NEXTera® ENERGY SEABROOK

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10 CFR 54

SBK-L-15202
Docket No. 50-443

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

Seabrook Station

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

References:

1. NextEra Energy Seabrook, LLC letter SBK-L-10077, "Seabrook Station Application for Renewed Operating License," May 25, 2010. (Accession Number ML101590099)
2. NRC Letter, Request For Additional Information Related to the Review of the Seabrook Station License Renewal Application- Set 25 (TAC NO. ME4028), October 2, 2015 (Accession Number ML15251A333)

In Reference 1, NextEra Energy Seabrook, LLC (NextEra) 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, the staff of the U.S. Nuclear Regulatory Commission identified areas where additional information is needed to complete the review of the license renewal application.

Enclosure 1 contains NextEra responses to the information requested in Reference 2. Enclosure 1 to this letter contains information proprietary to NextEra Energy Seabrook. This letter is supported by an affidavit signed by NextEra Energy Seabrook (Enclosure 6), setting forth the basis on which the information 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.

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Enclosure 2 provides a non-proprietary version of Enclosure 1.

Enclosure 3 and Enclosure 4 provide the revised LRA Appendix A - Updated Final Safety Analysis Report Supplement Section A.2.1.31A for Alkali-Silica Reaction and LRA Appendix B Section B.2.1.31A for Alkali-Silica Reaction (ASR) Aging Management Program, respectively. These two revisions supersede the respective previously submitted sections to the LRA.

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

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. Michael Ossing Licensing Manager, at (603) 773-7512.

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

Executed on December 3, 2015

Sincerely,

Dean Curtland

Dean Curtland
Site Vice President
NextEra Energy Seabrook, LLC

Enclosure 1 - Seabrook Station License Renewal Application Requests for Additional Information - Set 25, Response to RAIs Relating to the Alkali-Silica Reaction (ASR) Monitoring Program for the Seabrook Station License Renewal Application (Proprietary)

Enclosure 2 - Seabrook Station License Renewal Application Requests for Additional Information - Set 25, Response to RAIs Relating to the Alkali-Silica Reaction (ASR) Monitoring Program for the Seabrook Station License Renewal Application (Non-Proprietary)

Enclosure 3 – Seabrook Station Updated Final Safety Analysis Report Supplement Section A.2.1.31A for Alkali-Silica Reaction

Enclosure 4 - Seabrook Station Updated License Renewal Application Section B.2.1.31A for Alkali-Silica Reaction (ASR) Aging Management Program

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

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Enclosure 2 to SBK-L- 15202

Seabrook Station License Renewal Application
Requests for Additional Information - Set 25

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

(Non-Proprietary)

RAI B.2.1.31A-8: Addressing Recent Operating Experience

Background:

The regulation in 10 CFR 54.21(a)(3) requires applicants to demonstrate that the effects of aging will be adequately managed so that intended functions will be maintained consistent with the current licensing basis during the period of extended operation.

LR-ISG-2011-05 "Ongoing Review of Operating Experience" recommends that Aging Management Programs (AMPs) be informed and enhanced when necessary through the systematic and ongoing review of both plant-specific and industry operating experience (OE), as discussed therein. The mark-up in LR-ISG-2011-05 for Section A.1.2.3.10 "Operating Experience" of SRP-LR Appendix A.1 "Aging Management Review – Generic (Branch Technical Position RLSB-1)" states, in part:

> Consideration of future plant-specific and industry operating experience relating to AMPS should be discussed. The ongoing review of operating experience may identify areas where AMPs should be enhanced or new AMPs developed. As such, an applicant should ensure that it has adequate processes to monitor and evaluate plant-specific and industry operating experience related to aging management to ensure that the AMPs are effective in managing aging effects for which they are credited. The AMPs are informed by this review of operating experience on an ongoing basis, regardless of the AMP's implementation schedule. The ongoing review of operating experience information should provide objective evidence to support the conclusion that the effects of aging are managed adequately so that the structure- and component-intended function(s) will be maintained during the period of extended operation.

LR-ISG-2011-05 also states that "Currently available operating experience applicable to new programs should also be discussed. ... Thus, when developing the elements for new programs, an applicant should consider the impact of relevant operating experience from implementation of its existing AMPs and from generic industry operating experience."

As documented in Seabrook Station, Unit No. 1 – Integrated Inspection Report 05000443/2015002 (Agency wide Documents Access and Management System (ADAMS) Accession No. ML15217A256), Seabrook Station has recently discovered operating experience in structures affected by alkali-silica reaction (ASR), as described below, that may be potentially attributable to aging effects causing global bulk expansion of concrete. The report indicates that the applicant's evaluation of the degraded conditions confirmed that the identified deformation is due to bulk expansion from long-term cumulative effects of ASR and strain associated with creep.

During walkdown of plant structures, and from NRC Inspection Reports 05000443/2015002, 05000443/2014005 (ADAMS Accession No. ML15037A172), 05000443/2014003 (ADAMS Accession No. ML14212A458), and 05000443/2014009 (ADAMS Accession No. ML14349A751), the NRC staff noted the following:

- Relative deformation (differential movement) of the Containment Enclosure Building (CEB) indicated by changes in the 3-inch seismic gaps or annulus gap between adjacent structures, damaged fire seals, misalignment of conduits/piping at penetrations or between adjacent structures, deformed flexible conduit couplings, bent small pipes/conduits and supports, etc.

- Discrete wide horizontal cracking, spalling, doorway misalignments etc., in the Residual Heat Removal (RHR) and Containment Spray (CS) Vault.

- Cracking, displacements or other indications of structural conditions adverse to quality associated with the Fuel Storage Building (FSB).

The applicant's response to RAI B.2.1.31A-5(a), by letter dated June 30, 2015, includes changes to the "parameters monitored or inspected," "monitoring and trending," and "acceptance criteria" program elements of the ASR Monitoring Program in License Renewal Application (LRA) Section B.2.1.31A, with qualitative descriptions for "monitoring building deformation" and a related new Commitment No. 91 which states: "In building geometry locations where the potential for deformation is likely, enhance the program to monitor for building displacement using laser targets and by taking gap measurements." The implementation schedule for Commitment No. 91 is described as "within 10 years prior to the period of extended operation."

<u>Issue</u>:

Regarding aging management of structure and component as they relate to the ASR Monitoring Program or the Structure Monitoring Program or both, the wording in the applicant's response to RAI B.2.1.31A-5(a) appear to be unclear, relative to (a) monitoring building deformation, (b) the corresponding Commitment No. 91, and (c) implementation schedule (the descriptions in the response and new Commitment No. 91 appear to address the recently discovered operating experience related to the CEB). The staff identified the following concerns:

- [Issue 1] The applicant's response does not include an update to the "Operating Experience" program element of the ASR Monitoring Program describing the review and evaluation of the cause and impact of any of the relevant recent operating experience, described in the "Background" section and other operating experience (if any), to determine how the AMP will be affected or new AMPs developed to ensure adequate aging management. The "Operating Experience" program element of the revised AMP appears to be incomplete in addressing the recent potentially ASR-related operating experience.

