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

August 6, 2020

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

SUBJECT: NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2 - RE: REQUEST TO REVISE REACTOR VESSEL MATERIAL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULES (EPID L-2019-LLL-0038)

Dear Mr. Stoddard:

By letter dated November 25, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19329C748), as supplemented by letter dated May 18, 2020 (ADAMS Accession No. ML20140A336), Virginia Electric Power Company (VEPCO, Dominion Energy Virginia) requested approval to revise the reactor vessel materials surveillance capsule withdrawal schedules.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that VEPCO has demonstrated that the proposed schedule revision remains consistent with the intent and requirements found in Appendix H to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50. Therefore, the NRC staff approves the requested change.

If you have any questions, please contact the Project Manager, Ed Miller at (301) 415-2481 or via e-mail at Ed.Miller@nrc.gov.

Sincerely,

Michael T. Markley

Digitally signed by Michael T. Markley
Date: 2020.08.06 11:27:11 -04'00'

Michael T. Markley, Chief
Plant Licensing Branch 2-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-338 and 50-339

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REVISION TO REACTOR VESSEL MATERIALS SURVEILLANCE CAPSULE

WITHDRAWAL SCHEDULE

VIRGINIA ELECTRIC POWER COMPANY

NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2

DOCKET NO. 50-338 AND 50-339

1.0 INTRODUCTION

By letter dated November 25, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19329C748), as supplemented by letter dated May 18, 2020 (ADAMS Accession No. ML20140A336), Virginia Electric Power Company (the licensee, VEPCO, Dominion Energy Virginia) requested approval to revise the reactor vessel materials surveillance capsule withdrawal schedules. Specifically, the submittal proposes the removal of Capsule X in 2025 instead of Capsule Z in 2030 for North Anna Power Station (NAPS) Unit 1 and the removal of Capsule X in 2026 instead of Capsule Z in 2029 for NAPS Unit 2. In addition, the proposal included revised projected fluence values for standby capsules beyond end of license, updated neutron fluence values for capsules removed to date, and updated the lead factors for all capsules.

2.0 REGULATORY EVALUATION

Appendix H, “Reactor Vessel Material Surveillance Program Requirements,” to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR), establishes the requirements for designing and implementing reactor vessel (RV) material surveillance programs. Section I of Appendix H states that the purpose of the material surveillance program is to monitor changes in the fracture toughness properties of ferritic materials in the beltline region of the reactor pressure vessel (RPV) which result from exposure of the materials to neutron irradiation and the thermal environment. Section III.B in Appendix H establishes the requirements for the design of the surveillance program and for implementing capsule withdrawals and performing material testing in accordance with the program.

Section III.B.1 of Appendix H requires the design of the surveillance program and the surveillance capsule withdrawal schedule to meet the requirements specified in the edition of American Society for Testing and Materials (ASTM) Standard Practice E185 that is current on the issue date of the American Society of Mechanical Engineers (ASME) Code to which the reactor vessel was purchased. Appendix H, incorporates by reference, ASTM E185, but only editions up to and inclusive of ASTM E185-82.

Section III.B.1 of Appendix H requires that, for each capsule withdrawal, the procedures for performing tests of capsule specimens and for reporting test results must meet the requirements of ASTM E185-82 to the extent practical for the configuration of the specimens in the capsules.

Section III.B.2 of Appendix H establishes specific requirements for placing the surveillance capsules inside of the reactor vessel . Surveillance specimen capsules must be located at positions so that the capsule irradiation history duplicates, to the extent practical within the physical restraints of the system, the neutron spectrum, temperature history, and maximum neutron fluence experienced by the reactor vessel inner surface . If capsule holders are and attached to the vessel wall or to the vessel cladding, construction and inservice inspection of the attachments and attachment welds must be done according to the requirements for permanent structural attachments to reactor vessels given in ASME Section III and Section XI Code. The design and location of the capsule holders must permit for insertion of replacement capsules. Accelerated irradiation capsules may be used in addition to the required number of surveillance capsules.

