



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

December 19, 2024

Eric S. Carr
President – Nuclear Operations and
Chief Nuclear Officer
Dominion Energy Nuclear Connecticut, Inc.
Millstone Power Station
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 3 – REACTOR VESSEL
INTERNALS INSPECTIONS AGING MANAGEMENT PROGRAM SUBMITTAL
RELATED TO LICENSE RENEWAL COMMITMENT NO. 13
(EPID L-2023-LRO-0091)

Dear Eric Carr:

By letter dated November 20, 2023, Dominion Energy Nuclear Connecticut, Inc. (the licensee), submitted an updated document entitled, "Aging Management Program Description Inservice Inspection: Reactor Vessel Internals" in support of License Renewal (LR) Commitment No. 13 for Millstone Power Station, Unit No. 3. Specifically, the licensee submitted an updated Reactor Vessel Internals (RVI) Aging Management Program (AMP) and RVI Inspection Plan in accordance with topical report, "Material Reliability Program: Pressurized Water Reactor Inspection and Evaluation Guidelines (MRP-227-A)."

The Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's RVI AMP and RVI Inspection Plan. Based on that review, the NRC staff concludes that the licensee's RVI AMP and RVI Inspection Plan are acceptable and the licensee has fulfilled LR Commitment No. 13.

If you have any questions, please contact me at (301) 415-1030 or by email at Richard.Guzman@nrc.gov.

Sincerely,

/RA/

Richard Guzman, Senior Project Manager
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosure: Safety Evaluation

cc: Listserv



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STAFF EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
REACTOR VESSEL INTERNALS INSPECTIONS AGING MANAGEMENT PROGRAM
SUBMITTAL RELATED TO LICENSE RENEWAL COMMITMENT 13
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
DOCKET NO. 50-423

1.0 INTRODUCTION

By letter dated November 20, 2023 (Agencywide Documents Access and Management System Accession No. ML23324A422), Dominion Energy Nuclear Connecticut, Inc. (the licensee) requested approval of an enclosure containing the Aging Management Program (AMP) and Inspection Program for the Millstone Power Station, Unit No. 3 (Millstone Unit 3), reactor vessel internals (RVI). The Millstone Unit 3 RVI AMP and inspection program is based on Materials Reliability Program (MRP)-227, "Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines," Revision 1-A (ML19339G350), which provides a strategy for managing age-related material degradation of RVI components through the period of extended operation (PEO), which begins at midnight, November 25, 2025.

NUREG-1800, "Standard Review Plan for the Review of License Renewal Applications for Nuclear Power Plants" (ML012070391), includes that Nuclear Regulatory Commission (NRC) staff should confirm that aging degradation effects should be managed in RVI components when entering the PEO. Some owners of pressurized-water reactors, including Millstone Unit 3, were granted renewed licenses contingent on a commitment to: (1) participate in the industry programs for investigating and managing aging effects on RVI components; (2) evaluate and implement the results of the industry programs as applicable to the RVI components; and (3) upon completion of these programs, but not less than 24 months before entering the PEO, submit an inspection plan for RVI components to the NRC for review.

The licensee submitted the Millstone Unit 3 RVI AMP and inspection program in accordance with Commitment Item No. 13 of NUREG-1838 Volume 2, "Safety Evaluation Report Related to the License Renewal of the Millstone Power Station, Units 2 and 3" (ML053290180) and the Millstone Unit 3 Updated Final Safety Analysis Report Regulatory (UFSAR) Commitment Item No. 13 Table 19.6-1, which both state that, at least two years prior to the PEO:

Millstone will follow the industry efforts on reactor vessel internals regarding such issues as thermal or neutron irradiation embrittlement (loss of fracture toughness), void swelling (change in dimensions), stress corrosion cracking (PWSCC [primary water stress-corrosion cracking] and IASCC

Enclosure

[irradiation-assisted stress corrosion cracking]), and loss of preload for baffle and former-assembly bolts and will implement the appropriate recommendations resulting from this guidance. The revised program description, including a comparison to the 10 program elements of the NUREG-1801 program, will be submitted to the NRC for approval.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," governs the requirements of the plant license renewal process. The regulation at 10 CFR 54.21, "Contents of application - technical information," requires that each application for license renewal contain an integrated plant assessment and an evaluation of time-limited aging analyses. The plant-specific integrated assessment shall identify and list those structures and components subject to an aging management review and demonstrate that the effects of aging (e.g., cracking, loss of material, loss of fracture toughness, dimensional changes, and loss of preload) will be adequately managed so that their intended functions will be maintained consistent with the current licensing basis during the PEO as required by 10 CFR 54.29(a).