- [Issue 2] The AMP does not appear to provide information that "commits" ongoing and future review of all relevant plant-specific and industry operating experience related to ASR as is recommended in LR-ISG-2011-05 for Section A.1.2.3.10 "Operating Experience" of SRP-LR Appendix A.1 "Aging Management Review – Generic (Branch Technical Position RLSB-1).

- [Issue 3] It is not clear whether global aging effects of ASR such as potentially irreversible deformation, relative movement, displacements, or wide discrete cracking that manifests in the global direction of least restraint at the structural system level (as opposed to the structural component level) are addressed in the large-scale testing program that is being used to form the basis for structural functionality through the period of extended operation. It is also not clear if the applicant plans to address the global behavior of the structure by nonlinear analyses that simulate the kinetics of ASR.

- [Issue 4] Though the applicant stated that it will monitor building deformation aging effect by monitoring critical building geometry locations "for displacement via laser targets and gap measurements," it is not clear (i) whether the observed indications are irreversible deformations (ii) what acceptance criteria the applicant has determined to be appropriate in terms of gap measurements to detect damage prior to a loss of intended function, (iii) how a structural evaluation would be performed, and (iv) how the results of the evaluation will affect the program.

- [Issue 5] It is not clear that the applicant has fully characterized the phenomena observed in the recent operating experience and its implications to the current design basis in terms of impact to original calculations, etc. Although the applicant performed a temporary "prompt operability determination" (POD) that structures have been determined operable under the current operating license, the staff has not received any information to support a basis for long term functionality of affected structures and structural systems. Information is needed with regard to the current and long-term effects of this recent OE, for the staff's review.

- [Issue 6] The revised program appears only to address differential lateral movement between structures observed in areas such as the containment enclosure ventilation area slab-to-wall interface. It does not appear to address other recently identified operating experience of large horizontal cracks in the RHR vault and indications in the FSB. It is not clear whether these issues have been evaluated to be related, if there has been an evaluation to determine the mechanism and structural implications of large macro cracking in these areas, as well as any impact on aging management of those structures. It is also not clear whether there has been an evaluation to determine if rebar has yielded in these areas, how during or prior to the period of extended operation rebar yielding would be considered and/or evaluated, and the implications for service through the period of extended operation.

- [Issue 7] It is not clear if all potential aging effects of the ASR mechanism have been identified for monitoring in the AMP, including, but not limited to, those that involve irreversible deformation, relative movement, displacement, and discrete cracking.

- [Issue 8] The applicant's response to RAI B.2.1.31A-5(a) asserts that the observed building deformation is not a structural capacity concern but does not provide any supporting basis. Commitment No. 91 does not appear to consider the basis for service through the period of extended operation for the CEB structures, and does not provide information for staff to evaluate the adequacy of this statement. Further, the intent of the wording of the implementation schedule for the commitment is unclear and, as written, conveys that it will be implemented during the 10-year period prior to the period of extended operation. It is not clear how the timeliness of this commitment would ensure adequate management of aging effects of ASR at the global structure (structural system) level for the period of extended operation.

The staff does not have sufficient information to determine whether aging effects of ASR from the recent operating experience have been adequately evaluated and incorporated into the AMP to provide adequate aging management during the period of extended operation.

Request:

The staff requests information for resolution of the issues in the issue section.

1) Describe, including technical basis, how the appropriate program elements of the ASR Monitoring Program, the Structures Monitoring Program, or other applicable AMP will adequately account for all relevant recent plant-specific operating experience described in the "Background" section, to address the concerns described in the "Issues" section. The information should provide objective evidence to support the conclusion that the aging effects of ASR will be managed adequately such that structure- and component-intended functions will be maintained during the period of extended operation. The information should also include an update to the "operating experience" program element to describe the recent operating experience in sufficient technical detail.

2) If the applicant determines that no modifications or enhancements to the ASR Monitoring Program, the Structures Monitoring Program, or other applicable AMP are necessary based on the operating experience described as Issue items 1 and 2, explain, with sufficient technical detail, the basis for that determination.

3) Update the LRA program elements and Updated Final Safety Analysis Report (UFSAR) supplement, as applicable, based on the response. To facilitate efficient staff review, provide the updated ASR Monitoring Program and associated UFSAR supplement, in its entirety.

NextEra Energy Seabrook Response to RAI B.2.1.31A-8

1. NextEra has prepared a revised version of the ASR AMP (Enclosure 4) to incorporate new operating experience identified at Seabrook Station related to building deformation. Specific features of the revised AMP that address the concerns described in the "Issues" section of RAI B.2.1.31A-8 include the following:

   - (Issue 1) Updated Element 10 "Operating Experience" of the ASR AMP to include recent observations of expansion leading to building deformation in the Containment Enclosure Building (CEB) that have been attributed to ASR. Specifically, the root cause of the event was determined to be in-plane expansion of the CEB concrete produced by ASR and ASR expansion in the backfill concrete coincident with a unique building configuration. NextEra is in the process of revising the structural analysis of the CEB to include the effect of ASR expansion with validated deformations from completed walkdowns.

     LRA Appendix A, Section A.3, Commitment #91 has been revised as follows:

91.	Alkali-Silica Reaction Monitoring	***Enhance the ASR Aging Management 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 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	***March 15, 2020***

   - NextEra is currently evaluating observations of expansion resulting in building deformation in the Residual Heat Removal and Containment Spray Equipment Vault (i.e., the RHR Equipment Vault) and the Fuel Storage Building (FSB). Although ASR is a potential reason for these observations, the engineering evaluation has not been completed. NextEra will update the Operating Experience program element of the ASR AMP as necessary, pending the results of the evaluations of the RHR Equipment Vault and the FSB.

- (Issue 2) Added a requirement to program for reviewing plant-specific and industry operating experience related to ASR to confirm the effectiveness of the AMP. This statement is consistent with the guidance from the Standard Review Plan for License Renewal, Appendix A, Section A.1.2.3.10 (Reference 4).

  This operating experience review will include any new information identified from the follow-up actions for the CEB resulting from the root cause evaluation and the conclusions from the ongoing evaluations of observed expansion relating to building deformation affecting the RHR Equipment Vault and the FSB.

- (Issue 3) Clarified the role of the large-scale testing program for the evaluation of expansion relating to building deformation. Specifically, the large scale testing program provides insights on expansion behavior that can be used for engineering evaluations. For structural evaluations of components affected by deformation, the large scale testing program also provides information to supplement the original design code (ACI-318) in support of structural evaluations for shear capacity, reinforcement anchorage, and anchor capacity. Building deformation could affect the function of structures and equipment in many ways (e.g., creating interferences between components, closing or widening seismic gaps, degrading fire seals or seismic gap seals, displacing piping, ducting or conduit). If such impacts occur, NextEra will address them based on the specific equipment configuration in the location of interest.

  RAI B.2.1.31A-8 stated that it is not clear if NextEra plans to address the global behavior of the structure by nonlinear analyses that simulate the kinetics of ASR. NextEra will perform analyses of ASR-affected structures using analytical tools that are appropriate for the specific circumstances, potentially including nonlinear structural analyses. NextEra does not plan to perform any analyses regarding the development of ASR in concrete and the kinetics of the associated processes (e.g., chemistry modeling).

