



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

May 21, 2018

Mr. Mano Nazar  
President and Chief Nuclear Officer  
Nuclear Division  
NextEra Energy Seabrook, LLC  
Mail Stop: EX/JB  
700 Universe Blvd.  
Juno Beach, FL 33408

**SUBJECT: SEABROOK STATION, UNIT NO. 1 – SITE VISIT REPORT REGARDING  
REGULATORY AUDIT FOR LICENSE AMENDMENT REQUEST  
RE: ALKALI-SILICA REACTION LICENSE AMENDMENT REQUEST AND  
LICENSE RENEWAL ALKALI-SILICA REACTION AGING MANAGEMENT  
PROGRAM REVIEW (CAC NO. MF8260; EPID L-2016-LLA-0007)**

Dear Mr. Nazar:

By letter dated May 25, 2010, NextEra Energy Seabrook LLC (NextEra or the applicant) submitted to the U.S. Nuclear Regulatory Commission (NRC) its application for renewal of its operating license for Seabrook Station, Unit No. 1 (Seabrook). The applicant requested renewal of the operating license for an additional 20 years beyond the current 40-year license, which expires on March 15, 2030. In its letter dated November 3, 2017, the applicant supplemented its application to provide a revision to its plant-specific alkali-silica reaction (ASR) aging management program to manage the effects of aging due to ASR. This revision included a revised Appendix B, Sections B.2.1.31A and B.2.1.31B, ASR Monitoring Program and Building Deformation Program, respectively. These programs were submitted for the NRC staff's review related to Open Item 3.0.3.2.18-1 in the safety evaluation report.

By letter dated August 1, 2016, as supplemented by letters dated September 30, 2016, October 3 and December 11, 2017, NextEra submitted a license amendment request to revise the current licensing basis for Seabrook to adopt a methodology for the analysis of Seismic Category I structures with concrete affected by ASR. The proposed amendment would revise the Seabrook Updated Final Safety Analysis Report to include new methods for analyzing Seismic Category I structures affected by ASR. By e-mail dated January 13, 2017 (Agencywide Documents Access Management System Accession No. ML17017A162), the NRC staff opened an audit to review the final, complete calculations and other supporting documentation that implement the proposed methodology. In the audit plan, the NRC staff stated that site visits were one of the methods for conducting the audit.

M. Nazar

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During the week of March 19, 2018, the NRC staff conducted a site visit. Enclosed is our report of that visit.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. Poole', with a long horizontal flourish extending to the right.

Justin C. Poole, Project Manager  
Plant Licensing Branch I  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure:  
Site Visit Report

cc: Listserv

SITE VISIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
LICENSE AMENDMENT REQUEST RE: ALKALI-SILICA REACTION AND  
LICENSE RENEWAL ALKALI-SILICA REACTION AGING MANAGEMENT PROGRAM  
NEXTERA ENERGY SEABROOK, LLC, ET AL.  
SEABROOK STATION, UNIT NO. 1  
DOCKET NO. 50-443

Background

By letter dated May 25, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML101590094), NextEra Energy Seabrook (NextEra) submitted to the U.S. Nuclear Regulatory Commission (NRC) its application for renewal of its operating license for Seabrook Station, Unit No. 1 (Seabrook). NextEra requested renewal of the operating license for an additional 20 years beyond the current 40-year license, which expires on March 15, 2030. In its letter dated November 3, 2017 (ADAMS Accession No. ML17307A027), NextEra supplemented its application to provide a revision to its plant-specific alkali-silica reaction (ASR) aging management program to manage the effects of aging due to ASR. This revision included a revised license renewal application (LRA), Appendix B, Sections B.2.1.31A and B.2.1.31B, Alkali-Silica Reaction (ASR) Monitoring Program and Building Deformation Program, respectively. These programs were submitted for the NRC staff's review related to Open Item OI 3.0.3.2.18-1, in the safety evaluation report with Open Items (ADAMS Accession No. ML12160A374).

By letter dated August 1, 2016 (ADAMS Accession No. ML16216A250), as supplemented by letters dated September 30, 2016, October 3 and December 11, 2017 (ADAMS Accession Nos. ML16279A048, ML17277A337, and ML17345A641, respectively), NextEra submitted a license amendment request (LAR) to revise the current licensing basis for Seabrook to adopt a methodology for the analysis of Seismic Category I structures with concrete affected by ASR. The proposed amendment would revise the Seabrook Updated Final Safety Analysis Report to include new methods for analyzing Seismic Category I structures affected by ASR.

In a November 17, 2017, public meeting between NextEra and the NRC, NextEra stated that it credits a "methodology document" as technical basis for the Building Deformation Program, both for its current license and aging management through the period of extended operation. NextEra stated that this document provides the procedural basis for applicable elements of its plant-specific program. On December 11, 2017, NextEra, as part of its response to NRC staff's request for additional information (RAI) on the LAR, submitted the methodology document, titled "Methodology for the Analysis of Seismic Category I Structures with Concrete Affected by Alkali-Silica Reaction for Seabrook Station."