Structures and components subject to an AMP shall encompass those structures and components that are referred to as "passive" and "long-lived." Passive structures and components perform an intended function, as described in 10 CFR 54.4, without moving parts or without a change in configuration or properties. Long-lived structures and components are not subject to replacement based on a qualified life or specified time period. The scope of components considered for inspection under MRP-227, Revision 1-A, includes core support structures (typically denoted as Examination Category B-N-3 by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI), RVI components that serve an intended license renewal safety function pursuant to criteria in 10 CFR 54.4(a)(1), and other RVI components whose failure could prevent satisfactory accomplishment of any of the functions identified in 10 CFR 54.4(a)(1).

The scope of the program does not include consumable items, such as fuel assemblies, reactivity control assemblies, and nuclear instrumentation. The scope of the program also does not include welded attachments to the internal surface of the reactor vessel because these components are considered to be ASME Code Class 1 appurtenances to the reactor vessel and are managed in accordance with a different inservice inspection (ISI) program. Reactor vessel closure head penetration thermal sleeves are not within the scope of this AMP. However, wear of the sleeves and associated support flanges has been noted in industry operating experience and related guidance. Millstone Unit 3 has performed inspections consistent with this guidance and maintains an on-going effort within the corrective actions program to monitor wear of these components.

3.0 TECHNICAL EVALUATION

3.1 NRC Staff Assessment Approach

By letter dated December 3, 2019 (ML19339G364), Electric Power Research Institute (EPRI) submitted the NRC-approved version of MRP-227, Revision 1-A (ML19339G350), which contains the NRC's Safety Evaluation (SE) that approved MRP-227 Revision 1 (ML19081A001). By letter dated February 19, 2020 (ML20006D152), the NRC verified that MRP-227 Revision 1-A is acceptable to the extent delineated in the NRC SE that approved MRP-227 Revision 1,

but identified items in MRP-227, Revision 1-A that required clarification and requested that utilities who reference MRP-227, Revision 1-A address the action items described in the February 19, 2020, letter. By letter dated May 4, 2020 (ML20127H664), EPRI clarified these items related to MRP-227, Revision 1-A. By email dated June 9, 2020 (ML20141L313), the NRC verified and accepted the clarifications in the EPRI letter as addendum or errata to MRP-227, Revision 1-A and no further changes were needed to MRP-227 Revision 1-A.

The NRC staff assessment of the Millstone Unit 3 RVI AMP and inspection program focused on determining whether the licensee adequately incorporated the guidelines specified in MRP-227, Revision 1-A, if the action item in the NRC SE approving MRP-227 Revision 1 was addressed, and confirming that the attributes of the Millstone Unit 3 RVI AMP are consistent with NUREG-1801 Revision 2, Section XI.M16A, "PWR Vessel Internals", as supplemented by LR-ISG-2011-04, "Updated Aging Management Criteria for Reactor Vessel Internal Components for Pressurized-Water Reactors."

3.2 Millstone Unit 3 RVI AMP and Inspection Program per MRP-227, Rev 1-A

3.2.1 Applicability of MRP-227, Revision 1-A

Section 2.1 of the Millstone Unit 3 RVI AMP and inspection program discusses how MRP-227, Revision 1-A is applicable to Millstone Unit 3, in terms of the reactor design, RVI material specifications, stresses, and operating conditions. To demonstrate the applicability, Table 2.1-1 of the Millstone Unit 3 RVI AMP and inspection program discusses how it complies with the assumptions in section 2.4 of MRP-227, Revision 1-A.

The staff reviewed the Millstone Unit 3 RVI AMP and inspection program and noted the following:

- Millstone Unit 3 has operated for less than 30 years with a high-leakage core loading pattern.
- Millstone Unit 3 operates with average core power levels and proximity of active fuel to the upper core support plate in a manner that satisfies the limits described in MRP-227, Revision 1-A, Appendix B.
- Millstone Unit 3 has always operated as a base load unit.
- Millstone Unit 3 has no design changes beyond those identified in general industry guidance or recommended by the original vendor. Significant design changes in Millstone Unit 3 that were developed or evaluated by the designer include:
 - Control rod guide tube split pint replacement.
 - Partial replacement of flux thimble tubes.
 - Power uprates with no modification to reactor internals.
- The components and material class of each functional component were generically validated as listed in MRP-191 Revision 2 and the component materials were validated by the original designer (Westinghouse).
- The only other existing AMP, other than the ASME Section XI inspection program, is the AMP to manage wear and potential cracking of the bottom mounted instrumentation

neutron flux thimbles established in response to NRC Bulletin 88-09. The flux thimble tube AMP is in compliance with industry guidance.