- (Issue 4) Clarified that the indications of building deformation may reflect irreversible deformation.

- (Issue 4) Explained the approach for determining acceptance criteria for building deformation. Specifically, NextEra will perform walkdowns to identify indications of deformation and obtain measurements from areas affected by ASR. Guidance for performing these walkdowns states that spaces should be checked for the following symptoms:

  - Seismic gap distance different than expected. (All walkdowns include specific measurement of seismic gaps for monitoring.)
  - Conduit, duct, or piping exhibiting deformation, displacement or misalignment of expansion joints, displacement at support locations, or displaced or misaligned supports
  - Gate or door misalignment

  - Seismic gap seal or fire seal degradation
  - Any other observations of building deformation. (The list of specific symptoms is not exhaustive. The configuration of a particular location may enable monitoring of a different parameter than listed above.)
  - NextEra will identify specific limits for measurable symptoms on a location-specific basis to reflect the particular geometry and configuration in the area of interest. The limit will include margin to trigger action prior to loss of intended function.

- (Issue 4) Stated that 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.

- (Issue 4) Stated that results from structural evaluations will be used to determine whether additional corrective actions (e.g., repairs) to the concrete are required. Specific criteria for selecting effective corrective actions will be evaluated on a location-specific basis. Acceptance criteria may be adjusted based on results of structural evaluations.

- (Issue 5) Included detection of conditions similar to the symptoms observed in the Containment Enclosure Building (CEB) that are potentially attributable to ASR (e.g., displacement, relative movement, etc.). NextEra is currently resolving Prompt Operability Determinations (PODs) in several locations at Seabrook Station with the ultimate goal of reconciling the current structural condition to the original design basis. Analyses of the CEB are in progress. Evaluations of the RHR Equipment Vault and the FSB are currently characterizing the observed symptoms and how they are influenced by ASR. NextEra will update the AMP with any subsequent conclusions from these evaluations or any other plant-specific or industry operating experience related to ASR-affected concrete.

- (Issue 6) The guidance for performing walkdowns includes direction to look for symptoms of ASR that have been identified or postulated thus far at Seabrook Station. Such symptoms include:
  - Seismic gap distance different than expected (e.g., relative to design configuration).
  - Conduit, duct, or piping exhibiting deformation, displacement or misalignment of expansion joints, displacement at support locations, or displaced or misaligned supports
  - Gate or door misalignment
  - Seismic gap seal or fire seal degradation
  - Recognizing that the list of symptoms is not exhaustive, the guidance also directs that walkdowns look for any other symptoms of building deformation particular to the location being evaluated. Guidance for performing walkdowns will be updated

to reflect newly identified or postulated symptoms of ASR, as appropriate. 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. With regard to effects of rebar yielding in ASR-affected structures, refer to the response to RAI B.2.1.31A-5(a4).

- (Issue 7) Stated all known potential aging effects of the ASR mechanism, including effects of deformation discussed in the previous bullet. Any additional effects (e.g., identified by operating experience) will be added to the AMP and the walkdown guidance as necessary.
- (Issue 8) Clarified that structural implications of building deformation will be evaluated on a case-by-case basis. For expansion within a structural component, NextEra will evaluate the structural implications by evaluating the condition against the design basis, which may involve use of the large scale test program results. This process is identical to any structural component with observed ASR. Additional implications to component or system functionality resulting from the observed building deformation (e.g., seal degradation) will be evaluated considering the specific geometry of the location of interest.
- (Issue 8) Updated Commitment 91 to reflect implementation of the ASR AMP no later than March 15, 2020.

2. NextEra has performed a complete revision (Enclosure 4) of the ASR AMP to incorporate the most up-to-date information on plans for managing ASR at Seabrook Station. This latest revision includes the recent operating experience regarding building deformation attributed to ASR. Further revisions to the ASR AMP will be made, as necessary in accordance with Element 10, and will include pending resolution of the ongoing technical evaluations of the CEB, the RHR Equipment Vault and the FSB.
3. NextEra has updated the LRA program elements and UFSAR supplement (Enclosure 3) as necessary to reflect the discussion above.

RAI B.2.1.31A-5(a1): *Justify Representativeness of Large-scale Test Data to Actual Structure*

Background:

SRP-LR, Section A.1.2.3.3, states that the "parameters monitored or inspected" program element should provide a link between the parameters that will be monitored and how monitoring these parameters will ensure adequate aging management.

In its response to RAI B.2.1.31A-5(a), dated June 30, 2015, the applicant included as Enclosure 4 the report MPR-4153, Revision 1, "Seabrook Station – Approach for Determining Through-Thickness Expansion from Alkali-Silica Reaction (Proprietary)" as the technical basis for the proposed methodology to quantitatively relate the observed ASR effects in existing plant structures at Seabrook Station to the results of the large-scale test program at the Ferguson Structural Engineering Laboratory (FSEL). Chapter 2 of this document discusses expansion behavior in the test specimens, including formation of a large discrete crack on each specimen face between the reinforcement mats. The propagation of this crack dominates the through-thickness expansion measurements on the surface, whether measured between the deep pins or across the width, and causes bending of the deep pins. Section 2.2.1 of the report states that "Once the large crack forms, expansion measured using the embedded rods is governed by the increase in crack width. Expansion in the regions outside the embedded rods remains relatively unchanged. Therefore, expansion must be calculated based on the total width of the beam, rather than the distance between the rods, to appropriately characterize the expansion." Section 5.2 of calculation 0326-0062-CLC-03 appended to the report includes an expansion measurement correction equation (from Reference 21 of the report). This equation is based on average measured through-thickness expansions across the total width using 9 sets of measurements across the breadth, intended to correct and appropriately characterize the expansion measured between the pins.

With regard to correlation between strain measurements in large-scale test beams versus Seabrook structures, the boundary conditions of the large scale test beams are such that they are free to expand at the top, bottom and all edges, causing a large crack to form in the center of the beam thickness around the perimeter. Currently it appears that the applicant is using deep pin measurements taken at the free edge of the concrete (with a correction) to determine total expansion (and using this total expansion as a surrogate for strain).

The applicant indicated in its revised ASR Monitoring Program "Monitoring and Trending" program element that ASR expansion-to-date on Seabrook structures will be determined by directly comparing the reduction in elastic modulus (normalized modulus) on the structure to a correlating relationship between through-thickness expansion and reduction in elastic modulus and through-thickness expansion developed based on measured data on the large-scale specimens.

