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Dominion

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Docket Nos. 50-336
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B18466

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

Millstone Power Station, Unit Nos. 2 and 3
Response to NRC Bulletin 2001-01
Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles

This submittal is the Dominion Nuclear Connecticut, Inc. (DNC) response to the Nuclear Regulatory Commission (NRC) Bulletin 2001-01, dated August 3, 2001[1]. The information for Unit No. 2 is included as Attachment 1 and the information for Unit No. 3 is included as Attachment 2. DNC will provide additional information regarding Unit No. 2 prior to December 31, 2001.

There are no regulatory commitments contained within this letter.

Should there be any questions regarding this submittal, please contact Mr. Paul R. Willoughby at (860) 447-1791, extension 3655.

Very truly yours,

DOMINION NUCLEAR CONNECTICUT, INC.

J. Alan Price, Vice President
Nuclear Technical Services - Millstone

Attachments (2)

cc: H. J. Miller, Region I Administrator
J. T. Harrison, NRC Project Manager, Millstone Unit No. 2
NRC Senior Resident Inspector, Millstone Unit No. 2
V. Nerses, NRC Senior Project Manager, Millstone Unit No. 3
NRC Senior Resident Inspector, Millstone Unit No. 3

A088

(1) Nuclear Regulatory Commission Bulletin from D. B. Matthews to the industry, "NRC Bulletin 2001-01: Circumferential Cracking of Reactor Pressure Vessel head Penetration Nozzles," dated August 3, 2001.

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Millstone Power Station, Unit Nos. 2 and 3

Response to NRC Bulletin 2001-01
Millstone Unit No. 2 Response

Response to NRC Bulletin 2001-01
Millstone Unit No. 2 Response

NRC Bulletin 2001-01, Question 1:

1. *All addressees are requested to provide the following information:*

   a. *the plant-specific susceptibility ranking for your plant(s) (including all data used to determine each ranking) using the PWSCC susceptibility model described in Appendix B to the MRP-44, Part 2, report;*

   b. *a description of the VHP nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;*

   c. *a description of the RPV head insulation type and configuration;*

   d. *a description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past 4 years, and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;*

   e. *a description of the configuration of the missile shield, the CRDM housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.*

Millstone Unit No. 2 Response

a. Millstone Unit No. 2 is ranked 29th in susceptibility out of 69 operating pressurized water reactors (PWR) in the United States, as compared to Oconee Unit No. 3 (ONS3), in the latest PWR reactor vessel head nozzle primary water stress corrosion cracking (PWSCC) assessment submitted to the NRC in an NEI letter dated August 21, 2001.[1] This ranking is based on the sum of two different time and temperature operating conditions. Millstone Unit No. 2 operated for the first 2.15 effective full power years (EFPY) with a head temperature of 586.9°F and then another 11.85 EFPY with a head temperature of 594°F. Unit No. 2 is currently running with a head temperature of 594°F. Unit No. 2 has 14.3 EFPY until reaching the equivalent time at temperature as ONS3. As described in the August 21, 2001, letter this calculation assumes that the activation energy used in the arrehenius relationship is 50kcal/mole. This places Unit No. 2 in the population of plants with moderate susceptibility to PWSCC as defined in NRC Bulletin 2001-01.

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[1] NEI letter to Dr. Brian Sheron (NRC), "Generic Information for Use by Licensees in Response to NRC Bulletin 2001-01," dated August 21, 2001.

b. Unit No. 2 has 69 vessel head penetrations (VHP) for control element drive mechanisms (CEDM), eight VHP for incore instrumentation (ICI) and one head vent. The penetrations are all made of ASME SB 167, Alloy 600 from Huntington Alloys. The vent line is three-quarter inch NPS Schedule 80S pipe. The nominal dimensions of these VHP's are as follows:

Type	Inside Diameter	Outside Diameter
CEDM	2.718 in.	3.850 in.
ICI	4.750 in.	5.563 in.
Vent	0.742 in.	1.050 in.

