NRR-PMDAPEm Resource

From: Poole, Justin
Sent: Tuesday, July 18, 2017 2:21 PM
To: Browne, Kenneth
Cc: Danna, James
Subject: DRAFT - Request for Additional Information Regarding ASR Amendment Request
Attachments: DRAFT - MF8260 RAIs Rev1.pdf

Ken,

By letter dated August 1, 2016, as supplemented by letter dated September 30, 2016, NextEra Energy Seabrook, LLC (NextEra) submitted a license amendment request for Seabrook Station, Unit No. 1. The proposed amendment would revise the current licensing basis to adopt a methodology for the analysis of seismic category I structures with concrete affected by alkali-silica reaction. In reviewing NextEra's application, the NRC staff has developed the attached DRAFT request for additional information (RAI). These DRAFT RAIs were first transmitted to you on May 5, 2017. During the week of June 5, 2017, the NRC staff discussed these DRAFT RAIs as part of its site visit. As a result of the site visit, some of the DRAFT RAIs have been modified, while others were added or removed.

Please review these revised DRAFT RAIs to ensure that the questions are understandable, the regulatory basis is clear, there is no proprietary information contained in the RAI, and to determine if the information was previously docketed. The NRC staff would like to have a call to provide you any clarification needed to ensure the questions are fully understood. This email does not convey a formal NRC staff position, and it does not formally request for additional information.

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REQUEST FOR ADDITIONAL INFORMATION (RAI)
REGARDING LICENSE AMENDMENT REQUEST (LAR) 16-03 TO REVISE CURRENT LICENSING BASIS TO ADOPT A METHODOLOGY FOR THE ANALYSIS OF SEISMIC CATEGORY I STRUCTURES WITH CONCRETE AFFECTED BY ALKALI-SILICA REACTION,
NEXTERA ENERGY SEABROOK, LLC,
SEABROOK STATION
DOCKET NO. 50-443

References:

1. Letter SBK-L-16071, dated August 1, 2016, from Ralph A. Dodds III, NextEra Energy Seabrook to USNRC regarding the Request to Adopt a Methodology for Analysis of Seismic Category I Structures with Concrete Affected by Alkali-Silica Reaction (ADAMS Accession No. ML16216A240).
2. Letter SBK-L-16082, dated September 30, 2016, from Ralph A. Dodds III, NextEra Energy Seabrook to USNRC regarding the Supplement to Request to Adopt a Methodology for Analysis of Seismic Category I Structures with Concrete Affected by Alkali-Silica Reaction (ADAMS Accession No. ML16279A048).
3. Letter SBK-L16181, dated December 23, 2016, from Eric McCartney, NextEra Energy Seabrook to USNRC regarding License Renewal Application Relating to the Alkali-Silica Reaction Monitoring Program (ADAMS Accession No. ML16362A283).
4. MPR-4288, Revision 0, "Seabrook Station: Impact of Alkali-Silica Reaction on Structural Design Evaluations," July 2016 (ADAMS Accession No. ML16216A241).
5. MPR-4273, Revision 0, "Seabrook Station – Implications of Large-Scale Test Program Results on Reinforced Concrete Affected by Alkali-Silica Reaction," July 2016 (ADAMS Accession No. ML16216A242).

Regulatory Requirements

The regulatory requirements below apply generically to all requests for additional information (RAIs). Additional regulatory requirements specific to an RAI is stated in the Background Section of the RAI.

Section 3.1 of the Seabrook Station, Unit No.1 (Seabrook) Updated Final Safety Analysis Report (UFSAR) discusses how the principal design features for plant structures, systems and components important to safety meet the U.S. Nuclear Regulatory Commission (NRC) General Design Criteria (GDC) for Nuclear Power Plants, specified in Appendix A to 10 CFR Part 50 and identifies any exceptions that are taken. This section indicates, in part, that the principal design features for Seabrook structures did include, among others, meeting the requirements of GDC 1, 2 and 4 of 10 CFR 50, Appendix A.

10 CFR Part 50, Appendix A, GDC 1, Quality Standards and Records, requires, in part, structures be designed and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. Based on the LAR and UFSAR Section 3.8, the Seabrook seismic Category I concrete structures, other than containment, were designed in accordance with

ACI 318-71, while the containment was designed in accordance with ASME Section III, Division 2, 1975 Edition.

