



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

March 15, 2016

Mr. David A. Heacock  
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. 3 – REVISION TO THE  
REACTOR VESSEL SURVEILLANCE CAPSULE WITHDRAWAL SCHEDULE  
(CAC NO. MF6476)

Dear Mr. Heacock:

By letter dated July 2, 2015, as supplemented on January 28, 2016, Dominion Nuclear Connecticut, Inc. (the licensee) submitted a request for U.S. Nuclear Regulatory Commission (NRC) staff review and approval to revise the reactor vessel surveillance capsule removal schedule for Millstone Power Station, Unit No. 3 (MPS3). Specifically, the proposed change would revise the withdrawal schedule to reflect the removal of standby Capsule Z from the reactor and the reinstallation of standby Capsule Y into the reactor from the spent fuel pool.

The NRC staff has reviewed the licensee's submittal and concludes that the revised reactor vessel material surveillance capsule withdrawal schedule for MPS3 satisfies the requirements of Title 10 of the *Code of Federal Regulations*, Part 50, Appendix H, and guidelines of associated guidance documents. Therefore, the proposed changes are acceptable. Details of the NRC staff's review are set forth in the enclosed safety evaluation.

Sincerely,

A handwritten signature in black ink, appearing to read "Richard V. Guzman", with a long horizontal line extending to the right.

Richard V. Guzman, Senior Project Manager  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosure:  
Safety Evaluation

cc w/enclosure: Distribution via Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

MILLSTONE POWER STATION, UNIT NO. 3

REVISION TO THE REACTOR VESSEL SURVEILLANCE CAPSULE

WITHDRAWAL SCHEDULE

DOMINION NUCLEAR CONNECTICUT, INC.

DOCKET NO. 50-423

1.0 INTRODUCTION

By letter dated July 2, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15194A061) as supplemented by letter dated January 28, 2016 (ADAMS Accession No. ML16034A215), Dominion Nuclear Connecticut, Inc. (the licensee) submitted a request to revise the reactor vessel (RV) surveillance capsule removal schedule for Millstone Power Station, Unit No. 3 (MPS3), for U.S. Nuclear Regulatory Commission (NRC) staff approval. The licensee's submittal proposes to revise the surveillance capsule withdrawal schedule based on the latest industry guidance, while remaining in compliance with the requirements of Appendix H, "Reactor Vessel Material Surveillance Program Requirements," to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix H. Section III(B)(3) of 10 CFR 50, Appendix H, requires that proposed withdrawal schedules, and any changes to the withdrawal schedules, be submitted to and approved by the NRC staff prior to implementation. Specifically, the proposed change would revise the withdrawal schedule to reflect the removal of standby Capsule Z from the RV and the reinstallation of standby Capsule Y into the RV from the spent fuel pool.

2.0 REGULATORY EVALUATION AND BACKGROUND

In 10 CFR 50, Appendix H, licensees are required to monitor changes in the fracture toughness properties of ferritic materials in the RV beltline region of light water nuclear power reactors that result from exposure of these materials to neutron irradiation and the thermal environment. The surveillance program must comply with ASTM International (formerly American Society for Testing and Materials) Standard Practice E 185-82, "Standard Practice for Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels," which is current on the issue date of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code to which the RV was purchased, although the editions through ASTM E 185-82 may be used as incorporated by reference in 10 CFR 50, Appendix H. The MPS3 RV material surveillance capsule program was originally designed in accordance with ASTM E 185-82 and Appendix H to 10 CFR 50. Section III(B)(3) of 10 CFR 50, Appendix H, requires that surveillance capsule withdrawal schedules be submitted to and approved by the NRC staff prior to implementation.

Enclosure

Industry has developed a document entitled, “Materials Reliability Program: Coordinated PWR [Pressurized Water Reactor] Reactor Vessel Surveillance Program (CRVSP) Guidelines (MRP-326)” (ADAMS Accession Nos. ML12040A314 and ML12040A315). The purpose of this CRVSP is to increase the neutron fluence levels of future surveillance capsules prior to withdrawal and testing, while maintaining compliance with 10 CFR 50, Appendix H, and consistency with the guidance of NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” Revision 2, December 2010 (ADAMS Accession No. ML103490041) (“the GALL Report”). The CRVSP was designed to generate high neutron fluence PWR surveillance data in support of extended life operations.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Summary Description of Licensee Evaluation

The licensee’s July 2, 2015, submittal, provided the proposed RV surveillance capsule withdrawal schedule, which is summarized in Table 1 below. It should be noted that Capsules U, X, and W have already been withdrawn and tested in accordance with 10 CFR 50, Appendix H requirements and ASTM E 185-82 specifications.

**Table 1: Proposed Surveillance Capsule Withdrawal Schedule for MPS3**

Capsule	Withdrawal Effective Full Power Years (EFPY)	Lead Factor	Neutron Fluence (E > 1.0 MeV) Neutron/centimeter <sup>2</sup> (n/cm <sup>2</sup> )
U	1.3	4.06	4.00 x 10 <sup>18</sup>
X	8.0	4.35	1.98 x 10 <sup>19</sup>
W	13.8	4.22	3.16 x 10 <sup>19</sup>
Y	Standby	3.98	Note (1)*
V	Standby	3.98	Note (1)*
Z	Approx. 23.4	4.22	5.37 x 10 <sup>19</sup>

\*Note (1) Capsules Y and V were withdrawn after 13.80 EFPY and placed into storage after accruing 2.98 x 10<sup>19</sup> n/cm<sup>2</sup> fluence.