The minimum ligament distance between any two penetrations is 5.7 inches and occurs between the head vent and the number one CEDM penetration. The next smallest ligament distance between CEDMs is 7.3 inches. Most ligament distances are greater than 7.3 inches.

c. Unit No. 2 has encapsulated, contoured type insulation with panels between penetrations. Each penetration has a donut of insulation around it with panels of insulation between the rows of penetrations. The insulation is mineral wool encapsulated with stainless steel. The donut around each penetration is contoured to the head so that the gap is essentially zero.

d. Unit No. 2, which has a normal fuel cycle of approximately 18 months, conducts a visual inspection of the reactor coolant pressure boundary including the reactor pressure vessel at the start of each refueling outage. These inspections are done to locate boric acid deposits or other evidence of a pressure boundary leak. The inspections in the area around the reactor vessel are made with the insulation left in place and are also limited by the access doors to the cooling shroud which covers the CEDMs. However, the flange area and approximately the first foot of the reactor vessel head have the insulation removed for vessel head removal. Any indications of streaking or staining in this area are investigated to determine the source of the leak. Personnel performing these inspections are ASME Section XI VT-2 qualified. Results of these examinations to date have not identified any leakage which could be traced to the reactor VHPs.

Millstone Unit No. 2, also conducts visual inspections of the reactor coolant system pressure boundary including the reactor pressure vessel head during each plant start up following refueling. These inspections, which occur with the insulation in place, look for stream plumes or other evidence of leakage. Personnel performing these inspections are ASME Section XI VT-2 qualified. Results of these examinations to date have not identified any leakage which could be traced to the reactor VHPs.

In August 1997, Unit No. 2 performed a qualified eddy current (ECT) examination of all the CEDM and ICI reactor VHPs. The vent line was not included. The results of

these examinations were reported to the NRC in a letter dated February 12, 1998.[2] Seven shallow axial indications were found in CEDM penetration No. 15. The indications varied in length from 0.16 to 0.44 inches. The depth of these indications was measured with ultrasonics (UT). The depth of all the indications was less than 0.022 inches. The indications were removed by flapper wheel grinding to a depth of 0.032 inches. Removal was confirmed with ECT and UT examinations of the area.

e. The general arrangement of the reactor vessel closure head, and its relationship to the missile shield is shown in Millstone Unit No. 2 FSAR Figures 1.2-13 and 1.2-14. FSAR Figure 4.3-1 shows the general arrangement of the reactor head penetrations.

The CEDM housings are threaded and seal welded at the nozzles as depicted in FSAR Figure 3.3-15. The CEDM housings are free standing and extend approximately an additional 18 ft above the connection to the reactor head nozzles (approximate plant elevation 38 ft). Wiring connections for power and position indication are made near the top of each CEDM housing. A steel channel grid, which attaches to the outer periphery of the head lift rig, is located just above the top of the CEDMs and serves to support and route the cables for the CEDMs.

The ICI electrical connections are made at a special connector flange which is approximately 15 inches above the ICI nozzle penetration flange (approximate plant elevation 20 ft). As shown on FSAR Figure 4.3-1, the eight ICI connections are located around the outer periphery of the reactor head and are enclosed by the CEDM cooling shroud. The cables for the ICIs are routed through sheet metal cable trays which extend vertically from the outer periphery of the head to the top of the head lift rig structure.

The CEDM cooling shroud is a thin plate steel structure which surrounds the CEDM drive motors (i.e. mag jacks) and distributes cooling air from the cooling fans, located on the missile shield above, to the drive motors. The CEDM cooling system is generally depicted in FSAR Figure 1.2-14.

The head vent is constructed of a three quarter inch schedule 80S stainless steel pipe which is attached to the top central location of the head. The vent pipe then extends laterally to the outer periphery of the head where it connects to the remainder of the vent system.

The missile shield is located directly above the reactor head assembly as shown in FSAR Figure 1.2-13 and 1.2-14. The missile shield is a rectangular reinforced concrete and steel slab approximately 17 feet wide, 28 feet long, and 18 inches thick which spans the reactor containment refueling pool centered over the reactor.

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[2] Letter from M. L. Bowling to U.S. Nuclear Regulatory Commission, "Response to Generic Letter 97-01, Item 1, Degradation of Control Rod Drive Mechanism Nozzle and Other Vessel Closure Head Penetrations," dated February 12, 1998.

As discussed in FSAR Section 5.2.6, the primary purpose of the missile shield is to protect safety related systems, structures, and components from postulated missiles, including CEDM ejection, originating from the reactor vessel. The missile shield also serves as a base to which the CEDM cooling system heat exchangers and fans are mounted.

