June 30, 2025
L-2025-117
GL 2004-02

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington DC 20555-0001

RE: Seabrook Station
Docket No. 50-443
Renewed Facility Operating License No. NPF-86

Response to Requests for Additional Information (RAIs) Regarding Updated Final Response to NRC Generic Letter 2004-02

References:

1. NextEra Energy Seabrook, LLC, Letter SBK-L-18010, Updated Final Response to NRC Generic Letter 2004-02, January 31, 2018 (ADAMS Accession No. ML18031B248)

2. NextEra Energy Seabrook, LLC, Letter SBK-L-21049, Revision to Updated Final Response to NRC Generic Letter 2004-02, June 24, 2021 (ADAMS Accession No. ML21208A055)

3. US Nuclear Regulatory Commission electronic memorandum dated January 15, 2025, Seabrook GL 04-02 Summary RAIs (ADAMS Accession No. ML25027A215)

In Reference 1, as supplemented by Reference 2, NextEra Energy Seabrook, LLC (NextEra) provided on behalf of Seabrook Station, Unit No. 1 (Seabrook), an updated final response to Generic Letter (GL) 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors (ADAMS Accession No. ML 18031 B248). Included within were NextEra's statement of compliance with the *Applicable Regulatory Requirements* of GL 2004-02, a description of completed plant modifications and process changes, and an evaluation of the 16 issue areas identified in the NRC's 'Revised Content Guide for Generic Letter 2004-02 Supplemental Responses" (ADAMS Accession No. ML073110389), including a summary of the significant margins and conservatisms utilized in supporting analyses to demonstrate regulatory compliance.

In Reference 3, the NRC requested additional information deemed necessary to complete its review.

The enclosure to this letter provides NextEra's response to the request for additional information (RAI).

This letter contains no new or modified regulatory commitments.

Should you have any questions regarding this submission, please contact Ms. Maribel Valdez, Fleet Licensing Manager, at 561-904-5164.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on the 30th day of June 2025.

Kenneth A. Mack
Director, Licensing and Regulatory Compliance

cc: USNRC Region I Administrator
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In Reference 1, as supplemented by Reference 2, NextEra Energy Seabrook, LLC (NextEra) provided on behalf of Seabrook Station, Unit No. 1 (Seabrook), an updated final response to Generic Letter (GL) 2004-02, Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors (ADAMS Accession No. ML 18031B248).

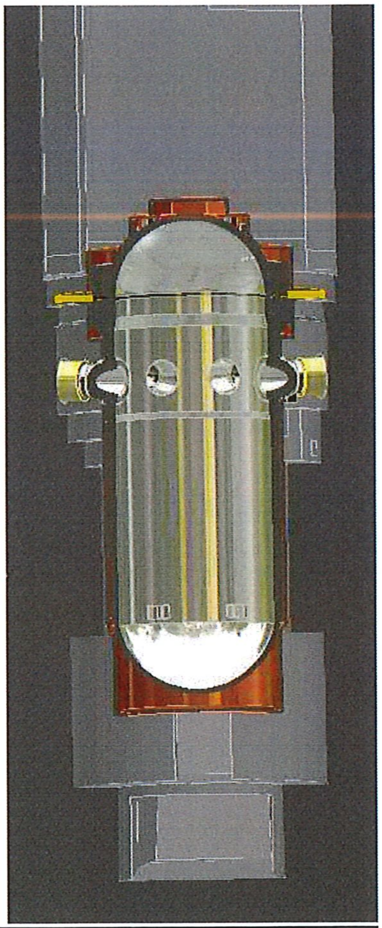
In Reference 3, the NRC requested additional information deemed necessary to complete its review, as indicated below. NextEra's response to the requests for additional information (RAIs) follows.

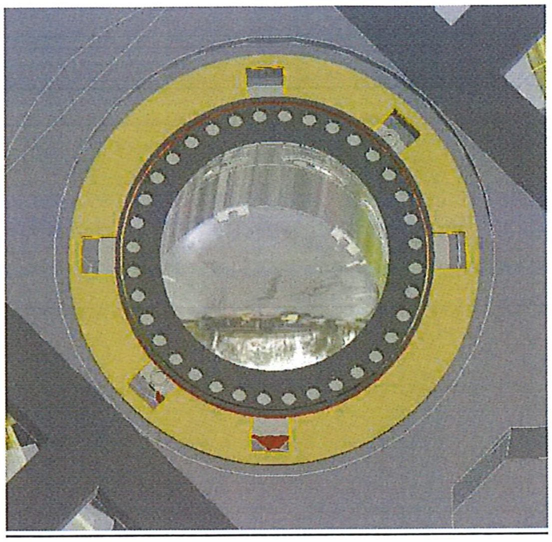
RAI-1

On page E1-20 of the submittal dated June 24, 2021, the licensee credited the reactor cavity seal ring for protection of insulation on the reactor head. Provide details that justify that the seal ring is a robust structure capable of shielding insulation on the reactor head from breaks in the reactor cavity.

