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May 7, 2019

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

Serial No.	19-077A
NRA/SS	R0
Docket No.	50-423
License No.	NPF-49

DOMINION ENERGY NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3
REVISED RESPONSES FOR TWO REQUEST FOR ADDITIONAL INFORMATION QUESTIONS FOR PROPOSED TECHNICAL SPECIFICATION CHANGES FOR SPENT FUEL POOL STORAGE AND NEW FUEL STORAGE

By letter dated May 3, 2018, Dominion Energy Nuclear Connecticut, Inc. (DENC) requested Nuclear Regulatory Commission (NRC) approval of a License Amendment Request (LAR) for Millstone Power Station Unit 3. The LAR proposed Technical Specification changes for spent fuel pool storage and new fuel storage. In an email dated February 11, 2019, the NRC transmitted a request for additional information (RAI) related to the LAR. By letter dated March 27, 2019, DENC responded to the NRC staff's RAI. Based on a conference call held with the NRC on April 10, 2019, DENC is revising the RAI response for Questions 4 and 9. The previously issued responses to RAI Questions 1 through 3 and 5 through 8, and the study included in Attachment 2 of the submittal, remain unchanged. The attachment to this letter provides the replacement responses for RAI Questions 4 and 9.

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

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering & Fleet Support

VICKI L. HULL
NOTARY PUBLIC
REG. # 140542
COMMONWEALTH OF VIRGINIA
MY COMMISSION EXPIRES 5/31/2022

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Sartain, who is Vice President - Nuclear Engineering & Fleet Support of Dominion Energy Nuclear Connecticut, Inc. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 7TH day of MAY, 2019.

My Commission Expires: 5-31-22

Notary Public

A001
NRR

Attachment:

Revised Responses for Two Request for Additional Information Questions for Proposed Technical Specification Changes for Spent Fuel Pool Storage and New Fuel Storage

Commitments made in this letter: None

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT

REVISED RESPONSES FOR TWO REQUEST FOR ADDITIONAL INFORMATION QUESTIONS FOR PROPOSED TECHNICAL SPECIFICATION CHANGES FOR SPENT FUEL STORAGE AND NEW FUEL STORAGE

MILLSTONE POWER STATION UNIT 3
DOMINION ENERGY NUCLEAR CONNECTICUT, INC.

By letter dated May 3, 2018, Dominion Energy Nuclear Connecticut, Inc. (DENC) requested Nuclear Regulatory Commission (NRC) approval of a License Amendment Request (LAR) for Millstone Power Station Unit 3 (MPS3). This LAR proposed Technical Specification changes for spent fuel pool storage (SFP) and new fuel storage. In an email dated February 11, 2019, the NRC transmitted a request for additional information (RAI) related to the LAR.

By letter dated March 27, 2019, DENC responded to the NRC staff's RAI. Based on a conference call held with the NRC on April 10, 2019, DENC is revising the RAI response for Questions 4 and 9. The previously issued responses to RAI Questions 1 through 3 and 5 through 8, remain unchanged. The replacement responses for RAI Questions 4 and 9 are provided below. It should be noted that references to "Attachment 2" in the revised responses cite the study included in Attachment 2 of the previous RAI response submittal. This study also remains unchanged.

RAI 4

Section 8.3, "Bounding Depletion Boron," indicates the depletion analysis used a cycle average soluble boron of 1050 ppm. The reference for using a cycle average soluble boron is J. C. Wagner, "Impact of Soluble Boron Modeling for PWR Burnup Credit Criticality Safety Analyses," Trans. Am. Nucl. Soc., 89, pp. 120 (2003). That reference indicates that using a cycle average soluble boron could be non-conservative for fuel discharged to the SFP following a mid-cycle shutdown or short cycle. Describe how the analysis accounts for this potential.

DENC Response

In support of this response, DENC performed a study using CASMO-5 and KENO V.a that replicates the Wagner paper (Reference 1) and extends the analysis to include typical MPS3 cycle characteristics. The study is included in Attachment 2 of this letter. The DENC study shows that the greatest potential effect is for third cycle fuel and that most of the potential non-conservatism is based on comparing the more realistic boron letdown depletion of a shortened cycle to a fixed boron depletion in which the boron is held equal to the full cycle average boron. The Wagner paper does not make use of the actual lifetime average boron in the constant boron depletion when calculating the k-ratio.