10 CFR Part 50, Appendix B, Criterion III "Design Control" requires, in part, that the design control measures shall assure that applicable regulatory requirements and the design basis, as defined in 10 CFR 50.2 and as specified in the license application, for applicable structures are correctly translated into specifications, drawings, procedures and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Design changes, including field changes, shall be subject to design control measures commensurate with those applied to the original design.

RAI-M1

Background

Section 3.2.3 of the LAR notes that adjustments to Seabrook design code methodologies are unnecessary if alkali-silica reaction (ASR) through-thickness expansion levels remain below limits established during the MPR Associates / Ferguson Structural Engineering Laboratory (MPR/FSEL) structural testing. These expansion limits are identified for flexure, reinforcement anchorage, shear, and structural attachments in Tables 2 and 4 of the LAR, and proposed Table 3.8-18 markup of the Seabrook UFSAR, which references Section 2.1 of MPR-4288, "Seabrook Station: Impact of Alkali-Silica Reaction on the Structural Design Evaluations" (Seabrook FP# 101020).

Because the proposed methodology to analyze ASR affected structures assumes through-thickness expansion remains below the identified limits, the NRC staff needs to understand what the limits are, and how frequently the through-wall expansions will be monitored.

Issue

a. The limits identified in Table 4 do not match the limits identified in Tables 2 and 3.8-18, so it is not clear what the limits are.

b. Proposed markup for UFSAR Section 3.8.4.7.2 notes that all locations meeting Tier 3 criteria will be monitored for Combined Cracking Index on a 6-month inspection interval and will be added to the through-thickness expansion monitoring via extensometers; however, it is not clearly stated how often through-thickness measurements will be taken.

Request

a. Identify the through-thickness limits that will be used for monitoring of Seabrook structures and referenced in the UFSAR.

b. State the interval at which through-thickness measurements will be taken and provide a justification for the interval. Update the proposed UFSAR Section 3.8.4.7.2 to include the interval of through-thickness measurements.

RAI-M2

Background

Section 3.2.3 of the LAR notes that adjustments to Seabrook design code methodologies are unnecessary if ASR through-thickness expansion levels remain below limits established during the MPR/FSEL structural testing. All of the limits are based on through-thickness expansion, which was selected as the monitoring parameter based on the performance of the specimens in the MPR/FSEL structural testing. Section 5.1.4 of MPR-4288 states that "a limit on in-plane expansion is not necessary, as expansion [as observed in the testing program] is predominately in the through-thickness direction."

ASR is a volumetric expansion phenomenon and cracking can preferentially occur in any direction, depending on various factors. Section 5.1.4 of MPR-4288 states that during MPR/FSEL structural testing, the in-plane expansion plateaued, but expansion continued in the through-thickness direction. Although Section 4.3 of MPR-4288 notes the beam test specimens were designed to be representative of the structural characteristics of safety-related structures at Seabrook, it is not clear that the Seabrook structural systems will exhibit similar expansion behavior as the MPR/FSEL test beams. In the December 23, 2016, response to license renewal RAI B.2.1.31A-A1, the licensee also stated that a small number of Tier 3 locations at Seabrook exhibit in-plane expansion that exceeds the plateau in-plane expansion observed in the large-scale test program (LSTP).

Issue

The above statements in MPR-4288 appear to assume that the structures at Seabrook will behave in a similar fashion to the test specimens, although the LAR does not discuss actions that have been taken or will be taken to validate or corroborate this hypothesis for in situ Seabrook structures. Preliminary expansion results from Seabrook appear to indicate that in-plane expansion may not plateau at the same level as that seen in MPR/FSEL structural testing, and that expansion behavior may be different between the test specimens and Seabrook structures.

a. It is not clear to the NRC staff if a review of data from Seabrook structures will be conducted to verify the apparent assumption that Seabrook structures are behaving in a similar fashion to the MPR/FSEL test specimens.

b. Based on preliminary operating experience with in-plane expansion, the NRC staff needs additional information on why limits on in-plane or volumetric expansion are not proposed in the monitoring program.

c. The NRC staff needs to understand how it was determined that MPR/FSEL test program conclusions continue to apply to Seabrook locations with in-plane expansion beyond the plateau levels seen in the test program.

