~~Enclosure 2 to this Letter Contains Proprietary Information~~
~~Withhold Enclosure 2 from Public Disclosure in Accordance with 10 CFR 2.390~~

NEXTera® ENERGY
SEABROOK

August 9, 2016
10 CFR 54

SBK-L-16013
Docket No. 50-443

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

Seabrook Station

Seabrook Station, License Renewal Application Relating to the Alkali-Silica Reaction (ASR) Monitoring Program

References:

1. NextEra Energy Seabrook, LLC letter SBK-L-10077, "Seabrook Station Application for Renewed Operating License," May 25, 2010. (Accession Number ML101590099)
2. NextEra Energy Seabrook, LLC letter SBK-L-15202, "Response to Requests for Additional Information for the Review of the Seabrook Station, License Renewal Application- SET 25 (TAC NO. ME4028) Relating to the Alkali-Silica Reaction (ASR) Monitoring Program," December 3, 2015. (Accession Number ML15343A470)
3. U.S. Nuclear Regulatory Commission Public Meeting Summary, Public Meeting with NextEra Energy Seabrook, LLC Regarding Aging Management of Alkali-Silica Reaction Pertaining to the License Renewal of Seabrook Station, Unit 1.;April 28, 2016 . (Accession Number ML16146A176)

In Reference 1, NextEra Energy Seabrook, LLC (NextEra Energy Seabrook) submitted an application for a renewed facility operating license for Seabrook Station Unit 1 in accordance with the Code of Federal Regulations, Title 10, Parts 50, 51, and 54.

In Reference 2, NextEra Energy Seabrook responded to the staff Request for Additional Information related to Alkali Silica Reaction. As documented in Reference 3 a meeting for NextEra Energy Seabrook, LLC (NextEra) to discuss their plan to address the U.S. Nuclear Regulatory Commission (NRC) staff's concerns related to the aging management of alkali-silica reaction (ASR) for Seabrook was conducted.

The enclosures provide additional clarifying information as discussed with the staff. Enclosure 1 provides a general description of the Containment and Containment Enclosure Building and discussion of clarifying changes to proposed commitments.

A053
A144
NRR

Enclosure 3 provides a revised LRA Appendix A - Updated Final Safety Analysis Report Section A.2.1.31A for Alkali-Silica Reaction and A.2.1.31B for Building Deformation. Enclosure 4 provides a revised LRA Appendix B Section B.2.1.31A for Alkali-Silica Reaction (ASR) and B.2.1.31B for Building Deformation Aging Management Programs. These two revisions supersede the respective previously submitted sections to the LRA. The enclosed ASR and Building Deformation aging management programs are intended to assure that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. NextEra recently requested an amendment of the Seabrook operating license (LAR) to modify its CLB to include methodologies to evaluate concrete affected by ASR in letter SBK-L-16071. The enclosed AMPs are consistent with the methodologies presented in the LAR. Any changes to those methodologies resulting from the NRC's review of the LAR will be reflected in the AMPs through updating the CLB or as operating experience, as appropriate.

Enclosure 5 provides the revised LRA Appendix A - Updated Final Safety Analysis Report Supplement Table A.3, License Renewal Commitment List. This letter contains three revised Commitments 71, 83 and 91.

This letter is supported by an affidavit signed by NextEra Energy Seabrook (Enclosure 6), setting forth the basis on which the information in Enclosure 2 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 10 CFR 2.390. The information provided in Enclosure 2 does not affect the non-proprietary version of information previously submitted in Reference 2.

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. Ken Browne Licensing Manager, at (603) 773-7932.

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

Executed on August 9th, 2016

Sincerely,

Eric McCartney
Site Vice President
NextEra Energy Seabrook, LLC

Enclosures:

Enclosure 1 - Seabrook Station License Renewal Application Relating to the Alkali-Silica Reaction (ASR) Monitoring Program for the Seabrook Station License Renewal Application Clarifying Information

Enclosure 2 - Seabrook Station License Renewal Application Seabrook Station License Renewal Application Resubmittal of SBK-L-15202 Enclosure 1 -Figures 17-19 (Proprietary)

Enclosure 3 - Seabrook Station Updated Final Safety Analysis Report Section A.2.1.31A for Alkali-Silica Reaction and Section A.2.1.31B for Building Deformation

Enclosure 4 - Seabrook Station License Renewal Application Section B.2.1.31A for Alkali-Silica Reaction and Section B.2.1.31B for Building Deformation Aging Monitoring Programs

Enclosure 5 - LRA Appendix A - Final Safety Report Supplement Table A.3, License Renewal Commitment List Updated to Reflect Changes to Date.

Enclosure 6 - NextEra Seabrook, Application for Withholding Proprietary Information from Public Disclosure and Affidavit

cc:		
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Enclosure 1 to SBK-L- 16013

Seabrook Station License Renewal Application Relating to the Alkali-Silica Reaction (ASR) Monitoring Program for the Seabrook Station License Renewal Application Clarifying Information

Containment Structures

During discussions with the staff it was noted that some external stakeholders are not familiar with the unique design of Seabrook Containment Structures, particularly the relationship of the Containment Enclosure Building (CEB) and Containment. To assist the staff in addressing this topic, the following general description is provided. Additional information related to the CEB and Containment can be found in the License Renewal Application (Reference 1) Section 2.4.2 and Seabrook Station Updated Final Safety Analysis Report Sections 1.2.2, 3.8 and 6.5.3.

Containment

The containment building is a reinforced concrete structure that is designed in accordance with the requirements of Section III of the American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code (1975 Edition). The containment structure completely encloses a Reactor Coolant System and is a seismic Category I reinforced concrete structure in the form of a right vertical cylinder with a hemispherical dome and flat foundation mat founded on bedrock. The inside face is lined with a welded carbon steel plate, providing a high degree of leak tightness. A protective 4-ft thick concrete mat that forms the floor of the Containment protects the liner over the foundation mat. The containment structure provides biological shielding for normal and accident conditions.

Containment penetrations are provided in the lower portion of the structure, and consist of a personnel lock and an equipment hatch/personnel lock, a fuel transfer tube, and piping, electrical, instrumentation, and ventilation penetrations. All penetrations are anchored to sleeves (or to barrels) which are embedded in the concrete containment wall. This embedment is accomplished by means of an engineered anchorage system that is welded to the sleeve (or barrel) which is, in turn, welded to the locally thickened liner. The Containment is heavily reinforced with tri-axial reinforcement.

The containment structure provides the primary containment.

Containment Enclosure Building

The Containment Enclosure Building_was designed and constructed to comply with the 1971 edition of ACI 318, *Building Code Requirements for Reinforced Concrete* (Reference Seabrook Station UFSAR Section 3.8.4.) The containment enclosure surrounds the containment structure and is designed in a similar configuration as a vertical right cylindrical seismic Category I, reinforced concrete structure with dome and ring base.

The containment enclosure is designed to entrap, filter and then discharge any leakage from the containment structure. To accomplish this, the space between the containment enclosure and the containment structure, as well as the penetration and safety-related pump areas, are maintained at a negative pressure following a loss-of-coolant accident, by fans which take suction from the containment enclosure and exhaust to atmosphere through charcoal filters. To ensure air tightness for the negative pressure, leakage through all joints and penetrations has been minimized.

The containment enclosure provides the secondary containment.

Commitment 71

Commitment 71 was originally submitted when testing at the University of Texas Ferguson Structural Engineering Laboratory was still in progress. As structural testing has been completed the commitment has been updated to confirm the results from testing will be applied to the ASR Monitoring Program described in B.2.1.31A of the License Renewal Application.

Commitment 71 has been updated to reflect the addition of a new plant specific aging management program and ongoing actions based on the completed testing.

71	Alkali-Silica Reaction (ASR) Monitoring Program / ***Building Deformation Monitoring Program***	***NextEra has completed testing at the University of Texas Ferguson Structural Engineering Laboratory which demonstrates the parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR.*** *NextEra* ~~will I~~implement the Alkali-Silica Reaction (ASR) Monitoring Program and ***Building Deformation Monitoring Program described in B.2.1.31A and B.2.1.31B of the License Renewal Application.*** ~~Testing will be performed to confirm that parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR~~	A.2.1.31A ***A.2.1.31B***	Prior to entering the period of extended operation.

Commitment 83

Commitment #83 was restructured to ensure a more precise description that extensometers will be installed in all Tier 3 locations that are subject to possible thru wall expansion due to ASR progression in two dimensional reinforced structures. Monitoring of out-of-plane expansion will commence with the installation of the extensometer and continue on a six month basis.

83.	Alkali-Silica Reaction Monitoring	Enhance the ASR AMP to install extensometers in ***all*** Tier 3 areas ***of two dimensional reinforced*** structures to monitor expansion due to alkali-silica reaction in the out-of-plane direction. Monitoring expansion in the out-of-plane direction will commence upon installation of the extensometers ~~in 2016~~ and ***continue on a six month frequency*** through the period of extended operation.	A.2.1.31A	December 31,2016.

Commitment 91

Commitment 91 has revised to reflect a new plant specific Aging Management Program for Building Deformation.

91	~~Alkali Silica Reaction~~ ***Building Deformation*** Monitoring	***Implement the Building Deformation Monitoring Program*** Enhance the ~~ASR Aging Management~~ ***Structures Monitoring*** Program to require structural evaluations be performed on buildings and components affected by deformation as necessary to ensure that the structural function is maintained. Evaluations of structures will validate structural performance against the design basis, and may use results from the large-scale test programs, as appropriate. Evaluations for structural deformation will also consider the impact to functionality of affected systems and components (e.g., conduit expansion joints). NextEra will evaluate the specific circumstances against the design basis of the affected system or component. Enhance the ~~ASR~~ ***Building Deformation*** AMP to include additional parameters to be monitored based on the results of the CEB Root Cause, Structural Evaluation and walk downs. Additional parameters monitored will include: alignment of ducting, conduit, and piping; seal integrity; laser target measurements; key seismic gap measurements; and additional instrumentation.	~~A.2.1.31A~~ ***A.2.1.31B***	March 15, 2020

Enclosure 3 to SBK-L- 16013

Seabrook Station Updated Final Safety Analysis Report
Section A.2.1.31A for Alkali-Silica Reaction and
Section A.2.1.31B for Building Deformation

A.2.1.31A ALKALI-SILICA REACTION (ASR) MONITORING

The plant specific ASR Monitoring Program manages cracking due to expansion and reaction with aggregates of concrete structures within the scope of License Renewal. 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 Structural 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 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.

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.

Monitoring of crack growth is used to assess the in-plane expansion associated with ASR and to specify monitoring intervals. 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. In the event ASR monitoring results indicate a need to amend either the monitoring program acceptance criteria or the frequency of monitoring, NextEra will take such action under the Operating Experience element of the Alkali-Silica Reaction Monitoring Program.

Tier	**Structural Monitoring Program Category**	**Recommendation for Individual Concrete Components**	**Criteria**
3	Unacceptable (requires further evaluation)	▪ Structural Evaluation ▪ Implement enhanced ASR monitoring, such as through-wall expansion monitoring using Extensometers.	1.0 mm/m or greater Combined Cracking Index (CCI)
2	Acceptable with Deficiencies	Quantitative Monitoring and Trending	▪ 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 an acceptance criterion of 1 mm/m provides sufficient margin.

For heavily reinforced structures, CCI is limited in 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. In the 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 so the limits specified below are maintained.

Structural Design Issue	Criteria[1]
Flexure & reinforcement anchorage	See FP#101020 - Section 2.1
Shear	See FP#101020 - Section 2.1
Anchor bolts and structural attachments	See FP#101020 - Section 2.1

A.2.1.31B BUILDING DEFORMATION MONITORING

The Building Deformation Monitoring Program is a plant specific program implemented under the existing Maintenance Rule Structures Monitoring Program. Building Deformation is an aging mechanism that may occur as a result of other aging effects of concrete. Building Deformation at Seabrook is primarily a result of the alkali silica reaction (ASR) but can also result from swelling, creep, and shrinkage. Building deformation can cause components within the structures to move such that their intended functions may be impacted.

The Building Deformation Monitoring Program uses visual inspections associated with the Structures Monitoring Program and cracking measurements associated with the Alkali-Silica Reaction program to identify buildings that are experiencing deformation. The first inspection is a baseline to identify areas that are exhibiting surface cracking. The surface cracking will be characterized and analytically documented. This inspection will also identify any local areas that are exhibiting deformation. The extent of surface cracking will be input into an analytical model. This model will determine the extent of building deformation and the frequency of required visual inspections.

For building deformation, location-specific measurements (e.g. via laser target and gap measurements) will be compared against location-specific criteria to evaluate acceptability of the condition.

Structural evaluations will be performed on buildings and components affected by deformation as necessary to ensure that the structural function is maintained. Evaluations of structures will validate structural performance against the design basis, and may use results from the large-scale test programs, as appropriate.

Evaluations for structural deformation will also consider the impact to functionality of affected systems and components (e.g. conduit expansion joints). NextEra will evaluate the specific circumstances against the design basis of the affected system or component. Structural evaluations will be used to determine whether additional corrective actions (e.g., repairs, additional inspections and/or analysis) to the concrete or components are required. Specific criteria for selecting effective corrective actions will be evaluated on a location-specific basis.

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[1] Expansion Limit Criteria is considered proprietary to NextEra Seabrook. FP #101020 MPR-4288, Revision 0, "Seabrook Station: Impact of Alkali-Silica Reaction on the Structural Design Evaluations," July 2016, was previously submitted to the NRC in SBL-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; Dated August 1, 2016

Enclosure 4 to SBK-L- 16013

Seabrook Station License Renewal Application

Section B.2.1.31A for Alkali-Silica Reaction (ASR) and

Section B.2.1.31B for Building Deformation

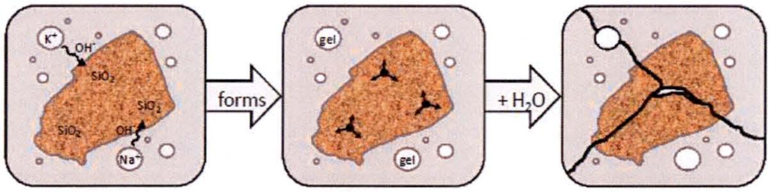
B.2.1.31A ALKALI-SILICA REACTION

PROGRAM DESCRIPTION

The Alkali-Silica Reaction Aging Management Program is a new plant specific program being implemented under the existing Maintenance Rule Structures Monitoring Program that will manage the aging effects related to Alkali-Silica Reaction of each structure and component subject to an Aging Management Review, so that the intended function(s) will be maintained consistent with the current licensing basis for the period of extended operation.

