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

September 9, 2022

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 NOS. 2 AND 3, NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2, AND SURRY POWER STATION, UNIT NOS. 1 AND 2 – REQUEST FOR ADDITIONAL INFORMATION RELATED TO RESPONSE TO GENERIC LETTER 2004-04 (EPID L-2017-LRC-0000)

Dear Mr. Stoddard:

By letters dated May 27, 2021 (Millstone 2), April 15, 2021 (Millstone 3), and February 25, 2021 (North Anna and Surry) (Agencywide Documents Access and Management System Accession Nos. ML21147A477 (Millstone 2), ML21105A433 (Millstone 3), ML21056A557 (North Anna), and ML21056A541 (Surry)) Dominion Energy Nuclear Connecticut, Inc. and Virginia Electric and Power Company, the licensees, submitted supplemental responses Generic Letter(GL) 2004-02 to provide information regarding their evaluations of the effects of debris on long-term core cooling with respect to in-vessel effects.

The U. S. Nuclear Regulatory Commission (NRC) staff have reviewed the responses to GL 2004-02 and determined that additional information is required to complete the review. The additional information needed is enclosed with this letter. Following a discussion with your staff, a response is requested within 60 days.

If you have any questions on this matter, I can be contacted at (301) 415-2481 or ed.miller@nrc.gov.

Sincerely,

/RA/

G. Edward Miller, Project Manager
Plant Licensing Branch 2-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-336, 50-423, 50-338,
50-339, 50-280, and 50-281

Enclosure:
Request for Additional Information

cc: Listserv

REQUEST FOR ADDITIONAL INFORMATION

OFFICE OF NUCLEAR REACTOR REGULATION

MILLSTONE POWER STATION, UNITS 2 AND 3

NORTH ANNA POWER STATION, UNITS 1 AND 2

SURRY POWER STATION, UNITS 1 AND 2

DOMINION ENERGY CONNECTICUT, INC

VIRGINIA ELECTRIC AND POWER COMPANY

RESPONSE TO GENERIC LETTER 2004-02

DOCKET NOS. 50-336, 50-423, 50-338, 50-339, 50-280, AND 50-281

RAIs for Generic Letter 2004-02

Title 10 of the *Code of Federal Regulations* Part 50, Section 50.46 requires that plants maintain the ability to provide long-term core cooling following any initial loss-of-coolant accident (LOCA) response. To ensure that this cooling is available, licensees demonstrate that in-vessel fiber accumulation will not adversely affect the required function.

Millstone Power Station, Unit 2 (Millstone 2)

In its most recent supplemental response for U. S. Nuclear Regulatory Commission (NRC) Generic Letter 2004-02, dated May 27, 2021 (ADAMS Accession No. ML21147A477), Dominion Energy Nuclear Connecticut, Inc. (Dominion Energy) provided information regarding the debris amounts used in the fiber penetration calculation for Millstone 2 and explained the methodology used to determine the amount of fiber that could penetrate the emergency core cooling system (ECCS) strainer. Regarding the basis for some of the assumptions used in the calculations, discuss the following aspects of the calculation, so that the NRC staff can understand how the in-vessel debris amounts were calculated:

1) The method for implementing the bed thickness correction was unclear. It seems that the Point Beach values would be directly applicable to Millstone 2 up to the tested thickness. Beyond the tested thickness, the model would have to be extrapolated to a higher debris load. With respect to extrapolation to higher debris loads, address the items below.
    a. Was the correction for bed thickness applied to the thickness that will occur at the “Initial Sump Fiber Load” amount or was it applied to the design basis load?
    b. Provide the characteristics of the fiber in the test compared to the characteristics of the fiber used to calculate the plant bed thickness for the penetration correction. Explain why any differences would not have to be accounted for in the correction factor, if applicable.
    c. Provide plots of penetrated debris vs. accumulated debris for the plant strainer. On the plot, or separately, provide points (timing/bed thickness) at which the

operating state of the ECCS and containment spray system (CSS) pumps change including swapover to recirculation, flow changes, and the end of injection from the refueling water storage tank (RWST).