<u>Issue</u>:

It is not clear if the expansion measured on the test specimens is representative of ASR expansion and its potential effects on Seabrook structures to which the test results will be applied for reasons below:

1) *Expansion measured on test beams may be overestimated:* ASR expansion at Seabrook is occurring in walls that are restrained at the four boundary edges, whereas the large-scale specimens with free edges have large cracking at the top and bottom that do not extend through the depth of the concrete. As indicated in Reference 21 to MPR-4153, this large cracking along the middle of the width is an edge effect unique to the design of the test specimen that may not be representative of Z-direction expansion of the entire specimen, and this effect is not likely to occur in actual structures with different restraints at the boundary. Even though the applicant stated that there is correction accounting for the crack by normalizing the expansion along the entire thickness of the beam as opposed to just between the deep pins, it appears that the measured top and bottom "expansions" across the width are predominantly a measure of the surface deformation from propagation of the

wide discrete surface crack developed in the top and bottom faces of the test specimen, and the measurements at these two surfaces are possibly outliers, and thus not representative of ASR expansion on the specimen. It appears that this methodology would likely result in significantly larger measurements in the top and bottom (which the applicant has indicated are the areas currently being measured) that could cause the expansion to be inflated versus the true through-thickness measurements. Therefore, it is not clear that the through- wall expansion measured from the freely expanding deep pins in the large-scale specimens is a true representation of expansion in the through-wall direction for these specimens. The expansion measurements used for correlation and comparison to Seabrook appear not to have an appropriate correction for this phenomenon, nor is there information to indicate that measurements are being taken at the center of the specimen. Thus, it is not clear whether the ASR strain measurements in the large-scale specimens are accurate for direct comparison.

Further, it appears that cores taken from the test specimens for measurement of elastic modulus at the time of expansion measurement do not traverse the large surface crack; therefore, its effect is not captured in the measured elastic modulus used for developing the correlation with measured expansion. Therefore, it is not clear whether outlier "expansion" measurements (i.e., on the surface with pins) in the large scale specimens can be directly associated with elastic modulus reduction of cores taken from the center where the large crack and free expansion is not occurring.

The methodology proposed by the applicant is such that this measured expansion value is applied directly to elastic modulus reduction factors (i.e., normalized modulus) which will be direct surrogates for expansion to-date in Seabrook structures; it is not clear whether this method of measuring expansion will accurately represent Seabrook expansion to date. The through-thickness expansions measured on the width of test specimen (even with the correction) appears to potentially overestimate the ASR expansion. This measured expansion on the specimen may not be conservative in developing the relationship between expansion and normalized modulus used to correlate the large scale test data to the actual structure and may need to be further corrected.

2) *Boundary conditions of Seabrook structures and components:* For the large-scale beam test specimens, there is no external restraint and the progression of ASR is likely to be relatively more uniform in the specimen because of the significantly aggressive reactive material in the concrete mix uniformly distributed through the volume to facilitate accelerated expansion. The boundary conditions (constraints at the boundary edges) of the test specimens are generally free on all the edges. The test specimens do not appear to represent the boundary conditions of the structural components (e.g., walls) and other external restraints on Seabrook structures. In addition to internal confinement provided by the reinforcement, the boundary

conditions of the monolithically constructed structural system and components and other external features, such as concrete structural fill in below-grade areas, may also provide significant external restraint that influences the overall expansion and distribution of aging effects (e.g., cracking) from ASR in the Seabrook structures. Further, in the actual structures, ASR results in differential volumetric expansion that is initiated and propagated randomly in a non-uniform manner. As a result of these boundary conditions, the volumetric expansion (i.e., swelling of the gel) will re-orient in the direction(s) of least restraint, which at the component level may be the out-of-plane direction, but likely more focused in the more unrestrained surface layers near the reinforcement mat; or at the structural system level in the global direction of least restraint (e.g., could be vertical or some other dimension). It is not clear whether through-wall measurements are fully representative of volumetric expansion. Since the boundary conditions are different between the large-scale specimens and the Seabrook walls, resulting in potentially different through-wall expansion behavior, the staff needs additional information to determine whether through wall measurements as the single monitoring parameter are sufficient and a basis for direct comparison of large-scale test specimens to Seabrook structures and structural components that are also subject to external restraint.

3) The descriptions in LRA Sections A.2.1.31A and B.2.1.31A, as revised by applicant's response to RAI B.2.1.31A-5(a), do not appear to include reference to the technical basis document(s) (e.g., Report MPR-4153) used by the revised AMP to correlate the large-scale test program results to Seabrook structures.

Request:

1) Considering the issues above, provide information, with supporting objective evidence, to demonstrate that ASR expansions observed and measured (even after proposed correction) on the large-scale test specimens at FSEL are representative of ASR effects on actual Seabrook structures, and appropriate for correlation of results between test specimens and actual Seabrook structures.

2) Since ASR results in volumetric expansion that can reorient in direction(s) of least restraint, explain why out-of-plane expansion (and not volumetric strain) is considered the appropriate parameter to correlate test results to Seabrook structures.

3) Update the ASR Monitoring Program elements and UFSAR supplement, as applicable, based on the response, and also to incorporate by reference the document(s) (e.g., Report MPR-4153) used as the technical basis for methodologies used by the AMP to correlate the large-scale test program results to Seabrook structures.

NextEra Energy Seabrook Response to RAI B.2.1.31A-5(a1)

1. The large-scale test programs were designed to provide results that represent performance of ASR-affected reinforced concrete at Seabrook Station to the maximum extent practical. During the course of testing, expansion phenomena were investigated in several different ways to confirm that the approach for applying the test results to Seabrook Station is appropriate.

   RAI B.2.1.31A-(a1) posed questions about specific aspects of the test program to establish that results are appropriately representative of Seabrook Station. The RAI focuses on the representativeness of the test specimens with regard to expansion behavior, and determination of expansion in the specimens and at the plant. The discussion below addresses these questions in several parts:

   - Test Specimen Design Philosophy and Boundary Conditions
   - Sectioning of Test Specimens (to assess observed expansion behavior)
   - Expansion Monitoring Methodology
   - Methodology for Obtaining Cores from Test Specimens
   - Observations from Material Property Testing and In-Plane Expansion Monitoring

   The last subsection in the response to Request #1 includes conclusions that integrate the content of these parts into a summary of the reasons that the large scale test program results are representative of the expected performance of ASR-affected reinforced concrete at Seabrook Station.

Test Specimen Design Philosophy and Boundary Conditions

The interim structural assessment (Reference 5) 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 that 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

(1) the literature data for reinforcement anchorage were from a test method that ACI indicates is inappropriate and

(2) 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.

Based on the lack of representative literature data, NextEra initiated large-scale test programs to evaluate shear capacity, reinforcement anchorage, and anchor bolt capacity of ASR-affected reinforced concrete.

The large-scale test programs were designed to maximize representativeness of reinforced concrete structures at Seabrook Station using a reasonable number of test specimens. The specimens were designed to be representative of a reference location (i.e., the B electrical tunnel). To enable application of the results to other structures, the test results are compared to provisions in ACI 318-71 to determine an appropriate reduction factor to reflect ASR development for the structural capacity calculated using code equations. This approach is appropriate, because the test program methodology is consistent with the experimental methods used to generate the data on which the code equations from ACI 318 are based.