Based on its review, the staff determined that the licensee has appropriately addressed the generic assumptions specified in section 2.4 of MRP-227, Revision 1-A, and, therefore, the use of MRP-227 Revision 1-A is appropriate.

3.2.2 NRC Condition and Action Item on MRP-227, Revision 1-A

Action Item 1 of section 4.0 of the NRC SE that approves MRP-227, Revision 1 states:

If the table in MRP 2017-009 indicates that the subsequent inspection interval is not to exceed 6 years (e.g., downflow plants with ≥ 3 percent [baffle former bolts] BFBs with indications or clustering, or upflow plants with ≥ 5 percent of BFBs with indications or clustering), the plant-specific evaluation to determine a subsequent inspection interval shall be submitted to the NRC for information within one year following the outage in which the degradation was found. Any evaluation to lengthen the determined inspection interval or to exceed the maximum inspection interval recommended in MRP-2017-009 shall be submitted to the NRC for information at least one year prior to the end of the current applicable interval for BFB subsequent examination.

The licensee notes in attachment 2 to the Millstone Unit 3 RVI AMP and inspection program that, as a tier 4 plant per MRP 2017-009, Millstone Unit 3 is required to perform a baseline volumetric inspection of the BFBs no later than 35 Effective Full Power Years (EFPY) and schedule reinspection based on the methodology provided or, optionally, to replace the BFBs to achieve an acceptable bolting pattern with a longer reinspection interval. Millstone Unit 3 complies with Action Item 1 by specifying notes 8 and 9 of Table 1 of attachment 1 to the Millstone Unit 3 RVI AMP and inspection program. Note 8 requires inspection within 35 EFPY. Note 9 requires a BFB reinspection based on the severity of bolting degradation found. MRP-227 Revision 1-A section 7.5 states that evaluations shall be conducted in accordance with NRC approved evaluation methods. The basis for evaluation of the BFB at Millstone Unit 3 is WCAP-17096-NP-A Revision 3, including the limitations and conditions of the associated NRC SE (ML23123A088). Page E-70 of Appendix E of the WCAP report states that any evaluation to lengthen the interval of the subsequent BFB inspection shall be submitted to the NRC for information at least one year prior to the end of the current interval for BFB subsequent examination. The staff noted that both these activities are consistent with Action Item 1 of the NRC SE.

The NRC staff finds that Millstone Unit 3 will inspect BFBs in accordance with MRP-227, Revision 1-A, and MRP 2017-009. The NRC staff notes that the proposed action is consistent with the requirements in Action Item 1 of the NRC's SE because: (1) if aggressive BFB degradation is discovered, the licensee will submit its evaluation within one year following the outage in which degradation was discovered, and (2) if the inspection interval will be lengthened or will exceed the maximum inspection interval recommended in MRP 2017-009, the licensee will submit the evaluation to the NRC for information at least one year prior to the end of the current reinspection interval. The NRC staff finds that the licensee has satisfied Action Item 1 of the NRC SE of MRP-227, Revision 1, and, therefore, the Millstone Unit 3 RVI AMP and inspection program is acceptable with respect to Action Item 1.

3.2.3 Millstone Unit 3 RVI AMP and Inspection Program Implementation Schedule

Section 2.3 of attachment 1 to the Millstone Unit 3 RVI AMP and Inspection Program, “Inspection Schedule”, addresses the licensee’s use of MRP-227 Revision 1-A to develop the Millstone Unit 3 plant-specific implementation schedule for the RVI AMP. Visual ISI inspections are implemented in accordance with the schedule required for Category B-N-3, Removable Core Support Structures, of ASME Code Section XI, Subsection IWB. The inspection schedule of MRP-227 Revision 1-A is implemented as shown in the tables in attachment 1 to the Millstone Unit 3 RVI AMP and inspection program. The tables refer to the start of the license renewal period (the PEO) which begins at midnight, November 25, 2025. The second refueling outage after this milestone, by which time MRP-227 Revision 1-A requires most baseline inspections to be complete, is anticipated to occur at refueling outage 25, in the spring of 2028.

