April 5, 2005

Mr. David A. Christian
Sr. Vice President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
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SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2, RE: RELIEF REQUEST RR-89-35, TEMPORARY INSTALLATION OF MECHANICAL NOZZLE SEAL ASSEMBLIES ON PRESSURIZER HEATER PENETRATION NOZZLES (TAC NO. MC3396)

Dear Mr. Christian:

By letter dated June 3, 2004, subsequently withdrawn and replaced by letter dated January 26, 2005, Dominion Nuclear Connecticut, Inc. (DNC) requested Nuclear Regulatory Commission (NRC) approval of a one-year extension of the previously-approved relief request (RR) RR-89-35 for Millstone Power Station, Unit No. 2 (MP2). Initially, RR-89-35, which was submitted by letter dated February 19, 2002, as supplemented on February 28 and March 1, 2002, was reviewed and approved by the NRC staff by letter dated March 22, 2002, to allow installation of Mechanical Nozzle Seal Assemblies (MNSAs) for two leaking pressurizer heater penetration nozzles as an alternative to certain requirements of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). As discussed in your letter dated February 28, 2002, the use of the MNSAs was proposed as a temporary repair for a time period not to exceed two operating cycles [i.e., refueling outage (RFO) 14 through RFO 16]. In a November 18, 2004, conference call with the NRC, DNC identified its plans to replace the MP2 pressurizer in the fall of 2006 (RFO 17). With the pressurizer replacement planned for RFO 17, the NRC staff considered that the review of DNC's request to extend the use of MNSAs by one additional cycle was warranted.

The NRC staff completed its review of the subject RR extension, and the Safety Evaluation (SE) is enclosed. Based on the NRC staff's SE, the proposed alternative to the ASME Code requirements described in RR-89-35, as modified by the commitments made in your January 26, 2005, letter, will provide an acceptable level of quality and safety for the repair of leaking pressurizer heater penetration nozzles at MP2. This RR extends to no longer than the conclusion of RFO 17 in the fall of 2006. It should be noted that in the NRC staff letter dated June 19, 2002, the staff noted potential concerns related to the stress analysis if the MNSAs were used beyond two cycles. The staff considers that the additional stress and fatigue levels for the presently-installed MNSAs to be within the criteria previously approved by the staff, and that the existing MNSA design is adequate for one additional cycle.

Therefore, the extension of the alternative is authorized pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* through RFO 17.

Sincerely,

/RA/

Darrell J. Roberts, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-336

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ONE CYCLE EXTENSION OF RELIEF REQUEST RR-89-35

TEMPORARY INSTALLATION OF MECHANICAL NOZZLE SEAL ASSEMBLIES ON

PRESSURIZER HEATER PENETRATION NOZZLES AT

MILLSTONE POWER STATION, UNIT NO. 2

DOMINION NUCLEAR CONNECTICUT, INC.

DOCKET NO. 50-336

1.0 INTRODUCTION

The inservice inspection (ISI) of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Nuclear Regulatory Commission (NRC or the Commission) pursuant to 10 CFR 50.55a(g)(6)(i). Pursuant to 10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

By letter dated June 3, 2004, subsequently withdrawn and replaced by letter dated January 26, 2005, Dominion Nuclear Connecticut, Inc. (DNC) requested NRC approval of a one-year extension of the previously-approved relief request (RR) RR-89-35 for Millstone Power Station, Unit No. 2 (MP2). Initially, RR-89-35, which was submitted by letter dated February 19, 2002, as supplemented February 28 and March 1, 2002, was reviewed and approved by the NRC staff in a letter dated March 22, 2002, to allow installation of Mechanical Nozzle Seal Assemblies (MNSAs) for two leaking pressurizer heater penetration nozzles as an alternative to certain requirements of Section XI of the ASME Code. As discussed in your letter dated February 28, 2002, the use of the MNSAs was proposed as a temporary repair for a time period not to exceed two operating cycles [i.e., refueling outage (RFO) 14 through RFO 16]. In a November 18, 2004, conference call with the NRC, DNC identified its plans to replace the MP2 pressurizer in the fall of 2006 (RFO 17). With the pressurizer replacement in RFO 17, the NRC staff considered that the review of DNC's request to extend the use of MNSAs by one additional cycle was warranted.

