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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No.	17-447
NRA/WDC	R0
Docket No.	50-423
License No.	NPF-49

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING GENERIC LETTER 2016-01, MONITORING OF NEUTRON-ABSORBING MATERIALS IN SPENT FUEL POOLS

By letter dated November 1, 2016, Dominion Nuclear Connecticut, Inc. (DNC) responded to Generic Letter (GL) 2016-01, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools," for Millstone Power Station Unit 3 (MPS3). In a letter dated October 27, 2017, the NRC transmitted a request for supplemental information related to the GL response. DNC agreed to provide the supplemental information by November 27, 2017.

The attachment to this letter provides the supplemental information requested by the NRC for MPS3.

If you have any questions regarding this submittal, please contact Wanda Craft at (804) 273-4687.

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering and Fleet Support
Dominion Energy Nuclear Connecticut, Inc.

Attachment:

Response to Request for Supplemental Information Regarding GL 2016-01 for MPS3

Commitments made in this letter: None

A158
NRR

cc: U.S. Nuclear Regulatory Commission
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Serial No. 17-447
Docket No. 50-423

ATTACHMENT

RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION REGARDING GL 2016-01 FOR MPS3

MILLSTONE POWER STATION UNIT 3
DOMINION NUCLEAR CONNECTICUT, INC.

By letter dated November 1, 2016, Dominion Nuclear Connecticut, Inc. (DNC) responded to Generic Letter (GL) 2016-01, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools," for Millstone Power Station Unit 3 (MPS3). In a letter dated October 27, 2017, the NRC transmitted a request for supplemental information related to the GL response. This attachment provides the supplemental information requested by the NRC.

Plant-Specific Monitoring Information

Title 10 of the Code of Federal Regulations (10 CFR) Section 50.68, "Criticality accident requirements," and General Design Criterion (GDC) 62, "Prevention of Criticality in Fuel Storage and Handling," provide the requirements for licensees with regards to maintaining sub-criticality in the spent fuel pool (SFP). For licensees that utilize neutron absorbing materials (NAM) in the SFP, the 10B areal density (AD) of the NAM must be verified so that the assumption for the ^{10}B minimum AD in the SFP criticality analysis is supported. In order for the NRC staff to verify the requirements of 10 CFR 50.68 and GDC 62 are met, the staff needs to ensure the programs in place to monitor the condition of the NAM in the SFP are appropriate for their intended purpose. By evaluating the programs that monitor the condition of the NAM in the SFP, the NRC staff will be able to determine whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met. In addition, the condition of the NAM must be considered in the SFP NCS AOR. In order to verify whether or not the requirements of 10 CFR 50.68 and GDC 62 will be met, the staff needs to verify that the potential reactivity changes due to degradation or physical changes to the NAM are accounted for in the SFP NCS AOR.

MPS3 - 1

In the response to question 2)b)ii)4), the licensee states that there may not be enough coupons remaining for the life of the SFP, and that two alternatives are being pursued to extend the life of the coupon monitoring program. These alternatives include either extending the interval between tests, and/or re-inserting the coupons into the SFP.

a. *Provide the potential extended surveillance intervals for the test coupons.*

b. *In addition, under what conditions are the Boral coupons that have been previously removed from the SFP being stored?*

c. *Provide the justification to re-insert coupons as described in question 2)b)ii)3).*

DNC Response

a. The potential extended surveillance interval for the test coupons is 10 years. The basis for this interval is in NEI 16-03 "Guidance for Monitoring of Fixed Neutron Absorbers in Spent Fuel Pools" which states the following in Section 2.1:

Sampling intervals are based upon the expected rate of material changes, which may be influenced by the qualification testing of the material. For new materials that do not have applicable operating experience in conditions similar to the pool environment (i.e. their ability to perform over time is not well known), the initial interval of 5 years, with subsequent intervals up to 10 years is acceptable. For materials that have been used for several years in conditions similar to the pool environment (i.e. their ability to perform is well known), and for which stability of the material condition has been documented, initial and subsequent intervals up to 10 years is acceptable.

The MPS3 BORAL was installed in 2000 and has been exposed to the SFP environment for 17 years. Since 2000, six coupons have been removed and tested with no blistering, no loss of B-10 areal density, and no pitting observed. Therefore, DNC considers the BORAL's ability to perform in the MPS3 SFP is well known. Thus, per the guidance in NEI 16-03, a 10 year surveillance interval is appropriate. However, MPS plans to continue the current five year surveillance for one more interval to trend stability of coupon conditions after reinsertion.

MPS3's response to GL 16-01 stated that five coupons had been removed for testing. Since the date of MPS3's response to GL 16-01, an additional coupon has been removed and tested bringing the total number to six.

b. Six BORAL coupons have been removed from the SFP for testing. The first four BORAL coupons were retained by the testing vendor, NETCO. The fifth coupon was removed in 2013 and was stored at NETCO's lab at room temperature until 2017. The fifth coupon was returned to MPS3 in 2017 and was returned to the SFP in August 2017 for unofficial observational purposes.

   The first five coupons that were removed and tested were heat-dried. The Electric Power Research Institute (EPRI) Report 1019110, "Handbook of Neutron Absorber Materials for Spent Nuclear Fuel Transportation and Storage Applications," (page 5-36) states that heat drying may cause blisters even if the coupon had none before the drying process. EPRI Report 3002008195, "Evaluation of BORAL Coupons from Zion Spent Fuel Pool," suggests not reusing heat-dried coupons (Section 5-4). In addition, these coupons have been out of the spent fuel pool for at least four years. Therefore, these coupons will not be reused to satisfy the monitoring program because they are no longer considered representative of the BORAL in the SFP racks.