In January 2017, the NRC staff opened an audit to review the final, complete calculations and other supporting documentation that implement the proposed methodology. In that audit plan, it was stated that one of the tools the staff would use is a site visit.

## Bases

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," includes the requirements for nuclear reactor licensees. Section 50.90, "Application for amendment of license, construction permit, or early site permit," requires license amendments be filed with the Commission as specified in 10 CFR 50.4. Section 50.71, "Maintenance of Records, Making of Reports," requires that records connected to licensed activities be maintained by the licensee.

License renewal requirements are specified in 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants." Stated in 10 CFR 54.17, "Filing of Application," it requires applicants for renewed licenses to send written correspondence to the NRC. Stated in 10 CFR 54.37, "Additional Records and Record Keeping Requirements," it requires that license renewal applicants maintain documents demonstrating compliance with the requirements of 10 CFR Part 54 in auditable and retrievable form. License renewal staff guidance is provided in NUREG-1800, Revision 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," dated December 2010, and in NUREG-1801, Revision 2, "Generic Aging Lessons Learned (GALL) Report," dated December 2010.

During review of a licensing action, there may be supporting information retained as records that, although may not necessarily be required to be submitted as part of the application, provide additional information and technical bases for the submitted information; and therefore, the NRC staff may determine an audit is necessary. Regulatory audits may focus on specific documents or may be performed by sampling analyses and information in support of the regulatory action. This audit was performed in accordance with staff guidance in NRC Office of Nuclear Reactor Regulation, Office Instruction LIC-111, "Regulatory Audits," in order for the NRC staff to gain a better understanding of detailed calculations and analyses underlying the formal application and confirm the NRC staff's understanding of the application.

The site visit plan is available in ADAMS under Accession No. ML18058A114, as supplemented by Accession No. ML18071A371. The overall audit plan is available in ADAMS under Accession No. ML17017A162.

## Dates

The site visit was conducted from March 19, 2018, to March 22, 2018.

## Site Visit Team Members

The following NRC staff members and contractors participated in discussions during the audit:

- A. Buford, Structural Engineer
- B. Lehman, Structural Engineer
- G. Thomas, Senior Structural Engineer
- J. Poole, Project Manager
- B. Wittick, Chief
- E. Benner, Director
- R. Morante, Consultant Engineer, Brookhaven National Laboratory
- J. Braverman, Consultant Engineer, Brookhaven National Laboratory

### NextEra and Industry Staff Participants

Ed Carley, NextEra  
Jackie Hulbert, NextEra  
Ken Browne, NextEra  
Josh Greene, NextEra  
Trevor Knott, NextEra  
John Simons, MPR Associates, Inc.  
Amanda Card, MPR Associates, Inc.  
Jim Moroney, MPR Associates, Inc.  
Dr. Said Bolourchi, Simpson Gumpertz & Heger Inc.  
Michael Mudlock, Simpson Gumpertz & Heger Inc.  
Glenn Bell, Simpson Gumpertz & Heger Inc.  
Mohammadreza Moharami Gargari, Simpson Gumpertz & Heger Inc.  
Omer Erbay, Simpson Gumpertz & Heger Inc.  
Nestor Castaneda, Simpson Gumpertz & Heger Inc.  
Rob Schofield, Enercon

### Documents Reviewed During the Site Visit

- Evaluation of the Containment Building, SGH Calculation 160268-CA-04, Revision 0, Seabrook FP 101113: Stage 1
- Evaluation and Design Confirmation of As-Deformed CEB, SGH Calculation 150252-CA-02, Revision 2, Seabrook FP100985: Stage 3
- Evaluation of Main Steam and Feed Water Pipe Chase – East, SGH Calculation 160268-CA-11, Revision 0, Seabrook FP 101216: Stage 2
- Evaluation of Fuel Storage Building, SGH Calculation 160268-CA-09, Revision 0, Seabrook FP 101212: Stage 3
- Evaluation of Electrical Cable Tunnel, SGH Calculation 170443-CA-01, Revision 0, Seabrook FP 101166: Stage 1
- Evaluation of Residual Heat Removal Equipment Vault, SGH Calculation 160268-CA-06, Revision 0, Seabrook FP 101179: Stage 3
- Evaluation of CST Enclosure Structure, SGH Calculation 160268-CA-03, Revision 0, Seabrook FP 101104: Stage 2
- MPR-4273, "Implications of Large-Scale Test Program Results in Reinforced Concrete Affected by ASR," Revision 1, March 2018, Seabrook FP 101050
- MPR Expansion Assessment of ASR-Affected Reinforced Concrete Structures at Seabrook Station, Revision 2, March 2018, Seabrook FP101070
- ISI Procedure Primary Containment Section XI IWL Program (ES1807.031, Revision 4)
- Structures Monitoring Program Manual (SMPM), Revision 04, Seabrook Station Program Manual

### Description of Site Visit Activities and Summary of Observations

During the site visit, in addition to reviewing the documents listed above, the NRC staff discussed the LAR with NextEra staff and contractors, and reviewed the technical topics included in the site visit audit plan and the associated additional discussion items. The NRC staff reviewed NextEra's use of their proposed methodology, as described in the "methodology document," and its application in the reviewed calculations. The NRC staff also engaged in focused discussions with NextEra, as summarized below. The NRC staff stated that it was

considering issuing RAIs to docket information associated with these discussion topics or to clarify existing information on the docket related to these topics.