2.0 BACKGROUND

MNSAs are mechanical devices that are designed to fit around ASME Code Class 1 Alloy 600 nozzles as a means of preventing leakage past the nozzles. The MNSA design consists of two split gasket/flange assemblies. A gasket made from Grafoil packing, a graphite compound, is compressed within the gasket assembly to prevent reactor coolant system (RCS) pressure boundary leakage past the nozzle. The gasket assembly is bolted in place via holes that are drilled and threaded on the outer surface of the RCS pressure boundary wall. A second assembly is bolted to the flanges which serves as the structural attachment of the nozzle to the wall. The flange assembly serves to carry the loads in lieu of the partial penetration J-groove welds used to adjoin the nozzles to the particular RCS pressure boundary vessel or piping component of interest.

2.1 Licensee's Rationale for Relief Request

Based on recent industry operating experience associated with Alloy 600 cracking, DNC elected to perform a visual ISI of the pressurizer heater penetrations during RFO 14 at MP2. Two penetrations were found to show indications of leakage with the presence of boron encircling the penetrations.

The pressurizer heater penetration nozzles consist of a sleeve welded to the pressurizer bottom head with an internal J-groove weld. The typical permanent repair of these sleeves consists of either installing a heater sleeve plug welded to a temper-bead pad or a half-sleeve replacement. The licensee's February 19, 2002, submittal stated that the typical repair/replacement techniques may be difficult or impractical to implement in certain locations such as the bottom of the pressurizer. The submittal also stated that installation of the MNSAs will shorten the repair/replacement time significantly and thereby reduce radiation exposure to workers.

Pursuant to the provisions of 10 CFR 50.55a(a)(3)(i), DNC proposed to install MNSAs as a temporary alternative repair method to the ASME Code requirements for the two leaking pressurizer heater penetration nozzles. The licensee's submittal stated that MNSAs have already been used in the industry as an NRC-approved temporary alternative and that MNSAs have been demonstrated to provide an acceptable level and quality and safety for degraded or potentially degraded pressurizer heater penetration nozzles.

2.2 Regulatory Framework

Paragraph (g) of 10 CFR 50.55a requires, in part, that all inservice examinations and system pressure tests conducted during the first 10-year interval and subsequent intervals on ASME Code Class 1, 2, and 3 components comply with the requirements in the latest edition and addenda of Section XI incorporated by reference in 10 CFR 50.55a(b), on the date 12 months prior to the start of the 10-year interval. By reference to, and implementation of, ASME Code Section XI, paragraphs IWB-3132 or IWB-3142, 10 CFR 50.55a also requires that existing flaws in ASME Code Class components be removed by mechanical means, or the components be repaired or replaced to the extent necessary to meet the acceptance standards in ASME Code Section XI, Article IWB-3000. Detection of leaks in the structural portion of an ASME Code Class 1, 2, or 3 component is direct evidence of a flaw in the component.

Paragraph IWA-4170 of Section XI of the ASME Code requires that repairs and the installation of replacements to the RCS pressure boundary be performed and reconciled in accordance with the Owner's Design Specifications and Original Code of Construction for the component or system. The MP2 RCS pressurizer was designed and constructed to the rules of ASME Section III, 1968 Edition with Addenda through summer 1969.

Paragraph NB-3671.7 to Section III of the ASME Code, "Sleeve Coupled and Other Patented Joints," requires that ASME Code Class 1 joints be designed to meet the following criteria:

(1) provisions must be made to prevent separation of the joint under all service loading conditions,

(2) the joint must be designed to be accessible for maintenance, removal, and replacement activities, and

(3) the joint must either be designed in accordance with the rules of ASME Code, Section III, Subarticle NB-3200, or be evaluated using a prototype of the joint that will be subjected to additional performance tests in order to determine the safety of the joint under simulated service conditions.

These criteria also apply to the design, installation, inspection, and maintenance of MNSAs.

3.0 EVALUATION

The licensee requested the use of MNSAs pursuant to 10 CFR 50.55a(a)(3)(i), stating that this alternative provides an acceptable level of quality and safety. In order to determine if the MNSAs would provide an acceptable level of quality and safety, the staff compared the MNSA design and operational characteristics to the applicable ASME Code requirements, reviewed the MNSAs' resistance to corrosion for the intended service period, and evaluated the licensee's commitments associated with the use of the MNSAs.

