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

May 25, 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-04-25 RE: BORIC ACID PUMP P-19B STUFFING BOX COVER (CAC NO. MF9497)

Dear Mr. Stoddard:

By letter dated March 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17090A110), 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 transfer pump with through-wall leakage at 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-04-25 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 staff authorizes the use of Relief Request RR-04-25 for the period until completion of the core offload of the Millstone Power Station, Unit No. 2, spring 2017 refueling outage. In addition, on March 29, 2017, the NRC staff verbally authorized the use of the alternative in Relief Request RR-04-25. The summary of the verbal authorization was issued on March 29, 2017 (ADAMS Accession No. ML17088A719). The enclosed safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

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-04-25

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 March 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17090A110), 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 transfer 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.

On March 29, 2017 (ADAMS Accession No. ML17088A719), the U.S. Nuclear Regulatory Commission (NRC) staff verbally authorized the use of Relief Request RR-04-25 for the period until completion of the core offload of the Millstone 2 spring 2017 refueling outage. This safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

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 preservice 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 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 Reason for Request

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 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, a repair/replacement per IWB-3142.3 is the only viable option for addressing the current observed condition. However, a replacement part is not readily available.

Due to the potentially degraded condition that exists with Control Element Assembly 39, the plant shutdown for the Millstone 2 spring 2017 refueling outage will be accomplished by injection of boron into the reactor coolant system. The licensee contends that the 'B' boric acid pump is needed to maximize the boric acid system reliability during the remainder of the operating cycle and for the execution of the plant shutdown and core offload. The licensee noted that the function of the 'B' boric acid pump is for reactivity control, but the pump is not credited in the Final Safety Analysis Report, Chapter 14, accident analyses.

3.5 Proposed Alternative and Basis for Use

The licensee's proposed alternative is to use the degraded 'B' boric acid pump until the plant is shut down and the core offload is complete. The licensee stated that it will inspect the affected pump stuffing box cover each shift for leakage until the pump is removed from service. The inspection results will be documented. The licensee stated that should leakage increase, an engineering evaluation will be performed to reassess structural integrity. The licensee further stated that if confidence in structural integrity cannot be maintained, the pump will be isolated.

The licensee stated that due to limited access and complex geometry of the pump stuffing box cover, a volumetric examination at the leak location is not possible. An LP examination was performed with no recordable indications identified. The licensee stated that leakage was confirmed visually following the LP examination and extended pump run. The stuffing box cover is made from ASTM A351 CF-8M, which is a cast austenitic steel.

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. Absent any known degradation mechanisms, the licensee contends that the leakage is likely due to small casting voids or porosity that enable a through-wall pathway for leakage.

The licensee estimated a stuffing box cover pressure of 41 pounds per square inch gauge (psig). The licensee estimated the wall thickness of the component in the area of the leak to be 0.25 inch. 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, and 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 contends that the minimum wall thickness calculation reasonably demonstrates the structural integrity of the pump stuffing box cover in the area of the observed leakage.

The licensee stated that its structural integrity evaluation supports the 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.

3.6 Duration of Proposed Alternative

This proposed alternative to the ASME Code is applicable from approval of the alternative until completion of core offload during the Millstone 2 spring 2017 refueling outage.

4.0 NRC Staff Evaluation

The licensee proposed to use degraded 'B' boric acid pump until the plant is shut down and the core is offloaded for the Millstone 2 spring 2017 refueling outage.

As discussed in Section 3.5 of this safety evaluation, the licensee discovered a small leak in the 'B' boric acid pump stuffing box cover. 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 the geometry and configuration of the stuffing box cover precludes the ability to characterize the flaw using nondestructive examination. 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 license 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. It is not unusual for castings to contain small voids and porosity. Any voids or porosity that were not open to the surface when the final LP examination was performed would have gone undetected. Hydrostatic testing of the component after fabrication verified leak-tightness of the component. 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. Therefore, the NRC staff finds that the most likely cause of the leak is small voids or porosity that was 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 finds that given the nature and presumed size of the flaw, the significant margin provided between the estimated thickness of the stuffing box cover in the area of the leak and the minimum calculated required thickness, that there is reasonable assurance that the stuffing box cover will maintain its structural integrity for the short duration of time until the plant is shut down and the core is offloaded, which is less than 1 month. 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) the required minimum wall thickness compared to the estimated wall thickness provides significant margin; (3) the licensee will monitor the stuffing box cover for changes in leakage rate and will reassess structural integrity of the component if necessary; and (4) if structural integrity cannot be assured, the pump will be isolated.

Hardship Justification

Due to the potentially degraded condition that exists with Control Element Assembly 39, the plant shutdown for the Millstone 2 spring 2017 refueling outage will be accomplished by injection of boron into the reactor coolant system. The licensee contends that the 'B' boric acid pump is needed to maximize the boric acid system reliability for defense-in-depth during the remainder of the operating cycle and for the execution of the plant shutdown and core offload.

In addition, the only option to meet the requirements of the ASME Code for the leaking stuffing box cover is repair/replacement, and a replacement part is not readily available. As discussed above, the NRC staff finds that the licensee's alternative provides reasonable assurance of the structural integrity until the plant is shut down and the core offloaded. 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-04-25 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-04-25 at Millstone 2 during the fourth 10-year ISI interval, until completion of core offload during the spring 2017 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 25, 2017

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – ALTERNATIVE RELIEF REQUEST RR-04-25 RE: BORIC ACID PUMP P-19B STUFFING BOX COVER (CAC NO. MF9497) DATED MAY 25, 2017

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