Alkali-Silica Reaction

Alkali-Silica Reaction (ASR) is an aging mechanism that may occur in concrete under certain circumstances. It is a reaction between the alkaline cement and reactive forms of silicate material (if present) in the aggregate. The reaction, which requires moisture to proceed, produces an expansive gel material. This expansion results in strains in the material that can produce micro-cracking in the aggregate and in the cement paste. The potential impact of ASR on the structural strength and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. These strains produce the associated cracking. Because the ASR mechanism requires the presence of moisture in the concrete, ASR has been predominantly detected in groundwater impacted portions of below grade structures, with limited impact to exterior surfaces of above grade structures.



alkali cement + reactive aggregate

expansive gel

cracking of the aggregate and paste

ASR Expansion Mechanism

Impact of Confinement

Reinforcing steel, loads on the concrete structure (i.e., deadweight of the structure itself), and the configuration of the structure provide confinement that restrains in-situ expansion of the gel and limits the resulting cracking in concrete.

Since the impact of ASR on mechanical properties relates to the extent of cracking, restraint of the expansion limits the reduction of in-situ mechanical properties and overall degradation of structural performance. There is a prestressing effect that occurs when reinforcement restrains the expansion caused by ASR. This effect is similar to concrete prestressing or analogous to pre-loading a bolted joint.

The concrete prestressing effect is only present when the concrete is confined. If the concrete is removed from the stress field, the concrete prestressing effect is lost. For example, a core taken from a reinforced concrete structure that has been affected by ASR will lose the confinement provided by the reinforcement and concrete surrounding the sample, and therefore is no longer representative of the concrete within its structural context.

Seabrook Station Concrete

The concrete mix designs used in original construction at Seabrook utilized an aggregate that was susceptible to ASR, which was not known at the time. Although the testing was conducted in accordance with the ASTM C289 standards, the standard was subsequently identified as limited in its ability to predict long term ASR for moderate to low reactive aggregates. ASTM C289 has since been withdrawn.

In 2009, Seabrook tested seasonal groundwater samples to support the development of a License Renewal Application. The results showed that the groundwater had become aggressive and Seabrook initiated a comprehensive review of possible effects to in-scope structures.

A qualitative walkdown of plant structures was performed and the "B" Electrical Tunnel was identified as showing the most severe indications of groundwater infiltration. Concrete core samples from this area were removed, tested for compressive strength and modulus of elasticity, and subjected to petrographic examinations. While the results showed that both compressive strength and modulus of elasticity had declined, the structures were determined to be within design basis and remain operable. The results of the petrographic examinations also showed that the samples had experienced Alkali-Silica Reaction (ASR). This discovery initiated an Extent of Condition evaluation. Because the ASR mechanism requires the presence of moisture or very high humidity in the concrete, ASR has been predominantly detected in portions of below-grade structures, with limited impact to exterior surfaces of above grade structures.

Large-Scale Testing Program

The structural assessment of ASR-affected structures at Seabrook Station considered the various limit states for reinforced concrete and applied available literature data to evaluate structural capacity. This evaluation identified gaps in the publicly available test data and the applicability to the reinforcement concrete at Seabrook. The limited available data for shear capacity and reinforcement anchorage for ASR-affected reinforced concrete with two-dimensional reinforcement mats were not representative of Seabrook Station. This conclusion was driven largely by the facts that the literature data for reinforcement anchorage were from a test method that ACI indicates is unrealistic and the literature data for shear capacity were from test specimens only inches in size. Additionally, no data were available on anchor bolt capacity on reinforced concrete with two dimensional reinforcement mats like Seabrook Station.

The need for Seabrook-specific testing was driven by limitations in the publicly available test data related to ASR effects on structures. Most research on ASR has focused on the science and kinetics of ASR, rather than engineering research on structural implications. Although structural testing of ASR-affected test specimens has been performed, the application of the conclusions to a specific structure can be challenged by lack of representativeness in the data (e.g., small-scale specimens; poor test methods; different reinforcement configuration). The large-scale test programs undertaken by NextEra provided data on the limit states that were essential for evaluating seismic Category I structures at Seabrook Station. The data produced from these programs were a significant improvement from the data in published literature sources, because test data across the range of ASR levels were obtained using a common methodology and identical test specimens. The results were used to assess the structural limit states and to inform the assessment of design considerations.

The large-scale test programs 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 extent of ASR cracking in the test specimens was quantified by measuring the expansion in the in-plane and through-thickness specimen dimensions. The in-plane dimension refers to measurements taken in a plane parallel to the underlying reinforcement bars. There was no reinforcement in the test specimen through-thickness direction (perpendicular to the in-plane direction). ASR expansion measurements were monitored throughout testing. The test programs assessed all relevant limit states except compression (i.e., flexure and reinforcement anchorage, shear, and anchor bolts and structural attachments to concrete). The results of the test program demonstrated that none of the assessed limit states are reduced by ASR when ASR expansion levels in plant structures are below those evaluated in the large-scale test programs.

The effect of ASR on compressive strength was not assessed in the large-scale test program. An evaluation of compression using existing data from published literature sources was performed. The evaluation concluded that ASR expansion in reinforced concrete results in compressive load that should be combined with other loads in design calculations. However, ASR does not reduce the structural capacity of compression elements.

The specimens used in the large-scale test programs experienced levels of ASR that bound ASR levels currently found in Seabrook structures (i.e., are more severe than at Seabrook), but the number of available test specimens and nature of the testing prohibited testing out to ASR levels where there was a clear change in limit state capacity. Because there is not testing data for these more advanced levels of ASR, periodic monitoring of ASR at Seabrook is necessary to ensure that the conclusions of the large-scale test program remain valid – that the level of ASR does not exceed that considered under the test programs.

The overall conclusion from analyses of structural limit states is that limit state capacity is not degraded when small amounts of ASR expansion are present in structures. Presently, the ASR expansion levels in Seabrook structures are below the levels at which limit state capacities are reduced.

One of the objectives of the test program was to identify effective methods for monitoring ASR. The program concluded that monitoring the in-plane and through-thickness expansion is effective for characterizing the significance of ASR in structures. A Combined Cracking Index (CCI) methodology based on crack width summation was shown to be effective for in-plane expansion monitoring. Snap ring borehole extensometers (SRBEs) provided accurate and reliable measurements for monitoring through-thickness expansion.

Results from the large-scale testing program are also used to support evaluations of structures subjected to deformation. These evaluations are discussed in the Building Deformation Monitoring Program in LRA Section B.2.1.31B.

PROGRAM ELEMENTS

The following provides the results of the evaluation of each program element against the 10 elements described in Appendix A of NUREG-1800 Rev. 1, *"Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants"*.

ELEMENT 1 - Scope of Program

The Seabrook Station Alkali-Silica Reaction (ASR) Monitoring Program provides for management of aging effects due to the presence of ASR. Program scope includes concrete structures within the scope of the License Renewal Structures Monitoring Program. License Renewal concrete structures within the scope of this program include:

Category I Structures

- Containment Building (including equipment hatch missile shield)
- Containment Enclosure Building

- Containment Enclosure Ventilation Area
- Service Water Cooling Tower including Switchgear Rooms
- Control Building
- Control Building Make-up Air Intake Structures
- Diesel Generator Building
- Piping (RCA) Tunnels
- Main Steam and Feed Water East and West Pipe Chase
- Waste Processing Building
- Tank Farm
- Condensate Storage Tank Enclosure
- Emergency Feed Water Pump House Building, including Electrical Cable Tunnels and Penetration Areas (Control Building to Containment)
- Fuel Storage Building
- Primary Auxiliary Building including RHR Vaults
- Service Water Pump House
- Service Water Access (Inspection) Vault
- Circulating Water Pump House Building (below elevation 21'-0)
- Safety Related Electrical Manholes and Duct Banks
- Pre-Action Valve Building

Miscellaneous Non-Category I Yard Structures

- SBO Structure – Transformers and Switch Yard foundations
- Non-Safety-Related Electrical Cable Manhole, Duct Bank Yard Structures foundations
- Switchyard and 345 KV Power Transmission foundations

Non-Category I Structures

- Turbine Generator Building
- Fire Pump House
- Aboveground Exterior Tanks 1-FP-TK-35-A, 1-FP-TK-35-B, 1-FP-TK-36-A, 1-FP-TK-36-B and 1-FP-TK-29 foundations
- Fire Pump House Boiler Building
- Non-Essential Switchgear Building
- Steam Generator Blowdown Recovery Building
- Intake & Discharge Transition Structures

ELEMENT 2 - Preventive Actions

There are no preventive actions specified in the Seabrook Station Structures Monitoring Program, which includes implementation of NUREG-1801 XI.S5, XI.S6, and XI.S7. These are monitoring programs only. Similarly, the ASR Monitoring Program does not rely on preventive actions.

ELEMENT 3 - Parameters Monitored/Inspected

The Alkali-Silica Reaction (ASR) Monitoring Program manages the effects of cracking due to expansion and reaction with aggregates. The potential impact of ASR on the structural performance and anchorage capacity of concrete is a consequence of strains resulting from the expansive gel. The strains consequently produce the associated cracking.

The program focuses on identifying evidence of ASR, which could lead to expansion due to the reaction with aggregates. The program reflects published guidance for condition assessment of structures and incorporates practices consistent with those used as part of the large-scale testing programs.

Initial screening of ASR

Walkdowns of the station are performed on a periodic basis (SMP walkdowns, Systems Walkdowns, etc.). Visual symptoms of deterioration are noted and compared to those commonly observed on structures affected by ASR. Common visual symptoms of ASR include, but are not limited to, "map" or "pattern" cracking and surface discoloration of the cement paste surrounding the cracks. The cracking is typically accompanied by the presence of moisture and efflorescence. The lists of symptoms associated with the initial screening of ASR is consistent with many published documents, including but not limited to the Federal Highway Administration (FHWA) document FHWA-HIF-09-004, "Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction (ASR) in Transportation Structures", and the Institution of Structural Engineering document "Structural Effects of Alkali-Silica Reaction: Technical Guidance on the Appraisal of Existing Structures."

Inspection of inaccessible areas of concrete will be performed during opportunistic or focused inspections for buried concrete performed under the Maintenance Rule every 5 years. The concrete materials used to produce the concrete placed in inaccessible areas were the same as the concrete materials used to produce the concrete placed in accessible areas. Thus, the performance and aging of inaccessible concrete would be the same as the performance and aging of accessible concrete.
Since the concrete mix and aggregates used at Seabrook Station is consistent between structures it is assumed unless demonstrated otherwise that ASR can be present. Petrographic examination can be performed on a concrete specimen to aid in confirming the proposed diagnosis arrived upon from visual inspection of the concrete surface. Typical petrographic features of ASR generally consist of the following:

- Micro-cracking in the aggregates and/or cement paste
- Reaction rims around the aggregates.
- Silica gel filling cracks or voids in the sample.
- Loss of cement paste-aggregate bond.

Expansion

For ASR-affected surfaces at Seabrook Station, NextEra will monitor the effects of ASR expansion by obtaining measurements in both the in-plane (X&Y directions) and through-thickness directions (Z-direction). Specifically, Seabrook will be monitoring the Combined Cracking Index (CCI) for in-plane expansion and extensometer measurements for through-thickness expansion. Expansion from ASR results in cracking and a change to the material properties of the concrete, and eventually requires an evaluation to ensure adequate structural performance.

Expansion is a readily quantifiable parameter and an effective method for determining ASR progression. Expansion measurements at Seabrook can be easily obtained in the in-plane directions. The Cracking Index (CI) is a quantitative assessment of cracking present in the cover concrete of affected structures. A CI measurement is taken on accessible surfaces exhibiting the typical ASR symptoms. The CI is the summation of the crack widths on the horizontal or vertical sides of a section of the ASR-affected concrete surface of predefined dimensions. Seabrook uses a grid size of 20 inches by 30 inches. The CI in a given direction is converted and reported in units of mm/m.

The CIs are used to establish the Combined Cracking Index (CCI). The CCI estimates expansion on a concrete surface using measurements of crack widths along a pre-determined length or grid. The CCI is calculated by summing the crack widths crossing all reference grid lines and dividing the result by the sum of all gridline lengths. Criteria used in assessment of expansion is expressed in terms of CCI and based on recommendations provided in MPR-3727, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments" and supported by the test programs. The test programs indicated that direction of expansion is not significantly affected by the reinforcement when expansion is at or below approximately 1 mm/m. Beyond this expansion level, the two-dimensional reinforcement mats provide confinement in the in-plane directions, and through-thickness expansion dominates.

Data analysis from the large-scale test program has been completed and thresholds established based on the test reports. The thresholds are based on the structure as a whole so if localized extensive ASR or macro cracking is experienced in particular areas of the structure, then the entire structure is assumed to be susceptible to similar degradation. The overall methodology for using in-plane and through-thickness expansion values for various aspects of the monitoring program is summarized as follows:

Initial screening for ASR will be performed using CCI only. CCI values exceeding 1 mm/m will trigger additional actions. CCI is a relatively simple, non-destructive method for monitoring cracking that appropriately characterizes expansion until expansion reorients in the direction of least restraint (i.e., the through-thickness direction at Seabrook Station).

Anchor Performance Monitoring Parameter

For anchor performance, the large scale test programs show that ASR does not have an effect until in-plane expansion reaches a sufficiently high level. Therefore, if the CCI exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the anchors.

