



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

July 26, 2017

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  
(CAC NO. MF8260)

Dear Mr. Nazar:

By letter dated August 1, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16216A240), as supplemented by letter dated September 30, 2016 (ADAMS Accession No. ML16279A048), NextEra Energy Seabrook submitted a license amendment request to revise the current licensing basis for the Seabrook Station, Unit No. 1 (Seabrook), to adopt a methodology for the analysis of Seismic Category I structures with concrete affected by alkali-silica reaction (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 alkali-silica reaction. By e-mail dated January 13, 2017 (ADAMS Accession No. ML17017A162), the U.S. Nuclear Regulatory Commission (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.

During the week of June 5, 2017, the NRC staff conducted a site visit. Enclosed is our report of that visit.

Sincerely,

A handwritten signature in black ink, appearing to read "Justin C. Poole", written over a horizontal line.

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 w/enclosure: Distribution via Listserv

SITE VISIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

LICENSE AMENDMENT REQUEST RE: ALKALI-SILICA REACTION

NEXTERA ENERGY SEABROOK, LLC, ET AL.

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

Background

By letter dated August 1, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16216A240), as supplemented by letter dated September 30, 2016 (ADAMS Accession No. ML16279A048), NextEra Energy Seabrook (NextEra or the licensee) submitted a license amendment request (LAR) to revise the current licensing basis for the Seabrook Station, Unit 1 (Seabrook), to adopt a methodology for the analysis of Seismic Category I structures with concrete affected by alkali-silica reaction (ASR). The proposed amendment would revise the Seabrook Updated Final Safety Analysis Report (UFSAR) to include new methods for analyzing Seismic Category I structures affected by ASR. In January 2017, the U.S. Nuclear Regulatory Commission (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

The purpose of the site visit was to support NRC staff review of the Seabrook LAR in accordance with NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Sections 3.8.1 and 3.8.4, and Revision 3 of Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis" (ADAMS Accession No. ML12220A043).

The site visit plan is available in ADAMS under Accession No. ML17150A285. The overall audit plan is available in ADAMS under Accession No. ML17017A162.

Dates

The site visit was conducted from June 5, 2017, to June 9, 2017.

Site Visit Team Members

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

D. Hoang, Structural Engineer  
B. Lehman, Structural Engineer  
G. Thomas, Senior Structural Engineer  
J. Poole, Project Manager  
B. Wittick, Chief  
R. Morante, Consultant Engineer, Brookhaven National Laboratory  
J. Braverman, Consultant Engineer, Brookhaven National Laboratory

Enclosure

### Applicant and Industry Staff Participants

Ed Carley, NextEra  
Jackie Hulbert, NextEra  
Jeff Sobotka, NextEra  
Brian Brown, NextEra  
Mike Collins, NextEra  
Christine Thomas, NextEra  
Ken Browne, NextEra  
John Simons, MPR Associates  
Chris Bagley, MPR Associates  
Amanda Card, MPR Associates  
Jim Moroney, MPR Associates  
Dr. Said Bolourchi, Simpson Gumpertz & Heger Inc.  
Ryan Mones, Simpson Gumpertz & Heger Inc.

### Documents Reviewed During the Site Visit

- MPR 3722, Revision 2 (Seabrook FP# 100718), "Strength Testing of Anchors in Concrete Affected by Alkali-Silica Reaction," January 2016.
- MPR 4231, Revision 0 (Seabrook FP# 1009720), Instrumentation for Measuring Expansion in Concrete Affected by Alkali-Silica Reaction, October 2015.
- MPR 4262, Revision 0 (Seabrook FP# 100994), "Shear and Reinforcement Anchorage Testing of Concrete Affected by Alkali-Silica Reaction Volume I of II," January 2016.
- Seabrook Station Administrative Procedure SMP 2.1, "Structures Monitoring Walkdowns, Data Collection, and Evaluation," Rev. 00.
- Seabrook Station Administrative Procedure SMP 3.1, "ASR Monitoring Walkdowns, Data Collection, and Evaluation," Rev. 00.
- Seabrook Station Administrative Procedure SMP 4.1, "Building Deformation Monitoring Walkdowns, Data Collection, and Evaluation," Rev. 01.
- SIGH 160268 CA 01, Revision 0 (Seabrook FP# 101042), "Computation of Load Factors for ASR Demands for Seismic Cat 1 Structures Other than Reactor Containment," July 2016.
- SG&H 160268 CD 01, Revision 1 (Seabrook FP# 101083), "Criteria Document for Analysis and Evaluation of Seismic Category I Structures," January 2017.
- SG&H Calculation 150252, "Seismic Response Computation Summary and Examples," Filename: "2182058.01 RG 1.92.pdf," February 2017.
- Smaoui, N., Bissonnette, B., Berube, M., and Fournier, B., Stresses induced by alkali-silica reactivity in prototypes of reinforced concrete columns incorporating various types of reactive aggregates, Canadian Journal of Civil Engineering , Volume 34, 2007 [Reference 1.11 in MPR 4273].
- Allford, Morgan Therese, "Expansion Behavior of Reinforced Concrete Elements due to ASR, Masters Thesis, University of Texas at Austin, August 2014 [Reference 6.1 in MPR 4273].