NextEra Response:

A vertical cross section of Unit 1's reactor cavity and a plan view of the reactor vessel are shown below. The reactor cavity seal ring is yellow in the figures.





The geometry and structural integrity of the reactor cavity and pressurized flow piping relative to the location of the shielding insulation on the reactor head makes dislodging of any insulation from the reactor head extremely unlikely. The reactor cavity seal ring (RCSR) spans the annulus between the reactor vessel seal ledge and the refueling cavity floor. It functions as both a watertight seal and a shield to reduce radiation levels. The top plate seal ring is a continuous ring 1-½ inch (nominal) thick. Below, the neutron / gamma shield consists of two 10 inch thick sections of borated concrete poured into a carbon steel support assembly in a two-tier configuration. Both sections contain a 3/8 inch horizontal steel plate. The seal ring assembly weighs 53,660 lbs.

Any break jet within the cavity would initiate below the reactor cavity seal ring, which is situated at the bottom of the reactor head. The jet could reflect off of the reactor vessel and reactor cavity walls before discharging upward through the openings in the RCSR. At this point, the jet would freely expand to upper containment without damaging the insulation on the reactor vessel head.

RAI-2

Tables 3.e.6-6 through 8 provide overall transport fractions including those where CBS is not operating. The NRC staff noted that these cases result in less transport to the strainer for fine fibrous and qualified coating debris than the cases where CBS is operating. What are the transport cases for CBS not operating used for in the analysis? Why is there a significant reduction in the transport of fine fiber and qualified coatings debris for these cases? Alternately confirm that only the CBS running cases were used to determine the transported debris amounts for the strainer evaluation.

NextEra Response:

Only the containment building spray (CBS) running cases were used to determine the transported debris amounts for the strainer evaluation.

RAI-3

Page E1-82 states that no voids will form at the mid-height of the strainer and concludes that there will be zero void fraction. The NRC staff concluded that evaluating void fraction at the midpoint of the strainer and using that value to estimate void fraction over the height of the strainer is valid only if voiding occurs over the full height of the strainer. If no voiding occurs at the top of the strainer than it is apparent that voids will not occur at lower elevations. If it has not been demonstrated that voids do not occur at the top of the strainer using the midpoint to estimate void fraction can result in non-conservative void fraction calculations. Justify the use of the mid-height of the strainer or re-evaluate the void fraction.

NextEra Response:

Degasification was not originally an issue associated with GSI-191 and is not discussed in NEI 04-07 Volume 1 (Reference 4), Generic Letter (GL) 2004-02 (Reference 5), or Regulatory Guide (RG) 1.82 Revision 3 (Reference 6). There was some discussion in Attachment V-1 of NEI-04-07 Volume 2 (Reference 7), but the focus was on prevention of flashing and the applicability of the NUREG/CR-6224 head loss correlation under two phase flow conditions. In January 2008, GL 2008-01 was issued identifying potential problems related to gas accumulation in various systems including the emergency core cooling system (ECCS) (Reference 8). This generic letter discussed the potential release of dissolved gas due to the pressure drop across emergency sump screens. The next revision of RG 1.82 (Reference 9) included extensive discussion on deaeration and provided guidance for adjusting pump NPSH required based on the calculated void fraction. However, direction was not provided on the submergence depth where degasification should be calculated.

Using the top of the strainer to calculate degasification would be overly conservative and using the bottom of the strainer would be non-conservative. Therefore, as a reasonable approximation of the overall gas void fraction, the mid-point elevation of the strainer was commonly used by licensees. For example, the Vogtle risk-informed GSI-191 submittal assessed flashing at the top of the strainer and degasification at the mid-point of the strainer (Reference 10). Although an integrated assessment of void fraction over the full height of the strainer would provide a more precise calculation, this level of precision is not warranted based on other conservatisms and simplifications used in the strainer performance evaluation, such as:

- The assumption of uniform flow and head loss across the entire strainer surface area
- Conservatively minimizing the sump water level
- Assessing head loss at high sump temperature with minimum credit for containment accident pressure
- Neglecting any potential for redissolution of gas voids downstream of the strainer
- Applying a significant penalty on NPSH required based on very small void fractions.

Based on these considerations and the precedent of other licensee submittals that were acceptable to the NRC, using the mid-height of the strainer for degasification calculations is reasonable and appropriate.

RAI-4

On page E1-85, and in other locations in the submittal, it was stated that a modification was planned to ensure that excessive water will not be held up in the refueling canal due to blockage of the drains. The modification included adding a drain line, enlarging the existing drain line, and installing strainers on each drain. Confirm that this modification has been completed or provide the estimated completion date.