NRC Bulletin 2001-01, Question 2

2. *If your plant has previously experienced either leakage from or cracking in VHP nozzles, addressees are requested to provide the following information:*

   a. *a description of the extent of VHP nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;*

   b. *a description of the additional or supplemental inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken in response to identified cracking to satisfy applicable regulatory requirements;*

   c. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

   d. *your basis for concluding that the inspections identified in 2.c will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

      (1) *If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will be continue to be met until the inspections are performed.*

      (2) *If your future inspection plans do not include volumetric examination of all VHP nozzles, provide your bases for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will be satisfied.*

Millstone Unit No. 2 Response

This question is not applicable as Millstone Unit No. 2 has not previously experienced any leakage from or cracking of VHP nozzles.

NRC Bulletin 2001-01, Question 3

3. *If the susceptibility ranking for your plant is within 5 EFPY of ONS3, addressees are requested to provide the following information:*

a. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

b. *your basis for concluding that the inspections identified in 3.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

(1) *If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.*

(2) *If your future inspection plans include only visual inspections, discuss the corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.*

Millstone Unit No. 2 response

This question is not applicable as Millstone Unit No. 2 has a susceptibility ranking greater than 5 EFPY.

NRC Bulletin 2001-01, Question 4

4. *If the susceptibility ranking for your plant is greater than 5 EFPY and less than 30 EFPY of ONS3, addressees are requested to provide the following information:*

a. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

b. *your basis for concluding that the inspections identified in 4.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

(1) *If your future inspection plans do not include a qualified visual examination at the next scheduled refueling outage, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements sections will continue to be met until the inspections are performed.*

(2) *The corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.*

Millstone Unit No. 2 Response

As noted in the response to question 1a., Millstone Unit No. 2 is ranked as having greater than 5 EFPY and less than 30 EFPY until the equivalent time at temperature

before ONS3 is reached. As discussed under DNC's response to Question 1.d, Millstone proactively performed a 100% volumetric inspection of the VHPs in 1997 using the best available technology in place at that time. Axial indications identified during that inspection were repaired prior to returning the unit to service. Given the proactive response to this matter in 1997, the fact that Millstone Unit No. 2 currently is estimated to have 14.3 EFPY until reaching the equivalent time at temperature as ONS3, and the challenges associated with removal and reinstallation of the vessel head insulation package, DNC is not currently planning to perform additional inspections during the upcoming Millstone Unit No. 2 refueling outage.

DNC recognizes that inspection techniques beyond those employed in 1997 are necessary to identify and characterize the range of flaws that have been identified through recent industry experience. To that end, DNC has initiated discussions with equipment vendors regarding the range of inspection techniques, insulation removal and reinstallation options that may be available today or in the near future. Incorporation of lessons learned from ongoing industry efforts in these areas is a focus of these discussions. We expect to continue these discussions and will take into account industry experience gained from future inspections, including those conducted at Dominion's other nuclear facilities, as we develop an inspection plan for Millstone Unit No. 2.

DNC will provide an update to this response by December 31, 2001.

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Millstone Power Station, Unit Nos. 2 and 3

Response to NRC Bulletin 2001-01
Millstone Unit No. 3 Response

Response to NRC Bulletin 2001-01
Millstone Unit No. 3 Response

NRC Bulletin 2001-01, Question 1:

1. *All addresses are requested to provide the following information:*

   a. *the plant-specific susceptibility ranking for your plant(s) (including all data used to determine each ranking) using the PWSCC susceptibility model described in Appendix B to the MRP-44, Part 2, report;*

   b. *a description of the VHP nozzles in your plant(s), including the number, type, inside and outside diameter, materials of construction, and the minimum distance between VHP nozzles;*

   c. *a description of the RPV head insulation type and configuration;*

   d. *a description of the VHP nozzle and RPV head inspections (type, scope, qualification requirements, and acceptance criteria) that have been performed at your plant(s) in the past 4 years, and the findings. Include a description of any limitations (insulation or other impediments) to accessibility of the bare metal of the RPV head for visual examinations;*

   e. *a description of the configuration of the missile shield, the CRDM housings and their support/restraint system, and all components, structures, and cabling from the top of the RPV head up to the missile shield. Include the elevations of these items relative to the bottom of the missile shield.*