   The sixth coupon was removed in August 2017, tested, and returned to the MPS3 SFP in early October 2017. The coupon was stored at room temperature and was not heat-dried during testing. The total time the coupon was out of the SFP is small as compared to the 16+ years the coupon was in the SFP.

c. Eight coupons were originally placed in the MPS3 SFP. The first five coupons removed from the SFP were heat-dried during testing and will not be used as

part of the monitoring program because they are no longer considered representative of the BORAL in the SFP racks. The three remaining coupons will be reinserted into the SFP after they are tested.

To maintain the analogy between the coupon and BORAL panels in the SFP, the last three coupons will be prepared for testing differently than the first five. The last three coupons will not be heat-dried and will be stored at room temperature when outside the SFP to preserve the integrity of the coupon. The coupons will also be promptly returned to MPS3 after testing to spend the least amount of time out of the SFP (generally about 2 months). The time period that these coupons will be out of the SFP is relatively short considering that each of the coupons have been in the SFP for at least 16 years. This ensures the coupons continue to represent the BORAL panels in the MPS3 SFP.

Not heat drying during testing, storing at room temperature, and re-inserting coupons as soon as reasonably achievable aligns with EPRI recommendations (EPRI Report 3002008195, Sections 5-4 and 7) because it allows more accurate trending and extends the life of the coupon monitoring program.

MPS3 - 2

In the response to question 1)e)iii), the licensee states that there has been no observed degradation of the Boral material. However, the estimated current minimum ^{10}B AD in the response to question 1)e)i) appears to be lower than the minimum as built ^{10}B AD in the response to question 1)b)ii). Why is the estimated current minimum lower than the as-built if no signs of degradation have been observed?

DNC Response

In the GL 16-01 response, DNC listed the as-built minimum B-10 areal density as 0.0310 g/cm^2 and the estimated current minimum B-10 areal density as 0.0302 g/cm^2. The basis for the estimated current value was the coupon measurement performed in 2013.

After submitting the response to GL 16-01, DNC reevaluated the 2013 post-irradiated areal density measurement. Based on a newer and more accurate chemical analysis, the testing vendor determined that coupon measurements taken during a period of time before 2014 underestimated the B-10 content. The 2013 coupon neutron attenuation data was reanalyzed with the vendor's updated calibration curve and it was determined that coupon had a B-10 areal density of 0.0325 g/cm^2. The originally measured B-10 areal density of this coupon was 0.0320 g/cm^2. This reanalysis corroborates DNC's original conclusion that the BORAL panels in the MPS3 SFP are not degrading.

DNC considers that the B-10 in the BORAL cannot degrade if the aluminum plates surrounding the boron cermet are still intact and in good condition. There are no known failure mechanisms which allow the B-10 in BORAL to migrate past the aluminum plates if the plates are still intact. The MPS3 coupon tests have determined that the aluminum

cladding is intact with no blisters or pitting. In addition, the boron cermet, which is exposed to the SFP environment at the edges of the BORAL coupon, shows no signs of dissolving or degrading away. Finally, the revised B-10 areal density measurement (0.0325 g/cm^2) for the post-irradiated 2013 coupon is within the uncertainty of the measurement from its pre-irradiated areal density.

Additional Information: Coupon Weight Anomaly

B-10 areal density is the principal metric for determining BORAL degradation and DNC has not identified any B-10 areal density loss, pitting, blistering, or degradation that affects the criticality of the spent fuel pool. However, DNC has identified some weight loss in the coupons.

The indicated weight loss of the coupons is slow, and fairly steady. The first five coupon weight measurements indicated weight losses that increased linearly over time. The sixth coupon weight measurement indicated a weight loss slightly less than the fifth coupon. See Table 1.

The cause of the coupons' weight loss is not known but DNC continues to monitor it. DNC contacted other utilities and no other plants have indicated a similar condition. NETCO postulated that the weight loss is likely due to the aluminum oxide layer chipping off or being mechanically removed during cleaning and decontamination prior to the measurement. To minimize potential coupon weight loss due to handling, extra caution was taken by DNC and NETCO during removal of the sixth coupon from the SFP and during decontamination and cleaning in the lab. Subsequent measurement of the sixth coupon showed less weight loss.

DNC postulates that the aluminum oxide layer is prone to flaking because the coupons are unjacketed and the coupons can freely swing when fastened to the coupon tree in the SFP. Therefore, DNC is jacketing and securely fastening the coupons that will be returned to the pool and will monitor the coupon condition after reinsertion. The BORAL in the racks is jacketed and securely fastened, so it is not expected that the racks are experiencing this same weight loss.

In conclusion, DNC has not observed any degradation that would affect the criticality of the SFP, and the coupon weight loss is slow and predictable. DNC will continue to monitor and use the corrective actions system to address the coupon weight loss as more information becomes available.

Table 1: Coupon Weight Change

Time	Years Elapsed	Percent Weight Change
2000	0	0% (Installation)
2/25/2003	3.15	-1.39%
2/26/2004	4.15	-1.93%
9/1/2005	5.67	-2.72%
9/18/2008	8.71	-4.47%
5/24/2013	13.39	-6.14%
10/20/2017	17.80	-5.85%