d. Confirm that the bed thickness is assumed to be zero at the time that ECCS pump suctions are realigned to the sump.
e. Provide the assumptions used for flow rates, timing of flow rate changes, and other factors that could impact the calculation. Provide these for the various scenarios for which in-vessel fiber loads were calculated.
f. What is the basis for the total fiber load of 5429 pounds (lb)? Was this value used to develop the bed thickness correction? If yes, what is the basis for using this value considering that lower amounts of fiber may transport for many scenarios, a more realistic erosion rate, and the debris generation and transport assumptions in the analysis? The fiber bed thickness is too small if only low-density fiberglass (LDFG) is considered. Did the thickness account for fiber densities other than LDFG? If so, justify this considering the test used only LDFG.
    i. This could result in a thinner bed and higher penetration at the time that ECCS is realigned to the sump.
g. What does the initial sump fiber load of 660.15 lb. represent? How was it calculated? What is its relevance and how is it used in the in-vessel debris loading calculation? How were the debris generation and transport analyses for this value performed?
h. How are the bed thickness correction values calculated for each time step?
i. If only a single thickness correction is used, provide a justification considering that bed thickness changes as debris arrives at the strainer.

2) Verify that the list of references in the submittal is correct and ensure that the citations in the text are correct. For example, there is a reference to South Texas Project (STP) testing in the text, but no STP references in the list.
3) Confirm that the CSS operates for all scenarios throughout the period during which transport to the reactor is calculated. Are there scenarios where the spray flow would be zero, or less than the flow rate analyzed? If so, justify the flow rate used.
4) In the listed conservatisms it is stated that the designated sacrificial area was included to minimize the thickness. Confirm that this means that no sacrificial area was subtracted from the total strainer area for the penetration calculations.
5) The Millstone 2 evaluation described the acceptability of a minimum ECCS flow rate below the analyzed values. The condition was accepted based on the maximum flow case resulting in higher fiber loading. If the fiber mass for the high flow case remains significantly below the total in-vessel limit a more refined evaluation would not be required. However, if the fiber value approaches the limit a more refined analysis could be required. Provide the calculated fiber load for the high flow case.
6) Table 5 appears to contain an error for t_{block}. The value is listed as 2.4 hours, but the value for combustion engineering (CE) plants is 333 minutes or about 5.6 hours. Please confirm the correct value.
7) Provide the basis for the maximum ECCS flow rate of 4100 gpm [gallons per minute] in the last row in Table 5. Explain how this value was used to calculate the maximum in-vessel fiber load. Does the full 4100 gpm inject to the reactor vessel as implied by the 18.9 gpm per fuel assembly flow rate or is some of this CSS flow?

Millstone Power Station, Unit 3 (Millstone 3)

In its most recent supplemental response for NRC Generic Letter 2004-02, dated April 15, 2021 (ML21105A433), Dominion Energy provided information regarding the debris amounts used in the fiber penetration calculation for Millstone 3 and explained the methodology used to determine the amount of fiber that could penetrate the emergency core cooling system strainer. Regarding the basis for some of the assumptions used in the calculations, discuss the following aspects of the calculation so that the NRC staff can understand how the in-vessel debris amounts were calculated:

1) The method for implementing the bed thickness correction was unclear. It seems that the Point Beach values corrected by Vogtle velocity data would be directly applicable to Millstone 3 up to the tested thickness. From that point on, the model would have to be extrapolated to a higher debris load. The items below should be considered.
    a. Was the correction for bed thickness applied to the thickness that will occur at the “ECCS strainer” (or the initial sump fiber load) amount or was it applied to the design basis load?
    b. Provide the characteristics of the fiber in the test compared to the characteristics of the fiber used to calculate the plant bed thickness for the penetration correction. Explain why any differences would not have to be accounted for in the correction factor, if applicable.
    c. Provide plots of penetrated debris vs. accumulated debris for the plant strainer. On the plot or separately provide points (timing/bed thickness) at which the operating state of the recirculation spray system (RSS) changes including RSS swapover to recirculation, swapping ECCS pump suctions from the RWST to the RSS, RSS flow changes, and the end of injection from the RWST.
    d. Provide the bed thickness calculated at the time that ECCS pump suctions are realigned to the RSS.
    e. Provide the assumptions used for flow rates, timing of flow rate changes, and other factors that could impact the calculation. Provide these for each scenario for which in-vessel debris loads were calculated.
    f. What is the basis for the total fiber load of 2053 lb? Was this value used to develop the bed thickness correction? If yes, what is the basis for using this value considering that lower amounts of fiber may transport for many scenarios, a more realistic erosion rate, and the debris generation and transport assumptions in the analysis?
        i. This could result in a thinner bed and higher penetration at the time that ECCS is realigned to the sump/RSS.
    g. What is the basis for the ECCS fiber amount (initial sump fiber load) of 380.32 lb? How was it calculated? What is its relevance and how is it used in the in-vessel debris loading calculation? How were the debris generation and transport analyses for this value performed?
    h. How are the bed thickness correction values calculated for each time step?
    i. If only a single thickness correction is used, provide a justification considering that bed thickness changes as debris arrives at the strainer.
2) Verify that the list of references in the submittal is correct and ensure that the citations in the text are correct. In the text, near the bottom of page 16 of 30, reference 4.14 is to STP testing. For example, in the list of references, 4.14 is to WCAP-17788. References

4.4 through 4.10 are referred to as Point Beach and Vogtle testing near the top of page 17 of 30. This appears to be an error.

3) Confirm that containment RSS operates for all scenarios throughout the period during which debris transport to the reactor is calculated. Are there scenarios where the spray flow would be zero, or less than the 4071 gpm analyzed?
4) The Millstone 3 evaluation described the acceptability of a minimum ECCS flow rate below the analyzed values. The condition was accepted based on the maximum flow case resulting in higher fiber loading. If the fiber mass for the high flow case remains significantly below the total in-vessel limit a more refined evaluation would not be required. However, if the fiber value approaches the limit a more refined analysis could be required. Provide the fiber value calculated for the high flow case.

North Anna Power Station (North Anna), Units 1 and 2

In its most recent supplemental response for NRC Generic Letter 2004-02, dated February 25, 2021 (ML21056A557), Virginia Electric and Power Company provided information regarding the debris amounts used in the fiber penetration calculation for North Anna, Units 1 and 2 and explained the methodology used to determine the amount of fiber that could penetrate the emergency core cooling system (ECCS) strainer. Regarding the basis for some of the assumptions used in the calculations, discuss the following aspects of the calculation so that the NRC staff can understand how the in-vessel debris amounts were calculated:

1) The method for implementing the bed thickness correction is unclear. It seems that the Point Beach values corrected by Vogtle velocity data would be directly applicable to North Anna up to the tested thickness. From that point on, the model would have to be extrapolated to a higher debris load. However, it appears to the staff that the in-vessel loading was simply calculated by multiplying the fine fiber amount by the corrected penetration fraction and dividing by the number of fuel assemblies. This may be appropriate if the correction factor was calculated correctly. To clarify the appropriateness of using a correction factor in lieu of extrapolation:
    a. Was the correction for bed thickness applied to the thickness that will occur at the low head safety injection (LHSI) strainer or was it applied to the design basis load? Was it developed for the same load to which it was applied?
    b. Provide the characteristics of the fiber in the Point Beach test compared to the characteristics of the fiber used to calculate the plant bed thickness for the penetration correction. Explain why any differences would not have to be accounted for in the correction factor, if applicable.
    c. Provide the assumptions used for flow rates in the fiber load calculation.
    d. Provide the basis for the total fiber load of 909 lb loading. On which strainer(s) was this value used to develop the bed thickness correction? What is the basis for using this value considering that lower amounts or different sizes of fiber may transport for many scenarios?
    e. How is the initial sump fiber load of 219 lb used in the in-vessel debris loading calculation?
    f. How are the bed thickness correction values calculated for each time step?
    g. If only a single thickness correction is used, provide a justification considering that bed thickness changes as debris arrives at the strainer.
2) Verify that the list of references in the submittal is correct and ensure that the citations in the text are correct. In the text, near the bottom of page 16 of 30, reference 4.13 is to

STP testing. For example, in the list of references, 4.13 is to WCAP-17788. References 4.4 through 4.10 are referred to as Point Beach and Vogtle testing near the top of page 17 of 30. This appears to be an error.

