UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 3, 2017

Mr. Daniel G. Stoddard
Senior Vice President and
Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – ALTERNATIVE RELIEF REQUEST RR-04-26 RE: BORIC ACID PUMP P-19B STUFFING BOX COVER (CAC NO. MF9655)

Dear Mr. Stoddard:

By letter dated April 28, 2017 (Agencywide Documents Access and Management System Accession No. ML17123A043), Dominion Nuclear Connecticut, Inc. (the licensee) submitted an alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), regarding the operation of the 'B' boric acid pump with through-wall leakage at the Millstone Power Station, Unit No. 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specified ASME Code requirements would result in hardship and/or unusual difficulty, without a compensating increase in the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee's proposed alternative in Relief Request RR-04-26 provides reasonable assurance of structural integrity of the 'B' boric acid pump. The NRC staff finds that requiring compliance with the ASME Code requirement to repair/replace the 'B' boric acid pump stuffing box cover would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Accordingly, pursuant to 10 CFR 50.55a(z)(2), the NRC staff authorizes the use of Relief Request RR-04-26 at the Millstone Power Station, Unit No. 2, during the fourth 10-year inservice inspection interval for operating Cycle 25, until the startup from the next refueling outage.

If you have any questions, please contact the Project Manager, Richard Guzman, at 301-415-1030 or by e-mail to Richard.Guzman@nrc.gov.

Sincerely,

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-336

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVE RELIEF REQUEST RR-04-26

BORIC ACID PUMP P-19B STUFFING BOX COVER

MILLSTONE POWER STATION, UNIT NO. 2

DOMINION NUCLEAR CONNECTICUT, INC.

DOCKET NO. 50-336

1.0 INTRODUCTION

By letter dated April 28, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17123A043, Dominion Nuclear Connecticut, Inc. (the licensee) submitted an alternative to the requirements of Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) regarding the operation of the 'B' boric acid pump with through-wall leakage at Millstone Power Station, Unit No. 2 (Millstone 2).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that complying with the specified ASME Code requirements would result in hardship and/or unusual difficulty, without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI.

The regulation in 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the U.S Nuclear Regulatory Commission (NRC), if the licensee demonstrates that (1) the proposed alternative provides an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

The affected component is the Millstone 2 'B' boric acid pump, which is classified as ASME Code Class 2. The examination category (see Table IWC-2500-1 of ASME Code, Section XI) for the component is Category C-H, item number C7.10. The location of the pump that is affected is the pump stuffing box cover, which is a Type 316 cast austenitic stainless steel per American Society for Testing and Materials (ASTM) A351 CF-8M.

3.2 Applicable Code Addition and Addenda

The Code of Record for the fourth 10-year inservice inspection (ISI) interval at Millstone 2 is the ASME Code, Section XI, 2004 Edition, no Addenda. The fourth 10-year ISI interval started on April 1, 2010, and is scheduled to end on March 31, 2020.

The pump was constructed in accordance with the "Draft ASME Code for Pumps & Valves for Nuclear Power," dated November 1968, as Class 2, and Combustion Engineering Specification 18767-PE-404, Revision 1, dated February 9, 1972.

3.3 Applicable Code Requirement

IWB-3142.3, "Acceptance by Corrective Measures or Repair/Replacement Activity," states:

> A component containing relevant conditions is acceptable for continued service if the relevant conditions are corrected by a repair/replacement activity or by corrective measures to the extent necessary to meet the acceptance standards of Table IWB-3410-1.

The licensee's alternative request proposes relief from the requirement in IWB-3142.3 to perform a repair/replacement activity on the Millstone 2 'B' boric acid pump.

3.4 Background

The licensee stated that the 'B' boric acid pump is one of two redundant pumps used for boron injection into the reactor coolant system. The licensee further stated that the function of the boric acid pumps is for reactivity control, but the pumps are not credited in the Final Safety Analysis Report, Chapter 14, accident analyses.

On February 28, 2017, the licensee discovered dry boric acid on the Millstone 2 'B' boric acid pump casing. The source of the boric acid could not be determined. The boric acid deposit was removed, and the pump was run for 2 hours with no evidence of leakage. On March 1, 2017, during an ISI walkdown, the licensee discovered dry boric acid in the same location as had been previously identified. The amount of dry boric acid discovered was smaller than the amount originally discovered on February 28, 2017. The pump was then declared non-functional. On March 2, 2017, the pump was tagged out, but not drained, to support an informational liquid penetrant (LP) examination. The pump was cleaned and then run for an additional time. After

1.5 hours of run time, a wet translucent spot of boric acid approximately 0.125-inch in diameter was observed by the licensee. Although the leakage rate could not be determined, growth of the spot confirmed the presence of a through-wall leak. The leakage was determined to be in the pump stuffing box cover. The pump was subsequently isolated on March 9, 2017.