NextEra Response:

The Seabrook modification adding a drain line, enlarging the existing drain line, and installing strainers on each drain was completed in October 2021.

RAI-5

On page E1-119, the submittal provides the equations used to calculate the structural acceptability of the strainers. Provide the Crush Pressure and the Debris Mass assumed in the structural evaluation.

NextEra Response:

The Seabrook sump strainer structural analysis used a crush differential pressure of 7 psi. The total submerged weight of the debris for the entire strainer is 2140.5 lbs.

RAI-6

On page E1-145, the chemical precipitation time for in-vessel effects is discussed. The chemical effects evaluation relies on the precipitation boundary equation contained in WCAP-17788-P, Volume 5, to determine precipitation timing. Although the evaluation methodology used all NaOH group autoclave tests with pH less than 10, confirm that the WCAP-17788 Volume 5 autoclave testing that directly applies to Seabrook is Test Group 9.

NextEra Response:

WCAP-17788 Volume 5 (Reference 11) autoclave test Groups 9 and 15 are representative of Seabrook. The following table shows key Seabrook post-LOCA conditions and debris loads for comparison to the tested parameters.

Key Seabrook Parameter Values for Chemical Precipitation

Parameter	Seabrook Value (Plant Scale)	Seabrook Value (Test Scale)
Buffer	Sodium Hydroxide	Sodium Hydroxide
Sump pH (Long-term)	8.8 – 9.4	8.8 – 9.4
Minimum Sump Volume	59,167 ft^3	1.76 ft^3 (50 L)
Maximum Sump Pool Temperature	265.5°F	265.5°F
Maximum Calcium Silicate	0 g	0 g*
Maximum E-Glass	3,064,774 g	91.2 g*
Maximum Silica	0 g	0 g*
Mineral Wool	0 g	0 g*
Maximum Aluminum Silicate	0 g	0 g*
Maximum Concrete	Not Determined**	Not Determined**
Maximum Interam™	0 g	0 g*
Aluminum	956.3 ft^2	0.0287 ft^2*
Galvanized Steel	Not Determined***	Not Determined***

* Test Scale = Plant Scale × (Test Volume/Seabrook Minimum Sump Volume)
** Concrete is not a significant contributor to chemical precipitation
*** The galvanized steel surface area was not determined for Seabrook. Test Groups 9 and 15 included tests with no galvanized steel present to inhibit aluminum release.

The Group 9 and Group 15 tests used sodium hydroxide as buffer. The test pH values of Group 9 and Group 15 reflect the maximum and minimum sump pH at Seabrook.

The material quantities for Test Group 9 are comparable with those of Seabrook, with the Group 9 tests having less E-Glass but more aluminum metal than Seabrook. The Group 15 tests contained less E-Glass than Seabrook but had approximately 50% more aluminum. The Seabrook chemical effects analysis showed that aluminum released from aluminum metal is significantly greater than from E-Glass. Additionally, mineral wool, which is not present as a Seabrook debris type, was used in the Group 15 tests and would contribute additional aluminum release.

Precipitation was not detected by filtration tests for Group 9 down to a temperature of 120°F and Group 15 down to a temperature of 160°F over the 24-hour test duration. Filtration tests were not performed below these temperatures for these groups. This supports the conclusions reached using the WCAP-17788 Volume 5 precipitation boundary equation as discussed in the Response to 3.n.1 (Reference 2).

RAI-7

In the section for in-vessel fiber loads (starting page E1-148 of the submittal), many margins have been removed decreasing confidence in the availability of long-term core cooling. The use of a longer sump switchover (SSO) time to set the decay heat value removes margin in the decay heat used. The Seabrook SSO time is increased not only to its maximum conservative value of 26 minutes, but a "realistic" value of 28.5 minutes is used to determine decay heat. This also reduces margin compared to the WCAP. Also, the use of the WCAP RAI model timing removes significant margin in PCT that results from the use of a fast debris buildup assumption in the base model. The NRC staff closure guidance and acceptance of use of the methods described in WCAP17788-P were based on the significant margins resulting from the WCAP methodologies. Describe any margins that remain in the in-vessel fiber load analyses and justify that they are adequate to assure that core blockage will not inhibit long-term core cooling.

NextEra Response:

Conservatisms were not removed from the debris limits specified in WCAP-17788-P. The section mentioned in RAI-7 (specifically, Section 3.n.1, pp. E2-143 through E2-160 of Reference 2) demonstrates that Seabrook exceeds the conservatism implicit in the WCAP evaluation, which provides adequate assurance that core blockage will not inhibit long-term core cooling. In particular:

- The first three rows of Table 3.n.1-3 on page E2-144 show that Seabrook's NSSS design, fuel specifications, and plant categorization (per Volume 4, p. 3-2 of Reference 13) meet the requirements for use of the WCAP-17788-P guidelines and parameters, which in combination provide adequate assurance that core blockage will not inhibit long-term core cooling.