Section 2.4 of attachment 1 to the subject submittal, “Inspection Standards and Examination Acceptance Standards”, address the licensee’s use of MRP-227 Revision 1-A to develop the Millstone Unit 3 plant-specific inspection plan for the RVI AMP. ASME Code Section XI visual inspections are implemented by the ISI program in accordance with Category B-N-3 and the acceptance standards are summarized in ASME Code Section XI paragraph IWB-3520.2. The visual inspections per MRP-227 Revision 1-A are performed in compliance with MRP-228. For certain bolting applications, ultrasonic inspection (UT) are performed, also in accordance with MRP-228. The acceptance standards for items inspected under MRP-227 Revision 1-A are described in MRP-227 Revision 1-A Section 5. Standards specific to Millstone Unit 3 are excerpted from MRP-227 Revision 1-A, Table 5-3 into Table 4 of attachment 1 to the Millstone Unit 3 RVI AMP and inspection program.

The tables in attachment 1 to the Millstone Unit 3 RVI AMP and inspection program specify the applicable RVI components identified in MRP-227 Revision 1-A that require inspection, along with the aging effect being managed, inspection method, inspection frequency, any links to expansion inspections, and the projected EFPY to perform the respective baseline inspections. Exceptions are noted where subsequent Needed guidance per NEI 03-08 has supplemented the published guidance. Specifically:

- The control rod guide plates (Item number W1) of Table 1 were updated to note a completed inspection per WCAP-17451-P, Revision 2.
- The core barrel upper flange weld (Item number W3), upper girth weld (Item number W3a), upper axial weld (item number W3.2) and lower girth weld (Item number W4) were updated in Tables 1, 2, and 4 per the guidance in MRP-2023-005.
- The clevis insert bolts (Item number W14) in Table 3 were supplemented per the guidance in PWROG Letter OG 21-160.

The NRC staff finds it appropriate that the licensee’s inspection plan accounts for the Needed guidance per NEI 03-08 because the Millstone Unit 3 RVI AMP and inspection program ensure adequate inspection of the affected RVI components in response to operating experience that occurred following the issuance of MRP-227 Revision 1-A.

The NRC staff reviewed attachment 1 Tables 1 through 4 to ensure the details of the Millstone Unit 3 RVI AMP and Inspection Program are consistent with the MRP-227, Revision 1-A, with the exceptions noted above.

Attachment 1 Table 1 of the Millstone Unit 3 RVI AMP and Inspection Program contains the primary inspection and monitoring recommendations for Westinghouse-designed internals as excerpted from MRP-227 Revision 1-A Table 4-3 with the exceptions noted above. The NRC staff verified that Table 1 is consistent with Table 4-3 of MRP-227, Revision 1-A, with the exceptions noted above. The NRC staff noted that the RVI of Millstone Unit 3 do not contain baffle-edge bolts (item number W5), 304 stainless steel hold down springs (item number W8), and thermal shield flexures (item number W9), which are identified in Table 4-3 of MRP-227, Revision 1-A. The NRC staff finds this acceptable as the design of Millstone Unit 3 does not include these three components; thus, the inspections per MRP-227, Rev 1-A are not applicable.

Attachment 1 Table 2 of the Millstone Unit 3 RVI AMP and Inspection Program contains the expansion inspection and monitoring recommendations for Westinghouse-designed internals as excerpted from MRP-227 Revision 1-A, Table 4-6, with the exception noted above. The NRC staff verified that Table 2 is consistent with Table 4-6 of MRP-227, Revision 1-A with the exception noted above.

Attachment 1 Table 3 of the Millstone Unit 3 RVI AMP and Inspection Program contains the existing inspection and AMPs credited in recommendations for Westinghouse-designed internals as excerpted from MRP-227 Revision 1-A, Table 4-9 with the exception noted above. The NRC staff verified that Table 3 is consistent with Table 4-9 of MRP-227, Revision 1-A with the exception noted above.

Attachment 1 Table 4 of the Millstone Unit 3 RVI AMP and Inspection Program contains the acceptance criteria and expansion criteria recommendations for Westinghouse-designed internals as excerpted from MRP-227 Revision 1-A, Table 5-3 with the exception noted above. The NRC staff verified that Table 4 is consistent with Table 5-3 of MRP-227, Revision 1-A with the exception noted above. The NRC noted that the RVI of Millstone Unit 3 does not contain baffle-edge bolts (item number W5), 304 stainless steel hold down springs (item number W8), or thermal shield flexures (item number W9) which are mentioned in Table 5-3 of MRP-227, Revision 1-A. The NRC staff finds this acceptable as the design of Millstone Unit 3 does not include these three components; thus, the inspections, and associated acceptance criteria and expansion criteria, per MRP-227, Rev 1-A Table 5-3 are not applicable.