Request

a. Explain whether (and how) the apparent assumption that ASR expansion in Seabrook structures will behave similarly to the test specimens (i.e., in-plane expansion will plateau at relatively low levels and through-thickness expansion will dominate, and

overall ASR behavior is similar) will be validated or corroborated through the service life of the plant.

b. Provide justification for the statement that "a limit on in-plane expansion is not necessary" considering the operating experience noted above and its potential impact on structural capacity. Explain how it can be determined Seabrook structures are behaving similarly to the test specimens, with regard to expansion impact on structural limit states (i.e., flexure, shear, reinforcement anchorage), without quantitative limits on in-plane or volumetric expansion. If limits are proposed provide a technical justification for the limit and associated monitoring interval.

c. Explain how it was determined that areas at Seabrook exceeding the expansion (either in-plane or volumetrically) seen during testing are bound by the test results with regard to structural limit states.

d. Update the UFSAR and LAR as necessary to reflect the responses provided to the above requests.

RAI-M3

Background

Section 3.2.3 of the LAR states that adjustments to Seabrook design code methodologies are unnecessary if ASR through-thickness expansion levels remain below limits established during the MPR/FSEL structural testing. Section 3.5.1 states that extensometers will be installed to monitor future expansion but that the expansion prior to extensometer installation must be estimated. To estimate prior through-thickness expansion, LAR Section 3.5.1 states that an empirical correlation will be used that was developed based on data from the MPR/FSEL structural testing, and forms a technical basis for direct application of LSTP results with regard to structural limit states to Seabrook structures by monitoring expansion limits. The correlation curve relates reduction in normalized concrete elastic modulus measurements with through-thickness expansion for levels of ASR expansion achieved in the LSTP. Since this correlation is an empirical, first-of-a-kind correlation that has not been corroborated with data from Seabrook structures or other ASR-affected structures in the field, it may need to be validated throughout the service life of the plant.

Issue

In the December 23, 2016, response to license renewal RAI B.2.1.31A-A4, the licensee noted that the correlation will be corroborated once at least 2 years prior to the period of extended operation by taking cores in the vicinity of three extensometers. However, no technical justification is provided for the adequacy of three locations or for corroborating the correlation with one point in time. The NRC staff is not clear how the proposed approach will corroborate that the correlation methodology remains valid as ASR progresses through the service life of the plant, if it is not re-evaluated. In addition, there is no discussion of any evaluation planned for some future date(s) or expansion levels to quantitatively corroborate that the correlation between through-wall expansion and reduction in normalized concrete elastic modulus continues to match the proposed curve. Further, it is not clear (1) what criteria will be used to determine whether the data correlates and (2) how locations will be selected such that the measurements adequately bound the population of Tier 3 locations.

Request

a. Explain how it will be determined whether the data taken for Seabrook structures match the correlation curve derived from large-scale test specimens.

b. Provide a technical basis for the adequacy of taking three measurements at Seabrook, at a single point in time, to corroborate the correlating curve derived from large-scale test specimens. In addition, discuss how locations will be selected such that the measurements adequately bound the population of Tier 3 locations.

c. Provide a technical justification that the timing of the corroboration activity (and number of times it will be performed) is sufficient to demonstrate that an adequate validation of the correlation curve exists, and will be ensured through the life of the plant. The response should address both the adequacy of the correlation as well as the similarity of ASR behavior between the test specimens and the structures at Seabrook.

RAI-T1:

Background

LAR Section 2.1.1 states, in part "[t]he structures and concrete anchors are operable but degraded, and structures, systems, and components housed within the structures are operable. NextEra is currently evaluating all Seismic Category I structures at Seabrook with indications of ASR to verify that structures continue to satisfy the ACI 318-71 and ASME Code acceptance criteria, as appropriate…" LAR Section 3.1.3 states "Seabrook station uses cast-in-place anchorages and post-installed anchors. The strength of the concrete in which an anchor is embedded must be sufficient to ensure the anchor is capable of sustaining loads equal to the ultimate loads specified by the anchor manufacturer." LAR Table 4 provides ASR expansion limits for structural limit states, including concrete anchors, that are based on the ASR expansion limits to which anchors were tested in the Seabrook-specific MPR/FSEL LSTP.

Issue

LAR Enclosure 2 (MPR-4288), Subsection 3.2.4 states that cast-in-place anchorages in use at Seabrook include embedded plates (with Nelson studs), embedded Unistrut type channels, Richmond studs, and anchor bolts. Further, the LAR states that post-installed anchors in use at Seabrook include both expansion anchors (Hilti Kwik bolts) and undercut anchors (Drillco Maxi-bolts). In LAR Enclosure 3 (MPR-4273), Section 5.1.1, states that the Hilti Kwik Bolt 3 expansion anchor and the Drillco Maxi-Bolt undercut anchor where used in the test program to represent anchors in Seabrook structures.