Section III.B.3 of Appendix H requires a proposed surveillance capsule withdrawal schedule be submitted with a technical justification and be approved by the NRC staff prior to implementation. Paragraph IV.A of Appendix H states, in part, that, Each capsule withdrawal and the test results must be the subject of a summary technical report to be submitted within one year of the date of capsule withdrawal, unless an extension is granted by the Director, Office of Nuclear Reactor Regulation.

3.0 TECHNICAL EVALUATION

The submittal proposes changes to the surveillance capsule withdrawal schedule and updates the reactor vessel neutron fluence estimates. Section 3.1 addresses the acceptability of the neutron transport methods and fluence estimates. Section 3.2 addresses the proposed change in the surveillance capsule withdrawal schedule.

3.1 Fluence Analysis

The licensee provided WCAP-18015-NP, Revision 2, “Extended Beltline Pressure Vessel Fluence Evaluations Applicable to North Anna 1 & 2,” to supplement the review of their request, which presented the RPV fluence evaluation. The evaluation was performed using methods described in WCAP-14040-A, Revision 4, “Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Curves” (ADAMS Accession No. ML050120209). The methods described in WCAP 14040 A, Revision 4, were generically reviewed and approved by U. S. Nuclear Regulatory Commission (NRC) staff, and have been found to meet Regulatory Guide (RG) 1.190 (ADAMS Accession No. ML010890301). The methods are also qualified for use with the Westinghouse RPV geometry. Since the methods are generically approved for use and qualified for the reactor vessel geometry at NAPS Units 1 and 2, the NRC staff determined that the fluence methods are acceptable for this application. WCAP-18015-NP provides fluence projections for the vessel shell forgings, shell circumferential welds, and for the nozzle forging attachment welds and nozzle forging postulated ¼ T flaws at NAPS Units 1 and 2.

The transport methods of WCAP-14040-A are qualified, and the associated uncertainties are estimated, under the assumption that the beltline region would include the axial extent of the vessel in proximity to active fuel. It is possible that the uncertainty may increase as the methods are applied further from the reactor core. In other words, WCAP-14040-A is not qualified

explicitly for fluence calculations in extended beltline materials. This applies especially to the nozzle forging attachment welds and nozzle forging postulated ¼ T flaws fluence projections. The NAPS extended beltline material with the highest fluence at 72 effective full power years (EFPY), as stated in WCAP-18015-NP, was Inlet Nozzle 1 for both Unit 1 and 2, with 3.13×10^{17} and 3.14×10^{17} neutrons per square centimeter (n/cm2), respectively.

The WCAP-14040-A fluence methodology uses S16 angular quadrature, which exceeds the minimum order suggested in RG 1.190 of S8. However, generic studies of pressurized water reactor designs have shown that the differences between S16 and higher order quadrature sets can be as high as 10 percent in either direction in the nozzle region. As a result, the fluence values in the nozzle region cannot be expected to have the same uncertainty as the beltline materials. The uncertainty for the materials in the nozzle region cannot be quantified without direct qualification data, which was not provided for this request. To evaluate the impact of this uncertainty, the NRC staff considered the analysis below.

WCAP-14040-A states that the uncertainty of the transport methods is about 13 percent, as determined through a combination of benchmark comparisons and analytic uncertainty analyses. This uncertainty estimate includes a category of “other factors,” which, according to the Topical Report (TR), “is intended to attribute an additional uncertainty to other geometrical or operational variables that individually have an insignificant impact on the overall uncertainty, but collectively should be accounted for in the assessment.”

RG 1.190 recommends an uncertainty of 20 percent or less, so in order to assess if the fluence calculations in the extended beltline region are acceptable, the uncertainty should be approximated. The effect of including additional contributors to the overall uncertainty can be illustrated as follows. The NRC staff expects that, if the qualification database were expanded to include an assessment of predictive capability in the nozzle region, there would be an additional contributor to the overall uncertainty, and the contribution of some of the “other factors” may increase as well. If an additional 10 percent were included in the analytical sensitivity studies to capture the effect of quadrature sets, and the 5 percent other factors were doubled to 10 percent simply to add additional conservatism, the overall uncertainty estimate would increase to approximately 18 percent, i.e., the contribution from sensitivity studies would increase to 14.5 percent, and the total would increase to 18 percent. Thus, this uncertainty remains within the 20 percent criterion recommended in RG 1.190.

