Director
Nuclear Station Operations and Maintenance

Attachment (1): LER 2003-004-00

cc: H. J. Miller, Region I Administrator
R. M. Pulsifer, NRC Project Manager, Millstone Unit No. 2
Millstone Senior Resident Inspector

JE22

Docket No. 50-336
B19016

Attachment 1

Millstone Power Station, Unit No. 2

LER 2003-004-00

NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

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.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Millstone Power Station - Unit 2	05000336	1 OF 3

TITLE (4)
Reactor Coolant System Pressure Boundary Leakage Event

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER 05000
10	11	2003	2003	– 004 –	00	12	03	2003	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	5
POWER LEVEL (10)	000

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

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)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
David W. Dodson, Supervisor Nuclear Station Licensing	860-447-1791

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

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)

This LER reports an event related to reactor coolant system pressure boundary leakage. On October 11, 2003, with the plant in Mode 5 (Cold Shutdown), a visual inspection of Millstone Unit No. 2 pressurizer heater penetrations and pressurizer instrument nozzle penetrations was being performed. Two heater sleeve penetrations were found to show indications of minor leakage as evidenced by boron precipitation build up on the outside of the penetrations. The cause of this event was a through-wall crack in two of the pressurizer heater sleeves as a result of primary water stress corrosion cracking. This allowed primary coolant into the annulus between the pressurizer lower head and the heater sleeve and therefore was a breach of the reactor coolant pressure boundary. Although most industry experience has identified axial cracking, recent inspections at Palo Verde identified the presence of some circumferentially oriented indications, predominantly in the area of the nozzle sleeve above the pressure boundary region. At Millstone Unit No. 2, the potential worst case situation of a circumferential crack that could result in the complete loss of the penetration would be well below the limiting hole size, less than 3 inch, for a Small Break Loss of Coolant Accident, and is therefore bounded by the current analysis basis. The heater elements were removed from the two identified locations, as well as two locations that were identified as leaking during the last refuel outage (2R14), and an ultrasonic test was performed to generally characterize the nature of the flaws. The defects were determined to be axial rather than circumferential and hence significantly less likely to suffer catastrophic failure. The leaking heater sleeves have been repaired by the use of Mechanical Nozzle Seal Assemblies.

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

This LER reports an event related to reactor coolant system [AB] pressure boundary leakage. The event was discovered during inspections conducted during refueling outage 15 (2R15).

1. Event Description

On October 11, 2003, with the plant in Mode 5 (Cold Shutdown), an in-service visual inspection of Millstone Unit No. 2 pressurizer [PZR] heater [EHTR] penetrations [PEN] and pressurizer instrument nozzle [NZL] penetrations was being performed. Two heater sleeve [SLV] penetrations were found to show indications of minor leakage as evidenced by boron precipitation build up on the outside of the penetrations. This leakage was too small to have been detected via normal means (containment particulate radiation monitors [RI] or other leakage monitoring [MON] systems) during cycle 15 operations.

The heater penetration nozzles in Combustion Engineering (CE) designed Nuclear Steam Supply Systems (NSSS) are fabricated from Alloy 600 (Inconel 600) and are joined to the pressurizer using partial penetration J-groove welds. The weld metal is also Alloy 600. Industry experience at other CE designed NSSSs has shown that these welds and nozzles are susceptible to primary water stress corrosion cracking (PWSCC). The inspection was being performed at Millstone Unit No. 2 as a result of this industry experience.

This event is being reported pursuant to 10CFR50.73(a)(2)(i)(B) as a condition prohibited by the plant's Technical Specifications. Technical Specification 3.4.6.2 states that in Modes 1 through 4 "Reactor Coolant leakage shall be limited to no Pressure Boundary Leakage." From the amount of boric acid build up on the outside of the pressurizer, it is conservatively assumed that the leakage could have existed in Modes 1 through 4.

2. Cause

The cause of this event was a through-wall crack in two of the pressurizer heater sleeves as a result of PWSCC. This allowed primary coolant to leak into the annulus between the pressurizer lower head and the heater sleeve, and therefore was a breach of the reactor coolant pressure boundary. A plant specific analysis of these cracks has not been done, but based upon ultrasonic inspections performed and industry experience cracks like these are due to PWSCC of the Alloy 600 heater sleeve. The thickness of the pressurizer lower head adjacent to the two leaking nozzles and other non-leaking nozzles was measured and no differences were noted.