Accounting for the actual average depletion boron reduces the non-conservatism shown in the Wagner paper by about 75%. For a typical MPS3 cycle, depletion with actual lifetime average boron for the constant boron depletion accounts for all but 44 pcm maximum non-conservatism. This value encompasses one cycle, two cycle, and three cycle fuel assemblies. Details regarding calculation of this maximum reactivity non-conservatism are shown in Attachment 2 of this letter.

The 44 pcm maximum boron history non-conservatism does not need to be accounted for directly because the maximum value is small relative to conservatism in the LAR. In particular, LAR burnup credit depletions use mutually exclusive maximum depletion temperatures and 50% reduced power during the last 40 days of depletion (LAR

Attachment 5 / 6, Section 5.2.4 and Section 8.10). The reduced power assumption allows for the possibility of a very long power coastdown near end of core life, which is inconsistent with operations before a mid-cycle shutdown. Therefore, it is not realistic to apply a bias to cover both the end of cycle power coastdown and the boron history non-conservatism which would occur after a middle of cycle shutdown. The effect of this non-physical hybrid power coastdown depletion as compared to a bounding high power-only depletion is on the order of 0.003 dk (LAR Attachment 5 / 6, Table 8.11), which is about seven times the amount needed to offset the maximum boron history non-conservatism. Relative to the LAR burnup credit depletions, power reduction for less than 40 days or of a lesser degree than 50% prior to a mid-cycle offload would result in lower depletion temperatures and higher Pm-149. This would reduce SFP fuel reactivity relative to the LAR analysis and tend to offset the already small potential boron history non-conservatism.

The MPS3 LAR uses a cycle average boron (1050 ppm) that bounds the fuel boron depletion history for all historical MPS3 fuel assemblies. For new cycle designs, the design process includes a step to verify that the LAR cycle average boron will remain bounding if the cycle is not unexpectedly shortened.

For a cycle that is unexpectedly shortened, a check will be performed prior to offloading fuel to determine if the actual cycle average boron is less than the limit. If the boron limit is exceeded, a disposition of affected fuel assemblies will be performed that incorporates the actual lifetime average boron. The results of the DENC study in Attachment 2 support the use of lifetime average boron for this purpose.

Nuclear Energy Institute (NEI) Guidance Document 12-16 (Reference 2) addresses the issue of mid-cycle offload:

> ***"A licensee would evaluate a mid-cycle offload in accordance with the licensee's corrective action program and current NRC guidance for identifying and resolving potential nonconservatisms or unanalyzed conditions in a design basis analysis. If an issue is identified, the licensee would make an initial operability determination, and subsequently evaluate in accordance with 50.59 to determine whether NRC approval is required. As a default, any fuel assembly could be conservatively treated as a fresh fuel assembly with no burnable absorbers."***

DENC will implement the following disposition process that is similar to, but somewhat less limiting than the NEI 12-16 (Reference 2) guidance. In the event that end of cycle average boron is greater than 1050 ppm, DENC will take the following steps:

1) Prior to fuel offload, determine the cumulative burnup averaged boron for fuel in the affected cycle. Identify affected fuel assemblies with average boron history greater than 1050 ppm.
2) Document any affected fuel assemblies using the corrective action system.
3) As a temporary resolution to allow offload to proceed, disregard the fuel burnup acquired by affected fuel assemblies in the affected cycle. This is less restrictive than the NEI guidance but fully bounds a mid-cycle offload. Fuel assemblies may only be moved to locations for which they are qualified with the administratively reduced fuel burnup.

4) Evaluate in accordance with 10 CFR 50.59 whether affected fuel assemblies are bounded by the bounding burnup credit analysis in the LAR.
5) If the evaluation identifies sufficient offsetting depletion parameters such that the affected fuel is bounded by the LAR analysis, document the analysis and close the corrective action issue.
6) If the evaluation does not identify sufficient offsetting depletion parameters, then determine the amount of non-conservatism and use MPS3 LAR reserved Dominion margin to disposition affected fuel.

References:

1. J. C. Wagner, "Impact of Soluble Boron Modeling for PWR Burnup Credit Criticality Safety Analyses," Trans. Am. Nucl. Soc., 89, pp. 120 (2003).

2. Nuclear Energy Institute (NEI) Guidance Document 12-16, Revision 3, ADAMS Accession No. ML18088B400, "Guidance for Performing Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants," March 2018.