The licensee stated that due to the complex geometry of the stuffing box cover, volumetric examination of the leakage area was not possible. Based on the informational LP examination and visual examination performed during an extended pump run, the licensee considered the leakage to be the result of small voids or porosity present in the original stainless steel casting material.

The licensee submitted a purchase order to the pump vendor for a new stuffing box cover; however, due to the long lead time to fabricate a replacement stuffing box cover, a code-compliant repair was not possible prior to the spring 2017 refueling outage (2R24).

On March 29, 2017, the licensee submitted proposed alternative Relief Request RR-04-25 to the NRC (ADAMS Accession No. ML17090A110) to provide continued operation of the 'B' acid pump for the remainder of Cycle 24 operation, execution of the plant shutdown, and core offload for 2R24 on the basis that compliance with the code requirement to repair the pump would have resulted in a hardship, without a compensating increase in the level of quality or safety. The NRC provided verbal approval of the licensee's requested alternative on March 29, 2017 (ADAMS Accession No. ML17088A719).

During 2R24, the licensee removed the 'B' boric acid pump stuffing box cover for further characterization of the through-wall flaw. Based on LP examinations and hydrostatic testing, the licensee assessed the stuffing box cover as structurally acceptable for continued service during operating Cycle 25, which is the subject of the current requested alternative.

3.5 Reason for Request

The licensee stated that of the three options available, in accordance with IWB-3142, for acceptance of a relevant condition such as the one in the boric acid pump stuffing box cover, a repair/replacement per IWB-3142.3 is the only viable option for addressing the current observed condition. However, as stated above, a replacement part is not readily available. The licensee stated that delivery of the stuffing box cover is not expected until mid-June 2017.

The licensee stated that although Millstone 2 can operate without boric acid pumps, maintaining the 'B' boric acid pump available provides additional assurance that the boric acid injection function will remain available for reactivity changes, if needed, until a permanent code repair of the stuffing box cover can be performed. Given that delivery of the replacement stuffing box cover is not expected until mid-June 2017, the licensee contends that compliance with the requirements of 10 CFR 50.55a would result in a hardship, without a compensating increase in the level of quality or safety.

3.6 Proposed Alternative and Basis for Use

The licensee stated that in lieu of a code repair in accordance with ASME Code, Section XI, IWB-3142.3, its proposed alternative is to keep the pump in service with the identified indications until a replacement part is delivered and a permanent code repair can be performed. As part of the licensee's alternative, it will inspect the affected pump stuffing box cover each shift for leakage until the pump is removed from service for repair. The licensee will document the inspection results. Should leakage increase, the licensee will perform an engineering evaluation to reassess structural integrity and the impact of the leakage on nearby equipment. If structural integrity cannot be maintained, the licensee will isolate the pump.

The licensee stated that during 2R24, the 'B' boric acid pump was disassembled to further evaluate the structural integrity of the stuffing box cover. The licensee stated that it attempted to perform a volumetric examination of the stuffing box cover using ultrasonic testing with the smallest available transducer; however, no useful information was attained due the inability of the transducer to maintain suitable surface contact. Due to the dimensions and geometry of the stuffing box cover, the licensee determined that examination of the leakage area using radiographic testing was not practical. LP examinations were performed on both the inside and outside surfaces of the stuffing box cover. The results of the licensee's LP examinations are listed in Table 1 below. Photographs and nondestructive examination reports are provided in the licensee's April 28, 2017, letter.

Table 1: 'B' Boric Acid Stuffing Box Cover LP Indications

Indication	Location	Diameter of bleed out (inches)
1	Outside Surface - East Side	1/32
2	Outside Surface - East Side	1/32
3	Inside Surface - East Side	3/32
4	Inside Surface - East Side	3/16
5	Inside Surface - West Side	3/16

The licensee stated that it performed an informational hydrostatic test of the stuffing box cover. The hydrostatic test was performed at a pressure of 220 pounds per square inch gauge (psig) and held for 10 minutes. The licensee stated that although the test did not result in any measurable leakage, indication of leakage (slight wetting) at two locations was visible through the use of an LP developer. The first location was in the area where the leakage was first observed, and the second location was on the opposite side of the cover, approximately 180 degrees from the first location. The locations where slight wetting was observed on the outside of the stuffing box cover corresponded to the locations of the identified indications on the inside.

Based on the results of the LP examinations and the hydrostatic testing results, the licensee contends that the stuffing box cover pressure boundary leakage is likely due to small casting void defects or porosity that enable a through-wall pathway for leakage.

The licensee stated that the general corrosion rate of Type 316 stainless steel in the process fluid is too small to measure, and this material is not susceptible to pitting or stress corrosion cracking. The licensee concluded that there are no active aging degradation mechanisms for this component that would cause initiation and through-wall growth of a planar flaw.