The proposed surveillance capsule withdrawal schedule in Table 1 reflects the removal and transfer to storage of Capsule Z at approximately 23.4 EFPY so that the projected neutron fluence exposure of the surveillance capsule does not exceed the two times end-of-license peak RV neutron fluence. The maximum projected 72 EFPY and 90 EFPY neutron fluence values at the beltline were estimated to be 3.57 x 10<sup>19</sup> n/cm<sup>2</sup> and 4.45 x 10<sup>19</sup> n/cm<sup>2</sup>, respectively. Therefore, Capsule Z will be removed and placed into storage with an accumulated neutron fluence exposure less than two times the maximum estimated 72 EFPY beltline value. Capsule Y will be reinserted to maintain the continued monitoring of the RV neutron fluence as required by Appendix H to 10 CFR 50.

### 3.2 Staff Evaluation

Six surveillance capsules were inserted in the RV prior to initial start-up. MPS3 received approval for a 60-year (54 EFPY) renewed license in November 2005. Currently, three of the six surveillance capsules (U, X, and W) have been removed and tested, meeting the requirements of Appendix H to 10 CFR 50 and the recommendations of the GALL Report for the period of extended operation (PEO). The staff notes that under the proposed RV material surveillance capsule withdrawal schedule, which extends through the PEO, there will continue to be three standby surveillance capsules: Capsules Y, V, and Z.

The surveillance capsules must be located near the inside vessel wall in the beltline region so that the material specimens duplicate, to the greatest degree possible, the neutron spectrum, temperature history, and maximum neutron fluence experienced at the reactor vessel's inner surface. Because of the resulting lead factors, surveillance capsules receive equivalent neutron fluence exposures earlier than the inner surface of the reactor vessel. This allows surveillance capsules to be withdrawn prior to the inner surface receiving an equivalent neutron fluence, and therefore, test results may bound the corresponding operating period in the capsule withdrawal schedule. The MPS3 surveillance capsules are exposed to relatively higher lead factors between 3.98 and 4.22; therefore, neutron fluence accumulated exposures are relatively higher rates.

The storage of all withdrawn and tested surveillance capsules (with the exception of those discarded before August 31, 2000) is a recommended element of the Aging Management Programs (AMPs) XI.M31, "Reactor Vessel Surveillance," in the GALL Report for plants that have been issued or that have applications pending for renewed operating licenses. The proposal to transfer Capsule Z to storage is consistent with the GALL Report recommendation in AMP XI.M31, which additionally states, "If the projected neutron fluence for these additional capsules is expected to be excessive if left in the reactor vessel, the program may propose to withdraw and place one or more untested capsules in storage for future reinsertion and/or testing." Therefore, the staff finds the transfer of Capsule Z to storage to be consistent with 10 CFR 50, Appendix H, and the GALL Report during the PEO.

Appendix H to 10 CFR 50 includes the requirement of dosimetry monitoring as part of the RV material surveillance program. In addition, GALL Report AMP XI.M31 states that programs without in-vessel capsules use alternative dosimetry to monitor neutron fluence during the PEO. The submittal stated that, "Concurrent reinsertion of Capsule Y will maintain continuous reactor vessel monitoring as required by 10 CFR 50, Appendix H." Surveillance capsules are designed and located to permit the insertion of replacement or standby capsules. Capsule Y was placed into storage after 13.8 EFPY in October 2005. By letter dated January 28, 2016, the licensee provided additional information regarding the effects of neutron fluence experienced by Capsule Y while stored in the spent fuel pool. The projected neutron fluence exposure after 13.8 EFPY was determined to be approximately  $3 \times 10^{19}$  n/cm<sup>2</sup>. With reinsertion of the capsule into the reactor, the additional neutron fluence projected for the capsule is projected to be approximately  $6 \times 10^{19}$  n/cm<sup>2</sup>. Electric Power Research Institute Technical Report-100784, "Borated Stainless Steel Application in Spent-Fuel Storage Racks," determined that the maximum anticipated neutron fluence of a 40-year service life in the spent fuel pool was approximately  $1 \times 10^{12}$  n/cm<sup>2</sup>. The neutron fluence exposure of Capsule Y while stored in the spent fuel pool is several orders of magnitude less than the projected neutron fluence exposure of the capsule while in the RV;

therefore, the staff concludes that the contribution of neutron fluence during the storage period in the spent fuel pool is not significant.

The staff notes that the licensee stated in the January 28, 2016, letter that "no analysis is planned for Capsule Y through the end of the current license period." The staff finds this statement acceptable since the three scheduled capsules (U, X, and W) have already been withdrawn and tested in accordance with 10 CFR 50, Appendix H requirements and ASTM E 185-82 E specifications. Capsule Y is considered a standby capsule during the PEO.

#### 4.0 CONCLUSION

The NRC staff has reviewed the licensee's July 2, 2015, submittal, as supplemented by letter dated January 28, 2016, regarding the proposed revision to RV material surveillance capsule withdrawal schedule for MPS3. Based on the above evaluation, the NRC staff concludes that the revised RV material surveillance capsule withdrawal schedule for MPS3 satisfies the requirements of Appendix H to 10 CFR 50 and the recommendations of the GALL Report as they relate to the PEO. Therefore, the proposed changes are acceptable.

Principal Contributors: Carolyn Fairbanks  
Matthew Hardgrove

Date: March 15, 2016

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 President and Chief Nuclear Officer  
 Dominion Nuclear Connecticut, Inc.  
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/RA/

Richard V. Guzman, Senior Project Manager  
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**ADAMS Accession No.: ML16067A234**

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OFFICE	DORL/LPL1-1/PM	DORL/LPL1-1/LA	DE/EVIB/BC*	DORL/LPL1-1/BC	DORL/LPL1-1/PM
NAME	RGuzman	KGoldstein (LRonewicz for)	JMcHale	TTate	RGuzman
DATE	3/8/16	3/8/16	3/4/16	3/15/16	3/15/16

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