3) Confirm that RSS spray operates for all scenarios throughout the period during which transport to the reactor is calculated. Are there scenarios where the spray flow would be zero as assumed in the analysis for conservatism? If spray is not in service more than 50 percent of the fiber could transport to the LHSI strainer.

Surry Power Station (Surry), Units 1 and 2

In its most recent supplemental response for NRC Generic Letter 2004-02, dated February 25, 2021 (ML21056A541), Virginia Electric and Power Company provided information regarding the debris amounts used in the fiber penetration calculation for Surry, Units 1 and 2 and explained the methodology used to determine the amount of fiber that could penetrate the ECCS strainer. Regarding the assumptions used in the calculations, discuss the following aspects of the calculation so that the NRC staff can understand how the in-vessel debris amounts were calculated:

1) The method for implementing the bed thickness correction is unclear. It seems that the Point Beach values corrected by Vogtle velocity data would be directly applicable to Surry up to the tested thickness. From that point on, the model would have to be extrapolated to a higher debris load. However, it appears to the staff that the in-vessel loading was simply calculated by multiplying the fine fiber amount by the corrected penetration fraction and dividing by the number of fuel assemblies. This may be appropriate if the correction factor was calculated correctly. The items below should be considered as appropriate.
    a. Was the correction for bed thickness applied to the thickness that will occur at the LHSI strainer or was it applied to the design basis load? Was it developed for the load to which it is applied?
    b. Provide the characteristics of the fiber in the Point Beach test compared to the characteristics of the fiber used to calculate the plant bed thickness for the penetration correction. Explain why any differences would not have to be accounted for in the correction factor, if applicable.
    c. Provide the assumptions used for flow rates in the fiber load calculation.
    d. What does the total fiber load of 526.08 lb represent? Loading on which strainer(s)? Was this value used to develop the bed thickness correction? If yes, what is the basis for using this value considering that lower amounts or different sizes of fiber may transport for many scenarios, debris characteristics, and the debris generation and transport assumptions in the analysis?
    e. How is the initial sump fiber load of 56.98 lb. used in the in-vessel debris loading calculation?
    f. How are the bed thickness correction values calculated for each time step?
    g. If only a single thickness correction is used, provide a justification considering that bed thickness changes as debris arrives at the strainer.
2) Verify that the list of references in the submittal is correct and ensure that the citations in the text are correct. In the text, near the bottom of page 18 of 37, reference 4.15 is to STP testing. However, in the list of references, 4.15 appears to be a Surry calculation. References 4.4 through 4.10 are referred to as Point Beach and Vogtle testing near the top of page 19 of 37. This appears to be an error.

3) Confirm that RSS spray operates for all scenarios throughout the period during which transport to the reactor is calculated. Are there scenarios where the spray flow would be zero as assumed in the analysis for conservatism? If spray is not in service more than 40 percent of the fiber could transport to the LHSI strainer.

The NRC staff also identified that it requires additional information regarding the assumption for the debris limit assumed for the fuel assemblies. Please respond to the following:

4) In the submittal dated February 25, 2021, the licensee states that Framatome expects the fiber limit for the AGORA-5A-I fuel product with the coarse mesh TRAPPER debris filter to lie between the debris limits for HTP [High Thermal Performance] fuel with FUELGUARD debris filter and the GAIA fuel with the GRIP debris filter as noted in Reference 4.11, Table 7-2. Explain why this limit would be expected to lie between the limits for the other two fuel debris filter designs or provide the relevant excerpt from Reference 4.11 that provides this information.

SUBJECT: MILLSTONE POWER STATION, UNIT NOS. 2 AND 3, NORTH ANNA POWER STATION, UNIT NOS. 1 AND 2, AND SURRY POWER STATION, UNIT NOS. 1 AND 2 – REQUEST FOR ADDITIONAL INFORMATION RELATED TO RESPONSE TO GENERIC LETTER 2004-04 (EPID L-2017-LRC-0000) DATED SEPTEMBER 9, 2022

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