Based on its review, the NRC staff determined that Tables 1 through 4 of attachment 1 to the Millstone Unit 3 RVI AMP and Inspection Program are acceptable and consistent with the guidelines of MRP-227 Revision 1-A, with the exceptions noted above.

3.2.4 Reactor Internal Aging Management Program Elements

Section 3 of the Millstone Unit 3 AMP and Inspection Program, "Evaluation Using NUREG-1801 Rev. 2 and LR-ISG-2011-04, Generic Aging Lessons Learned (GALL) Report Elements," states that the existing license renewal basis for Millstone Unit 3 is NUREG-1801 Revision 0.

At the time of issuance of MRP-227 Revision 1-A, the NRC SE approving MRP-227 Revision 1 requested that comparisons of the AMP be made to NUREG-1801 Revision 2, Section XI.M16A, "PWR Vessel Internals." Subsequently, the recommendations of NUREG-1801 Revision 2 were modified by LR-ISG-2011-04, still with reference to MRP-227-A. For subsequent license renewal (SLR) applications the NRC issued NUREG-2191, which also referenced MRP-227. Approval of SLR has not been requested for MPS3, therefore, the SLR-related guidance is not applicable.

Additionally, the NRC SE approving MRP-227 Revision 1 concludes that the updated MRP guidance document "is acceptable for referencing in LR applications" but does not require a direct comparison with a GALL-like document. The SE also states in Section 3.6.8 that no licensee action item for submittal of the AMP or the inspection plan is required because each licensee with an approved license renewal has a commitment to submit the AMP and inspection plan two years prior to the PEO. Thus, the licensee notes that LR-ISG-2011-04 is the most relevant document for describing the 10 element AMP for managing the RVIs of Millstone Unit 3.

Further, in Section 4 of the Millstone Unit 3 AMP and Inspection Program the licensee provides a comparison between NUREG-1801 Revision 0 and NUREG-1801 Revision 2, as supplemented by LR-ISG-2011-04. The licensee concludes that the Millstone Unit 3 RVI AMP and Inspection Program meets MRP-227, Revision 1-A and is consistent with the recommendations in NUREG-1801 Revision 2, as updated by LR-ISG-2011-04, without exception or enhancement.

During its review, the NRC staff reviewed each program element and compared them to with the Section XI.M16A of NUREG-1801 Revision 2, as updated by LR-ISG-2011-04, to verify consistency. The NRC staff compared the "scope of program," "preventative actions," "parameters monitored or inspected," "detection of aging effects," "monitoring and trending," "acceptance criteria," "corrective actions," "confirmation process," "administrative controls," and "operating experience" program elements of the licensee's Millstone Unit 3 RVI AMP and Inspection Program to the corresponding GALL elements in the Section XI.M16A of the NUREG-1801 Revision 2, as modified by LR-ISG-2011-04. Based on its review, the NRC staff finds that the ten program elements of the Millstone Unit 3 RVI AMP and Inspection Program are consistent with the corresponding program elements in Section XI.M16A of NUREG-1801 Revision 2, as modified by LR-ISG-2011-04, and that the licensee's AMP is adequate to manage the applicable aging effects of the RVIs at Millstone Unit 3.

4.0 CONCLUSION

The NRC staff has determined that (1) the licensee has adequately addressed Action Item 1 in the NRC SE for MRP-227, Revision 1, (2) the Millstone Unit 3 RVI AMP and Inspection Program is consistent with the inspection and evaluation guidance of MRP-227, Revision 1-A, and (3) the Millstone Unit 3 RVI AMP and Inspection Program is consistent with Section XI.M16A of NUREG-1801 Revision 2, as modified by LR-ISG-2011-04; therefore, it is acceptable.

Based on the above, the NRC staff concludes that the licensee has demonstrated that the Millstone Unit 3 RVI AMP and Inspection Program, will adequately manage the aging effects and provide reasonable assurance of structural integrity of the RVIs through the PEO set to begin on November 25, 2025. The NRC staff noted that: (1) its approval of the Millstone Unit 3 RVI AMP and Inspection Program does not reduce, alter, or otherwise affect ASME Code,

Section XI, ISI requirements, or any licensing basis requirements related to the ISI of RVI components at Millstone Unit 3, and (2) if the licensee wishes to use a new version of MRP-227, Revision 1-A, in the future, the new version of the topical report must have prior NRC review and approval.

Principal Contributors: S. Levitus, NRR
O. Yee, NRR

Date: December 19, 2024

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