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

October 20, 2020

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

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – PROPOSED ALTERNATIVE RR-05-05 TO THE REQUIREMENTS OF THE ASME CODE RE: CONTAINMENT UNBONDED POST-TENSIONING SYSTEM INSERVICE INSPECTION REQUIREMENTS (EPID L-2019-LLR-0120)

Dear Mr. Stoddard:

By letter dated December 17, 2019 (Agencywide Documents Access and Management System Accession No. ML19352B898), Dominion Energy Nuclear Connecticut, Inc. (the licensee) requested authorization of proposed alternative request RR-05-05 from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Subsection IWL, for the third 10-year inservice inspection interval for Millstone Power Station, Unit No. 2 (Millstone 2).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee proposed an alternative, RR-05-05, to the examination requirements of the ASME Code, Section XI, Subsection IWL, related to the containment unbonded post-tensioning system for Millstone 2 on the basis that the alternative provides an acceptable 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 has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes RR-05-05 for the third 10-year inservice inspection interval at Millstone 2.

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

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

Sincerely,

James G. Danna

Digitally signed by James G. Danna
Date: 2020.10.20 14:49:28 -04'00'

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: Listserv

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

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# ALTERNATIVE REQUEST RR-05-05 REGARDING CONTAINMENT

# UNBONDED POST-TENSIONING INSERVICE INSPECTION REQUIREMENTS

# DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

# MILLSTONE POWER STATION, UNIT NO. 2

# DOCKET NO. 50-336

## 1.0 INTRODUCTION

By letter dated December 17, 2019 (Agencywide Documents Access and Management System Accession No. ML19352B898), Dominion Energy Nuclear Connecticut, Inc. (the licensee) requested authorization of proposed alternative request RR-05-05 from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Subsection IWL, for the third 10-year inservice inspection (ISI) interval for Millstone Power Station, Unit No. 2 (Millstone 2).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee proposed an alternative, RR-05-05, to the examination requirements of the ASME Code, Section XI, Subsection IWL, related to the containment unbonded post-tensioning (P-T) system for Millstone 2 on the basis that the alternative provides an acceptable level of quality and safety.

## 2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), throughout the service life of a nuclear power facility, components that are classified as Class CC pressure-retaining components must meet the requirements set forth in Section XI of the ASME Code, Subsection IWL, as incorporated by reference in paragraph (a)(1)(ii), subject to the conditions listed in paragraph (b)(2)(ix) of 10 CFR 50.55a. Section XI, Subsection IWL of the ASME Code, provides rules for ISI and repair/replacement activities of the reinforced concrete and P-T system components of Class CC containment structures. The appropriate edition of the code to be used for successive 120-month inspection intervals is determined pursuant to paragraph (g)(4)(ii) of 10 CFR 50.55a. Alternatives to the requirements of 10 CFR 50.55a(g) may be authorized by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(z)(1) if the licensee demonstrates that the proposed alternative would provide an acceptable level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4)(ii), the licensee's code of record for the third 10-year containment ISI interval is the 2013 Edition of the ASME Code, Section XI, Subsection IWL. Table IWL-2500-1 (L-B), "Examination Category L-B, Unbonded Post-Tensioning System,"

provides the examination and test requirements for the P-T system components to be performed in accordance with subarticle IWL-2520, "Examination of Unbonded Post-Tensioning Systems," and the 5-year ISI schedule (examination frequency) specified in subarticle IWL-2420, "Unbonded Post-Tensioning Systems." The licensee has proposed an alternative to the code requirements for the examination of unbonded P-T system in Table IWL-2500-1 (L-B), Examination Category L-B, to extend the examination frequency to 10 years, to not perform wire extraction and testing, and to limit corrosion protection medium (CPM) testing to only absorbed water content.

The licensee requested authorization for use of the proposed alternative for the third ISI interval pursuant to 10 CFR 50.55a(z)(1) on the basis that it provides an acceptable level of quality and safety based on performance of its P-T system components, as supported by documented results and data of past plant-specific examinations and testing and operating experience over a period of 40 years (1976-2016).