The MNSAs are designed, fabricated, and constructed using approved ASME Code materials (except for the Grafoil gasket, which is a non-Code material), in accordance with the applicable rules of ASME Code Section III. The MNSAs are designed to prevent separation of the joint under all service loadings. This design is supported by manufacturer technical analysis and tests that meet the design criteria specified in the ASME Code Section III, Subsection NB, 1989 Edition, no Addenda. Additionally, MNSA installations are accessible for maintenance, removal, and replacement. The provisions of NB-3671.7 are, therefore, nominally satisfied.

MNSAs have been approved for installation on a temporary basis at other nuclear plants (e.g., Palo Verde Nuclear Generating Station and San Onofre Nuclear Generating Station). The acceptance was based on industry experience which demonstrated that the structural integrity and leak tightness of the MNSAs, and the structural integrity of the components to which the MNSAs are attached, was maintained at least through one or two cycles. The staff has also reviewed calculations and tests performed by the manufacturer for installations at other plants that demonstrate the structural integrity of the MNSAs, and the conformance of the component fatigue calculations with the ASME Code Section III, Class 1 design fatigue limit. Based on experience at other plants, the staff considers the probability of exceeding the ASME Code, Section III, Class 1 fatigue cumulative limit of 1.0 in three cycles of operation to be very low. Based on the preceding information, the staff finds the proposed alternative acceptable from a structural standpoint.

The licensee's February 19, 2002, submittal provided the following information regarding the installation, inspection, and testing of the MNSAs:

(1) The licensee has performed a visual examination of the leaking nozzles. An informational ultrasonic test has been performed to determine the thickness of the pressurizer shell near the nozzles. A comparison of the data will be made between the leaking and non-leaking penetrations to evaluate if any measurable corrosion damage is present around the leaking nozzles.

(2) The licensee's installation procedure for the MNSAs contains instructions/guidance to ensure that the surface of the pressurizer is in a condition such that the MNSA will seal correctly.

(3) As required by IWA-4600, a VT-1 preservice inspection will be performed on all MNSA installations in accordance with IWB-2200.

(4) During plant startup (Mode 3), after initial MNSA installation and during subsequent plant restarts following a refueling outage, the pressurizer heater penetration nozzle MNSAs will be pressure tested and inspected for leakage. To ensure quality of the installation and continued operation with the absence of leakage, a pressure test with VT-2 visual examination will be performed on each of the installed MNSAs with any insulation removed. The test will be performed as part of plant restart and will be conducted at normal operating pressure with the test temperature determined in accordance with the pressure and temperature limits as stated in the MP2 Technical Specifications. Additionally, VT-3 exams will be performed, along with the VT-2 exams, during subsequent plant restarts following a RFO.

In its letter dated February 19, 2002, and its subsequent letter dated February 28, 2002, DNC also provided an evaluation to address potential corrosion of the nozzle bore holes, J-groove weld cracking, galvanic corrosion (Grafoil seal to low alloy steel), and stress-corrosion cracking of the MNSA components. The results of this evaluation are summarized as follows:

(1) A through-wall crack in the nozzle could be a source of corrosion. However, the borated water will stagnate and will not replenish and the boric acid will be consumed. The pH level will decrease the corrosion rate, and eventually the process will be stopped.

(2) Boric acid corrosion of the materials of construction for the MNSA has been addressed by use of corrosion-resistant materials, testing, and analysis.

(3) A history of galvanic corrosion problems in applications where low alloy steel is in contact with a Grafoil seal in an environment of an electrically conductive fluid (water) exists. This particular combination is used in other applications where the low alloy (or carbon steel) is frequently inspected (for example, steam generator secondary side manway and hand hole applications). The Grafoil seal, grade GTJ, is chemically

resistant to attack from nearly all organic and inorganic fluids, and is very resistant to borated water. The MNSA application is similar (i.e., Grafoil material is in contact with low alloy steel and visual inspections will be conducted at each RFO to identify signs of leakage) and for these reasons significant galvanic corrosion is not expected. The licensee also noted that, in the absence of leakage past the Grafoil seal, the boric acid solution in the annulus region will become stagnant and will not allow replenishment of the boric acid or oxygen, thereby limiting the corrosion potential.