This approach is based on the fact that anchor performance is sensitive to in-plane expansion, but not through-thickness expansion. In-plane expansion creates micro-cracks parallel to the axis of an anchor, mainly in the concrete cover. These micro-cracks perpendicular to the concrete surface have the potential to provide a preferential failure path within a potential breakout cone, leading to degraded anchor performance.

Through-thickness expansion has the potential to create micro-cracks perpendicular to the axis of an anchor. These potential micro-cracks that open parallel to the concrete surface do not provide a preferential failure path to result in degraded anchor performance. An anchor loaded in tension would compress the through-thickness expansion and close any potential micro-cracks within the area of influence of that anchor. Without a 'short-circuit' of the breakout cone, through-thickness expansion is a non-factor in anchor performance.

Crack Width Summation

Crack width summation is a simple methodology for initial assessment of ASR-affected components and is recommended by publicly available resources.
ASR produces a gel that expands as it absorbs moisture. This expansion exerts a tensile stress on the surrounding concrete which strains the concrete and eventually results in cracking.

The engineering strain in a structural member at the time of crack initiation (ε_{cr}) is equivalent to the tensile strength of the concrete divided by the elastic modulus ($\varepsilon_{cr} = \sigma_t / E$). The Cracking Index quantifies the extent of the surface cracking. The total strain in the concrete can be approximated as the sum of the strain at crack initiation plus the cracking index ($\varepsilon \approx \varepsilon_{cr} + CI$). Figure 1 depicts a concrete specimen with rebar being put in tension resulting in cracking.

Concrete has little strain capacity; therefore, in ASR-affected concrete, the crack widths comprise most of the expansion (ΔL). As a result, the Cracking Index provides a reasonable approximation of the total strain applied to the concrete after crack initiation, because strain in the un-cracked concrete between cracks is minimal.

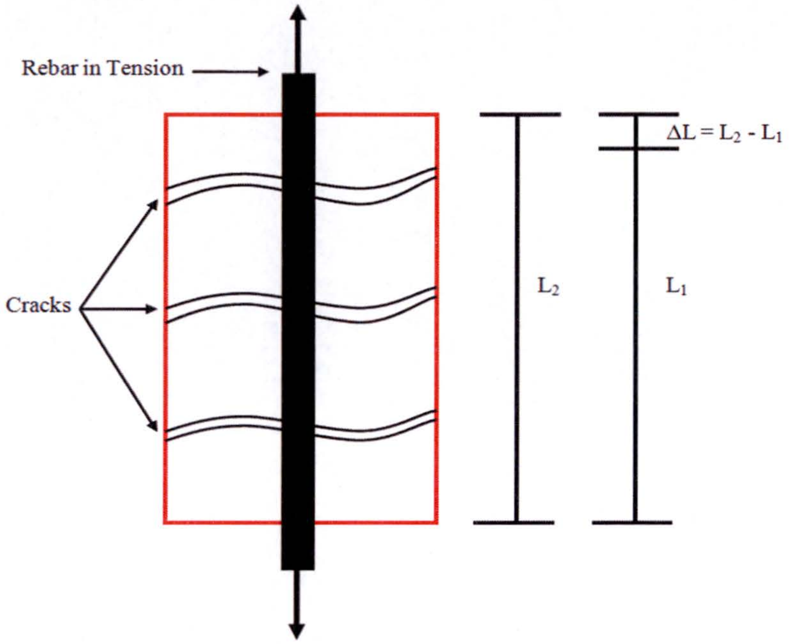


Figure 1 - Concrete Specimen put in Tension

For surfaces where horizontal and vertical cracking indices are similar (e.g., where there is equivalent reinforcement in both directions), a Combined Cracking Index (CCI) that averages the horizontal and vertical Cracking Indices can consolidate the expansion assessment to a single parameter. The CCI is also used to measure the effects of associated rebar strain.

Change in Elastic Modulus and Extensometer Measurements

The large scale test program shows that out-of-plane expansion dominates for structures with two-dimensional reinforcement mats (like seen at Seabrook Station).

Data from the structural testing programs have shown that expansion in the in-plane direction plateaus at low expansion levels, while expansion in the through-thickness direction continues to increase. Seabrook will install the extensometers in Tier 3 and other selected locations to measure expansion in the through-thickness direction. This approach will enable measuring expansion for a given concrete structural member from the time the extensometer is installed and going forward. To calculate the total expansion, Seabrook will determine expansion from original construction until the time the extensometers are installed (pre-instrument + extensometer measurements).

The method to determine the total ASR induced through-thickness expansion at each instrument location at Seabrook is to use a determined pre-instrument expansion based on the reduction in modulus of elasticity.

A correlation relating expansion to reduction in elastic modulus was developed from the large scale testing program data. The correlation relating expansion to reduction in elastic modulus is applicable to reinforced concrete structures at Seabrook. The elastic modulus was chosen because the large scale test program showed it to be the most sensitive and most repeatable material property. The test data used to generate the correlation were obtained from the test specimens that were designed to be as representative as practical of the concrete at Seabrook, including the reinforcement detailing. Additionally, comparison against literature data shows that the correlation follows a trend that is consistent with other published studies.

The extensometer measurements will provide direct measurements of through-thickness expansion going forwards. The measurements are the parameter to be monitored. The elastic modulus will not be monitored going forward; Pre-instrument expansion is calculated initially to establish expansion to date and is not repeated.

Structural Limit States

The applicable design codes provide methodologies to calculate structural capacities for the various limit states and loading conditions applicable to Seabrook Station. Each relevant limit state was evaluated using published literature and the results of the MPR/FSEL large-scale test programs that used specimens designed and fabricated to represent reinforced concrete at Seabrook Station. The following guidance applies for structural evaluations of ASR-affected concrete structures at Seabrook Station:

- Flexure/Reinforcement Anchorage - Based on the MPR/FSEL large-scale test program results, structural evaluations should consider that there has been no adverse impact on flexural capacity and reinforcement anchorage (development length) performance, provided that through-thickness expansion is at or below bounding conditions of the large scale testing and expansion behavior is comparable to the test specimens.

- Shear – Based on the MPR/FSEL large-scale test program results, structural evaluations should consider that there has been no adverse impact on shear capacity, provided that through-thickness expansion is at or below bounding conditions of the large scale testing and expansion behavior is comparable to the test specimens.

- Anchors and Embedments – Based on the MPR/FSEL large-scale test program results, structural evaluations should consider that there is no adverse effect to post-installed or cast in place anchor/embedment capacity, provided that in-plane expansions remain at or below limits established by large scale testing. Through-thickness expansion is not relevant for anchor/embedment capacity.

ELEMENT 4 - Detection of Aging Effects

Monitoring walkdowns are performed on a periodic basis. The Structural Monitoring Program (SMP) walkdowns identify areas that show symptoms of ASR being present. The SMP includes periodic visual inspection of structures and components for the detection of aging effects specific for that structure. The inspections are completed by qualified individuals at a frequency determined by the characteristics of the environment in which the structure is found. A structure found in a harsh environment is defined as one that is in an area that is subject to outside ambient conditions, very high temperature, high moisture or humidity, frequently large cycling of temperatures, frequent exposure to caustic materials, or extremely high radiation levels. For structures in these harsh environments, the inspection is conducted on a five (5) year basis (plus or minus one year due to outage schedule and two inspections within ten years. Structures not located in an area qualifying as a harsh environment are classified as being in a mild environment, and are inspected on a ten (10) year basis (plus or minus one year due to outage schedule and two inspections within twenty years).

In-Plane Expansion

As previously discussed in Element 3, Seabrook uses the CCI methodology to monitor the expansion of ASR affected areas in the in-plane direction. A CCI is established at thresholds at which structural evaluation is necessary. The CCI of less than 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. A CCI of 1.0 mm/m or greater requires structural evaluation (Tier 3). All locations meeting Tier 3 will be monitored via CCI on a ½ year (6-month) inspection frequency. All locations meeting Tier 2 will be monitored on a 2.5 year (30-month) frequency. In the event ASR monitoring results indicate a need to amend either the monitoring program acceptance criteria or the frequency of monitoring, NextEra will take such action under the Operating Experience element of the Alkali-Silica Reaction Monitoring Program.

Seabrook has established reference grids that track the CCI of ASR affected areas. These grids are 20" x 30" and consist of three parallel vertical lines and two parallel horizontal lines. Measurement referenced points (gage points) are installed at the intersections of horizontal and vertical lines of the reference grid to allow for long-term monitoring of potential ongoing expansion. The CI is obtained from measurements of crack widths along a set of lines drawn on the surface of a concrete member. Expansion is documented by measuring the increase in the length of the lines used to determine the CI (distance between gage points). A pocket-size crack comparator card and an optical comparator are used to take the measurements.

The location of the CCI reference grid is established in the area that appears to exhibit the most-severe deterioration due to ASR (accessibility and structure geometry also factor into the decision making progress on where to establish a grid). At Seabrook the axes of the reference grid/grids are parallel and perpendicular to the main reinforcement of the associated reinforced concrete member.

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. CCI's limitation for heavily reinforced structures is that in-plane expansion (and therefore CCI) has been observed to plateau at a relatively low level of accumulated strain in test specimens from the large scale testing program. No structural impacts from ASR have been seen at these plateau levels in the large scale testing program. 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. The difference between the in-plane expansion and the through-thickness expansion is due to the reinforcement detailing and the resulting difference in confinement between the in-plane and through-thickness direction. Through thickness expansion is less confined due to the fact that there is no reinforcement in that direction, therefore, expansion occurs preferentially in the through-thickness direction. Similarly, for unreinforced concrete backfill, expansion occurs in all directions.

Out-of- Plane Expansion

The need for out-of-plane expansion monitoring is triggered by a CCI exceeding 1 mm/m. The expansions of the test specimens fabricated and tested at Ferguson Structural Engineering Laboratory (FSEL), at The University of Texas at Austin, were significantly more pronounced in the through-thickness direction (i.e. perpendicular to the reinforcement mats) than the in-plane directions (i.e. on the faces of the specimens parallel to the reinforcement mats).

Elastic Modulus

To determine expansion to date at a location selected for instrument installation, Seabrook will be removing concrete cores at the location in which the instruments will be installed and testing them for compressive strength and elastic modulus. Using the methodology from MPR-4153, the elastic modulus values will be used to determine pre-instrument expansion in the through-thickness direction.

Concrete cores will be removed from all Tier 3 locations for material property testing. Cores removed for property testing will have the approximate dimensions of 4" diameter × 8" length and will be tested in accordance with ASTM C39 for Compressive Strength and C469 for Elastic Modulus. The cores will be taken perpendicular to the reinforcement mat.

A visual examination of the cores will confirm there is no mid-plane crack or edge-effect cracking.

Snap-Ring Borehole Extensometer

Seabrook will install Snap-Ring Borehole Extensometers (SRBEs) at the station to monitor through-thickness expansion. The Large Scale Testing Program evaluated performance of the SRBEs, along with two other instrument types, in a test specimen representative of the concrete at Seabrook Station over a one-year period. The SRBE provided accurate measurements of through-thickness expansion throughout the test program and did not exhibit any problems related to reliability. The test program involved cycles of extended exposure to high temperature and humidity, which bounds the conditions expected at Seabrook Station.

The SRBE consists of a graphite rod that is held in place by an anchor placed in the borehole. Measurements are performed by using a depth micrometer to measure the distance from a reference anchor at the surface of the concrete to the end of the graphite rod. The SRBE design contains no electronics and does not require calibration. Therefore, failure of the SRBE is unlikely. In the event that an SRBE did fail (e.g., an anchor broke loose), Seabrook could install another SRBE nearby to the failed location and continue expansion monitoring. This will not result in significant loss of data.

A SRBE will be installed in a core bore at each Tier 3 location. The elastic modulus will only be determined at the time of core removal to determine pre-instrument expansion to date. Additionally, mid-plane or edge-effect cracking will be visually observed at the time of core removal.

ELEMENT 5 - Monitoring and Trending

The progression of ASR degradation of the concrete is an important consideration for assessing the long term implications of ASR and specifying monitoring intervals. The most reliable means for establishing the progression of ASR degradation is to monitor expansion of the *in situ* concrete. Results of walkdowns are initially reviewed by a licensed Professional Engineer (PE) or qualified person to determine whether the symptoms shown have potential to be ASR and if CCI measurements are needed.

In-Plane and Out-of-Plane Expansion

For anchor capacity, shear capacity, and reinforcement anchorage, use in-plane expansion (CCI) and out-of-plane expansion (modulus + SRBE measurements) to compare with the test results from the Large Scale Testing program.

ASR is a slow progressing phenomenon. Seabrook will consider the rate at which a location is approaching the CCI and expansion limits and take appropriate action to ensure continued structural adequacy.

ELEMENT 6 - Acceptance Criteria

Identification of the typical symptoms indicative of ASR generates the need to initially start monitoring the area using CCI. For the structures subject to ASR monitoring, rebar strain as a result of ASR induced stresses and ASR induced stresses in combination with design bases loads will be verified to be within code allowable limits.

In-Plane

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 1 structures do not display signs of ASR and are monitored consistent with the Structures Monitoring Program. In the event ASR monitoring results indicate a need to amend either the monitoring program acceptance criteria or the frequency of monitoring, NextEra will take such action under the Operating Experience element of the Alkali-Silica Reaction Monitoring Program.

Tier	**Structural Monitoring Program Category**	**Recommendation for Individual Concrete Components**	**Criteria**
3	Unacceptable (requires further evaluation)	▪ Structural Evaluation ▪ Implement enhanced ASR monitoring, such as through-wall expansion monitoring using Extensometers.	1.0 mm/m or greater Combined Cracking Index (CCI)
2	Acceptable with Deficiencies	Quantitative Monitoring and Trending	▪ 0.5 mm/m or greater CCI ▪ CI of greater less 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.