## 3.0 TECHNICAL EVALUATION

### 3.1 Licensee's Proposed Alternative

The licensee's proposed alternative request RR-05-05 is applicable to the unbonded P-T system components of the Millstone 2 Containment Building. Specifically, the request is against the following examination requirements in Table IWL-2500-1 (L-B) of the ASME Code, Section XI, Subsection IWL:

- Item Number L2.10 requires that selected tendon force and elongation be measured every 5 years in accordance with IWL-2522.
- Item Number L2.20 requires that tendon single-wire samples be removed and examined for corrosion and mechanical damage as well as tested to obtain yield strength, ultimate tensile strength, and elongation on each removed wire. This inspection must be done every 5 years in accordance with IWL-2523.
- Item Number L2.30 requires that a detailed visual examination be performed every 5 years in accordance with IWL-2524 on selected tendon anchorage hardware and adjacent concrete. In addition, the quantity of free water released from the tendon during examination must be documented.
- Item Number L2.40 requires that samples of selected tendon CPM be obtained and analyzed every 5 years in accordance with IWL-2525.
- Item Number L2.50 requires that samples of free water be obtained and analyzed every 5 years in accordance with IWL-2525.

The licensee's requested proposed alternatives corresponding to the above code requirements for the duration of the third 10-year Millstone 2 IWL ISI interval (March 8, 2020, through March 7, 2030) are as follows:

- Item Number L2.10 – the licensee proposed to extend the interval of the examination from 5 years to 10 years.
- Item Number L2.20 – the licensee proposed to eliminate this examination for the third IWL ISI interval.
- Item Number L2.30 – the licensee proposed to extend the interval of the examination from 5 years to 10 years.

- Item Number L2.40 – the licensee proposed to extend the interval of the examination from 5 years to 10 years. The licensee also proposed to remove the requirement to determine the reserve alkalinity of the CPM and the concentrations of water-soluble chlorides, nitrates, and sulfides, unless there is visual evidence of active corrosion or the quantity of absorbed water has increased over time.
- Item Number L2.50 – the licensee proposed to extend the interval of the examination from 5 years to 10 years.

To demonstrate that the proposed alternative actions will provide an acceptable level of quality and safety, the licensee provided the information summarized below. The licensee also provided additional benefits to the deferral of the physical testing, such as less exposure of personnel to industrial safety hazards and undesirable conditions, and a reduction of unnecessary loading cycles on the tendons and environmental waste.

In its request, the licensee noted that the proposed alternative only applies to the tendon tests and associated examinations that require close-in access to tendon end anchorage areas. General visual or detailed visual examinations of accessible containment concrete surfaces, bearing plates, and tendon end caps will continue to be performed at the required 5-year interval in accordance with Tables IWL-2500-1 (L-A), IWL-2410, and IWL-2510. If these visual examinations reveal conditions that could indicate degradation of tendons or tendon hardware components, additional examinations per item numbers L2.10, L2.20, L2.30, L2.40, or L2.50 may be conducted, as determined and documented by the Responsible Engineer (RE). Conditions that could lead to these examinations include:

- Evidence of possible damage to the enclosed P-T hardware as indicated by conditions such as end cap deformation found during external visual examination. Conditions observed by removal of the end cap would determine the extent of additional examinations.
- Active corrosion on a bearing plate or end cap that requires further investigation as determined by the RE in an engineering evaluation.
- Evidence of corrosion protection medium leakage will be evaluated, and a plan developed that requires further investigation and corrective actions as defined in an engineering evaluation documented by the RE.

Attachment 2 of the licensee's request provides an industrywide summary of P-T systems (covering 41 pre-stressed concrete containments), as well as a detailed summary of plant-specific operating experience for each of the IWL examinations that is being postponed or not performed during the 10-year ISI interval. These plant-specific examination results constitute the basis for the proposed deviations from the ASME Section XI requirements. Section 4 of Attachment 2 evaluates past inspection results for tendon force measurements, P-T system hardware, tendon mechanical properties, CPM chemical properties, and free water analysis over a 40-year period (1976-2016).

