UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

September 23, 2025

The Honorable David A. Wright
Chairman
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: REPORT ON THE SAFETY ASPECTS OF THE ALKALI-SILICA REACTION PHENOMENON AT THE SEABROOK NUCLEAR POWER STATION

Dear Chairman Wright:

During the 728th meeting of the Advisory Committee on Reactor Safeguards (ACRS), September 3 through 5, 2025, we reviewed the alkali-silica reaction (ASR) phenomenon and its impact on Seismic Category I concrete structures at Seabrook Nuclear Station (Seabrook). Our review considered actions taken by the NextEra Energy Resources (NextEra) site representatives, as well as the oversight provided by both the Nuclear Regulatory Commission (NRC) Region I inspectors and Office of Nuclear Reactor Regulation (NRR) staff experts. During this multi-year review, we had the benefit of discussions with NRC staff, including the resident inspectors, NextEra representatives during a site visit, and external stakeholders, including C-10 Research & Education Foundation. We also had the benefit of the referenced documents. This report contains our conclusions and recommendations regarding our extended review.

CONCLUSIONS AND RECOMMENDATIONS

1. We reaffirm the Committee's December 14, 2018, and December 19, 2018, conclusions that the programs and commitments to manage age-related degradation and the ASR condition through NextEra's License Amendment Request 16-03 and license renewal application provide confidence that Seabrook can be operated safely.

2. NextEra representatives and the NRC staff concluded the containment and other structures affected by ASR continue to be able to perform their safety functions. We concur because, in our judgement, there continues to be ample margin in both the physical structures and analyses to deal with uncertainties associated with the progression of ASR.

3. Seabrook is currently operating under the large-scale testing program (LSTP) boundaries that may potentially be exceeded in the future. Additional testing to expand the data range will benefit from knowledge learned from tests performed on ASR since the original LSTP testing.

4. The slow progression of ASR combined with continued monitoring and oversight, and NextEra's tiered analytical framework supports our conclusion of reasonable assurance of safety at Seabrook.

5. The NextEra site representatives and management, as well as NextEra corporate representatives, are now providing sufficient focus on the management of the ASR issue, ensuring adequate safety margins are maintained.

6. Currently, the Committee finds the focus by NRC staff exercising regulatory oversight at the facility to be sufficient. The Committee will maintain awareness and advise the Commission as appropriate.

BACKGROUND

Our review considered NextEra's actions to address a concrete degradation mechanism observed in Seabrook plant structures, known as ASR. Degradation typical of ASR was first detected at the plant in 2009 and confirmed by concrete borings withdrawn from Seabrook structures in 2010. In August 2016, NextEra submitted License Amendment Request (LAR) 16-03 to revise the Seabrook current licensing basis to adopt a methodology for the analysis of Seismic Category I structures with concrete affected by ASR. In the Committee's December 14, 2018, letter report on the review of LAR 16-03, we concluded:

> NextEra has undertaken comprehensive actions to characterize, evaluate, and apply test results into Seabrook-specific analysis and monitoring programs to understand current building structural capacity and to monitor and evaluate future building performance. The staff has conducted assessments of the testing program, the data from the testing, and the efficacy of licensee employment of these programs as bases for judging the acceptability of the affected structures for present and extended life through the PEO [period of extended operation]. We concur with the staff conclusion that, while some of the structures are degraded, they are fully capable of performing their credited function through the requested PEO under the committed enhanced monitoring and evaluations.

On December 19, 2018, we concluded in our review of the license renewal application for Seabrook:

> The programs established and committed to by NextEra to manage age-related degradation provide reasonable assurance that Seabrook can be operated in accordance with its licensing basis for the period of extended operation without undue risk to the health and safety of the public.

In 2020, the Atomic Safety and Licensing Board concluded hearings regarding the impact of concrete degradation caused by ASR affecting Seismic Category I reinforced concrete structures at Seabrook.

On December 10, 2021, the NRC Chairman received a letter from Senators Markey and Warren expressing concerns regarding the progression of ASR at Seabrook. In their letter, they highlighted the findings of the NRC inspections regarding NextEra's performance of tracking the progression of ASR and their management of the issue. The ACRS interest in the issue was acknowledged and the Senators encouraged continued deliberation on the issue by the Committee. They asked the Commission to "ensure that the ACRS conduct a review that is of sufficient breadth and depth to develop an ongoing solution for ASR monitoring and management." On January 10, 2022, the NRC Chairman noted that, "NRC staff continues to engage with the ACRS on this issue and plans to hold a briefing in early 2022."

On April 27, 2022, the ACRS held a Subcommittee meeting and decided to continue to follow the inspections and licensee actions. In addition, C-10 Research and Education Foundation, a 501(c)(3) nonprofit organization that works to protect public health and the natural environment surrounding NextEra's Seabrook Station, also made a presentation to the ACRS during that meeting. The Committee received an update from the NRC staff on September 4, 2024, after the recent inspections were completed by Region I staff. To gain confidence in the licensee's commitment and performance in implementing the aging management programs, the Committee visited the site in April 2025 and had focused discussions with the NextEra representatives.