Seabrook Station includes many reinforced concrete structures and the specific configuration of structural components within those structures varies widely. Because the approach for the test programs supplements (rather than replaces) the design code, results from appropriately representative test specimens may be applied for reinforced concrete structures throughout Seabrook Station. Additionally, the test specimen design represents actual structures at Seabrook Station to the maximum extent practical. Specific features of the test specimens that support this objective include the following:

- Typical test specimens are [redacted] long, [redacted] in height, and [redacted] in width. These dimensions are significantly larger than the existing literature data and are therefore a much better representation of structural performance in actual structures at Seabrook Station.
- The specimens included two-dimensional reinforcement mats, one along each longitudinal face, with no shear reinforcement. [redacted].
- Stirrups, consisting of [redacted] rebar, tie together the reinforcement mats on the longitudinal edges of each shear and reinforcement anchorage test specimen, which provides through-thickness restraint at the ends of the specimen. The primary purpose of the stirrups is to ensure that the failure mode of each beam supports the limit state of interest. However, these stirrups also mimic the context of an actual structure where the interface with adjacent components provides through-thickness restraint at the component edges. The stirrups are outside of the structural test region and do not provide through-thickness restraint that influences the structural test.

No additional features are required to represent below-grade exterior walls where distributed load on one side of the wall would exist due to the presence of ground water or backfill material. Applied load on only one side of the structure does not provide restraint that would inhibit ASR development. Therefore, the test specimens adequately represent below-grade exterior components.

Figure 1 illustrates the dimensions and reinforcement configuration of a typical reinforcement anchorage test specimen. The design of typical shear specimens and anchor test specimens is comparable.

[redacted]

Figure 1. Diagram of Example Reinforcement Anchorage Test Specimen

The concrete mix design and storage of the test specimens accelerated development of ASR and promoted relatively uniform ASR development in the test specimens. The concrete mix design for the test specimens was based on specifications used at Seabrook Station (compressive strength, coarse aggregate grading and type, water-to-cement ratio, cement type, aggregate proportions, etc.), but also includes features to promote accelerated ASR development including highly siliceous aggregate material, high alkali cement, and [redacted] admixture. In addition, the test specimens were stored in an environmental conditioning facility that resulted in exposure to elevated temperature and humidity. The relatively uniform ASR in the test specimens bounds the effects of ASR at Seabrook Station, where ASR development is not uniform within a single structural component, but is monitored at the location of greatest apparent expansion.

Sectioning of Test Specimens

As ASR progressed in the test specimens, a large crack was noted in the center of the surfaces of the beam that were between the reinforcement mats. This large crack is not representative of expansion behavior of actual structures at Seabrook Station; which have a network of members that are either cast together or integrally cast with special joint reinforcing details. In an actual structure, a vertical wall with two-dimensional reinforcement will be confined in the through-thickness direction at its intersection with neighboring members (i.e., at the top and bottom with floor and ceiling slabs, at the sides with perpendicular walls, and uniformly along the wall face by the subgrade for below grade external walls). The confinement provided by the network of members in a structure are likely sufficient to preclude a large, through-thickness crack.

To confirm that this large crack was an edge effect that did not compromise the representativeness of the test area, the laboratory sectioned the beam cross section (i.e., cut with a saw) to assess the depth of the crack. Test specimens sectioned as part of this effort included one shear test specimen (post-load testing) and one anchor program test specimen (which has a similar design as the shear and reinforcement anchorage specimens). In both cases, the laboratory observed that the large crack penetrated only a few inches into the specimen height.

Figures 2 and 3 are photographs of the large crack from the shear test specimen located between the embedded pins used as points of reference for through-thickness expansion measurements.

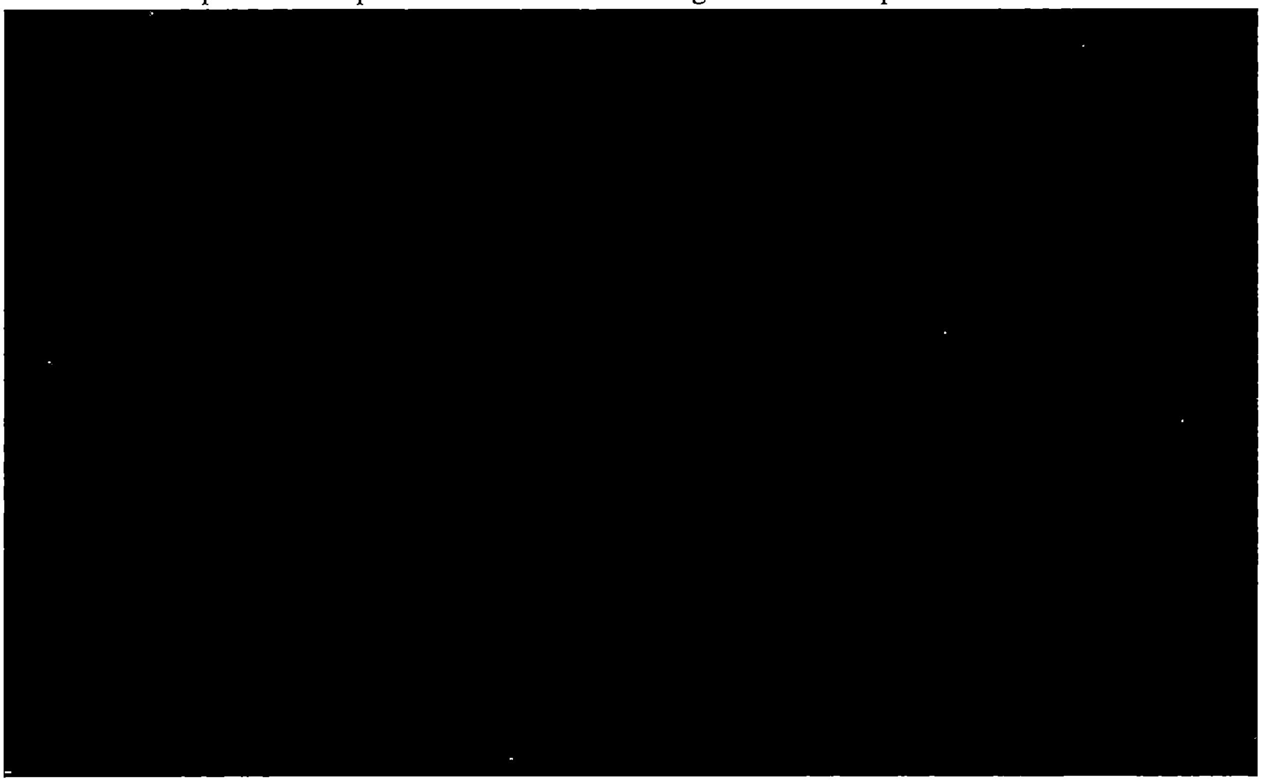


Figure 2. Photograph of Large Crack from Surface Between Reinforcement Mats

[redacted]

Figure 3. Photograph of Large Crack from Specimen Cross-Section (as Cut with Saw)

Sectioning of the selected test specimens provided assurance that the large crack was an edge effect that did not compromise the representativeness of the test specimens. However, it was not clear from these observations whether the large crack at the specimen edges had affected the ability to measure expansion in the through-thickness direction using the embedded pins. The large crack concentrated expansion between the embedded pins, rather than distributing the expansion across the entire specimen width, as would be expected in actual structures at Seabrook Station. Damage incurred to the specimens by the sectioning process and the immediate expansion after sawing resulting from relaxation of confinement prevented quantitative evaluation of the sectioned specimen. Therefore, additional monitoring was implemented to better characterize through-thickness expansion.