RAI 9

Section 11.3.2, "Reconstituted Fuel," addresses the process of reconstituting fuel and the storage of reconstituted fuel. Provide the following information:

a. *Region 1 wasn't explicitly modeled. Confirm that the requirement for storage cells that are face adjacent to the fuel assembly being reconstituted will also be applied to Region 1.*

b. *The analysis did not address the number of fuel rod lattice locations that can be empty during the reconstitution process. Specify the number of fuel rod lattice locations that can be empty during the reconstitution process.*

c. *The analysis addresses one fuel assembly with two empty fuel rod lattice locations. How would the licensee address other fuel assemblies with empty fuel rod lattice locations?*

DENC Response

RAI 9a Response:

The requirement to maintain empty storage cells in the four face-adjacent locations of a fuel assembly being reconstituted applies to storage Regions 1, 2, and 3. Region 1 was not addressed directly because it is less reactive than and bounded by the analysis for Regions 2 and 3 (e.g. LAR Attachment 5 / 6, Section 11.4 fresh fuel enrichment with 4 out of 4 storage).

RAI 9b Response:

With the reconstitution fuel assembly isolated, there is no limit on the number of empty fuel lattice locations. Confirmation is provided in Table 9.1. The Region 2 reconstitution model (LAR Attachment 5 / 6, Table 11.2) is modified by replacing the normal reconstitution fuel assembly near the center of the model with uniform pitch fuel lattices of varying number of fuel rods per side (maintaining the normal fuel assembly envelope) and, for some cases, varying rod pitch with the same reduced number of fuel rods. Varying the number of fuel rods and rod pitch will iteratively search for the optimum fuel to moderator ratio. KENO cases have no soluble boron and are run with moderator temperature set to 32°F. Figure 9.1 shows the configuration of the 100 fuel rod reconstitution model. Region 2 results were confirmed to also be valid for Region 3. As stated in RAI response 9a, Region 1 is bounded by Regions 2 and 3.

Table 9.1 and Figure 9.2 show that the reconstitution cases have k-eff well below the nominal full rack base case k-eff, and that the effects of empty fuel rod locations in the reconstitution assembly are negligible when the reconstitution assembly is neutronically isolated (four face adjacent empty cells). Therefore, there is no limit on the number of empty fuel lattice locations during reconstitution in Regions 1, 2, or 3.

