

~~Enclosure 1 to this Letter Contains Proprietary Information
Withhold Enclosure 1 from Public Disclosure in Accordance with 10 CFR 2.390~~



October 03, 2017

10 CFR 50
Docket No. 50-443
SBK-L-17156

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

Seabrook Station
Response to Request for Additional Information Regarding License Amendment
Request 16-03 Related to Alkali-Silica Reaction (CAC No. MF8260)

References:

1. NextEra Energy Seabrook, LLC letter SBK-L-16071, "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 (ML16216A240).
2. NRC, "Request for Additional Information Regarding License Amendment Request Related to Alkali-Silica Reaction (CAC No. MF8260)," August 4, 2017 (Accession Number ML17214A085).

In Reference 1, NextEra Energy Seabrook, LLC (NextEra Energy Seabrook) submitted letter SBK-L-16701, requesting an amendment to the license for NextEra Energy Seabrook. Specifically, the proposed change revises the NextEra Energy Seabrook Updated Final Safety Analysis Report (UFSAR) to include methods for analyzing seismic Category I structures with concrete affected by an Alkali-Silica Reaction (ASR).

In Reference 2, the NRC requested additional information to complete the review of the NextEra Energy Seabrook License Amendment Request 16-03.

Enclosure 1 provides NextEra Energy Seabrook's response to the NRC's Request for Additional Information (RAI) concerning the License Amendment Request related to Alkali-Silica Reaction.

NextEra Energy Seabrook, LLC

P.O. Box 300, Lafayette Road, Seabrook, NH 03874

Enclosure 2 provides the revised NextEra Energy Seabrook Updated Final Safety Analysis Report (UFSAR) Section 3.8 markup as referenced in the RAI responses within Enclosure 1.

Enclosure 1 to this letter contains information proprietary to NextEra Energy Seabrook. This letter is supported by an affidavit (Enclosure 3), setting forth the basis on which the information in Enclosure 1 may be withheld from public disclosure by the Commission and addressing the considerations listed in 10 CFR 2.390(b)(4). Accordingly, it is respectfully requested that the information which is proprietary be withheld from public disclosure in accordance with 10 CFR 2.390. A non-proprietary version of this letter will be submitted under separate cover by November 3, 2017.

If there are any questions or additional information is needed, please contact Mr. Edward J. Carley, Engineering Supervisor - License Renewal, at (603) 773-7957.

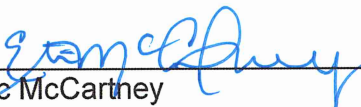
If you have any questions regarding this correspondence, please contact Mr. Kenneth Browne, Licensing Manager, at (603) 773-7932.

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

Executed on October 3, 2017.

Sincerely,

NextEra Energy Seabrook, LLC


Eric McCartney
Regional Vice President - Northern Region

Enclosures:

Enclosure 1 – Response to Request for Additional Information Regarding License Amendment Request 16-03 Related to Alkali-Silica Reaction (CAC No. MF8260) (Proprietary)

Enclosure 2 – NextEra Energy Seabrook Updated Final Safety Analyses Report Markup of Section 3.8 – Design of Structures, Components, Equipment and Systems – Design of Category I Structures

Enclosure 3 – NextEra Energy Seabrook, Application for Withholding Proprietary Information from Public Disclosure and Affidavit

cc: D. H. Dorman NRC Region I Administrator
J. C. Poole NRC Project Manager
P. C. Cataldo NRC Senior Resident Inspector
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Enclosure 2 to SBK-L-17156

NextEra Energy Seabrook Updated Final Safety Analyses Report Markup of Section 3.8
– Design of Structures, Components, Equipment and Systems – Design of Category I
Structures

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3.8.4.7 Testing and In-Service Surveillance Requirements

Normal quality control testing is discussed in Subsection 3.8.3.6. A general visual inspection of the exposed accessible interior and exterior surfaces of the Containment Enclosure Building will be periodically conducted as discussed in Subsection 6.2.6.1.

The Structural Monitoring Program includes requirements for inspecting structures affected by ASR. The total expansion of ASR-affected areas is limited to less than the amounts specified in Table 3.8-18. Periodically verifying that ASR expansion levels are below the limits is necessary to ensure structural properties of ASR-affected areas are similar to areas with no evidence of ASR.