Criterion of 1mm/m distinguishes between Tier 2 and Tier 3 locations in relation to CCI. The large scale test program shows agreement between embedded pins and CCI, therefore ensuring CCI is acceptable. A structural evaluation is needed when the CCI reaches what is classified as Tier 3 (CCI > 1 mm/m).

Out-of-Plane

In areas in which the CCI is classified as Tier 3 the expansion due to ASR will be monitored in the through-thickness direction as well. Specific acceptance criteria have been established by the large scale test program test reports, and are summarized in the Table below. Maintaining these limits is assured by periodically measuring through-thickness expansion in areas affected by ASR.

Effect of ASR on Structural Limit States

Structural Design Issue	**Criteria**[2]
Flexure & reinforcement anchorage	See FP#101020 - Section 2.1
Shear	See FP#101020 - Section 2.1
Anchor bolts and structural attachments	See FP#101020 - Section 2.1

ELEMENT 7 - Corrective Actions

Evaluations will be performed under the Seabrook Corrective Action Program (CAP) and an appropriate analysis will be performed to evaluate against the design basis of that structure. The NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 7 Corrective Actions.

ELEMENT 8 - Confirmation Process

The FPL/NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 8 Confirmation Process.

ELEMENT 9 - Administrative Controls

The FPL/NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 9 Administrative Controls.

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[2] Expansion Limit Criteria is considered proprietary to NextEra Seabrook. FP #101020 MPR-4288, Revision 0, "Seabrook Station: Impact of Alkali-Silica Reaction on the Structural Design Evaluations," July 2016, was previously submitted to the NRC in SBL-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; Dated August 1, 2016

ELEMENT 10 - Operating Experience

The primary source of OE, both industry and plant specific, was the Seabrook Station Corrective Action Program documentation. The Seabrook Station Corrective Action Program is used to document review of relevant external OE including INPO documents, NRC communications and Westinghouse documents, and plant specific OE including corrective actions, maintenance work, orders generated in response to a structure, system or component deficiencies, system and program health reports, self-assessment reports and NRC and INPO inspection reports.

Newly Identified Operating Experience (OE)

Seabrook will update the Aging Management Program for any new plant-specific or industry OE. This includes ongoing industry studies performed both nationally and internationally. Research data taken from these studies will be used to enhance the ASR program, if applicable. In addition NextEra Seabrook has submitted a License Amendment Request to the Commission in accordance with 10CFR50.90 to incorporate a revised methodology related to ASR material properties and building deformation analysis for review and approval. NextEra will incorporate changes related to this LAR submittal as necessary to maintain alignment of the aging management program to the current license basis.

Groundwater Operating Experience

Historically, NextEra Energy Seabrook has experienced groundwater infiltration through cracks, capillaries, pore spaces, seismic isolation joints, and construction joints in the below grade walls of concrete structures. Some of these areas have shown signs of leaching, cracking, and efflorescence on the concrete due to the infiltration. During the early 1990's an evaluation was conducted to assess the effect of the groundwater infiltration on the serviceability of the concrete walls. That evaluation concluded that there would be no deleterious effect, based on the design and placement of the concrete and on the non-aggressive nature of the groundwater.

In 2009, NextEra tested seasonal groundwater samples to support the development of a License Renewal Application. The results showed some of the groundwater to be aggressive. Ground water testing performed in November 2008 and September 2009 found pH values between 6.01 and 7.51, chloride values between 19 ppm and 3900 ppm, and sulfate values between 10 ppm and 100 ppm. Aggressive chemical attack becomes a concern when environmental conditions exceed threshold values (Chlorides > 500 ppm, Sulfates >1500 ppm, or pH < 5.5). Based on determination of aggressive ground water and observed efflorescence on the concrete surface, NextEra initiated a comprehensive review of possible effects to concrete of in-scope structures.

ASR Identification OE

In 2009, NextEra performed a qualitative walkdown of plant structures and the "B" Electrical Tunnel was identified as showing the most severe indications of groundwater infiltration. Concrete core samples from this area were removed, tested for compressive strength and modulus of elasticity, and subjected to petrographic examinations. The results showed that both compressive strength and modulus of elasticity were less than the expected values, which is symptomatic of ASR. The results of the petrographic examinations also showed that the samples had experienced Alkali-Silica Reaction (ASR).

NextEra initiated an extent of condition evaluation and concrete core samples were taken from five additional areas of the plant that showed characteristics with the greatest similarity to the "B" Electrical Tunnel. Additional concrete core samples were also taken from an expanded area around the original concrete core samples in the "B" Electrical Tunnel.

Tests on these core samples confirmed that the original "B" Electrical Tunnel core samples show the most significant ASR. For the five additional areas under investigation, final results of compressive strength and modulus testing indicate that the compressive strength in all areas is greater than the strength required by the design of the structures. Modulus of elasticity was in the range of the expected value except for the Diesel Generator, Containment Enclosure Buildings, Emergency Feedwater Pumphouse, and the Equipment Vaults, which were less than the expected value in localized areas.

Evaluation of the affected structures concluded that they are fully capable of performing their safety function but margin had been reduced. Material property results from cores removed from a reinforced concrete structure do not properly represent the actual structural performance because the structural context is lost. However, the areas are potentially subject to further degradation of material properties due to the effects of ASR.

EXCEPTIONS TO NUREG-1800

None

ENHANCEMENTS

- Implement the Alkali-Silica Reaction (ASR) Monitoring
- Revise the Seabrook Structural Monitoring Procedure EDS 36180 to include Alkali-silica reaction description, aging effects, inspection criteria, acceptance criteria.
- Revise the Seabrook ASME Section XI, Subsection IWL Program ES1807.031 to include Alkali-silica reaction aging effects.

CONCLUSION

To manage the aging effects of cracking due to expansion and reaction with aggregates in concrete structures, the existing Structures Monitoring Program, B.2.1.31, and ASME Section XI, Subsection IWL Program, B.2.1.28 have been augmented by this plant specific Alkali-Silica Reaction (ASR) Monitoring Program, B.2.1.31A.

Routine inspections are performed by the Structures Monitoring and the ASME Section XI, Subsection IWL Program. Areas that have no visual presence of ASR are considered "acceptable" (Tier 1). An area with a Combined Cracking Index (CCI) of less than 1.0 mm/m is deemed "acceptable with deficiencies" (Tier 2). An area with a CCI of 1.0 mm/m or greater is deemed "unacceptable" and requires further evaluation (Tier 3). In addition, an area that meets Tier 3 requirements will be monitored for through-thickness expansion in addition to CCI.

Evaluations will be performed under the Seabrook Corrective Action Program (CAP) and an appropriate analysis will be performed to evaluate against the design basis of that structure.

The Seabrook Station ASR Monitoring Program provides reasonable assurance that the effects of aging of in-scope concrete structures due to the presence of Alkali-Silica reaction will be managed to ensure the structures continue to perform their intended function consistent with the current licensing basis for the period of extended operation.

B.2.1.31B BUILDING DEFORMATION

PROGRAM DESCRIPTION

The Building Deformation Monitoring Program is a new plant specific program being implemented under the existing Maintenance Rule Structures Monitoring Program. Building Deformation is an aging mechanism that may occur as a result of other aging effects of concrete. Building Deformation at Seabrook is primarily a result of the alkali silica reaction (ASR) described in LRA section B.2.1.31A but can also result from swelling, creep, and shrinkage. Building deformation can cause components within the structures to move such that their intended functions may be impacted.

The Building Deformation Monitoring Program uses visual inspections associated with the Structures Monitoring Program and cracking measurements associated with the Alkali-Silica Reaction program to identify buildings that are experiencing deformation. The first inspection is a baseline to identify areas that are exhibiting surface cracking. The surface cracking will be characterized and analytically documented. This inspection will also identify any local areas that are exhibiting deformation. The extent of surface cracking will be input into an analytical model. This model will determine the extent of building deformation and the frequency of required visual inspections.

For building deformation, location-specific measurements (e.g. via laser target and gap measurements) will be compared against location-specific criteria to evaluate acceptability of the condition.

Structural evaluations will be performed on buildings and components affected by deformation as necessary to ensure that the structural function is maintained. Evaluations of structures will validate structural performance against the design basis, and may use results from the large-scale test programs, as appropriate.

Evaluations for structural deformation will also consider the impact to functionality of affected systems and components (e.g., conduit expansion joints). NextEra will evaluate the specific circumstances against the design basis of the affected system or component. Structural evaluations will be used to determine whether additional corrective actions (e.g., repairs) to the concrete or components are required. Specific criteria for selecting effective corrective actions will be evaluated on a location-specific basis.

PROGRAM ELEMENTS

The following provides the results of the evaluation of each program element against the 10 elements described in Appendix A of NUREG-1800 Rev. 1, *"Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants"*.

ELEMENT 1 - Scope of Program

The Seabrook Building Deformation Monitoring Program provides for management of the effect of building deformation on Seismic Category 1 structures and associated components within the scope of license renewal. Program scope includes components within the scope of license renewal contained in concrete structures within the scope of the Structures Monitoring Program. Concrete structures within the scope of this program include:

- Containment Building (including equipment hatch missile shield)
- Containment Enclosure Building
- Containment Enclosure Ventilation Area
- Service Water Cooling Tower including Switchgear Rooms
- Control Building
- Control Building Make-up Air Intake Structures
- Diesel Generator Building
- Piping (RCA) Tunnels
- Main Steam and Feed Water East and West Pipe Chase
- Waste Processing Building
- Tank Farm
- Condensate Storage Tank Enclosure
- Emergency Feed Water Pump House Building, including Electrical Cable Tunnels and Penetration Areas (Control Building to Containment)
- Fuel Storage Building
- Primary Auxiliary Building including RHR Vaults
- Service Water Pump House
- Service Water Access (Inspection) Vault
- Circulating Water Pump House Building (below elevation 21'-0)
- Safety Related Electrical Manholes and Duct Banks
- Pre-Action Valve Building

ELEMENT 2 - Preventive Actions

There are no preventive actions specified in the Seabrook Station Structures Monitoring Program, which includes implementation of NUREG-1801 XI.S5, XI.S6, and XI.S7. These are monitoring programs only. Similarly, the Building Deformation Monitoring Program does not rely on preventive actions.

ELEMENT 3 - Parameters Monitored/Inspected

A three step process will be used to initially screen for deformation and to analyze the effects on structures for the self-straining loads from ASR expansion, creep, shrinkage, and swelling. Each stage of the process would have increasing levels of rigor.

Stage One – Susceptibility Screening Evaluation: Each of the seismic Category I structures are screened for susceptibility to structural deformation caused by ASR using existing field data and conservative hand calculations.

Stage Two – Analytical Evaluation: An analytical evaluation is performed for structures that the Stage One Susceptibility Screening Evaluation identifies as susceptible to deformation, but do not satisfy ACI 318-71 acceptance criteria. A finite element model of the structure is used to estimate structural demands due to self-straining loads, while all other demands are taken from existing design calculations. Additional field data is obtained to provide input to the analysis. The evaluation verifies compliance with ACI 318-71 using the same criteria as the original design.

Stage Three – Detailed Evaluation: A detailed design confirmation calculation is performed when the Stage Two Analytical Evaluation concludes that some area of a structure does not satisfy ACI 318-71 acceptance criteria or when the structure has sufficient deformation that may impact demands computed in the original design. The detailed evaluation uses the Stage Two finite element model to compute demands due to self-straining loads as well as all other design loads. In the Stage Three evaluation, consideration is given to cracked section properties, self-limiting secondary stresses, and the redistribution of structural demands when sufficient ductility is available.

All three stages of the evaluation process use the original design acceptance criteria given in the UFSAR Chapter 3 including separation of structures by seismic gaps. Each analysis stage will determine threshold monitoring limits to define the monitoring frequency and criteria for re-evaluating structures with deformation. The threshold monitoring limits are described below.

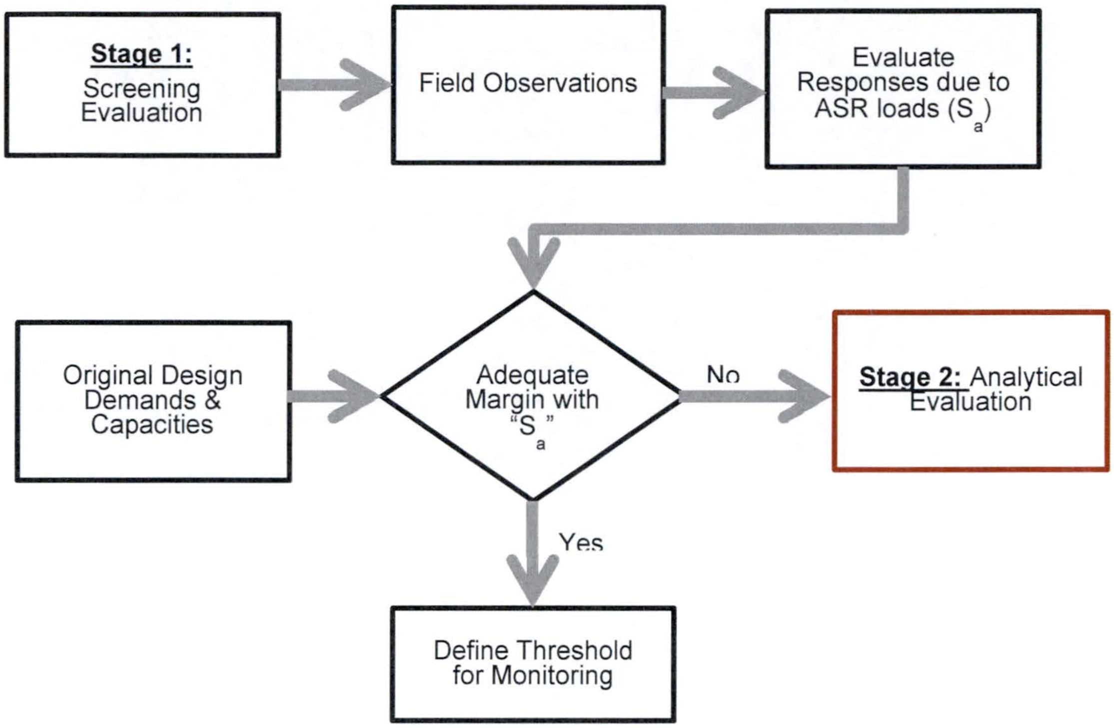
Stage One: Susceptibility Screening Evaluation

NextEra has conducted walkdowns of selected in scope structures and plant equipment to identify items of interest and evaluate the items through the Corrective Action Program for their impact on plant operations. NextEra will perform future walkdowns for all in scope structures. Inspection data from these walkdowns and other measurements obtained for ASR-affected structures will be reviewed to determine if deformation is occurring and to identify potential locations and directions of movement or deformation. The data that will be collected includes measurements of relative building movements, equipment misalignments, and concrete cracking indexes. ASR monitoring grids, which are used to measure the strain in reinforced concrete, were installed on structures throughout the facility. The monitoring grids were installed at the most severe locations for ASR cracking, and therefore, provide a conservative estimate of the strain in the structure. After reviewing existing field data, a walkthrough inspection will be performed to verify field conditions and determine if ASR expansion only affected localized regions of the structure or whether the structure has experienced global deformation of structural members.