The licensee estimated a stuffing box cover pressure of 41 psig. The licensee estimated the wall thickness of the component in the area of the leak to be 0.25 inch. The licensee stated that there is no code-specified methodology for evaluating the structural integrity of this type of component when through-wall leakage is detected. The licensee stated that the stuffing box cover in the area of concern can be conservatively bounded as a cylindrical section, similar to a cylindrical vessel with localized leakage. The licensee calculated the minimum required wall thickness in accordance with ASME Code, Section III, NC-3324. For conservatism, a pressure of 50 psig was used to calculate a minimum required thickness of 0.0045 inch. The licensee stated that the stuffing box cover is not required to withstand any significant mechanical loading, and the affected portion of the stuffing box cover supports only the mechanical seal. The pump shaft is supported independently of the stuffing box cover. Seismic loading from the shaft, impeller, and piping nozzles are transferred through the pump frame adaptor and pump casing to anchorage feet attached to the pump casing. The loads do not pass through this portion of the stuffing box cover. Therefore, the licensee assesses that the minimum wall thickness calculation reasonably demonstrates the structural integrity of the pump stuffing box cover in the area of the observed leakage. In addition, the licensee stated that the absence of an active degradation mechanism also supports the conclusion that the currently observed leak rate will remain nearly constant for the duration of the requested alternative.

The licensee further stated that its structural integrity evaluation supports its conclusion that the pump is capable of performing its intended function of transferring concentrated boric acid from the boric acid storage tank to the suction of the charging pumps and will retain this capability for the duration of the requested relief. The licensee concluded that the overall mechanical integrity of the pump will be maintained such that the pump will be able to generate sufficient head for the required flow, and since the pressure boundary is maintained, there would be no significant diversion of boric acid intended for injection into the charging pump suction.

3.7 Duration of Proposed Alternative

This proposed alternative to the ASME Code is applicable from approval of the alternative until a permanent code repair of the boric acid stuffing box cover is performed during operating Cycle 25. As stated in by the licensee, delivery of the replacement stuffing box cover is expected in mid-June 2017, and a permanent code repair will be performed as soon as practical after receipt of the part, but no later than the startup from the next refueling outage.

4.0 NRC Staff Evaluation

On March 29, 2017, the NRC staff verbally authorized the use of Relief Request RR-04-25 during a teleconference with Dominion Nuclear Connecticut, Inc. Relief Request RR-04-25 permitted the licensee to operate the 'B' boric acid pump for the last few weeks of operating Cycle 24 through plant shutdown and core offload during 2R24. The current requested alternative seeks to use the degraded 'B' boric acid pump during operating Cycle 25. During

2R24, the licensee disassembled the 'B' boric acid pump to further assess the stuffing box cover in order to justify continued operation during Cycle 25.

ASME Code, Section XI, Table IWC-3410-1, "Acceptance Standards," references the acceptance standards in IWC-3516, "Standards for Examination Category C-H, All Pressure Retaining Components." IWC-3516, applicable to ASME Code Class 2 components, does not provide standards for examination, but states that the standards of IWB-3522, "Standards for Examination Category B-P, All Pressure Retaining Components," which are applicable ASME Code Class 1 components, may be applied. IWB-3522 refers to IWB-3142, "Acceptance."

As stated by the licensee, IWB-3142 provides three options (IWB-3142.2, IWB-3142.3, and IWB-3142.4) to address unacceptable relevant conditions described in Table IWB-3410-1. IWB-3142.2, "Acceptance by Supplemental Examination," cannot be applied to through-wall leaks. IWB-3142.4, "Acceptance by Analytical Evaluation," cannot be applied because there is not a code-specified methodology for analyzing the condition. The licensee stated that the only viable option to address the through-wall leak is a repair/replacement per IWB-3142.3. Given the above considerations, the NRC staff acknowledges that the only option available to comply with ASME Code, Section XI, requirements is a repair/replacement of the stuffing box cover. As stated by the licensee, a replacement part is not readily available but has been ordered.

The stuffing box cover is fabricated from ASTM A351 CF-8M cast stainless steel. The NRC staff notes that the general corrosion rate of this material in a boric acid environment is negligible. This material is not known to be susceptible to stress corrosion cracking in the environment to which it is exposed. Taking into account the environmental conditions and the molybdenum content of this material, it is not expected to be susceptible to pitting corrosion. The NRC staff is not aware of any corrosion-related degradation mechanisms that would be applicable to the stuffing box cover. The licensee stated that the original casting received a satisfactory LP examination and hydrostatic test in accordance with the code of construction. Radiographic testing was not performed, or required, due to the size of the pump inlet, which is less than 4 inches. The NRC staff notes that it is not unusual for castings to contain small voids and porosity.