### 3.2 NRC Staff Evaluation

The NRC staff reviewed the information provided in the proposed alternative request and noted that the licensee will continue to conduct the general visual examinations and detailed visual examination of suspect areas on a 5-year frequency as required by Table IWL-2500-1 (L-A), "Examination Category L-A, Concrete." Any indications identified during these examinations may lead to additional examinations in accordance with Table IWL-2500-1 (L-B), "Examination

Category L-B, Unbound Post-Tensioning System," as determined by the RE. As required by IWL-2511, this would include examination of the concrete surfaces and tendon end anchorage areas (end caps, bearing plates, area concrete) on a 5-year frequency to identify evidence of damage, deformation, water intrusion, corrosion, cracking, or CPM leakage. Tendon end caps are required to be removed for this examination if there is evidence of tendon end cap deformation or damage. The NRC staff also reviewed the plant-specific information and summary results of Millstone 2 examinations conducted over a 40-year period (1976-2016), for each of the requirements of Section XI, Subsection IWL, Table IWL-2500-1 (L-B), Item Numbers L2.10, L2.20, L2.30, L2.40, and L2.50. A summary of the NRC staff's evaluation of each item number is provided below.

Item Number L2.10 – Tendon Force Trends and Forecasts

Section 4.1 of Attachment 2 of the licensee's request states that the measured tendon forces and trend forecasts demonstrate that the mean pre-stressing forces in the containment will remain above the specified limits. Section 4.1.4 summarizes the results of past tendon surveillances and notes that the projected (forecast) forces in the hoop, vertical, and dome tendons, based on regression analysis of measured forces, remain above the minimum required mean force at time (T) = 51 years and at T = 60.4 years. These dates are the deadline for completion of the next surveillance if the interval is extended, and the expiration of the renewed facility operating license, respectively.

The NRC staff reviewed the liftoff force data and verified that the projected forces remain above the minimum required value through the next inspection and through the end of the current facility operating license. Based on the statistical analyses of past surveillance results, and the significant margin between the measured force trend (forecast) values and the minimum required valve, the NRC staff finds it acceptable to extend the interval of the P-T system examinations and tests (ASME Section XI, Table IWL-2500-1(L-B), Item Number L2.10) from 5 years to 10 years for the third 10-year Millstone 2 IWL ISI interval.

Item Number L2.20 – Wire Examination and Test Results

Section 4.2 of Attachment 2 of the licensee's request states that during each surveillance sample, wires have been extracted and tested from at least one tendon in each tendon group, along with any wires that were found to be broken. This led to testing of 39 wires, 7 of which were broken, and a total of 96 specimen tests. The specimens were tested for ultimate tensile strength and elongation at failure.

The NRC staff reviewed the results of the tests, as summarized in Tables 5A, 5B, 6A, and 6B of the request, and noted that all the tensile tests were above the minimum specified value of 240 kips per square inch, and all of the elongation tests were at or above the minimum of 4 percent elongation. In addition, the data did not show a significant trend in increasing or decreasing of tensile strength or elongation over time. Visual examination of the extracted wires did not identify any evidence of active corrosion on the wires. Since the examination and testing of sample wires has shown no degradation of condition, strength, or elongation over a time period of 40 years, and has not identified any cases of active corrosion, the NRC staff finds it acceptable to waive the requirement for sample wire removal and testing (ASME Section XI, Table IWL-2500-1 (L-B), Item Number L2.20) for the third 10-year Millstone 2 IWL ISI interval.

Item Number L2.30 – Anchorage Hardware and Surrounding Concrete Inspection

Section 4.3 of Attachment 2 of the licensee's request summarizes the results of end anchorage examinations performed periodically through the 40-year surveillance. During each of the surveillances, end anchorage areas were visually examined for evidence of corrosion, presence of free water, discontinuous wires, and damage to or distortion of load-bearing components. Beginning with the 15-year surveillance, the concrete adjacent to the bearing plates was examined for cracks, spalling, and other indications of structural distress. Attachment 2 notes that isolated areas of corrosion have been identified in past examinations; however, none of the indications were considered active, and in the last three surveillances (30-year, 35-year, and 40-year), no indications beyond "light rusting" were identified. Attachment 2 also notes that four broken wires (out of 11,346 total wires over the 61 examined tendons) have been identified during anchorage examinations, and no damaged load-bearing components have been identified. Concrete cracking has been found near the bearing plates; however, this cracking has been reviewed and determined to be non-structural or shrinkage cracks. Attachment 2 also notes that there has been no significant free water found during examination of the end caps, except for below-grade tendons. Starting with the 1-year surveillance, it was discovered that groundwater was infiltrating into some below-grade tendon ducts. To address this, the original CPM was replaced with a CPM that provides better protection for tendons subject to water infiltration. In addition, a pressurization system was developed after the 10-year surveillance for 16 below-grade tendons that ensures the effective head of the CPM remains above that of the groundwater. Table 8D of the request shows the results of the free water quantity measurements on the below-grade tendons, and it indicates a significant drop in free water after the installation of the pressurization system.