Expansion Monitoring Methodology

As discussed in MPR-4153 (Reference 6) and in RAI B.2.1.31A-5(a1), expansion of the reinforced concrete beams in the shear and reinforcement anchorage test programs was initially determined by measuring the distance between [redacted] pins that were embedded in the concrete during specimen fabrication. A correction equation was used to adjust this measured value for the full width of the test specimen. The cumulative expansion at a given point in time is the difference between the initial value and the measurement at a given time. (Reference 6: MPR-4153 Section 2.1.2.)

To support development of the correction equation, additional through-thickness expansion measurements were performed along the entire height of test specimens using a laboratory-fabricated frame. Specifically, the frame fit around the test specimen and enabled repeatable measurements of through-thickness (i.e., z-direction) expansion at [redacted] points along the height of the beam. These measurements provide an independent check of the through-thickness expansion observed using the embedded pins. Figure 4 provides a diagram of this frame (i.e., the z-frame) and the embedded pins.

[redacted]

Figure 4. Diagram of Z-Frame Measurement Equipment and Embedded Pins

The z-frame methodology was implemented in May 2015, at which point [redacted] of the test specimens had not yet been tested. Table 1 summarizes expansion measurements from these [redacted] specimens using both the embedded pin and z-frame methodologies. The corrected measurements from the embedded pins agree closely with the average z-frame expansion measurements.

Table 1. Expansion Measurement Summary

[redacted]

Figures 5 through 14 provide the expansion profile for each test specimen using the [redacted] measurement locations along the z-frame. The red line in each plot corresponds to the measured value (uncorrected) from the embedded pins. The [redacted] blue dots represent the [redacted] z-frame measurements and the dashed blue line is average of the z-frame measurements.

These figures show that the expansion measured near the edge of the beam (i.e., where the large crack exists) is consistent with the expansion measured over the entire beam height. Therefore, the corrected expansion values obtained from the embedded pins are representative of expansion throughout the test specimen.

[redacted]

Figure 5. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 6. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 7. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 8. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 9. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 10. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 11. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 12. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 13. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

[redacted]

Figure 14. Expansion Profile of Specimen [redacted] (as Measured with Z-Frame)

The z-frame data and the observations from sectioning indicate that while total expansion in the through-thickness direction is consistent across the profile of the test specimen, the cracking behavior is different. These observations suggest that along the specimen edges, expansion is concentrated in the large crack; whereas away from the edges, expansion is distributed into finer cracks across the specimen cross-section. Figure 15 illustrates this expansion behavior.

[redacted]

Figure 15. Expansion Behavior of Test Specimens

Methodology for Obtaining Cores from Test Specimens

The methodology for determining expansion to date at Seabrook Station (i.e., normalized elastic modulus) requires obtaining cores to determine elastic modulus of ASR-affected concrete. The correlation in MPR-4153 (Reference 6) is based on elastic modulus data from cores removed from the test specimens. The laboratory removed cores from the center portion of the test specimens, where expansion is distributed across the beam width in many fine cracks. Therefore, the cores would include expanded concrete that would be representative of the bulk specimen and of a structural component at Seabrook Station, which would not have free edges. Figure 16 illustrates the location of coring from the test specimens. Coring at Seabrook Station will also be in the through-thickness direction.

[redacted]

Figure 16. Coring Location in Test Specimens

Observations from Material Property Testing and In-Plane Expansion Monitoring

In addition to expansion monitoring, the laboratory has been monitoring material properties of the test specimens as an independent means for monitoring progression of ASR. Figures 17, 18, and 19 show the material properties as a function of through-thickness expansion for test specimens from the shear test program, reinforcement anchorage test program, and the instrumentation program.

[redacted]

Figure 17. Normalized Compressive Strength of Test Specimens

[redacted]

Figure 18. Normalized Elastic Modulus of Test Specimens

[redacted]

Figure 19. Normalized Tensile Strength of Test Specimens

Figures 17 through 19 identify no discernible difference between the test specimens over the course of aging, despite the differences in the design of the test specimens:

- The shear test specimens included [redacted] stirrups ([redacted] rebar) at each end of the beam, the reinforcement anchorage test specimens included [redacted] stirrups ([redacted] rebar) at each end of the beam, and the instrumentation beam did not have any stirrups.
- The shear and reinforcement anchorage test specimens were [redacted] in height and the instrumentation test specimen was [redacted] in height.
- The reinforcement anchorage test specimens and the instrumentation test specimen included longitudinal reinforcement at a [redacted] interval. The shear test specimens included longitudinal reinforcement at a [redacted] interval. Therefore, the shear test specimens had a higher reinforcement ratio in the longitudinal direction.

The consistent relationship between material properties and expansion for the various beam designs suggests that the specific boundary conditions of a particular specimen design do not affect the aging mechanism or the measured material properties. Therefore, results can be broadly applied to Seabrook Station where similar differences in configuration exist in reinforced concrete structures around the site.

Expansion monitoring information in the in-plane directions also supports the conclusion that the test program results are applicable to the range of reinforced concrete structures at Seabrook

Station. FSEL monitored expansion in the in-plane directions using both embedded pins and combined cracking index. Despite the difference in reinforcement ratio between the shear test specimens and the reinforcement anchorage test specimens, the in-plane expansion of all specimens has stabilized at approximately [redacted].

Conclusions on Representativeness of Test Results

Based on the discussions above, the through-thickness expansion observed and measured (with correction) on the large-scale test specimens is representative of ASR effects on actual structures at Seabrook Station and is appropriate for correlation of structural test results. Key conclusions from these discussions include the following:

- The approach for the test programs is to supplement the design code for Seabrook Station, ACI 318-71, by determining an appropriate reduction factor to reflect ASR development for the structural capacity calculated using code equations. This approach is appropriate, because the test program methodology is consistent with the methods used to generate the data on which the code equations are based. Because the approach for the test programs supplements (rather than replaces) the design code, results from appropriately representative test specimens may be applied for reinforced concrete structures throughout Seabrook Station that conform to the design code.
- The design of the large-scale test specimens is significantly more representative of Seabrook Station than the small specimens used for testing in publicly-available literature. The specimens were designed to represent a range of structural configurations that enables application of test results to all reinforced concrete structures at Seabrook Station.
- Sectioning of selected beam specimens confirmed that the large cracking on the surface of beam specimens between the reinforcement mats is an edge effect that is not expected to occur in structures at Seabrook Station.
- Z-frame measurements demonstrate that expansion measured with embedded pins, as corrected for gauge length, is a strong representation of expansion throughout the shear and reinforcement anchorage test specimens.
- Expansion away from the edges of the specimen is characterized by fine cracking across the beam width, so cores obtained from this region are sufficiently representative of the bulk condition of the test specimen.
- Test data show that differences in specimen geometry and reinforcement do not affect aging of the concrete by ASR. This conclusion supports general applicability of the test results to structures at Seabrook Station.