The licensee performed LP examinations of the inside and outside surfaces of the stuffing box cover. The results of the licensee's LP examinations are listed in Table 1 of Section 3.6 above. Given the absence of a linear flaw, the extremely low leakage rate, and the low mechanical loads due to normal operation as reported by the licensee, the NRC staff concludes that it is unlikely that the flaw is the result of fatigue.

The normal operating pressure of the 'B' boric acid pump is 112 psig, and the design pressure is 150 psig. The licensee estimated the pressure in the stuffing box cover under normal operating conditions to be 41 psig. The licensee performed an informational hydrostatic test at 220 psig for 10 minutes. The NRC staff notes that the hydrostatic test was performed at almost double the normal pump operating pressure and over one-third greater than the pump design pressure. Although the first location of leakage was in the same location as the two 1/32-inch indications on the outside surface (which corresponded with the two inside surface indications), the second location of leakage was not identified by the LP examination on the outside surface. The licensee stated that there was no measurable leakage and only slight wetting was observed

through the use of an LP developer. Given the hydrostatic pressure of almost double the pump operating pressure, the absence of any known active degradation mechanisms, the nature of the indications reported by the licensee, and the unmeasurable leakage rate, the NRC staff finds that the most likely cause of the leaks is small voids or porosity that were present in the original casting.

As stated by the licensee, there is no code-specified methodology for evaluating the structural integrity of this type of component when through-wall leakage is detected. The licensee conservatively bounded the stuffing box cover in the area of concern as a cylindrical section, similar to a cylindrical vessel with localized leakage. The licensee then calculated the minimum required wall thickness per ASME Code, Section III, NC-3324. Considering the cylindrical nature of the stuffing box cover and the relatively low operating pressure in the stuffing box, the NRC staff finds this approach acceptable. The licensee calculated the minimum required thickness to be 0.0045 inch. Although the stuffing box cover thickness in the area of the through-wall leakage is not specified on the pump drawings, the licensee estimated the thickness of the component in this area to be 0.25 inch. The NRC staff notes that Figure 4 in Attachment 1 of the licensee's April 28, 2017, letter supports its estimated wall thickness. Figure 4 shows that the wall thickness is approximately 0.25 inch.

The NRC staff finds that given the nature of the indications identified, the significant margin provided between the estimated thicknesses of the stuffing box cover in the areas of the leaks and the minimum calculated required thickness, and the unmeasurable leakage during hydrostatic testing, there is reasonable assurance that the stuffing box cover will maintain its structural integrity for up to one operating cycle. The NRC staff notes that the licensee will inspect the pump stuffing box cover each shift for any observed increase in leakage, and if necessary, due to increased leakage, reassess the structural integrity of the stuffing box cover, and if necessary, isolate the pump.

The NRC staff finds that the licensee's alternative provides reasonable assurance of structural integrity of the stuffing box cover because: (1) there are no known active degradation mechanisms present; (2) there is unmeasurable leakage at a hydrostatic pressure (220 psig, which is nearly twice the pump operating pressure); (3) the calculated minimum wall thickness compared to the estimated wall thickness provides significant margin; (4) the licensee will monitor the stuffing box cover for changes in leakage rate and will reassess structural integrity of the component if necessary; and (5) if structural integrity cannot be assured, the pump will be isolated.

Hardship Justification

The 'B' boric acid pump provides a redundant means of delivering boric acid to the suction of the charging pumps to control reactivity during normal power operation and for such events as a technical specification-required cooldown to cold shutdown. The only option to meet the requirements of the ASME Code for the leaking stuffing box cover is repair/replacement. As indicated by the licensee, a replacement part is not readily available. As discussed above, the NRC finds that the licensee's alternative provides reasonable assurance of the structural integrity for up to one operating cycle. The NRC staff concludes that complying with the specified code requirement would result in a reduction in defense-in-depth. Therefore, the NRC

staff finds that complying with the specified code requirement to repair/replace the 'B' boric acid stuffing box cover would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

On the basis of the above review, the NRC staff concludes that the proposed alternative, in Relief Request RR-04-26, provides reasonable assurance of structural integrity of the 'B' boric acid pump. The NRC staff finds that requiring compliance with the ASME Code requirement to repair/replace the 'B' boric acid pump stuffing box cover would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(z)(2), the NRC authorizes the use of Relief Request RR-04-26 at Millstone 2 during the fourth 10-year ISI interval, for operating Cycle 25, until the startup from the next refueling outage.

All other ASME Code, Section XI, requirements for which relief has not been specifically requested and approved remain applicable, including a third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: R. Davis

Date: May 3, 2017

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – ALTERNATIVE RELIEF REQUEST RR-04-26 RE: BORIC ACID PUMP P-19B STUFFING BOX COVER (CAC NO. MF9655) DATED MAY 3, 2017

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