Millstone Unit No. 3 Response

a. Using the time at temperature model developed by EPRI, Unit No. 3 is ranked 56th out of 69 operating PWR's in the United States as compared to Oconee Unit No. 3 (ONS3).[1] This ranking is based upon operating for 9.3 effective full power years (EFPY) with a head temperature of 558°F. This value assumes an activation energy of 50 kcal/mole. Unit No. 3 has 115.6 EFPY until reaching the equivalent time at temperature as ONS3. This places Unit No. 3 in the population of plants with low susceptibility to primary water stress corrosion cracking (PWSCC) as defined in NRC Bulletin 2001-01.

b. Unit No. 3 has 78 vessel head penetrations (VHPs) for control rods (CRDM's) and one head vent. The penetrations are all made from ASME SB-167 Alloy 600 from Huntington Alloys. The dimensions of these VHP's is as follows:

Type	Inside Diameter	Outside Diameter
CRDM	2.75 in.	4.00 in.
Vent	0.815 in.	1.315 in.

[1] NEI letter to Dr. Brian Sheron (NRC), "Generic Information for Use by Licensees in Response to NRC Bulletin 2001-01," dated August 21, 2001.

The minimum ligament distance is 5.8 inches between the vent line and the number 1 CRDM. The minimum ligament distance between any two CRDM's is 8.0 inches.

c. Unit No. 3 has reflective horizontal insulation. The smallest gap is about two inches at the top of the reactor vessel head.

d. Each cold shutdown Millstone Unit No. 3 conducts a visual inspection of the reactor coolant pressure boundary bolting which is susceptible to degradation from boric acid (C EN 109). The inspection includes the reactor pressure vessel, pressurizer and steam generator. The inspections are performed with the insulation in place, specifically looking at seams and low points in accordance with the ASME Section XI inspection criteria. The inspectors are qualified to ASME Section XI VT-2.

During each refueling Millstone Unit No. 3, in accordance with ASME Code Case N-533, removes the insulation at all the class one bolted connections and inspects for indications of leakage, past or present. Following start up from each refueling outage, Millstone Unit No. 3 conducts a visual inspection of the reactor coolant pressure boundary including the reactor vessel head area. The insulation is in place for this inspection. The inspectors are qualified to ASME Section XI VT-2.

e. The configuration of the equipment above the reactor vessel head and below the missile shield can be found on the attached Drawing No. 2512-27013 (Attachment 2a).

NRC Bulletin 2001-01, Question 2

2. *If your plant has previously experienced either leakage from or cracking in VHP nozzles, addressees are requested to provide the following information:*

   a. *a description of the extent of VHP nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;*

   b. *a description of the additional or supplemental inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken in response to identified cracking to satisfy applicable regulatory requirements;*

   c. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

   d. *your basis for concluding that the inspections identified in 2.c will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

      (1) *If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will be continue to be met until the inspections are performed.*

(2) *If your future inspection plans do not include volumetric examination of all VHP nozzles, provide your bases for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will be satisfied.*

Millstone Unit No. 3 Response

This question is not applicable as Millstone Unit No. 3 has not previously experienced any leakage from or cracking of VHP nozzles.

NRC Bulletin 2001-01, Question 3

3. *If the susceptibility ranking for your plant is within 5 EFPY of ONS3, addressees are requested to provide the following information:*

   a. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

   b. *your basis for concluding that the inspections identified in 3.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

      (1) *If your future inspection plans do not include performing inspections before December 31, 2001, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements section will continue to be met until the inspections are performed.*

      (2) *If your future inspection plans include only visual inspections, discuss the corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.*

Millstone Unit No. 3 response

This question is not applicable as Millstone Unit No. 3 has a susceptibility ranking greater than 30 EFPY.

NRC Bulletin 2001-01, Question 4

4. *If the susceptibility ranking for your plant is greater than 5 EFPY and less than 30 EFPY of ONS3, addressees are requested to provide the following information:*

   a. *your plans for future inspections (type, scope, qualification requirements, and acceptance criteria) and the schedule;*

   b. *your basis for concluding that the inspections identified in 4.a will assure that regulatory requirements are met (see Applicable Regulatory Requirements section). Include the following specific information in this discussion:*

(1) *If your future inspection plans do not include a qualified visual examination at the next scheduled refueling outage, provide your basis for concluding that the regulatory requirements discussed in the Applicable Regulatory Requirements sections will continue to be met until the inspections are performed.*

(2) *The corrective actions that will be taken, including alternative inspection methods (for example, volumetric examination), if leakage is detected.*

Millstone Unit No. 3 Response

This question is not applicable as Millstone Unit No. 3 has a susceptibility ranking greater than 30 EFPY.

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