DISCUSSION

On the morning of April 17, 2025, the Plant Operations Subcommittee met the NextEra and NRC staff for an onsite meeting and tour of Seabrook. The Committee focused on three areas in our evaluation: 1) the technical understanding and assessment of the ASR phenomenon, 2) the aging management programs of the licensee that monitor, track, and manage the ASR issue, and 3) ongoing inspections and oversight by the NRC staff. During the tour, the members were able to observe ASR locations in safety-related structures that were unmitigated, mitigated, and pending resolution.

It is important to note that Seabrook's evaluation methodology integrates monitoring of surface crack progression and analysis of concrete structures with clearly defined acceptance criteria that trigger more detailed evaluations. Initial analyses are prepared with bounding, highly conservative assumptions consistent with the plant's original licensing-basis methods. If those conservative analyses identify concerns, analyses are refined to better reflect actual plant conditions. If still more precision is needed, higher fidelity methods are applied. When structural capacity cannot be confidently demonstrated by these methods, repairs or mitigation actions must be implemented.

The Committee recognizes that this methodology maintains margin by providing a graded safety net: initial analyses are deliberately conservative and bounding and if further evaluation is required, higher fidelity modeling is utilized in a controlled, stepwise fashion and always supported by direct monitoring of surface cracks correlated to ASR expansion. Beyond the safety margins associated with the analysis and the structural code allowable limits, it is important to note that ASR is a slowly evolving phenomenon allowing ample time to respond to monitoring results as appropriate. This temporal aspect of ASR progression combined with continued monitoring and oversight, and this tiered analytical framework supports our conclusion of reasonable assurance of safety at Seabrook.

In the afternoon of April 17, 2025, a Plant Operations Subcommittee meeting was held local to the plant. During the public meeting, the Committee discussed the information gained from both the site tour earlier in the day and with the NRC Region I staff supported by NRR personnel. Public comments were received and recorded in the meeting transcript. Prior to the visit, the ACRS received a letter from C-10 Research and Education Foundation that provided detailed questions for the Committee's consideration as part of the onsite visit. These questions were considered during the site visit.

Finally, on May 7, 2025, during a Full Committee meeting we concluded that the NextEra site representatives and management, as well as NextEra corporate, are now providing sufficient focus on the management of the ASR issue, ensuring adequate safety margins are maintained. Strong programmatic management of the issue is demonstrated by:

- Past issues with problem identification and resolution appear to have been corrected, and improvements have been made based on knowledge gained from the inspection findings;

- Site leadership is engaged, informed, involved in decision-making, and providing adequate resources;

- Site technical representatives are knowledgeable on ASR and remain current on state-of-technology in both analysis and monitoring of the issue;

- Field personnel (operations, maintenance, and engineering) are keenly aware of the issue and walkdowns are regimented, monitored, and assessed on a frequent basis;

- Corporate support has been reorganized to enable more focus for site personnel on the technical issue while project management, procurement, and support are accomplished by corporate project support groups and;

- The site is supported by a broadly respected and highly experienced contractor with significant experience in engineering analyses of complex nuclear concrete structures.

The NextEra representatives and its contractors showed technical competency as demonstrated by the following:

- Structural analysis using field expansion data, in combination with best estimate and conservative assumptions related to loading conditions, to demonstrate significant safety margin in affected concrete structures;

- Ongoing core bore testing and physical modifications to mitigate the effects of ASR on the concrete structures, both reactively to locations of visible degradation, and proactively in response to analysis prediction of susceptible areas and;

- Expected follow-up testing to expand the data range and benefit from knowledge learned from tests performed on ASR since the original LSTP testing.

Finally, the present Region I and NRR support staff are knowledgeable, engaged, actively inspecting, and keenly aware of the safety implications of the issue. The long-term nature of the issue will require this level of expertise in the future.

During the May 7th Committee meeting, Dr. Saouma (C-10 expert consultant) presented a review of ASR tests from National Institute of Standards and Technology (NIST) Task 3, asserting they were more representative of Seabrook's ASR than the LSTP tests. He further suggested earlier technical, and operability conclusions might have been premature or incorrect. The Committee requested a briefing from the staff on the NIST tests and their relevance to Seabrook. The NRC staff concluded that the NRC-sponsored NIST Task 3 testing was generic and not representative of Seabrook geometry and that the licensee's LSTP test was more appropriate for monitoring and mitigation at the plant. This reaffirms our prior findings and the conclusions of the Atomic Safety and Licensing Board that ruled on contentions regarding the ASR issue.