The Structural Monitoring Program also has limits on structure deformation from ASR concrete expansion. Structures with increasing levels of deformation, as determined by an analysis of the self-straining loads, are classified as Stage 1, 2, or 3. Monitoring criteria for each structure are included in the Structural Monitoring Program and inspection requirements are defined based on the analysis and classification of each structure.

3.8.4.7.1 STRUCTURES MONITORING PROGRAM

The Structures Monitoring Program is implemented through the plant Maintenance Rule Program, which is based on the guidance provided in NRC Regulatory Guide 1.160 "Monitoring the Effectiveness of Maintenance at Nuclear power Plants" and NUMARC 93-01 "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants", and with guidance from ACI 349.3R, "Evaluation of Existing Nuclear Safety-Related Concrete Structures". The Structures Monitoring Program was developed using the guidance of these three documents. The Program is implemented to monitor the condition of structures and structural components within the scope of the Maintenance Rule, such that there is no loss of structure or structural component intended function.

3.8.4.7.2 ALKALI-SILICA REACTION (ASR) MONITORING

The ASR Monitoring Program manages cracking due to expansion and reaction with aggregates of concrete structures. The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel.

The Structures Monitoring Program performs visual inspections of the concrete structures at Seabrook for indications of the presence of alkali-silica reaction (ASR). ASR involves the formation of an alkali-silica gel which expands when it absorbs water. This expansion is volumetric in nature but is most readily detected by visual observation of cracking on the surface of the concrete. This cracking is the result of expansion that is occurring in the in-plane directions. Expansion is also occurring perpendicular (through the thickness of the wall) to the surface of the wall, but cracking will not be visible in this direction from the accessible surface. Cracking on the surface of the concrete is typically accompanied by the presence of moisture and efflorescence. Concrete affected by expansive ASR is typically

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characterized by a network or "pattern" of cracks. Micro-cracking due to ASR is generated through forces applied by the expanding aggregate particles and/or swelling of the alkali-silica gel within and around the boundaries of reacting aggregate particles. The ASR gel may exude from the crack forming white secondary deposits at the concrete surface. The gel also often causes a dark discoloration of the cement paste surrounding the crack at the concrete surface. If "pattern" or "map" cracking typical of concrete affected by ASR is identified, an evaluation will be performed to determine further actions.

Monitoring of crack growth is used to assess the in-plane expansion associated with ASR and to specify monitoring intervals. In selected locations, cores will be removed for modulus testing to establish the level of through-thickness expansion to date. Instruments (extensometers) will be placed in the resulting bore holes to monitor expansion in this direction going forward.

ASR is primarily detected by non-intrusive visual observation of cracking on the surface of the concrete. The cracking is typically accompanied by the presence of moisture and efflorescence. ASR may also be detected or confirmed by removal of concrete cores and subsequent petrographic analysis.

A Combined Cracking Index (CCI) is established at thresholds at which structural evaluation is necessary (see table below). The Cracking Index (CI) is the summation of the crack widths on the horizontal or vertical sides of 20-inch by 30-inch grid on the ASR-affected concrete surface. The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. A CCI of less than the 1.0 mm/m can be deemed acceptable with deficiencies (Tier 2). Deficiencies determined to be acceptable with further review are trended for evidence of further degradation. The change from qualitative monitoring to quantitative monitoring occurs when the Cracking Index (CI) of the pattern cracking equals or is greater than 0.5 mm/m in the vertical and horizontal directions. Concrete crack widths less than 0.05 mm cannot be accurately measured and reliably repeated with standard, visual inspection equipment. A CCI of 1.0 mm/m or greater requires structural evaluation (Tier 3). All locations meeting Tier 3 criteria will be monitored via CCI on a ½ year (6-month) inspection frequency and added to the through-thickness expansion monitoring via extensometers. All locations meeting the Tier 2 structures monitoring criteria will be monitored on a 2.5 year (30-month) frequency. CCI correlates well with strain in the in-plane directions and the ability to visually detect cracking in exposed surfaces making it an effective initial detection parameter.