The fluence analysis detailed in WCAP-18015, Revision 2, is consistent with the NRC generically approved neutron transport methods outlined in WCAP-14040-A, and the NRC staff’s evaluation of the uncertainty associated with those transport methods indicates that the uncertainty may be able to accommodate a reasonable increase associated with the increased distance from the core and still remain within the 20 percent agreement recommended by RG 1.190. As a result, the NRC staff finds the fluence estimates provided in WCAP-18015, Revision 2, to be acceptable insofar as they may be used to justify a surveillance capsule schedule change. Application of the methods described in WCAP-14040-A to the NAPS extended beltline components for other purposes would require more detailed evaluation than has been performed to support this review.

3.2 Surveillance Capsule Withdrawal Schedule Change

The submittal proposes the removal of Capsule X in 2025 instead of Capsule Z in 2030 for NAPS Unit 1 and the removal of Capsule X in 2026 instead of Capsule Z in 2029 for NAPS Unit 2. Capsule Z for NAPS Unit 1 and Capsule Z for NAPS Unit 2 would change to standby

capsule status. The associated neutron fluences for the proposed withdrawal schedule changes are 7.20 x 10^{19} and 7.34 x 10^{19} n/cm^2 for Units 1 and 2, respectively. These are the projected 80-year (72 EFPY) neutron fluences for NAPS Units 1 and 2. In the currently approved withdrawal schedules, located in Tables 5.4-2 and 5.4-3 of the updated final safety analysis report (UFSAR), the withdrawal fluences are projected to be 9.44 x 10^{19} and 10.17 x 10^{19} n/cm^2 for Units 1 and 2, respectively. The proposed changes to the surveillance capsule withdrawal schedules are consistent with the recommendation in the Generic Aging Lessons Learned (GALL) report to support the current 60-year license, for the withdrawal and testing of surveillance capsules between one and two times the 60-year RV peak RV neutron fluence.

The NRC staff finds the revised fluence schedule to be acceptable because the projected values were made with acceptable estimates, as detailed in Section 3.1 of this SE. Therefore, the NRC staff finds that the proposed surveillance capsule withdrawal schedule for NAPS Units 1 and 2 is acceptable for implementation because it will comply with the requirements in Appendix H. After the withdrawal of Capsule X from NAPS Unit 1 in 2025 and Capsule X from NAPS Unit 2 in 2026 in accordance with approval of the proposed schedule, testing of the specimens in the capsule is subject to the post-removal testing requirements specified in Section III.B.1 of Appendix H and the NRC's reporting requirements for submitting the reactor pressure vessel surveillance material test results to the Director, Office of Nuclear Reactor Regulation, as specified in Section IV of Appendix H.

4.0 CONCLUSION

Based on the above, the NRC staff concludes that the fluence analysis described in WCAP-18015, Revision 2, and the proposed surveillance capsule withdrawal schedule changes are acceptable. The neutron fluence values were determined using NRC-approved methods that meet RG 1.190 guidance. In the extended beltline, the uncertainty was evaluated to be able to accommodate the increase in uncertainty due to an increased distance from the core while still meeting RG 1.190 recommendations.

The NRC staff finds that the proposed surveillance capsule withdrawal schedule change as detailed in the letter dated November 25, 2019, is consistent with Appendix H for the withdrawal of Capsule X in 2025 for NAPS Unit 1 (replacing Capsule Z in 2030), and Capsule X for NAPS Unit 2 in 2026 for NAPS Unit 2 (replacing Capsule Z in 2029). The staff also finds that the proposed withdrawal schedule change complies with the requirements of Section III.B.3 in Appendix H. Based on the above, the NRC staff approves the licensee's request and concludes that Dominion Energy is authorized to revise the surveillance capsule withdrawal schedule as proposed. The proposed changes to the surveillance capsule withdrawal schedule change are acceptable because they meet the requirements of 10 CFR Part 50, Appendix H.

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Date: August 6, 2020

SUBJECT: NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2 - RE: REQUEST TO REVISE THE SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULES (EPID L-2019-LLL-0038) DATED AUGUST 6, 2020

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