In the susceptibility screening process, conservative estimates of deformations and strains based on the field data are used to estimate demands caused by self-straining loads for critical locations in the structure. Self-straining loads include four components: ASR, creep, shrinkage, and swelling. Based on guidance in ACI 318-71, creep, shrinkage and swelling are included with the dead load. The ASR demands (identified as "Sa" herein) are factored and then combined with demands due to design loads for critical load combinations in the current licensing basis. An evaluation is performed using strength acceptance criteria as described in the current licensing basis.

For screening evaluations that conclude a structure fully complies with the strength acceptance criteria, the critical locations of the structure are re-evaluated for a higher level of ASR demand to determine the maximum allowable, factored self-straining loads at which the structure meets the design acceptance criteria. A set of monitoring elements (consisting of strain measurements, deformation measurements, seismic gap measurements, and/or other quantifiable behaviors) is established along with threshold limits for each monitoring element. The threshold limits are defined as the maximum measurement for each monitoring element that results in a factored self-straining load equal to the factored self-straining load at the structural design limit (with factored design basis loads included). The threshold limit for the monitoring elements defined in Stage One is equal to the set of monitoring element measurements that produce a factored ASR demand that is 90% of the factored self-straining load at the acceptance limit. If a structure monitoring element measurement obtained from walkdowns and other monitoring activities exceeds the monitoring threshold limit, then a Stage Two Analytical Evaluation is required.

A structure is classified as Stage 1 if the Susceptibility Screening Evaluation concludes that the structure satisfies the strength acceptance criteria and the structure monitoring element measurements are less than the Stage One threshold limits. The Susceptibility Screening Evaluation for Stage 1 structures is summarized in a calculation package that supplements the original design calculation. The calculation package also documents the set of monitoring measurements and the threshold limits for the monitoring process. The monitoring measurements and the threshold limits are incorporated into the Seabrook Structures Monitoring Program to periodically assess the condition of structures and verify that the structure meets the design acceptance criteria.



Stage Two: Analytical Evaluation

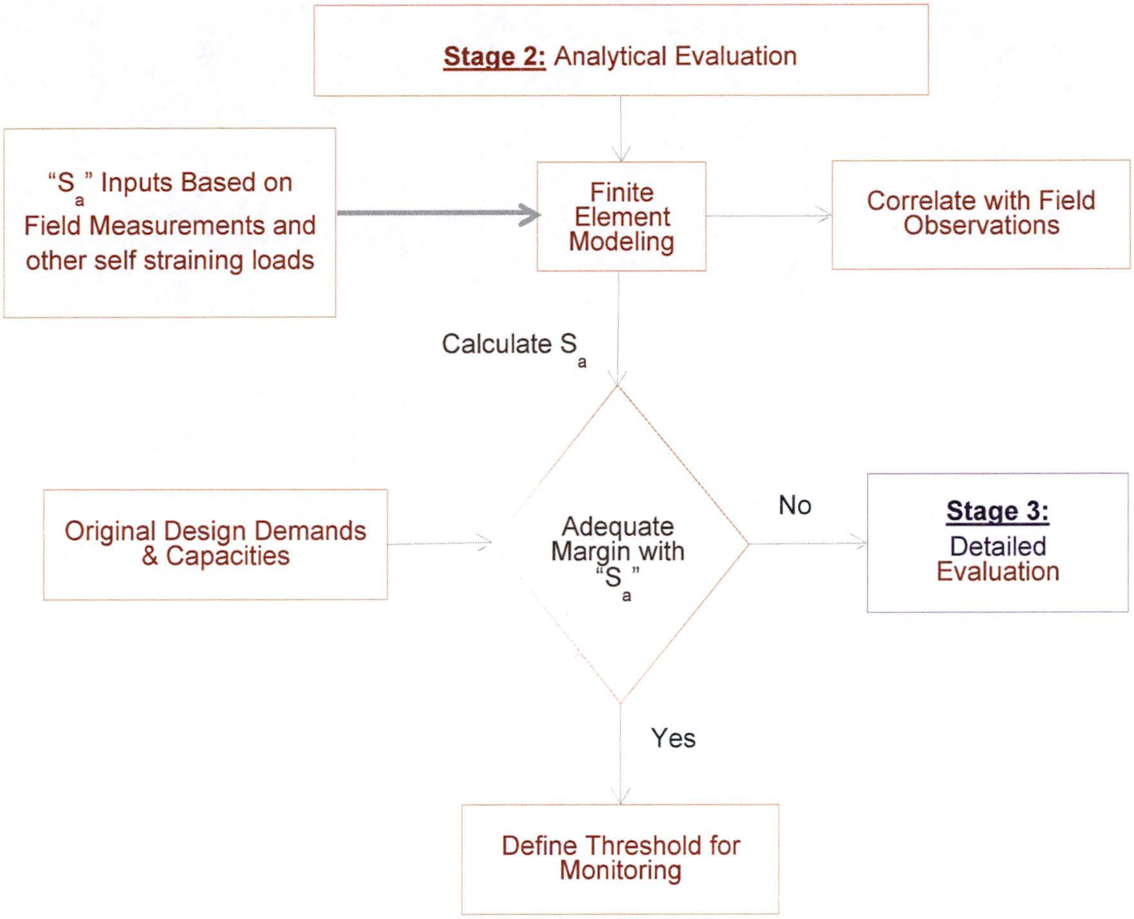
For structures that cannot be shown to meet the ACI 318-71 acceptance criteria using the conservative methods of the Susceptibility Screening Evaluation or monitoring measurements indicate high Sa demands, an Analytical Evaluation is required. The Analytical Evaluation uses more accurate methods to quantify demands due to self-straining loads. Also, additional inspections are performed to measure structural strains and deformations at a broader range of critical locations of the structure. These measurements would be used to compute the self-straining loads with more accuracy than possible using the inputs from the Susceptibility Screening Evaluation process.

An ANSYS finite element model (FEM) of the structure is created based on design drawings and uncracked design section properties. The model is initially benchmarked to the original design analysis of the structure with only the current licensing basis loads. The FEM is then calibrated such that the deformations and strains due to unfactored sustained loads and self-straining loads are consistent with field measurements. The FEM is used to compute the structural demands due to ASR loads (Sa). The self-restraining demands from finite element analysis are factored and

then combined with demands due to factored design loads from the original design calculations for the load combinations described in the current licensing basis. The structural demand in critical regions of the structure are evaluated using strength acceptance criteria described in the current licensing basis. The methods used for the Stage Two analysis are unchanged from the original design analyses with the exception of accounting for the self-straining loads in the analysis and the use of the ANSYS software program for computing the sustained and self-straining loads.
Structures that satisfy the Analytical Evaluation acceptance criteria are re-evaluated for a higher level of Sa to compute the maximum allowable self-straining loads on the structure. The maximum allowable loads correspond to the maximum, factored self-straining loads at which the structure meets the design acceptance criteria. A set of monitoring measurements are identified and threshold limits are set for each measurement based on the maximum allowable self-straining load. The threshold limits for each monitoring element defined in Stage Two are determined by scaling all measurements proportionally such that a factored self-restraining demand equal to 95% of the value at the design acceptance limit is achieved.

A structure is classified as Stage 2 if the Analytical Evaluation concludes that the structure satisfies the strength acceptance criteria and the structure monitoring element measurements are less than the Stage Two threshold limits. The Analytical Evaluation calculation for Stage 2 structures supplements the original design calculation. The monitoring measurements, measuring locations, and threshold limits for monitoring are also included in the supplement to the calculation.

Monitoring elements may include strain measurements, measurements of the relative displacement between structures, component specific measurements (e.g. gap measurements) and other quantifiable parameters. The threshold limits are defined as the maximum allowable measurement for each monitoring parameters that limits the self-straining loads to some fraction of the maximum allowable self-straining load. The monitoring measurements and the threshold limits are used to periodically assess the condition of structures and verify that the structure meets the design acceptance criteria.

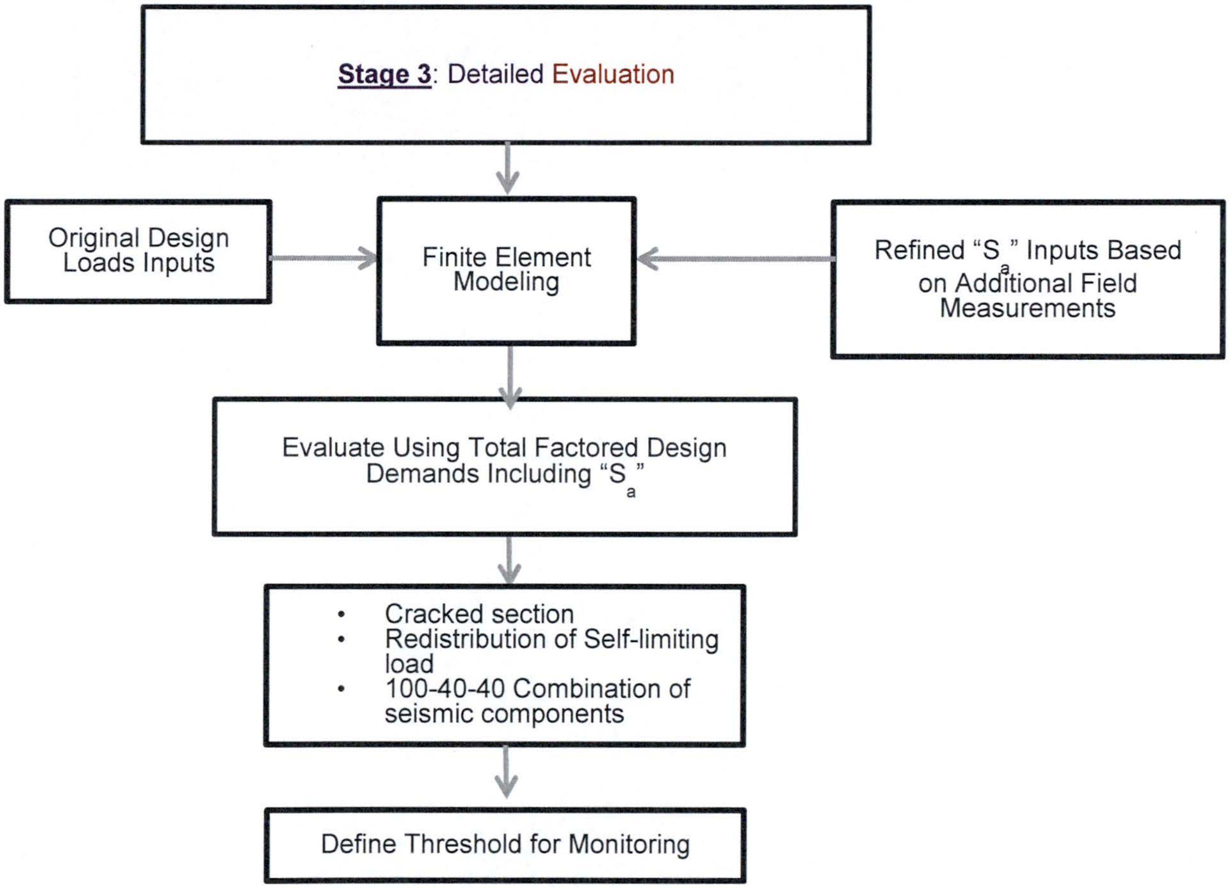


Stage Three: Detailed Evaluation

Structures that do not meet the acceptance criteria of the Stage Two Analytical Evaluation are analyzed by a Detailed Evaluation. In the Detailed Evaluation, Sa demands and the loads from creep, shrinkage and swelling are recomputed using the Stage Two FEM. Structural demands due to design loads are recomputed by applying design demands (i.e. wind, seismic, hydrostatic pressure, etc.) to the FEM. A detailed structural evaluation is performed for all load combinations described in the licensing basis. The structure is evaluated using strength acceptance criteria described in the current licensing basis. Consideration is given to force and moment redistribution in regions with localized overstresses and sufficient ductility. In the Stage Three evaluation, consideration is given to cracked section properties, self-limiting secondary stresses, and the redistribution of structural demands when sufficient ductility is available. The 100-40-40 percent rule in NRC Regulatory Guide 1.92, Revision 3, is used as an alternative to the SRSS method for combining three directional seismic loading in the analysis of seismic, Category I structures that are deformed by the effects of ASR.

Structures that meet the acceptance criteria of the Detailed Evaluation are re-evaluated for a higher level of self-straining load to establish the threshold limits for each monitoring element measurement. A similar process is used as described in the Stage Two Analytical Evaluation above. The threshold limit for each monitoring element defined in Stage Three is equal to the limit for the monitoring element measurement that produces a factored Sa load at the design acceptance limit.

The Detailed Evaluation is summarized in a design calculation package that will supersede the original design calculation. The calculation package documents the set of monitoring measurements and the threshold limit of the monitoring measurements for the structural monitoring program to verify that the structure to meets the design acceptance criteria.