2. For ASR-affected surfaces at Seabrook Station, NextEra will monitor volumetric effects of ASR expansion by obtaining measurements in both the in-plane and through-thickness directions. Specifically, the ASR AMP specifies monitoring combined cracking index (CCI) for in-plane expansion and extensometer measurements for through-thickness expansion. Data analysis from the large-scale test programs is ongoing and monitoring thresholds for the ASR

AMP will be developed based on the test reports. However, the overall methodology for using in-plane and through-thickness expansion values for various aspects of the ASR AMP is summarized as follows.

- Initial screening for ASR will be performed using CCI only. CCI values exceeding a defined low-level threshold 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).

  The test programs indicated that direction of expansion is not significantly affected by the reinforcement when expansion is at or below [redacted] Beyond this expansion level, the two-dimensional reinforcement mats provide confinement in the in-plane directions, and through-thickness expansion dominates. Figure 20 describes the observed expansion of a representative specimen.

[redacted]

Figure 20. Expansion of Specimen A5[1]

[1] Figure 20 is for illustrative purposes only. All measurements described in Figure 20 were performed using an approved test procedure. However, periodic monitoring of expansion is considered for information only, whereas the measurements at the time of testing are formal test measurements.

- 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, the ASR AMP specifies that if the CCI exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the structure.

  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 microcracks parallel to the axis of an anchor, mainly in the concrete cover. These microcracks 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 microcracks perpendicular to the axis of an anchor. These potential microcracks 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 microcracks 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.

- For shear and reinforcement anchorage performance, the large scale test programs show that ASR does not have an effect until at least the maximum through-thickness expansion observed in the test programs. Therefore the ASR AMP specifies that if through-thickness expansion exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the structure. NextEra will determine through-thickness expansion from the sum of the calculated pre-instrument expansion (using the methodology of MPR-4153) and subsequent measurements with an extensometer.

  This approach is based on the observed expansion behavior of the test specimens, in which expansion in the through-thickness direction was dominant. (See Figure 20.) It is not necessary to also incorporate in-plane expansion, which represents a very small proportion of the volumetric strain.

3. NextEra has performed a complete revision of the ASR AMP (Enclosure 4) to incorporate the most up-to-date information on plans for managing ASR at Seabrook Station. This latest revision includes the currently available information from the large scale test programs and plans for using the final data from the test programs, as discussed above. The ASR AMP and the UFSAR supplement have also been updated to reflect the discussion above and the content of MPR-4153. After the test program reports have been issued, the ASR AMP will be updated to reference the test program reports for the specific thresholds for expansion that trigger further evaluation in accordance with Element 10 "Operating Experience".

RAI B.2.1.31A-5(a2): *Uncertainties and Variations Associated with Estimate of Normalized Modulus*

Background:

In its response to RAI B.2.1.31A-5(a), dated June 30, 2015, the applicant included as Enclosure 4 the report MPR-4153, Revision 1, "Seabrook Station – Approach for Determining Through-Thickness Expansion from Alkali-Silica Reaction (Proprietary)" as the technical basis for the proposed methodology to quantitatively relate the extent alkali-silica reaction (ASR) in existing plant structures at Seabrook Station to the results of the large-scale test program at the FSEL. Figure 3-3 and Equation 1 of the report show the development of the correlation between normalized concrete modulus and expansion data from the test specimens. Based on Sections 3.1.1 and 3.2.1 of report MPR-4153, the normalized modulus value used in Figure 3-3 and Equation 1 of the report for developing the relationship between normalized modulus and through-thickness expansion, is the ratio (E_t/E_0) of the elastic modulus by testing cores extracted from the specimen at the time of expansion measurement (E_t) to the 28-day elastic modulus (E_0) obtained by testing cylinders (8 inches in height and 4 inches in diameter), that were molded at the time of specimen fabrication, at age 28 days.

Section 3.3 of report MPR-4153 describes two approaches for obtaining elastic modulus at 28 days in Seabrook structures for the purpose of normalization and determining the expansion to date. "Approach 1" uses 28-day elastic modulus calculated using the American Concrete Institute (ACI) 318 equation based on original concrete cylinder strength (f'_c) measured at 28 days. For "Approach 2," MPR-4153 states that it plans to test the elastic modulus of the cores obtained during installation of extensometers at "control locations where ASR has not affected the structure." MPR-4153 states that the applicant "should evaluate selection of a representative reference core on a case-by-case basis.

In both approaches, there are variations introduced in the estimate 28-day elastic modulus from the use of the ACI 318 equation based on 28-day cylinder strength ("Approach 1") or measured elastic modulus from cores because of change (i.e., increase) in concrete strength with age ("Approach 2"). In both cases, the normalized modulus at the time of installation of extensometers is determined as the ratio of the measured modulus on cores extracted at the installation location to the 28-day modulus estimate from Approach 1, or Approach 2, or both.

Section 3.3.1 of MPR-4153, states:

> NextEra has retrieved records for concrete fabrication from original construction for selected buildings...For structural assessment of particular concrete members; application of values from [MPR Calculation 0326-0062-CLC-02] will need to be evaluated on a case-by-case basis to determine whether the available data are sufficiently representative of the concrete being evaluated. NextEra may need to retrieve additional original construction records to implement this approach.

Section 4.2 of MPR-4153 discusses an uncertainty value related to the approach for determining original elastic modulus but does not give any information regarding the methodology for determining this uncertainty value.

Issue:

- Report MPR-4153 does not provide the size, orientation, and locations of cores extracted from test specimens to be used in conducting tests for concrete material properties at the time of expansion measurement and load test.

- It is not clear if using the concrete material properties (i.e., modulus); from cylinder test, data at 28-days and core test data from the large scale beam specimens at the time of expansion measurement is appropriate for normalization of elastic modulus to determine ASR degradation. It is not clear whether the error associated with variations such as type of specimen (cylinder vs core) and size (diameter, d; height, h; and h/d ratio) of test specimens used may influence the values obtained for the normalized modulus were considered in the calculation of uncertainty or in the development of the correlating factors between expansion and normalized modulus.

- It is not clear what value of f'c (mean, median, or probability of exceedance consistent with the statistical basis in the ACI 318 code) will be used in the ACI 318 equation for arriving at the 28-day elastic modulus based on 28-day test data of cylinder strength.

- With regard to the statement from Section 3.3.1 of MPR-4153 referenced in the "Background" section above, it is not clear how the applicant will assess the data and the criteria to be used to determine whether the available data are "sufficiently representative." It is not clear whether original data is available and if not, how the inputs to the modulus calculation will be determined.

- Uncertainties and variations associated with the recommended correlating approach based on estimate of normalized elastic modulus on the test specimens and on Seabrook structures are not addressed and it is not clear whether they need to be addressed statistically in a bounding manner.

Request:

The staff requests information for resolution of the issues in the issue section.