The NRC staff reviewed the information related to the anchorage hardware examinations and noted that no active or significant corrosion has been identified in the last 15 years. In addition, an insignificant number of broken wires (four out of 11,346 examined) have been found, and no significant concrete degradation has been identified. Free water quantities identified during these inspections have also been insignificant since the pressurization system was installed. None of the inspection results to date indicate the presence of active degradation mechanisms that will cause significant degradation if the inspection interval is extended. Therefore, the NRC staff finds it acceptable to extend the interval of the anchorage hardware examinations (ASME Section XI, Table IWL-2500-1(L-B), Item Number L2.30) from 5 years to 10 years for the third 10-year Millstone 2 IWL ISI interval.

Item Numbers L2.40 and L2.50 – CPM and Free Water Testing

Section 4.4 of Attachment 2 of the licensee's request notes that CPM was collected at the ends of the sample tendons during each of the 10 surveillances and tested for chlorides, nitrates, sulfides, absorbed water content, and neutralization (base) number.

The NRC staff reviewed the summary information and the data provided in Tables 7A – 7C and 8A – 8C of the request and noted that with a single exception, every test met the acceptance criteria. The one exception was related to water content, and it was from a below-grade tendon prior to the installation of the pressurization system. In addition, none of the test results demonstrate a trend with time. Based on the adequate results, and no indication that the results will degrade over time, the NRC staff finds it acceptable to extend the interval of the CPM test for absorbed water and free water tests (ASME Section XI, Table IWL-2500-1(L-B), Item Numbers L2.40 and L2.50) from 5 years to 10 years for the third 10-year Millstone 2 IWL ISI interval. In addition, the NRC staff finds it acceptable to waive the requirement to perform the

tests of CPM for corrosive ions and neutralization (base) number for the third Millstone 2 IWL ISI interval because these tests may not be necessary unless evidence of active corrosion is found from visual examinations of anchorage hardware/wires or the quantity of absorbed water in the CPM has increased with time; such conditions of significance have not been found during past examinations. However, as indicated in the request, if found, free water will be collected and analyzed to determine pH as required by Item Number L2.50.

Summary

Based on the above evaluation, the NRC staff determines that the licensee demonstrated adequate performance of the unbonded P-T system by presenting plant-specific P-T system inspection results and operating experience, and technical evaluations demonstrating applied tendon pre-stress will remain acceptable through the extended inspection interval. Therefore, the NRC staff finds that the use of proposed alternative RR-05-05 for the third 10-year Millstone 2 IWL ISI interval (March 8, 2020, through March 7, 2030) provides an acceptable level of quality and safety. This alternative extends the interval of the P-T examinations and tests, and the detailed visuals of adjacent concrete, from 5 years to 10 years (Table IWL-2500-1 (L-B), Items L2.10, L2.30, L2.40, and L2.50), waives the sample wire removal and testing (Table IWL-2500-1(L-B), Item L2.20) for this interval, and reduces the number of CPM chemical tests to absorbed water only (Table IWL-2500-1, Item L2.40).

## 4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative at Millstone 2 for the third 10-year IWL ISI interval (March 8, 2020, through March 7, 2030).

All other ASME Code Section XI requirements for which the alternative was not specifically requested and authorized in this proposed alternative remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: B. Lehman

Date: October 20, 2020

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 2 – PROPOSED ALTERNATIVE RR-05-05 TO THE REQUIREMENTS OF THE ASME CODE RE: CONTAINMENT UNBONDED POST-TENSIONING SYSTEM INSERVICE INSPECTION REQUIREMENTS (EPID L-2019-LLR-0120) DATED OCTOBER 20, 2020

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