(4) ASME Code, Section XI requirements applicable to the MNSA during each 10-year ISI interval include a system leak test at the end of each RFO and bolting examination based on the schedule of percentages required. For the MNSA installed on the pressurizer heater penetration nozzles, the Table IWB-2500-1 Category B-G-2 examination requirements would allow the VT-1 examination to be performed as follows: (a) in place under tension; (b) when the connection is disassembled; (c) or when the bolting is removed. This examination is required once each 10-year interval. If the MNSA device leaks, the bolts may be exposed to borated water or steam under conditions in which deposits or slurries will develop. Under these conditions and at stress levels present in the MNSA application, the bolts will operate satisfactorily for at least one fuel cycle. A leaking MNSA will be discovered and repaired as part of the walk-down inspections performed in response to NRC Generic Letter 88-05, "Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR [pressurized-water reactor] Plants". These walk-down inspections are performed prior to entering unit outages. Therefore, the existence of leaking MNSA conditions would be limited to one cycle.

Based on the preceding evaluation of potential corrosion effects, the staff concludes that there are no significant corrosion issues associated with the application of the MNSAs to pressurizer heater penetration nozzles. The data indicates that corrosion of the nozzle hole will also be acceptable over the requested period of use. To justify the one-cycle extension, the licensee provided the following description of the MNSA inspection program:

(1) The MNSAs have been added to the MP2 ISI plan.

(2) If the MNSA includes a leakage detection/diversion fitting, it will be examined for evidence of leakage before other visual examinations are performed.

(3) Pressure-retaining bolting will be subject to the equivalent of a Table IWB-2500-1 Category B-G-1 examination with bolting in place. A Category B-G-2 examination will be performed when the MNSA is disassembled for any reason after initial installation. Category B-G-2 examinations shall be performed for the type of component on which MNSA is installed on component surfaces, including bore, counterbore (if any), bolt holes, and bolting, following disassembly.

(4) Disassembly of a sample (10% rounded to the next larger integer value) of MNSAs shall be performed once an interval. A Category B-G-2 examination shall be performed on component surfaces, including bore, counterbore (if any), bolt holes and bolting, following disassembly. The MNSA to be disassembled shall be selected based on the

longest installed service life with preference given to the presence of known through-wall flaws in the original pressure boundary, if any, or locations identified for high susceptibility to primary water stress-corrosion cracking.

(5) During each RFO, a VT-3 visual examination of each MNSA shall be performed. The following relevant conditions shall require corrective actions:

- (a) structural distortion or displacement of parts to the extent that component function may be impaired;
- (b) loose, missing, cracked, or fractured parts, bolting, or fasteners;
- (c) foreign materials or accumulation of corrosion products;
- (d) corrosion or erosion that reduces the nominal section thickness by more than 5%, or
- (e) wear of mating surfaces that may lead to loss of function.

(6) A VT-2 visual examination shall be performed with insulation removed in accordance with IWA-5240 on each MNSA location during the IWB-5000 system pressure test conducted in accordance with Table IWB-2500-1, Category B-P during each RFO. MNSAs shall be VT-2 examined. If leakage is detected, the entire MNSA shall be disassembled and inspected. The following relevant conditions shall require corrective action:

- (a) structural distortion or displacement of parts to the extent that component function may be impaired;
- (b) loose, missing, cracked, or fractured parts, bolting, or fasteners;
- (c) foreign materials or accumulation of corrosion products;
- (d) corrosion or erosion that reduces the nominal section thickness by more than 5%, or
- (e) wear of mating surfaces that may lead to loss of function.

(7) There shall be no evidence of leakage upon startup.

This inspection program, combined with the previously discussed corrosion evaluation, provides adequate assurance of the integrity of the MNSAs for an additional cycle of operation.

The staff has reviewed the licensee's submittal with respect to the installation, inspection, and testing of the MNSAs. The staff concludes that these actions are sufficient to ensure proper installation and operation of the MNSAs for their intended use for a period not to exceed three operating cycles.

4.0 CONCLUSION

Based on the preceding evaluation, the NRC staff concludes that the proposed alternative to the ASME Code requirements described in Relief Request RR-89-35 will provide an acceptable level of quality and safety for repair of leaking pressurizer heater penetration nozzles at MP2 for a time period not to exceed the conclusion of RFO 17. Therefore, the extension of the alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) through RFO 17.

Principal Contributors: M. Hartzman
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Date: April 5, 2005