- The NRC staff discussed NextEra's approach for implementing cracked section properties and how the "pre-stressing" effect of ASR impacted the stiffness of the structures. The NRC staff also discussed what actions will be taken if in-plane expansion reaches "severity zone 4" which aligns with potential rebar yielding or slipping.
- The NRC staff discussed how NextEra's commitments for future actions are going to be captured and tracked and how the supplements to the code of record will be adequately captured in licensing basis documents.
- From the review of the calculation for the electric tunnel, an embedded wall against concrete backfill with no observed signs of ASR distress, the NRC staff noted that implementation of the conservative procedure in the methodology document for determining ASR expansion effects of the concrete backfill produced evaluation results that did not meet code requirements, and an outcome (proposed modifications) not aligned with a wall demonstrating no observed signs of distress. This issue was discussed and NextEra expressed its intent to revise the proposed methodology to more effectively address cases of embedded walls against concrete backfill with no signs of distress while meeting code acceptance criteria.
- The NRC staff discussed NextEra's basis for invoking subparagraph 11.7.7 of American Concrete Institute (ACI) 318-83 (Supplement 3 from the methodology document), without invoking Section 11.7, and all related requirements, in its entirety.
- The NRC staff reviewed expansion measurement data obtained from the ASR Monitoring program and discussed the behavior of Seabrook structures to date (in-plane and through-wall expansion, crack behavior, etc.) in comparison to the behavior seen in the test specimens. NextEra provided this discussion in a report titled MPR Expansion Assessment of ASR-Affected Reinforced Concrete Structures at Seabrook Station, Revision 2, March 2018, Seabrook FP101070. The NRC staff also discussed the need for future actions to verify any future ASR expansion behavior aligns with that observed in test specimens.
- Based on statements in docketed reports and the LAR that appeared to be contradictory, the NRC staff discussed the effect of ASR on structural members subject to axial compression or combined axial compression and flexure. NextEra clarified that the basis for assessment of the compression limit state is provided in MPR-4288, Section 5.3.

The NRC staff and NextEra also conducted breakout sessions to discuss aspects of the review associated strictly with the LRA. NextEra provided demonstrations of the structures monitoring program database and inspection management system. The NRC staff noted that the system appears to effectively track age-related degradation of structures such that intended functions are maintained and degradation will not cause a loss of intended function prior to the next inspection. In addition, the NRC staff noted that the structures monitoring program procedure and the database capture misalignment and distortions of other components and equipment due to building deformations. In its discussions with NextEra, the NRC staff also noted that there appears to be discrepancies between the November 3, 2017, LRA submittal; the information in

the LAR; and in the program basis information reviewed on-site. The NRC staff discussed that if the activities discussed in the LAR apply to the LRA, whether the LRA aging management programs need to be updated to be appropriately consistent and aligned with the LAR submittals.

In addition, the NRC staff noted several items in the methodology document which were clarified during the audit but were not clearly explained in the docketed submittals. In addition to those items, the NRC staff identified several locations where threshold monitoring acceptance criteria developed from the calculations were not reflected correctly into the Structures Monitoring Program. The items related to the methodology document are listed below.

- It is not clear what the equation in Section 4.4.3.2, Step 6, represents.
- In Appendix A:
  - o Steps 1 – 3 are not clear in reflecting the steps taken in the calculations (e.g., which loads were considered in the analyses, if the loads were factored or unfactored)
  - o Step 4 appears to incorrectly refer to “ACI 318-79”
  - o Equation 9-4, Step 4, does not note that the calculated moment of inertia cannot be greater than the gross moment of inertia
  - o It is not clear that the Steven’s equation, under “Axial rigidity” in Step 4, is in metric units
  - o The description of orthotropic shell in Step 5 does not appear to be correct as written
  - o Step 6 notes that stopping before convergence is conservative. This may not be accurate when the analysis is being done for displacements

#### Site Exit Briefing

The NRC staff’s site visit exit briefing was conducted on March 22, 2018. The NRC staff informed NextEra that based on the discussions the staff identified a potential for seven new RAIs related to the implementation of the methodology document. The NRC staff stated it planned to send NextEra draft RAIs, which could be followed by a clarification call if NextEra requests one. The NRC staff would finalize the RAIs following the clarification call.

#### Requests for Additional Information Resulting from the Audit

As stated above, the NRC staff identified seven potential new RAIs based on the discussions held during the site visit. The NRC staff determined that five of those potential seven warranted issuance as formal RAIs. On May 1, 2018, the NRC staff issued its formal RAIs (ADAMS Accession No. ML18121A399).

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 DATED MAY 21, 2018

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**ADAMS Accession No.: ML18135A046**

\*by e-mail

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