SUMMARY

We reaffirm the Committee's December 14, 2018, and December 19, 2018, conclusions that the programs and commitments to manage age-related degradation and the ASR condition through NextEra's License Amendment Request 16-03 and license renewal application provide confidence that Seabrook can be operated safely. NextEra and the NRC staff concluded the containment and other structures affected by ASR continue to be able to perform their safety functions. We concur because, in our judgement, there continues to be ample margin in both the physical structures and analyses to deal with uncertainties associated with the progression of ASR.

Seabrook is currently operating under the LSTP boundaries that may potentially be exceeded in the future. Additional testing to expand the data range will benefit from knowledge learned from tests performed on ASR since the original LSTP testing. The slow progression of ASR combined with continued monitoring and oversight, and NextEra's tiered analytical framework supports our conclusion of reasonable assurance of safety at Seabrook.

The NextEra site representatives and management, as well as NextEra corporate representatives, are now providing sufficient focus on the management of the ASR issue, ensuring adequate safety margins are maintained. Currently, the Committee finds the focus by NRC staff exercising regulatory oversight at the facility to be sufficient. The Committee will maintain awareness and advise the Commission as appropriate.

We are not requesting a formal response to this letter report.

Member Sunseri recused himself from deliberations on this matter.

Sincerely,

Walter L Kirchner Signed by Kirchner, Walter on 09/23/25

Walter L. Kirchner
Chairman

REFERENCES

1. U.S. Nuclear Regulatory Commission, ACRS Letter, “Seabrook Station Unit 1 License Renewal Application: Review of Licensee Program Addressing Alkali-Silica Reaction,” December 14, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18348A951).

2. U.S. Nuclear Regulatory Commission, ACRS letter, “Report on the Safety Aspects of the License Renewal Application for the Seabrook Station, Unit 1,” December 19, 2018 (ADAMS Accession No. ML18353A954).

3. NextEra Energy Seabrook LLC, License Amendment Request 16-03, “Revise Current Licensing Basis to Adopt a Methodology for the Analysis of Seismic Category I Structures with Concrete Affected by Alkali-Silica Reaction,” August 1, 2016 (ADAMS Accession No. ML16216A240).

4. NextEra Energy Seabrook LLC, “Seabrook Station License Renewal Application,” Volumes I, II and III, March 2016 (ADAMS Accession No. ML101590098, ML101590101, ML101590091).

5. U.S. Nuclear Regulatory Commission, ASLBP No. 17-953-02-LA-BD01, NRC Atomic Safety and Licensing Board Seabrook Memorandum and Order, Docket No. 50-443-LA-2, November 6, 2020 (ADAMS Accession No. ML20322A417 (public), ML20311A151 (non-public)).

6. U.S. Senators Edward J. Markey and Elizabeth Warren Letter to Chairman Hanson, expresses concerns about findings in the NRC’s second quarter integrated inspection report for the Seabrook Station, December 10, 2021 (ADAMS Accession No. ML21344A151).

7. U.S. Nuclear Regulatory Commission, Christopher T. Hanson Letter response to Honorable Edward Markey and Elizabeth Warren, responds to letter regarding concerns about findings in the NRC staff’s second quarter integrated inspection report concerning alkali-silica reaction at Seabrook Station, January 10, 2022 (ADAMS Accession No. ML21348A006).

8. U.S. Nuclear Regulatory Commission, Christopher T. Hanson Letter response to Natalie Treat, Executive Director, C-10 Research and Education Foundation, from Chairman Hanson, responds to several questions about alkali-silica reaction at Seabrook Station, September 16, 2021 (ADAMS Accession No. ML21235A104).

9. U.S. Nuclear Regulatory Commission, Christopher T. Hanson Letter to Senators Edward J. Markey and Elizabeth Warren from Chairman Hanson, responds to request for NRC to reopen the record on the Seabrook license amendment request relating to alkali-silica reaction expansion, June 10, 2021 (ADAMS Accession No. ML21139A161).

10. U.S. Nuclear Regulatory Commission, ACRS meeting Transcript, May 7, 2025 (ADAMS Accession No. ML25156A010).

11. C-10 Research & Education Foundation letter to ACRS, “C-10 Research & Education Foundation pre-meeting questions and comments in advance of April 14, 2025 Advisory Committee on Reactor Safeguards (ACRS) subcommittee meeting regarding Alkali-Silica

Reaction (ASR) at Seabrook Station," April 14, 2025 (ADAMS Accession No. ML25254A146).

12. C-10 Research & Education Foundation letter to ACRS, "Subject: C-10 Research & Education Foundation requests time to present during the upcoming May 7, 2025 Advisory Committee on Reactor Safeguards (ACRS) Full Committee (FC) meeting regarding Alkali-Silica Reaction (ASR) at Seabrook Station," April 30, 2025 (ADAMS Accession No. ML25121A280).

List of Acronyms

ACRS	Advisory Committee on Reactor Safeguards
ADAMS	Agencywide Documents Access and Management System
ASR	Alkali- silica reaction
FC	Full Committee
LAR	License Amendment Request
LSTP	Large-scale testing program
NextEra	NextEra Energy Resources
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation

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