Request

a. Provide the technical justification explaining why the Hilti Kwik Bolt 3 and the Maxi-bolt post-installed anchors were chosen for testing in the LSTP Anchor Test Program, as opposed to the other anchor types (manufacturer) installed at Seabrook.

b. Provide the technical justification explaining why cast-in-place anchors (equipment anchors for pumps, motors, etc.) were not included in the test program and why the test results are applicable to cast-in-place anchors at Seabrook.

RAI-T2:

Background

LAR Section 3.2 states that the evaluation for impact of ASR on Seabrook structures considered data from the MPR/FSEL LSTP conducted specifically for Seabrook Station by MPR Associates in collaboration with FSEL at the University of Texas at Austin. It also states that the specimens that were used in testing were structurally representative of concrete used in constructing Seabrook structures. LAR Section 3.2.1 states: "[t]he LSTP included testing of specimens that reflected the characteristics of ASR-affected structures at Seabrook Station. Tests were completed at various levels of ASR cracking to assess the impact on selected limit states." The LSTP is described in MPR-4273 (LAR Enclosure 3). Section 3.1.1 of MPR-4273 notes that the concrete mix design for the fabricated specimens was specifically designed to accelerate ASR development. This allowed levels of ASR beyond that seen at Seabrook after only a short time (i.e., maximum of 2.5 years for the LSTP).

LAR Section 2.1 states that a root cause investigation into ASR at Seabrook concluded that the original concrete mix designs used a slow-reacting, coarse aggregate that was susceptible to ASR, but passed the ASTM C289-71 aggregate reactivity test during construction. It also states that ASTM C289-71 test was an appropriate test at the time of construction, but it is now known that the test may not accurately predict the reactivity of slow-reacting aggregates, such as the aggregate used at Seabrook.

Issue

The LAR does not discuss the potential influence, with respect to structural effects, of the use of significantly accelerated development of ASR in the large-scale test specimens versus the slow natural development of ASR over time in Seabrook structures. The development of creep effects in concrete depends on the time to loading following the concrete pour; the larger the elapsed time the smaller the creep effects will be. The development of ASR internal prestress load during the early age of concrete following casting of the test specimens could result in ASR-induced in-plane creep effects in the test specimens that counteracts and thereby reduces the in-plane ASR expansion effects measured. This early age creep phenomenon in test specimens is potentially un-conservative and is not likely to occur in the normal slow development of ASR where the internal ASR prestress load develops a very long time duration after concrete has set.

Request

a. With regard to structural effects, explain how it was determined that the LSTP results from test specimens with accelerated ASR are not un-conservative compared to Seabrook structures with normal slow ASR development.

b. Explain how the possible early age concrete creep effects due to accelerated ASR-induced prestress load were accounted for in the LSTP, or in the application of the LSTP results to Seabrook structures. If early age creep effects due to ASR load in the test specimens were determined to be insignificant, provide a technical justification for this conclusion.

RAI-D1

Background

GDC 2 of 10 CFR 50 Appendix A requires structures important to safety to be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods considering appropriate combinations of the effects of normal and accident conditions with the effects of natural phenomena. GDC 4 requires these structures to be designed to accommodate the effects of environmental conditions associated with normal operation and postulated accidents, and appropriately protected against associated dynamic effects.

Section 2.2 of the LAR provides a summary of the proposed changes to the Seabrook UFSAR and UFSAR markup pages are provided as Attachment 1, but neither includes any changes to UFSAR Section 3.8.5, "Foundations," to account for the effects of ASR. In addition, Section 3.3 of the LAR describes how structural evaluations will be performed on structures impacted by ASR; however, no discussion is provided for how ASR in building foundations will be addressed.

Issue

Since concrete foundations of the Seabrook Category 1 structures used the same reactive aggregate as the superstructure, it is unclear whether foundations were evaluated for the impacts of ASR, and whether UFSAR Section 3.8.5 needs to be updated to account for ASR effects.

Request

Explain how the concrete foundations of Seabrook Category 1 structures have been or will be evaluated for ASR. If it is determined necessary to include evaluation of foundations in the UFSAR, provide a corresponding markup of UFSAR Section 3.8.5. If not, provide a technical basis for why it is determined that no UFSAR changes are necessary to address evaluation of foundations for ASR.