Example

An example of the process of determining threshold limits for subsequent monitoring (if required for a particular structure) is described below. For the containment enclosure building, seismic gap measurements and annulus width measurements can be used to monitor deformation of the structure. Specific locations are chosen and threshold limits are set for these locations to ensure license renewal intended functions are met. The calculation of these threshold limits is defined and evaluated using the following equations:

$$\overline{TM} \leq TL$$

$$\overline{TM} = \sum_{i=0}^{n} \left| d_{n,field} - d_{n,design} \right| \times \left(\frac{1}{n}\right)$$

$$TL = \sum_{i=0}^{n} \left[\left| d_{n,baseline} - d_{n,design} \right| \times k_{n,thf} \right] \times \left(\frac{1}{n}\right)$$

$$k_{n,thf} = \frac{d_{n,FEA,1.2}}{d_{n,FEA,baseline}}$$

Where:

$\overline{TM}$ = Average deformation for locations in threshold measurement set

TL = Threshold Limit

n = Number of measurement locations in threshold measurement set

$d_{n,field}$ = Field measurement of threshold measurement n at time of monitoring

$d_{n,design}$ = Design dimension of threshold measurement n

$d_{n,baseline}$ = Field measurement of threshold measurement n at time when TL is established and CEB evaluation is performed

$d_{FEA,1.2}$ = Radial deformation of the CEB at location of threshold measurement n due to unfactored sustained loads plus unfactored self-straining loads with a 1.2 threshold factor

$d_{n,FEA,baseline}$ = Radial deformation of the CEB at location of threshold measurement n due to unfactored sustained loads plus unfactored self-straining loads without threshold factor amplification

For each threshold measurement, a method will be established to perform the measurement in a repeatable way. It is particularly important to perform the measurement in a well-defined location; otherwise, seemingly small deviations in the concrete surfaces can have a significant impact on the repeatability of the threshold measurements. For some of the locations in the containment enclosure building, a repeatable measurement method has already been established and a baseline measurement has been obtained. Other locations have been measured in the past, but have not been measured in a suitably repeatable way for continued monitoring. Once a suitable baseline measurement is established for all locations in the each structure, then the average threshold limit can be computed. An example projected value of the threshold limit is provided in Table below. It should be noted that the values in the table are presented as an example and are not intended to be applicable to actual locations.

Example Threshold Limits

Measurement ID	1	2	3	4
Measurement Type	Seismic Gap	Seismic Gap	Annulus Width	Annulus Width
Measurement Azimuth	180	305	220	240
Measurement Elevation	+5.5 ft	+21 ft	+9 ft	+9 ft
Relative-to Structure	CB	Personnel Hatch	CB	CB
Direction of deformation	Inward	Inward	Inward	Inward
Measurement taken from Inside or Outside of Annulus	Inside	Outside	Inside	Inside
Baseline Measurement Date and Report Reference	April 2016 [XX]	April 2016 [XX]	April 2016 [XX]	April 2016 [XX]
$d_{n,baseline}$, in.	1.5	1.97	51.00	52.00
$d_{n,design}$, in.	3.0	3.0	54.00	54.00
Baseline Measurement, in. $\lvert d_{n,baseline} - d_{n,design} \rvert$	1.50	1.03	3.00	2.00
$d_{n,FEA,baseline}$, in.	-0.34	-0.65	-1.01	-0.41
$d_{n,FEA,1.2}$, in.	-0.34	-0.69	-1.18	-0.48
$k_{n,thf}$	1.01	1.05	1.17	1.17
Local Threshold Limit, in. $\lvert d_{n,baseline} - d_{n,design} \rvert \times k_{n,thf}$	1.52	1.08	3.51	2.34
Average of Baseline Measurements			**1.88 in.**	
Threshold Limit (based on projected baseline values)			**2.11 in.**	

Summary

In summary, the process will classify affected structures into one of three categories: (1) structures with minimal amounts of deformation that do not affect the structural capacity as determined in the original design analysis; (2) structures with elevated levels of deformation that are shown to be acceptable using Finite Element Analysis (FEA) but still meeting the original design basis requirements when ASR effects are included; and (3) structures with significant deformation that are analyzed and shown to meet the requirements of the code of record using the methods described herein.

This approach is consistent with guidance in ACI 349.3R-1996 used to establish the inspection criteria for the Structures Monitoring Program. The ASR deformation categories do not necessarily correspond to the criteria used to characterize ASR cracking in structures that is discussed in LRA section B.2.1.31A. That is, a Stage 2 structure does not necessarily have ASR cracking that is classified as Tier 2. Structures will be monitored based on the most limiting parameter for monitoring from either the ASR Monitoring Program or the Building Deformation Monitoring Program. The building deformation monitoring frequency for structures for each Stage are summarized in Table 1.

Table 1 Structure Deformation Monitoring Requirements

Stage	Deformation Evaluation Stage	Monitoring Interval
1	Screening assessment	3 years
2	Analytical Evaluation	18 months
3	Detailed Evaluation	6 months

The monitoring frequencies in Table are based on guidelines developed for inspecting transportation structures with ASR degradation. The guidance recommends inspections from six months to 5 years depending on the age of the damage to the structure and the rate of change in degradation. The interval for recording monitoring elements for deformation for each structure can be increased to the interval in the next lower Stage (i.e., Stage 3 to Stage 2 and Stage 2 to Stage 1) if no change in measurements are observed for 3 years. Stage 1 structures that have shown no change in deformation for 10 years may increase the inspection interval to once every 5 years. Structures that show no evidence of building deformation will continue to be inspected with a frequency as established by the Structures Monitoring Program.

Components Impacted by Structural Deformation

With deformation, an aging effect of concern is component functionality and structural interferences. Condition walkdowns are performed with a focus on safety-related components such as pumps, valves, conduits, piping etc. The identification of items of interest is entered into the Seabrook Corrective Action Program (CAP) to be dispositioned for impact on plant structures. Specific features to look for include, but are not limited to, the following:

- Distorted flexible couplings
- Non-parallel pipe/conduit/HVAC joints
- Gaps, distortions, or tears in seals
- Crimped tubing
- Distorted support members/structural steel
- Distorted/bent anchor bolts
- Offset rod hangers
- Support members exceeding minimum clearance
- Cracked welds
- Support embedment plates – not flush with walls
- Misaligned pipe flanges
- Misaligned pipes in penetrations
- Roof membranes and weather seals degraded
- Electrical box, panel, or fitting distorted

Component specific features may indicate irreversible deformation of the affected component or irreversible plastic deformation of the structure such as rebar yielding or rebar slip. If these features are observed, then they will be documented in the corrective action process so that future monitoring walkdowns will observe the same features. Inspections of these features are in addition to the installed monitoring elements such as strain measurements and measurements of the relative deformation between structures. All of these measurements will be performed at the frequency described in Table 1.

The walkdowns will be performed in accordance with the Structures Monitoring Program and ASME Section XI, Subsection IWL Program documents. Seabrook will update the walkdown guidance documents as necessary to accommodate new Operating Experience (OE) identified during the walkdowns.

ELEMENT 4 - Detection of Aging Effects

As discussed in Element 3 baseline walkdowns to identify the potential effects caused by building deformation will be performed. The results of the baseline walkdowns will be used to determine the key assumptions in the structural analysis in addition to determining the monitoring frequencies for equipment impacted by building deformation. Subsequent monitoring will be performed as part of future Structural Monitoring Program (SMP) walkdowns. The inspection frequencies identified by Table 1 will be applied in locations where symptoms of deformation are identified; otherwise, the inspection frequency will follow the requirements of the SMP. The SMP includes periodic visual inspection of structures and components for the detection of aging effects specific for that structure. The inspections are completed by qualified individuals at a frequency determined by the characteristics of the environment in which the structure is found.

ELEMENT 5 - Monitoring and Trending

Once the inspection frequencies are determined as described by Element 3, visual inspections will be used to monitor and trend future building deformation. Any new indications of building deformation will be placed in the corrective action program, and evaluations will be performed to determine if inspection frequencies should be changed to ensure that future effects of degradation would be identified before loss of components' intended function.

ELEMENT 6 - Acceptance Criteria

A systematic approach to evaluation of structures and components impacted by ASR expansion and building deformation is utilized. A structural model is developed where ASR induced expansion is applied to the structure developing force, moments, and displacements that are attributed to the effects of ASR. The added load due to ASR is then combined with other CLB loads (deadweight, wind, hydrostatic, seismic, etc.). Resultant load combinations are then evaluated to validate compliance with structural design code requirements

Specific quantitative criteria to ensure component-intended functions will be maintained under all design conditions and is condition and location specific. Field observations of distorted/misaligned components and local structural deformation indicated by strain measurements or relative building movements are evaluated utilizing the existing acceptance criteria or design code specified for the design function of the component.
NextEra will determine appropriate criteria based on the walkdown results and the particular geometry and configuration in the area of interest. The criteria will include margin to trigger action prior to loss of intended function whether that action is an additional inspection or repair/replacement of the component.

ELEMENT 7 - Corrective Actions

Structural evaluations are performed to ensure impacted structures are in compliance with the Current Licensing Basis are documented in the Corrective Action Program. The NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 7 Corrective Actions. (Ref: LRA A.1.5 and B.1.3.)

ELEMENT 8 - Confirmation Process

The FPL/NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 8 Confirmation Process.

ELEMENT 9 - Administrative Controls

The FPL/NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 9 Administrative Controls.

ELEMENT 10 - Operating Experience

Building Deformation – Containment Enclosure Building (CEB)

In late 2014, a walkdown was performed to investigate a concern from the NRC that water, leaking from SB-V-9, was leaking into the Mechanical Penetration (Mech Pen) area though building seals. The walkdown documented that a Mechanical Penetration area seal was found torn. The damaged seal was a vertical seismic gap seal between the Containment Enclosure Building (CEB) and the Containment Building (CB). It was then stated that the condition of the seal and other local evidence indicated that the damage to the seal appeared to be caused by relative building movement and not seal degradation (i.e. shrinkage or material deterioration).

Following the discovery mentioned above, Engineering identified that the damage to the seal was caused by CEB outward radial deformation. Seabrook engaged an engineering firm to perform visual assessments of accessible areas surrounding the

CEB to determine the behavior of the CEB, whether the CEB movement is localized or widespread, and if other plant structures or components had been impacted. A Cause and Effect Diagram was prepared to understand the physical phenomena occurring with the CEB. Parametric studies using a linear finite element model of the CEB with boundary conditions modeling parameters appropriate for estimating structural deflections and deformed shapes were performed. The results were compared to in-situ field measurements taken between structures and at seismic isolation joints between various structures. The deformation patterns simulated by finite element analysis (FEA) were generally similar to field measurements. The results of the FEA showed that the deformation of the CEB was most likely due to Alkali-Silica Reaction (ASR) expansion in the concrete when combined with the expected creep and swelling of the concrete.

The root cause to the event was determined to be the internal expansion (strain) in the CEB concrete produced by ASR in the in-plane direction of the CEB shell and ASR expansion in the backfill concrete coincident with a unique building configuration. The Root Cause Evaluation identified that there are many different symptoms of building deformation. These include:

- Conduit, duct, or piping seismic connection deformation
- Gate or door misalignment
- Seismic gap seal degradation
- Seismic gap width variations
- Fire seal degradation

(Note: above list is not intended to be all inclusive)

As a result walkdowns were performed to identify the above symptoms that may have been missed during the Structural Monitoring Program Walkdowns that were conducted prior to this discovery. The items identified were entered Seabrook's Corrective Action Program.

Building Deformation – RHR & FSB

Seabrook is currently evaluating observations of expansion resulting in building deformation in the Residual Heat Removal (RHR) Equipment Vault and the Fuel Storage Building (FSB). Because the evaluation of the RHR Equipment Vault and the FSB are ongoing and the observed deformation has not yet been conclusively attributed to ASR, the walkdown guidance has not been updated to reflect observations in these locations.

Plant Specific Operating Experience

AR 02044627 notes that the as-measured width of seismic isolation gaps is less than the nominal value of 3 inches specified on concrete drawings for isolation between structures. There are a total of 93 as-measured gaps less than 3 inches between the following abutting structures: Containment Building, Containment Enclosure Building, Mechanical Penetration Area, West Main Steam and Feed Water Pipe Chase, Electrical Penetration Area and Emergency Feed Water Pump House. Initial finite element analysis completed determined that the deformation is attributed to ASR expansion and creep. The compensatory measure implemented requires measuring seismic isolation gaps every six months.

AR 2114299 documents that a seismic isolation joint located on an expansion boot near ductwork in the Containment Enclosure Building is vertically misaligned by approximately 2". The boot appeared to be in good shape and not dry or cracking. The AR determined that the cause of the misalignment is building deformation of the Containment Enclosure Building. The engineering evaluation concluded that the displaced ducts resulted in some slipping of the expansion joint material relative to the clamp at the areas of highest relative movement and that there is reasonable assurance that the joint material would most likely slip rather than tear or elongate during a seismic event. The condition was found acceptable as is and no loss of intended function was identified.

AR 02107225 documents a deformed and misaligned flexible coupling on a conduit located in the West Pipe Chase area. Based on a field walkdown, the coupling was misaligned by 1.75" which is greater than the established 1.25" acceptable limit. The cause of the misalignment was building deformation. Therefore, engineering analysis was performed to ensure that the enclosed cable can continue to perform its safety function. Even though the cable could continue to perform its safety function, the flexible conduit was repaired to restore design margin.

AR 02129621 documents the seismic gap between Containment and the CEB horizontal cantilevered concrete shield block at Azimuth 230 elevation 22' is less the the minimum required seismic gap of .277 inches. The cause of the reduced gap was building deformation. An engineering analysis was performed to ensure that the structural remains operable while steps are taken to restore to design requirements.