The heater elements were removed from the two identified locations, as well as two locations that were identified as leaking during the last refuel outage (2R14), and an ultrasonic test was performed to generally characterize the nature of the flaws. The defects were determined to be axial rather than circumferential and hence significantly less likely to suffer catastrophic failure.

3. Assessment of Safety Consequences

The design function of the pressurizer is to maintain reactor coolant system pressure. This is done with a combination of heaters to raise the temperature in the pressurizer and spray valves [V] to lower the temperature in the pressurizer. The heater sleeves are part of the pressure boundary of the pressurizer. A through-wall crack in a heater sleeve creates a leak path in the reactor coolant pressure boundary that is not permitted by Technical Specifications.

PWSCC of a number of Alloy 600 penetrations has been observed in CE and other NSSS designed reactor coolant systems. Cracking has been observed in pressurizer heater sleeves, pressurizer instrumentation nozzles and resistance temperature detector [TE] nozzles on the reactor coolant piping. All of these penetrations are

made the same way with a partial penetration J-groove weld of the Alloy 600 to the vessel [VSL] or pipe. This cracking has been observed at virtually all CE designed plants.

The actual safety significance of the cracking found in these heater sleeves is low. The cracks from PWSCC are very tight and the leakage rate was well below the allowable rate of 1 gpm for unidentified leakage. The situation at Millstone Unit No. 2 is similar to the cracking found at other CE designed NSSSs. The defects at Millstone Unit No. 2 were determined by ultrasonic examination to be axial rather than circumferential, and hence significantly less likely to suffer catastrophic failure. Although most industry experience has identified axial cracking, recent inspections at Palo Verde identified the presence of some circumferentially oriented indications, predominantly in the area of the nozzle sleeve above the pressure boundary region. At Millstone Unit No. 2, the potential worst case situation of a circumferential crack that could result in the complete loss of the penetration would be well below the limiting hole size, less than 3 inch, for a Small Break Loss of Coolant Accident, and is therefore bounded by the current analysis basis.

The leaking heater sleeves have been repaired by the use of Mechanical Nozzle Seal Assemblies (MNSAs). The MNSA is a mechanical device with a mechanical seal that encapsulates the pressurizer heater sleeve to prevent leakage in the event of cracks in the sleeve or J-groove welds due to PWSCC of the Inconel 600 material. The MNSA also acts as a restraint to prevent a heater nozzle from ejecting from the vessel in the event of a complete circumferential failure of the heater sleeve. The MNSA design qualification test runs included simulated partial cracks and complete 360 degree cracks in the nozzles. When installed, the MNSA replaces both the sealing and structural integrity functions of the existing weld. Therefore, for heater nozzles repaired with a MNSA, the pressure boundary moves from the internal heater sleeve weld to the compression seal of the MNSA, external to the pressurizer.

4. Corrective Action

The leaking heater sleeves have been repaired by the use of MNSAs. The use of the MNSAs was approved by the Nuclear Regulatory Commission's Safety Evaluation Report, "Safety Evaluation of Relief Request RR-89-43, Temporary Installation of Mechanical Nozzle Seal Assemblies on Pressurizer Heater Penetration Nozzles, Millstone Power Station, Unit No. 2," dated October 28, 2003 (Accession No. ML032690807).

Long-term resolution of Alloy 600 PWSCC cracking concerns at Millstone Unit No. 2 is being addressed under the Millstone Corrective Action Program (CR-02-05391 and CR-03-08856).

5. Previous Occurrences

The PWSCC of the Alloy 600 heater sleeves at Millstone Unit No. 2 is similar to the PWSCC that has been found in the pressurizer heater nozzles and Control Element/Rod Drive Mechanisms (CEDM/CRDMs) at various plants (including Millstone Unit No. 2) within the past several years. The materials of construction and the design with partial penetration J-groove welds for the pressurizer heater sleeves are the same as for the CEDM/CRDM and Incore Instrumentation (ICI) nozzles. During refueling outage 2R15, Millstone Unit No. 2 completed an inspection of 100% of the reactor vessel head penetrations, 69 CEDMs, 8 ICIs and the vent line, via ultrasonic and liquid penetrant techniques. Eleven penetrations with shallow cracking below the J-groove weld on the outer diameter of eleven CEDMs were repaired. During 2R14, two heater sleeves were repaired with MNSAs and three CEDMs were repaired using a partial penetration replacement technique.

LER: 50-336/2002-001-00

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].