Figure 9.1 – KENO Region 2 6x6 Model

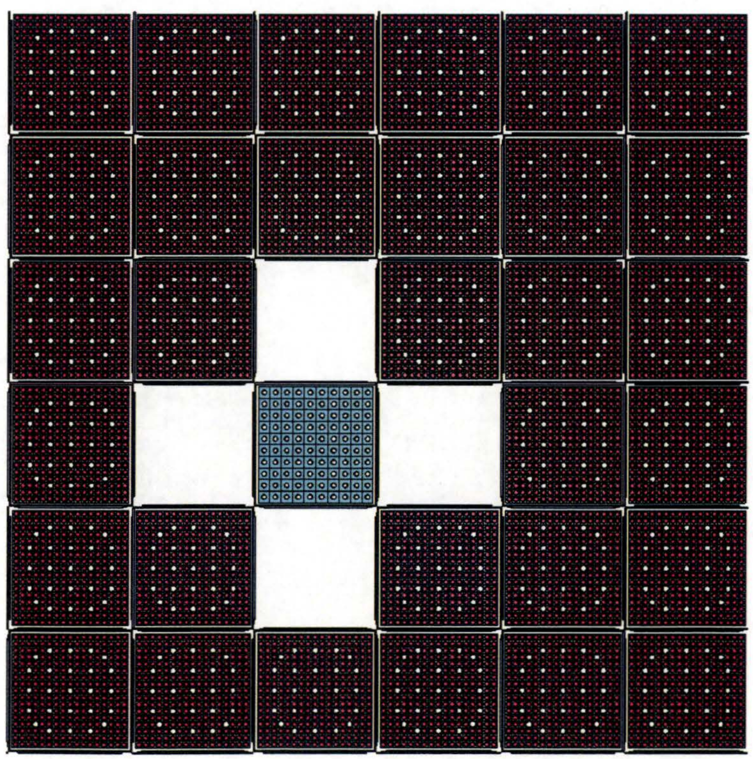
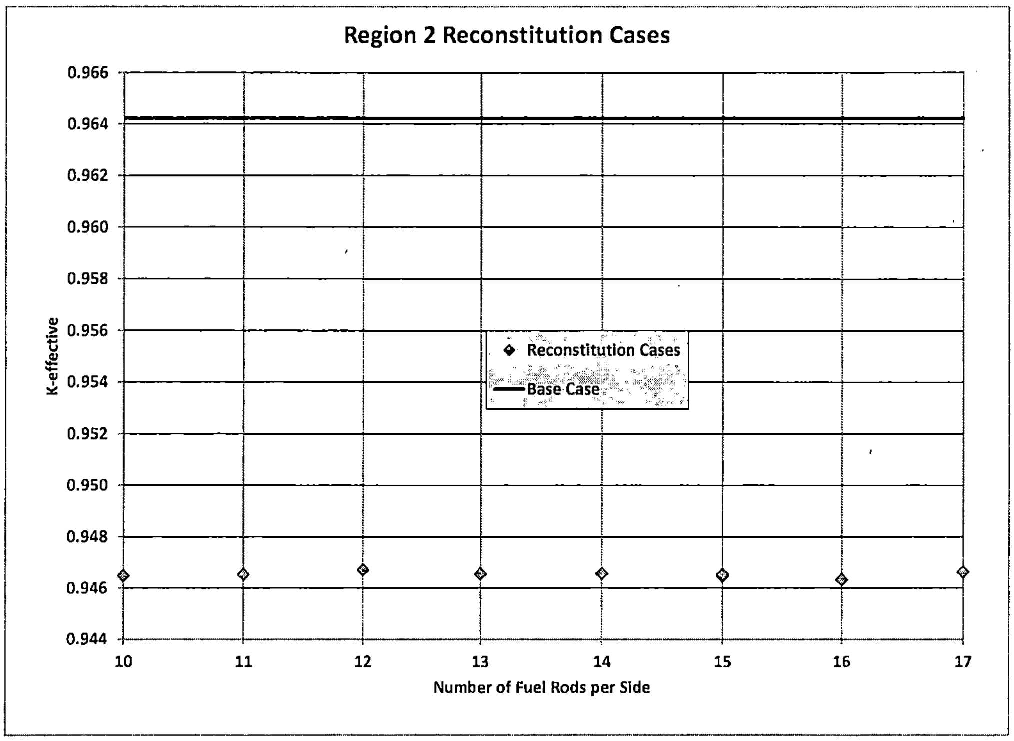


Table 9.1 – KENO 6x6 Model Region 2 Reconstitution Cases

Case	Fuel rods per side	Fuel rods	Pitch (cm)	k-eff	Uncert.	KENO Case
Base	17	264	1.260	0.96422	0.00006	MPS3_Reg2_recon_base
Pitch1	17	289	1.260	0.94663	0.00007	MPS3_Reg2_recon_isolface_pitch1
Pitch2	16	256	1.339	0.94634	0.00007	MPS3_Reg2_recon_isolface_pitch2
Pitch3	15	225	1.428	0.94646	0.00006	MPS3_Reg2_recon_isolface_pitch3
Pitch3A	15	225	1.339	0.94651	0.00007	MPS3_Reg2_recon_isolface_pitch3A
Pitch 3B	15	225	1.260	0.94654	0.00007	MPS3_Reg2_recon_isolface_pitch3B
Pitch4	14	196	1.530	0.94657	0.00006	MPS3_Reg2_recon_isolface_pitch4
Pitch5	13	169	1.648	0.94657	0.00007	MPS3_Reg2_recon_isolface_pitch5
Pitch6	12	144	1.785	0.94671	0.00007	MPS3_Reg2_recon_isolface_pitch6
Pitch7	11	121	1.947	0.94653	0.00007	MPS3_Reg2_recon_isolface_pitch7
Pitch8	10	100	2.142	0.94649	0.00007	MPS3_Reg2_recon_isolface_pitch8

Figure 9.2 – KENO 6x6 Model Region 2 Reconstitution Cases



RAI 9c Response:

Analysis of the effect of empty fuel rod locations will be performed on an assembly-specific basis in the same manner as for assembly MR71 (LAR Attachment 5 / 6, Section 11.3.2). Fuel assemblies in the KENO rack model are modeled with removed fuel rods replaced by water and the resulting k-eff is compared to an analogous base case for an assembly with no removed rods. If the k-eff of the intact assembly is bounding, the assembly may be stored as a normal assembly. If k-eff for the fuel assembly with missing fuel rods is higher than the intact assembly, then the excess reactivity will be dispositioned using the LAR methodology to identify a source of k-eff margin in accordance with 10 CFR 50.59.