Newly Identified Operating Experience (OE)
Seabrook will update the Aging Management Program for any new plant-specific or industry OE. This includes ongoing industry studies performed both nationally and internationally. Research data taken from these studies will be used to enhance the Building Deformation Monitoring Program, if applicable. In addition NextEra Seabrook has submitted a License Amendment Request to the Commission in accordance with 10CFR50.90 to incorporate a revised methodology related to ASR material properties and building deformation analysis for review and approval.

NextEra will incorporate changes related to this LAR submittal as necessary to maintain alignment of the aging management program to the current license basis.

EXCEPTIONS TO NUREG-1800

None

ENHANCEMENTS

Implement the Building Deformation (BD) Monitoring Program
The Seabrook Structural Monitoring Procedure EDS 36180 will be revised to include building deformation aging effects, inspection criteria, and acceptance criteria.

CONCLUSION

To manage the aging effects of building deformation due to ASR, swell, creep, and expansion, the existing Structures Monitoring Program and ASME Section XI, Subsection IWL Program, have been augmented by this plant specific Building Deformation Monitoring Program. This program will perform baseline inspections to determine the extent of deformation, input the inspection results into an analytical model, and use this model to determine the projected rate of future deformation, and set inspection frequencies both to ensure that the calculated deformation rate is valid, and the established monitoring frequencies ensure that intended functions for structures and components will be maintained.

Enclosure 5 to SBK-L-16013

LRA Appendix A - Final Safety Report Supplement Table A.3, License Renewal Commitment List Updated to Reflect Changes to Date

A.3 LICENSE RENEWAL COMMITMENT LIST

No.	PROGRAM or TOPIC	COMMITMENT	UFSAR LOCATION	SCHEDULE
1.	PWR Vessel Internals	Provide confirmation and acceptability of the implementation of MRP-227-A by addressing the plant-specific Applicant/Licensee Action Items outlined in section 4.2 of the NRC SER.	A.2.1.7	Complete
2.	Closed-Cycle Cooling Water	Enhance the program to include visual inspection for cracking, loss of material and fouling when the in-scope systems are opened for maintenance.	A.2.1.12	Prior to the period of extended operation.
3.	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Enhance the program to monitor general corrosion on the crane and trolley structural components and the effects of wear on the rails in the rail system.	A.2.1.13	Prior to the period of extended operation.
4.	Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems	Enhance the program to list additional cranes for monitoring.	A.2.1.13	Prior to the period of extended operation.
5.	Compressed Air Monitoring	Enhance the program to include an annual air quality test requirement for the Diesel Generator compressed air sub system.	A.2.1.14	Prior to the period of extended operation.
6.	Fire Protection	Enhance the program to perform visual inspection of penetration seals by a fire protection qualified inspector.	A.2.1.15	Prior to the period of extended operation.
7.	Fire Protection	Enhance the program to add inspection requirements such as spalling, and loss of material caused by freeze-thaw, chemical attack, and reaction with aggregates by qualified inspector.	A.2.1.15	Prior to the period of extended operation.

8.	Fire Protection	Enhance the program to include the performance of visual inspection of fire-rated doors by a fire protection qualified inspector.	A.2.1.15	Prior to the period of extended operation.
9.	Fire Water System	Enhance the program to include NFPA 25 (2011 Edition) guidance for "where sprinklers have been in place for 50 years, they shall be replaced or representative samples from one or more sample areas shall be submitted to a recognized testing laboratory for field service testing".	A.2.1.16	Prior to the period of extended operation.
10.	Fire Water System	Enhance the program to include the performance of periodic flow testing of the fire water system in accordance with the guidance of NFPA 25 (2011 Edition).	A.2.1.16	Prior to the period of extended operation.
11.	Fire Water System	Enhance the program to include the performance of periodic visual or volumetric inspection of the internal surface of the fire protection system upon each entry to the system for routine or corrective maintenance to evaluate wall thickness and inner diameter of the fire protection piping ensuring that corrosion product buildup will not result in flow blockage due to fouling. Where surface irregularities are detected, follow-up volumetric examinations are performed. These inspections will be documented and trended to determine if a representative number of inspections have been performed prior to the period of extended operation. If a representative number of inspections have not been performed prior to the period of extended operation, focused inspections will be conducted. These inspections will commence during the ten year period prior to the period of extended operation and continue through the period of extended operation	A.2.1.16	Within ten years prior to the period of extended operation.

12.	Aboveground Steel Tanks	Enhance the program to include 1) In-scope outdoor tanks, except fire water storage tanks, constructed on soil or concrete, 2) Indoor large volume storage tanks (greater than 100,000 gallons) designed to near-atmospheric internal pressures, sit on concrete or soil, and exposed internally to water, 3) Visual, surface, and volumetric examinations of the outside and inside surfaces for managing the aging effects of loss of material and cracking, 4) External visual examinations to monitor degradation of the protective paint or coating, and 5) Inspection of sealant and caulking for degradation by performing visual and tactile examination (manual manipulation) consisting of pressing on the sealant or caulking to detect a reduction in the resiliency and pliability.	A.2.1.17	Within 10 years prior to the period of extended operation.
13.	Fire Water System	Enhance the program to perform exterior inspection of the fire water storage tanks annually for signs of degradation and include an ultrasonic inspection and evaluation of the internal bottom surface of the two Fire Protection Water Storage Tanks per the guidance provided in NFPA 25 (2011 Edition).	A.2.1.16	Within ten years prior to the period of extended operation.
14.	Fuel Oil Chemistry	Enhance program to add requirements to 1) sample and analyze new fuel deliveries for biodiesel prior to offloading to the Auxiliary Boiler fuel oil storage tank and 2) periodically sample stored fuel in the Auxiliary Boiler fuel oil storage tank.	A.2.1.18	Prior to the period of extended operation.
15.	Fuel Oil Chemistry	Enhance the program to add requirements to check for the presence of water in the Auxiliary Boiler fuel oil storage tank at least once per quarter and to remove water as necessary.	A.2.1.18	Prior to the period of extended operation.

16.	Fuel Oil Chemistry	Enhance the program to require draining, cleaning and inspection of the diesel fire pump fuel oil day tanks on a frequency of at least once every ten years.	A.2.1.18	Prior to the period of extended operation.
17.	Fuel Oil Chemistry	Enhance the program to require ultrasonic thickness measurement of the tank bottom during the 10-year draining, cleaning and inspection of the Diesel Generator fuel oil storage tanks, Diesel Generator fuel oil day tanks, diesel fire pump fuel oil day tanks and auxiliary boiler fuel oil storage tank.	A.2.1.18	Prior to the period of extended operation.
18.	Reactor Vessel Surveillance	Enhance the program to specify that all pulled and tested capsules, unless discarded before August 31, 2000, are placed in storage.	A.2.1.19	Prior to the period of extended operation.
19.	Reactor Vessel Surveillance	Enhance the program to specify that if plant operations exceed the limitations or bounds defined by the Reactor Vessel Surveillance Program, such as operating at a lower cold leg temperature or higher fluence, the impact of plant operation changes on the extent of Reactor Vessel embrittlement will be evaluated and the NRC will be notified.	A.2.1.19	Prior to the period of extended operation.
20.	Reactor Vessel Surveillance	Enhance the program as necessary to ensure the appropriate withdrawal schedule for capsules remaining in the vessel such that one capsule will be withdrawn at an outage in which the capsule receives a neutron fluence that meets the schedule requirements of 10 CFR 50 Appendix H and ASTM E185-82 and that bounds the 60-year fluence, and the remaining capsule(s) will be removed from the vessel unless determined to provide meaningful metallurgical data.	A.2.1.19	Prior to the period of extended operation.
21.	Reactor Vessel Surveillance	Enhance the program to ensure that any capsule removed, without the intent to test it, is stored in a manner which maintains it in a condition which would permit its future use, including during the period of extended operation.	A.2.1.19	Prior to the period of extended operation.

22.	One-Time Inspection	Implement the One Time Inspection Program.	A.2.1.20	Within ten years prior to the period of extended operation.
23.	Selective Leaching of Materials	Implement the Selective Leaching of Materials Program. The program will include a one-time inspection of selected components where selective leaching has not been identified and periodic inspections of selected components where selective leaching has been identified.	A.2.1.21	Within five years prior to the period of extended operation.
24.	Buried Piping And Tanks Inspection	Implement the Buried Piping And Tanks Inspection Program.	A.2.1.22	Within ten years prior to the period of extended operation
25.	One-Time Inspection of ASME Code Class 1 Small Bore-Piping	Implement the One-Time Inspection of ASME Code Class 1 Small Bore-Piping Program.	A.2.1.23	Within ten years prior to the period of extended operation.
26.	External Surfaces Monitoring	Enhance the program to specifically address the scope of the program, relevant degradation mechanisms and effects of interest, the refueling outage inspection frequency, the training requirements for inspectors and the required periodic reviews to determine program effectiveness.	A.2.1.24	Prior to the period of extended operation.
27.	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Implement the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program.	A.2.1.25	Prior to the period of extended operation.
28.	Lubricating Oil Analysis	Enhance the program to add required equipment, lube oil analysis required, sampling frequency, and periodic oil changes.	A.2.1.26	Prior to the period of extended operation.
29.	Lubricating Oil Analysis	Enhance the program to sample the oil for the Reactor Coolant pump oil collection tanks.	A.2.1.26	Prior to the period of extended operation.
30.	Lubricating Oil Analysis	Enhance the program to require the performance of a one-time ultrasonic thickness measurement of the lower portion of the Reactor Coolant pump oil collection tanks prior to the period of extended operation.	A.2.1.26	Prior to the period of extended operation.

31.	ASME Section XI, Subsection IWL	Enhance procedure to include the definition of "Responsible Engineer".	A.2.1.28	Prior to the period of extended operation.
32.	Structures Monitoring Program	Enhance procedure to add the aging effects, additional locations, inspection frequency and ultrasonic test requirements.	A.2.1.31	Prior to the period of extended operation.
33.	Structures Monitoring Program	Enhance procedure to include inspection of opportunity when planning excavation work that would expose inaccessible concrete.	A.2.1.31	Prior to the period of extended operation.
34.	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Implement the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program.	A.2.1.32	Prior to the period of extended operation.
35.	Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits	Implement the Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits program.	A.2.1.33	Prior to the period of extended operation.
36.	Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Implement the Inaccessible Power Cables Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program.	A.2.1.34	Prior to the period of extended operation.
37.	Metal Enclosed Bus	Implement the Metal Enclosed Bus program.	A.2.1.35	Prior to the period of extended operation.
38.	Fuse Holders	Implement the Fuse Holders program.	A.2.1.36	Prior to the period of extended operation.

39.	Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements	Implement the Electrical Cable Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements program.	A.2.1.37	Prior to the period of extended operation.
40.	345 KV SF6 Bus	Implement the 345 KV SF6 Bus program.	A.2.2.1	Prior to the period of extended operation.
41.	Metal Fatigue of Reactor Coolant Pressure Boundary	Enhance the program to include additional transients beyond those defined in the Technical Specifications and UFSAR.	A.2.3.1	Prior to the period of extended operation.
42.	Metal Fatigue of Reactor Coolant Pressure Boundary	Enhance the program to implement a software program, to count transients to monitor cumulative usage on selected components.	A.2.3.1	Prior to the period of extended operation.
43.	Pressure –Temperature Limits, including Low Temperature Overpressure Protection Limits	Seabrook Station will submit updates to the P-T curves and LTOP limits to the NRC at the appropriate time to comply with 10 CFR 50 Appendix G.	A.2.4.1.4	The updated analyses will be submitted at the appropriate time to comply with 10 CFR 50 Appendix G, Fracture Toughness Requirements.

44.	Environmentally-Assisted Fatigue Analyses (TLAA)	NextEra Seabrook will perform a review of design basis ASME Class 1 component fatigue evaluations to determine whether the NUREG/CR-6260-based components that have been evaluated for the effects of the reactor coolant environment on fatigue usage are the limiting components for the Seabrook plant configuration. If more limiting components are identified, the most limiting component will be evaluated for the effects of the reactor coolant environment on fatigue usage. If the limiting location identified consists of nickel alloy, the environmentally-assisted fatigue calculation for nickel alloy will be performed using the rules of NUREG/CR-6909. (1) Consistent with the Metal Fatigue of Reactor Coolant Pressure Boundary Program Seabrook Station will update the fatigue usage calculations using refined fatigue analyses, if necessary, to determine acceptable CUFs (i.e., less than 1.0) when accounting for the effects of the reactor water environment. This includes applying the appropriate Fen factors to valid CUFs determined from an existing fatigue analysis valid for the period of extended operation or from an analysis using an NRC-approved version of the ASME code or NRC-approved alternative (e.g., NRC-approved code case). (2) If acceptable CUFs cannot be demonstrated for all the selected locations, then additional plant-specific locations will be evaluated. For the additional plant-specific locations, if CUF, including environmental effects is greater than 1.0, then Corrective Actions will be initiated, in accordance with the Metal Fatigue of Reactor Coolant Pressure Boundary Program, B.2.3.1. Corrective Actions will include inspection, repair, or replacement of the affected locations before exceeding a CUF of 1.0 or the effects of fatigue will be managed by an inspection program that has been reviewed and approved by the NRC (e.g., periodic non-destructive examination of the affected locations at inspection intervals to be determined by a method accepted by the NRC).	A.2.4.2.3	At least two years prior to the period of extended operation.