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

During the site visit, the staff conducted a tour of the concrete structures impacted by ASR and observed the extent of ASR and the corrective actions taken to date. The staff observed locations where crack monitoring has been ongoing, as well as locations with installed

extensometers. In addition to reviewing the documents listed above, the staff discussed the LAR with licensee staff and contractors, and reviewed the topics included in the site visit audit plan and the draft requests for additional information (RAIs), which were shared with the licensee on May 5, 2017 (ADAMS Accession No. ML17150A286).

The staff reviewed the licensee's use of the "100 40 40 method" for combining the effects of the three directions of earthquake loading. This review focused on the 100 40 40 clarification question included in the site audit plan and resulted in two potential RAIs, one addressing the use of 100 40 40 in conjunction with an equivalent static analysis, as opposed to a response spectrum analysis, and the second addressing how the 100 40 40 method will be applied when there is a multiple load interaction effect.

The staff also reviewed the licensee's approach to developing the ASR load factors. This discussion focused on clarification of issues summarized in the audit plan and did not result in any further issues.

The staff also discussed the licensee's approach for implementing moment redistribution in Stage 3 analysis, primarily relating to how ACI 318 71 code provisions were being met, and the acceptance criteria for demonstrating adequate plastic hinge rotation capacity. This was a topic that may be reviewed further through the RAI process.

The staff discussed how the licensee intended to address ASR degradation in foundations and if the UFSAR markup in the LAR needed to be updated to include a markup for Section 3.8.5, "Foundations." This discussion resulted in a potential RAI to address the UFSAR markup and how ASR degradation is being managed in concrete foundations.

The staff also 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. This discussion led to revisions in the draft monitoring RAIs to address potential for deviations in in plane expansion behavior from the test specimens.

Finally, the staff reviewed the documentation related to the concrete anchor test program. This review led to a potential RAI related to the representativeness of the test program to Seabrook structures, and specifically, how the anchor types used in the test program would properly represent the behavior of the anchors installed at Seabrook.

The staff also discussed the proposed draft RAIs that were shared with the licensee on May 5, 2017. Discussion of the draft RAIs led to revisions to the proposed RAIs. These changes were intended to clarify and focus the RAIs based on information gathered during the audit. As noted above, the monitoring RAIs were revised to better capture how the licensee is determining the behavior of Seabrook structures is aligning with the specimen behavior seen during the test program. Discussion of the proposed deformation RAIs led to revisions focusing on the use of moment redistribution in Stage 3 analyses, and specifically, how the related code requirements are being met, whether there are any acceptance criteria for when moment redistribution can be used, and whether there are limits on the amount of moment that can be redistributed.

#### Site Exit Briefing

The NRC staff's site visit exit briefing was conducted on the afternoon of June 8, 2017. The staff informed the applicant that based on the discussions, the staff would be modifying the draft RAIs as discussed above. The staff also noted that there was a potential for two new RAIs

related to the use of the 100 40 40 spatial combination method, as well as RAIs on foundations and anchor bolts. The staff stated it planned to send NextEra the modified draft RAIs, which could be followed by a clarification call if the licensee requests one. The staff would finalize the RAIs following the clarification call.

Requests for Additional Information Resulting from the Audit

As stated above, there were four new potential RAIs based on the discussions held during the site visit, along with modifications to the existing draft RAIs. The revised draft RAIs were sent by e-mail on July 18, 2017 (ADAMS Accession No. ML17201Q107).

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**ADAMS Accession No.: ML17199T383**

\*by e-mail dated July 11, 2017

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