Tier	Structural Monitoring Program Category	Recommendation for Individual Concrete Components	Criteria
3	Unacceptable (requires further evaluation)	<ul style="list-style-type: none"> • Structural Evaluation • Implement enhanced ASR monitoring, such as through-wall expansion monitoring using Extensometers. 	1.0 mm/m or greater Combined Cracking Index (CCI)

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2	Acceptable with Deficiencies	Quantitative Monitoring and Trending	<ul style="list-style-type: none"> • 0.5 mm/m or greater CCI • CI of greater than 0.5 mm/m in the vertical and horizontal directions.
		Qualitative Monitoring	Any area with visual presence of ASR (as defined in FHWA-HIF-12-022) accompanied by a CI of less than 0.5 mm/m in the vertical and horizontal directions.
1	Acceptable	Routine inspection as prescribed by the Structural Monitoring Program	Area has no indications of pattern cracking or water ingress. No visual symptoms of ASR

The Alkali-Silica Reaction Monitoring Program was initially based on published studies describing screening methods to determine when structural evaluations of ASR affected concrete are appropriate. Large scale destructive testing of concrete beams with accelerated ASR has confirmed that parameters being monitored are appropriate to manage the effects of ASR and that acceptance criterion of 1 mm/m a used provides sufficient margin.

CCI's limitation for heavily reinforced structures is that in-plane expansion, and therefore CCI, has been observed in the large scale test programs to plateau at a relatively low level of accumulated strain (approximately 1 mm/m). No structural impacts from ASR have been seen at these plateau levels in the large scale testing program at the University of Texas at Austin, Ferguson Structural Engineering Laboratory. While CCI remains useful for the detection and monitoring of ASR at the initial stages, an additional monitoring parameter in the out-of-plane direction is required to monitor more advanced ASR progression. ASR expansion in the out-of-plane direction will be monitored by borehole extensometers installed in drilled core bore holes.

Although the observed strains due to ASR are of very small magnitude and adequately monitored by CCI and extensometers, over large distances and with the right building geometry, they can result in discernable dimension changes in a structure. Additional monitoring of this relative displacement potential and its impact to plant systems and components is included in the ASR Monitoring Program. Specifically, monitoring includes identifying signs of relative displacement or building deformation (e.g., fire seal displacement, seismic gap width changes, pipe/conduit misalignments at penetrations or between adjacent structures, bent or displaced pipe/conduit and supports, doorway misalignments). Critical building geometry locations where the potential for deformation is likely will be monitored for displacement via location-specific techniques.

3.8.4.7.3 BUILDING DEFORMATION MONITORING PROGRAM

The Building Deformation Monitoring Program is a plant specific program implemented under the existing Maintenance Rule Structures Monitoring Program. Building

Through-thickness expansion will be monitored every six months, consistent with the monitoring interval for CCI of Tier 3 locations. This interval is appropriate because ASR is a relatively slow moving process and the concrete at Seabrook Station has been in existence for decades. There is no reason to expect a sudden acceleration of ASR development. Hence, structural implications will not change significantly in a short time period of six months.

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TABLE 3.8-18 ASR EXPANSION LIMITS FOR STRUCTURAL LIMIT STATES

Structural Limit State	ASR Expansion Limit
Shear	Through-thickness: See FP#101020 Section 2.1 (Ref 7) (2) Volumetric: See FP#101050 Appendix B (Ref 8) (3)
Flexure	
Reinforcement Anchorage	
Anchors	See FP#101020 Section 2.1 (Ref 7)
Compression	(1)

- (1) Compressive load from ASR in the direction of reinforcement is combined and evaluated with other applied compressive loads.
- (2) The through-thickness expansion limit for shear, flexure and reinforcement anchorage presented in FP#101020 are different. The most limiting value is applied as the acceptance criterion for through-thickness expansion monitoring among these structural limit states.
- (3) The maximum observed maximum volumetric expansion for shear, flexure and reinforcement anchorage identified in FP#101050, Appendix B, Section 5 are different. The most limiting value is applied as the acceptance criterion for volumetric expansion monitoring among these structural limit states.