- The remaining six rows of the same table and the supporting text detailing the values on pages E2-145 to E2-148 demonstrate that the key in-vessel effects parameters for Seabrook exceed the level of conservatism of those from the WCAP evaluation.

- Similarly, Table 3.n.1-4 on page E2-148 and the supporting text detailing the values on pages E2-148 to E2-150 show that Seabrook's key in-vessel fiber loads provide sufficient margin in comparison with those from in WCAP analysis to demonstrate adequate assurance that core blockage will not inhibit long-term core cooling.

- Several additional conservatisms and mitigation factors applicable to Seabrook are discussed in detail with relevant calculations on pages E2-150 through E2-162.

RAI-8

Figure 3.n.1-14 references "a case similar to Seabrook". Provide specific similarities and differences between this case and Seabrook and justify the use of this figure for modeling peak cladding temperature at Seabrook.

NextEra Response:

In 2019, Westinghouse published a six-volume response to NRC RAIs on their Comprehensive Analysis and Test Program for GSI-191 Closure (Reference 12). In Volume 4 of this response (Reference 13), four groups of plants were identified for joint analysis due to their similarities relevant to GSI-191 closure issues (p. 3-2). Seabrook is in the category designated "Westinghouse design with upflow barrel/baffle channel." This is the case of the models shown in Figure 3.n.1-14. In this manner, the Westinghouse upflow barrel/baffle model is appropriate for Seabrook.

The Westinghouse upflow barrel/baffle model is much more conservative than Seabrook in several areas. WCAP-17788-P, pages A-203 to A-206, provide discussion on parameters used for the Westinghouse upflow barrel/baffle model. Table 3.n.1-5 of the submittal (Reference 2) shows that the sump switch over time and start of resistance for Seabrook is bounded by the model as those events occur sooner. Page E2-153 shows it would take Seabrook 223 minutes to reach the max core inlet fiber load compared to 120 minutes for the model. Additionally, the peak core inlet fiber limit shown in Figure 3.n.1-12 is much greater than Seabrook. The instantaneous buildup assumption artificially limits flow as the downcomer cannot build up level during debris accumulation.

References:

1. NextEra Energy Seabrook, LLC, Letter SBK-L-18010, Updated Final Response to NRC Generic Letter 2004-02, January 31, 2018 (ADAMS Accession No. ML18031 B248)

2. NextEra Energy Seabrook, LLC, Letter SBK-L-21049, Revision to Updated Final Response to NRC Generic Letter 2004-02, June 24, 2021 (ADAMS Accession No. ML21208A055)

3. US Nuclear Regulatory Commission electronic memorandum dated January 15, 2025, Seabrook GL 04-02 Summary RAIs (ADAMS Accession No. ML25027A215)

4. NEI 04-07 Volume 1, "Pressurized Water Reactor Sump Performance Evaluation Methodology," Revision 0, December 2004 (ADAMS Accession No. ML050550138)

5. Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," September 13, 2004 (ADAMS Accession No. ML042360586)

6. Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," Revision 3, November 2003 (ADAMS Accession No. ML033140347)

7. NEI 04-07 Volume 2, "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to NRC Generic Letter 2004-02, Revision 0, December 6, 2004 (ADAMS Accession No. ML050550156)

8. Generic Letter 2008-01, "Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray Systems," January 11, 2008 (ADAMS Accession No. ML072910759)

9. Regulatory Guide 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident," Revision 4, March 2012 (ADAMS Accession No. ML111330278)

10. Southern Nuclear Operating Company, Inc., NL-18-0915, "Vogtle Electric Generating Plant - Units 1 & 2, Supplemental Response to NRC Generic Letter 2004-02," July 10, 2018 (ADAMS Accession No. ML18193B165)

11. WCAP-17788, Volume 5, Revision 1, "Comprehensive Analysis and Test Program for GSI-191 Closure (PA-SEE-1090)," December 2019 (ADAMS Accession No. ML20010F181)

12. WCAP-17788-P, Volumes 1 - 6, Revision 1, "Comprehensive Analysis and Test Program for GSI-191 Closure (PA-SEE-1090)," July 2015 (ADAMS Accession No. ML20010F181)

13. WCAP-17788-NP, Volume 4, Revision 1, "Comprehensive Analysis and Test Program for GSI-1-91 Closure {PA-SEE-1090) - Thermal-Hydraulic Analysis of Large Hot Leg Break with Simulation of Core Inlet Blockage," pp. A-129 - A-215, December 2019 (ADAMS Accession No. ML20010F181)