45.	Number Not Used			
46.	Protective Coating Monitoring and Maintenance	Enhance the program by designating and qualifying an Inspector Coordinator and an Inspection Results Evaluator.	A.2.1.38	Prior to the period of extended operation.
47.	Protective Coating Monitoring and Maintenance	Enhance the program by including, "Instruments and Equipment needed for inspection may include, but not be limited to, flashlight, spotlights, marker pen, mirror, measuring tape, magnifier, binoculars, camera with or without wide angle lens, and self sealing polyethylene sample bags."	A.2.1.38	Prior to the period of extended operation.
48.	Protective Coating Monitoring and Maintenance	Enhance the program to include a review of the previous two monitoring reports.	A.2.1.38	Prior to the period of extended operation.
49.	Protective Coating Monitoring and Maintenance	Enhance the program to require that the inspection report is to be evaluated by the responsible evaluation personnel, who is to prepare a summary of findings and recommendations for future surveillance or repair.	A.2.1.38	Prior to the period of extended operation.
50.	ASME Section XI, Subsection IWE	Perform UT of the accessible areas of the containment liner plate in the vicinity of the moisture barrier for loss of material. Perform opportunistic UT of inaccessible areas.	A.2.1.27	Baseline inspections were completed during OR16. Repeat containment liner UT thickness examinations at intervals of no more than five (5) refueling outages.
51.	Number Not Used			
52.	ASME Section XI, Subsection IWL	Implement measures to maintain the exterior surface of the Containment Structure, from elevation -30 feet to +20 feet, in a dewatered state.	A.2.1.28	Complete
53.	Reactor Head Closure Studs	Replace the spare reactor head closure stud(s) manufactured from the bar that has a yield strength > 150 ksi with ones that do not exceed 150 ksi.	A.2.1.3	Prior to the period of extended operation.

54.	Steam Generator Tube Integrity	NextEra will address the potential for cracking of the primary to secondary pressure boundary due to PWSCC of tube-to-tubesheet welds using one of the following two options: 1) Perform a one-time inspection of a representative sample of tube-to-tubesheet welds in all steam generators to determine if PWSCC cracking is present and, if cracking is identified, resolve the condition through engineering evaluation justifying continued operation or repair the condition, as appropriate, and establish an ongoing monitoring program to perform routine tube-to-tubesheet weld inspections for the remaining life of the steam generators, or 2) Perform an analytical evaluation showing that the structural integrity of the steam generator tube-to-tubesheet interface is adequately maintaining the pressure boundary in the presence of tube-to-tubesheet weld cracking, or redefining the pressure boundary in which the tube-to-tubesheet weld is no longer included and, therefore, is not required for reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary must be approved by the NRC as part of a license amendment request.	A.2.1.10	Complete
55.	Steam Generator Tube Integrity	Seabrook will perform an inspection of each steam generator to assess the condition of the divider plate assembly.	A.2.1.10	Within five years prior to the period of extended operation.
56.	Closed-Cycle Cooling Water System	Revise the station program documents to reflect the EPRI Guideline operating ranges and Action Level values for hydrazine and sulfates.	A.2.1.12	Prior to the period of extended operation.
57.	Closed-Cycle Cooling Water System	Revise the station program documents to reflect the EPRI Guideline operating ranges and Action Level values for Diesel Generator Cooling Water Jacket pH.	A.2.1.12	Prior to the period of extended operation.

58.	Fuel Oil Chemistry	Update Technical Requirement Program 5.1, (Diesel Fuel Oil Testing Program) ASTM standards to ASTM D2709-96 and ASTM D4057-95 required by the GALL XI.M30 Rev 1	A.2.1.18	Prior to the period of extended operation.
59.	Nickel Alloy Nozzles and Penetrations	The Nickel Alloy Aging Nozzles and Penetrations program will implement applicable Bulletins, Generic Letters, and staff accepted industry guidelines.	A.2.2.3	Prior to the period of extended operation.
60.	Buried Piping and Tanks Inspection	Implement the design change replacing the buried Auxiliary Boiler supply piping with a pipe-within-pipe configuration with leak detection capability.	A.2.1.22	Prior to the period of extended operation.
61.	Compressed Air Monitoring Program	Replace the flexible hoses associated with the Diesel Generator air compressors on a frequency of every 10 years.	A.2.1.14	Within ten years prior to the period of extended operation.
62.	Water Chemistry	Enhance the program to include a statement that sampling frequencies are increased when chemistry action levels are exceeded.	A.2.1.2	Prior to the period of extended operation.
63.	Flow Induced Erosion	Ensure that the quarterly CVCS Charging Pump testing is continued during the PEO. Additionally, add a precaution to the test procedure to state that an increase in the CVCS Charging Pump mini flow above the acceptance criteria may be indicative of erosion of the mini flow orifice as described in LER 50-275/94-023.	~~N/A~~ A.2.1.2	Prior to the period of extended operation.
64.	Buried Piping and Tanks Inspection	Soil analysis shall be performed prior to entering the period of extended operation to determine the corrosivity of the soil in the vicinity of non-cathodically protected steel pipe within the scope of this program. If the initial analysis shows the soil to be non-corrosive, this analysis will be re-performed every ten years thereafter.	A.2.1.22	Prior to the period of extended operation.
65.	Flux Thimble Tube	Implement measures to ensure that the movable incore detectors are not returned to service during the period of extended operation.	N/A	Prior to the period of extended operation. – In Progress
66.	Number Not Used			

67.	Structures Monitoring Program	Perform one shallow core bore in an area that was continuously wetted from borated water to be examined for concrete degradation and also expose rebar to detect any degradation such as loss of material. The removed core will also be subjected to petrographic examination for concrete degradation due to ASR per ASTM Standard Practice C856.	A.2.1.31	Complete
68.	Structures Monitoring Program	Perform sampling at the leak off collection points for chlorides, sulfates, pH and iron once every three months.	A.2.1.31	Complete
69.	Open-Cycle Cooling Water System	Replace the Diesel Generator Heat Exchanger Plastisol PVC lined Service Water piping with piping fabricated from AL6XN material.	A.2.1.11	Complete
70.	Closed-Cycle Cooling Water System	Inspect the piping downstream of CC-V-444 and CC-V-446 to determine whether the loss of material due to cavitation induced erosion has been eliminated or whether this remains an issue in the primary component cooling water system.	A.2.1.12	Within ten years prior to the period of extended operation.
71.	Alkali-Silica Reaction (ASR) Monitoring Program / ***Building Deformation Monitoring Program***	***NextEra has completed testing at the University of Texas Ferguson Structural Engineering Laboratory which demonstrates the parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR.*** ***NextEra*** ~~will I~~implement the Alkali-Silica Reaction (ASR) Monitoring Program and ***Building Deformation Monitoring Program described in B.2.1.31A and B.2.1.31B of the License Renewal Application.*** ~~Testing will be performed to confirm that parameters being monitored and acceptance criteria used are appropriate to manage the effects of ASR~~	A.2.1.31A A.2.1.31B	Prior to the period of extended operation.
72.	Flow-Accelerated Corrosion	Enhance the program to include management of wall thinning caused by mechanisms other than FAC.	A.2.1.8	Prior to the period of extended operation.

73.	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Enhance the program to include performance of focused examinations to provide a representative sample of 20%, or a maximum of 25, of each identified material, environment, and aging effect combinations during each 10 year period in the period of extended operation.	A.2.1.25	Prior to the period of extended operation.
74.	Fire Water System	Enhance the program to perform sprinkler inspections annually per the guidance provided in NFPA 25 (2011 Edition). Inspection will ensure that sprinklers are free of corrosion, foreign materials, paint, and physical damage and installed in the proper orientation (e.g., upright, pendant, or sidewall). Any sprinkler that is painted, corroded, damaged, loaded, or in the improper orientation, and any glass bulb sprinkler where the bulb has emptied, will be evaluated for replacement.	A.2.1.16	Prior to the period of extended operation.
75.	Fire Water System	Enhance the program to a) conduct an inspection of piping and branch line conditions every 5 years by opening a flushing connection at the end of one main and by removing a sprinkler toward the end of one branch line for the purpose of inspecting for the presence of foreign organic and inorganic material per the guidance provided in NFPA 25 (2011 Edition) and b) If the presence of sufficient foreign organic or inorganic material to obstruct pipe or sprinklers is detected during pipe inspections, the material will be removed and its source is determined and corrected. In buildings having multiple wet pipe systems, every other system shall have an internal inspection of piping every 5 years as described in NFPA 25 (2011 Edition), Section 14.2.2.	A.2.1.16	Prior to the period of extended operation.
76.	Fire Water System	Enhance the Program to conduct the following activities annually per the guidance provided in NFPA 25 (2011 Edition). • main drain tests • deluge valve trip tests • fire water storage tank exterior surface inspections	A.2.1.16	Prior to the period of extended operation.

77.	Fire Water System	The Fire Water System Program will be enhanced to include the following requirements related to the main drain testing per the guidance provided in NFPA 25 (2011 Edition). • The requirement that if there is a 10 percent reduction in full flow pressure when compared to the original acceptance tests or previously performed tests, the cause of the reduction shall be identified and corrected if necessary. • Recording the time taken for the supply water pressure to return to the original static (nonflowing) pressure.	A.2.1.16	Prior to the period of extended operation.
78.	External Surfaces Monitoring	Enhance the program to include periodic inspections of in-scope insulated components for possible corrosion under insulation. A sample of outdoor component surfaces that are insulated and a sample of indoor insulated components exposed to condensation (due to the in-scope component being operated below the dew point), will be periodically inspected every 10 years during the period of extended operation.	A.2.1.24	Prior to the period of extended operation.
79.	Open-Cycle Cooling Water System	Enhance the program to include visual inspection of internal coatings/linings for loss of coating integrity.	A.2.1.11	Within 10 years prior to the period of extended operation.
80.	Fire Water System	Enhance the program to include visual inspection of internal coatings/linings for loss of coating integrity.	A.2.1.16	Within 10 years prior to the period of extended operation.
81.	Fuel Oil Chemistry	Enhance the program to include visual inspection of internal coatings/linings for loss of coating integrity.	A.2.1.18	Within 10 years prior to the period of extended operation.
82.	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Enhance the program to include visual inspection of internal coatings/linings for loss of coating integrity.	A.2.1.25	Within 10 years prior to the period of extended operation.

83.	Alkali-Silica Reaction Monitoring	Enhance the ASR AMP to install extensometers in ***all*** Tier 3 areas ***of two dimensional reinforced*** structures to monitor expansion due to alkali-silica reaction in the out-of-plane direction. Monitoring expansion in the out-of-plane direction will commence upon installation of the extensometers ~~in 2016~~ and ***continue on a six month frequency*** through the period of extended operation.	A.2.1.31A	December 31,2016.
84.	ASME Section XI, Subsection IWL	Evaluate the acceptability of inaccessible areas for structures within the scope of ASME Section XI, Subsection IWL Program.	A.2.1.28	Prior to the period of extended operation.
85.	Fire Water System	Enhance the program to perform additional tests and inspections on the Fire Water Storage Tanks as specified in Section 9.2.7 of NFPA 25 (2011 Edition) in the event that it is required by Section 9.2.6.4, which states "Steel tanks exhibiting signs of interior pitting, corrosion, or failure of coating shall be tested in accordance with 9.2.7."	A.2.1.16	Prior to the period of extended operation.
86.	Fire Water System	Enhance the program to include disassembly, inspection, and cleaning of the mainline strainers every 5 years.	A.2.1.16	Prior to the period of extended operation.
87.	Fire Water System	Increase the frequency of the Open Head Spray Nozzle Air Flow Test from every 3 years to every refueling outage to be consistent with LR-ISG-2012-02, AMP XI.M27, Table 4a.	A.2.1.16	Prior to the period of extended operation.
88.	Fire Water System	Enhance the program to include verification that a) the drain holes associated with the transformer deluge system are draining to ensure complete drainage of the system after each test, b) the deluge system drains and associated piping are configured to completely drain the piping, and c) normally-dry piping that could have been wetted by inadvertent system actuations or those that occur after a fire are restored to a dry state as part of the suppression system restoration.	A.2.1.16	Within five years prior to the period of extended operation.

89.	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Incorporate Coating Service Level III requirements into the RCP Motor Refurbishment Specification for the internal painting of the motor upper bearing coolers and motor air coolers. All four RCP motors will be refurbished and replaced using the Coating Service Level III requirements prior to entering the period of extended operation.	A.2.1.25	Prior to the period of extended operation.
90.	PWR Vessel Internals	Implement the PWR Vessel Internals Program. The program will be implemented in accordance with MRP-227-A (Pressurized Water Reactor Internals Inspection and Evaluation Guidelines) and NEI 03-08 (Guideline for the Management of Materials Issues).	A.2.1.7	Prior to the period of extended operation
91	~~Alkali-Silica Reaction~~ ***Building Deformation*** Monitoring	***Implement the Building Deformation Monitoring Program*** Enhance the ~~ASR Aging Management~~ ***Structures Monitoring*** Program to require structural evaluations be performed on buildings and components affected by deformation as necessary to ensure that the structural function is maintained. Evaluations of structures will validate structural performance against the design basis, and may use results from the large-scale test programs, as appropriate. Evaluations for structural deformation will also consider the impact to functionality of affected systems and components (e.g., conduit expansion joints). NextEra will evaluate the specific circumstances against the design basis of the affected system or component. Enhance the ~~ASR~~ ***Building Deformation*** AMP to include additional parameters to be monitored based on the results of the CEB Root Cause, Structural Evaluation and walk downs. Additional parameters monitored will include: alignment of ducting, conduit, and piping; seal integrity; laser target measurements; key seismic gap measurements; and additional instrumentation.	~~A.2.1.31A~~ ***A.2.1.31B***	March 15, 2020

Enclosure 6 to SBK-L-16013

Next Era Seabrook: Application for Withholding Proprietary Information from Public Disclosure

Affidavit in Support of Application for Withholding Proprietary Information from Public Disclosure

NEXTera ENERGY SEABROOK

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 Site Vice President 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 2 of NextEra Energy Seabrook's letter SBK-L-16013, Eric McCartney (NextEra Energy Seabrook) to U.S. Nuclear Regulatory Commission, entitled "Seabrook Station, License Renewal Application Relating to the Alkali-Silica Reaction (ASR) Monitoring Program,"

(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
Site Vice President
NextEra Energy Seabrook, LLC
626 Lafayette Road
Seabrook, New Hampshire 03874

Subscribed and sworn to before me
this 9th day of August, 2016.

Victoria S. Brown
Notary Public
My commission expires 10/17/2017

VICTORIA S. BROWN
MY COMMISSION EXPIRES OCT. 17, 2017