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3.8.6 **References**

1. Wilson, E.L., "Structural Analysis of Axisymmetric Solids," AIAAJ. Vol. 3, No. 12 (1965) pp. 163-182.
2. Wilson, E.L., "A Digital Computer Program for the Finite Element Analysis of Axisymmetric Solids with Orthotropic, Nonlinear Material Properties," November 1969.
3. Duchon, N.B., "Analysis of Reinforced Concrete Membrane Subject to Tension and Shear," ACI Journal, September, 1972, pp. 578-583.
4. Wilson, E.L. and Nicholl, R.E., "Application of the Finite Element Method to Heat Conduction Analysis," Journal of Nuclear Engineering and Design, Vol. 4, 1966.
5. Alexandria, S. C., Effects of Irradiation of Concrete, Final Results, Research Reactor Division UKAEA, Harwell, AERE-R-4490, December 1963.
6. Foreign Print 100716, Impact of ASR on Structures.
7. MPR-4288, Revision 0, "Seabrook Station: Impact of Alkali-Silica Reaction on the Structural Design Evaluations," July 2016. FP#101020
8. MPR-4273, Revision 0, "Seabrook Station – Implications of Large-Scale Test Program Results on Reinforced Concrete Affected by Alkali-Silica Reaction." FP#101050

Enclosure 3 to SBK-L-17156

NextEra Energy Seabrook, Application for Withholding Proprietary Information from
Public Disclosure and Affidavit



NextEra Energy Seabrook, LLC

**AFFIDAVIT IN SUPPORT OF APPLICATION FOR WITHHOLDING
PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE**

County of Rockingham)
)
State of New Hampshire)

I, Eric McCartney, being duly sworn according to law, depose and state the following:

- (1) I am the Regional Vice President - Northern Region of NextEra Energy Seabrook, LLC (NextEra Energy Seabrook), and have been delegated the function of reviewing the information described in paragraph (3) which is sought to be withheld, and have been authorized to apply for its withholding.

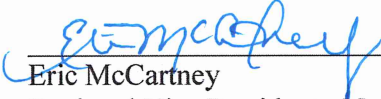
- (2) I am making this Affidavit in conjunction with NextEra Energy Seabrook’s “Application for Withholding Proprietary Information from Public Disclosure” accompanying this Affidavit and in conformance with the provisions of 10 CFR Section 2.390.

- (3) The information sought to be withheld is contained in Enclosure 1 of NextEra Energy Seabrook’s letter SBK-L-17156, Eric McCartney (NextEra Energy Seabrook) to U.S. Nuclear Regulatory Commission, entitled “Response to Request for Additional Information Regarding License Amendment Request 16-03 Related to Alkali-Silica Reaction (CAC No. MF8260).”

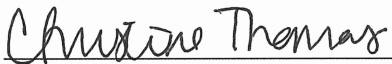
- (4) The information sought to be withheld is considered to be proprietary and confidential commercial information because alkali-silica reaction (ASR) is a newly-identified phenomenon at domestic nuclear plants. The information requested to be withheld is the result of several years of intensive NextEra Energy Seabrook effort and the expenditure of a considerable sum of money. This information may be marketable in the event nuclear facilities or other regulated facilities identify the presence of ASR. In order for potential customers to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended. The extent to which this information is available to potential customers diminishes NextEra Energy Seabrook’s ability to sell products and services involving the use of the information. Thus, public disclosure of the information sought to be withheld is likely to cause substantial harm to NextEra Energy Seabrook's competitive position and NextEra Energy Seabrook has a rational basis for considering this information to be confidential commercial information.

- (5) The information sought to be withheld is being submitted to the NRC in confidence.
- (6) The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by NextEra Energy Seabrook, has not been disclosed publicly, and not been made available in public sources.
- (7) The information is of a sort customarily held in confidence by NextEra Energy Seabrook, and is in fact so held.
- (8) All disclosures to third parties, including any required transmittals to the NRC, have been or will be pursuant to regulatory provisions and/or confidentiality agreements that provide for maintaining the information in confidence.

I declare that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief. Further, the affiant sayeth not.


Eric McCartney
Regional Vice President - Northern Region
NextEra Energy Seabrook, LLC
626 Lafayette Road
Seabrook, New Hampshire 03874

Subscribed and sworn to before me
this 3rd day of October, 2017.


Notary Public
My commission expires 3/8/22