1) Provide additional information regarding the methodology used to determine the uncertainty value associated with developing the empirical relationship between concrete material property and measured expansion. Include the basis for determination of the uncertainty

value used for the normalized correlation between expansion and reduction in elastic modulus.

2) Discuss whether and how the methodology considered factors such as size variation, orientation and locations of cores from the test specimens used in measuring concrete material properties, including elastic modulus. In addition, discuss whether and how the methodology considered uncertainty or errors associated with comparison between concrete cylinders 28-day test data and extracted cores. If these factors were not considered, provide technical justification that such consideration is not needed.

3) Clarify, with the basis, what value of f'c (mean, median, or probability of exceedance consistent with the statistical basis in the ACI 318 code) will be used in the ACI 318 equation in "Approach 1" for arriving at the 28-day elastic modulus based on 28-day test data of cylinder strength of Seabrook structures.

4) With regard to the statement from Section 3.3.1 of report MPR-4153 referenced in the "Background" section above, clarify how the applicant will assess the data and the criteria to be used to determine whether the available data are "sufficiently representative." Also clarify whether "original data" referenced in that statement are available and if not, how the inputs to the modulus calculation will be determined.

NextEra Energy Seabrook Response to RAI B.2.1.31A-5(a2)

Summary of MPR-4153 Methodology

The correlation in MPR-4153 relates normalized elastic modulus to through-thickness expansion. Normalized elastic modulus is the ratio of the elastic modulus at the time of interest (i.e., from material property testing of the removed cores) to the original elastic modulus. Elastic modulus was the material property selected for the correlation (rather than compressive strength or splitting tensile strength), because elastic modulus was the most sensitive to expansion and the most repeatable.

MPR-4153 recommends two different methods for determining the original elastic modulus, as summarized below:

- Approach 1 - Use original construction records to determine the 28-day compressive strength of the concrete. Apply the ACI 318 correlation relating compressive strength to elastic modulus to calculate the 28-day elastic modulus, which is used as the original elastic modulus.
- Approach 2 - Identify a location from the same concrete placement as the concrete surface of interest that does not appear to be affected by ASR. Obtain cores from this location and

perform material property testing to determine elastic modulus of non-ASR-affected concrete, This non-ASR core is used as the original elastic modulus.

NextEra will select an appropriate approach to determine the original elastic modulus based on the specific circumstances for each location of interest. NextEra would prefer to use Approach 1, because it requires fewer cores. However, this approach may not be practical in all cases, depending on the effort required to retrieve the compressive strength test records for a specific concrete placement. Approach 2 provides an alternate methodology.

Pending Update to MPR-4153

At the time MPR-4153 was published, only a portion of the test data were available, as testing had not yet been performed on [redacted] of the [redacted] test specimens. Data from all of the test specimens and the final report from the laboratory will be transmitted by test reports and commercially dedicated by the end of 2015. After all data are available (i.e., in early 2016), MPR-4153 will be updated and a treatment for uncertainty will be included. (The data not included in the previously-transmitted version of MPR-4153 were for expansion levels markedly higher than our estimate of the expansion levels currently exhibited at Seabrook Station. Therefore, the correlation is not expected to significantly change in the region of the curve that reflects the current conditions at the plant.)

NextEra plans to install extensometers at Seabrook Station to monitor expansion in selected locations affected by ASR. Installation of extensometers requires core boring into the concrete surface in question. The methodology specified in MPR-4153 relies on elastic modulus data from concrete cores of an ASR-affected surface to determine the expansion that had occurred. At Seabrook Station, the cores removed to enable extensometer installation will also be tested to determine the elastic modulus of the concrete.

1 & 2. The methodology described in MPR-4153 considered the factors identified by RAI B.2.1.31A-5(a2) for contributions to uncertainty. As discussed above, Revision 1 of MPR-4153 did not include a quantitative evaluation of uncertainty. A qualitative discussion of each contributor to uncertainty identified by RAI B.2.1.31A-5(a2) is provided as follows:

- Size Variation - Cores obtained from large scale test specimens were approximately 4.0 inches in diameter. At Seabrook Station, all new cores obtained for the ASR program will be obtained with a bore that will yield a core with a diameter of approximately 4.0 inches.

  Cores obtained from the large scale test specimens were trimmed to a length of approximately 8.0 inches to satisfy the target length-to-diameter ratio of 2.0 (which is the median of the 1.9 to 2.1 range specified by ASTM C42). Cores obtained from Seabrook Station will also be trimmed to approximately 8.0 inches.

  Because the approximate dimensions of the cores obtained from the large scale test specimens and the cores from Seabrook Station will be identical, uncertainty associated with size variation will be negligible. Further, material tests of specimens with these dimensions do not require corrections for reduced size specimens.

- Orientation - For the large scale test program, the laboratory obtained most cores by drilling into the face of the test specimen representative of the interior wall at Seabrook Station (i.e., perpendicular to the face with two inches of cover above the reinforcement mat). Most cores obtained from Seabrook Station will also be from interior wall surfaces, including all surfaces monitored below grade. NextEra will install selected extensometers above grade on exterior concrete surfaces, which have three inches of cover above the reinforcement mat. This small difference in cover will not have a significant effect on confinement of the concrete in the core.

  The orientation of cores obtained from the large scale test specimens and cores obtained from Seabrook Station will be the same (i.e., perpendicular to the embedded reinforcement mats). Therefore, there is no uncertainty related to orientation of the core relative to the dominant direction of expansion.

- Locations of Cores - For the large-scale test program, the laboratory obtained cores from locations that were in the central portion of the specimens, through the openings in the reinforcement mats. As discussed in the response to RAI B.2.1.31A-5(a1), these locations are not subject to edge effects. Additionally, laboratory procedures required strict controls on specimen treatment (e.g., exposure in the environmental conditioning facility), so exposure conditions were consistent across the entire specimen. Therefore, variability in ASR development within a test specimen is expected to be low.

  At Seabrook Station, ASR-related expansion is not typically consistent across a single concrete member. The locations for extensometer placement (and therefore coring) will be the areas that have the greatest symptoms of ASR-related expansion. This approach will conservatively characterize the elastic modulus of the concrete member in question. Because this approach is inherently conservative, quantitative treatment of uncertainty for core location may not be necessary.

- Cylinders vs. Cores - The data used for preparing the correlation in MPR-4153, Approach 1, and Approach 2 all determine elastic modulus at the time of interest (i.e., the numerator) by testing removed cores. Differences in determination of original elastic modulus (i.e., the denominator) may contribute to uncertainty of the methodology described in MPR-4153.

  - For the data used to prepare the correlation in MPR-4153, the original elastic modulus is the average elastic modulus test result from cylinders tested 28 days after specimen fabrication.

  - For Approach 1 at Seabrook Station, the original elastic modulus would be calculated from the average compressive strength test result of cylinders tested 28 days after the concrete was placed.

  - For Approach 2 at Seabrook Station, the original elastic modulus would be the average elastic modulus test result of "reference" cores obtained at the time of extensometer installation. The reference cores will be obtained from a nearby area from the same concrete placement that does not exhibit signs of ASR.

For Approach 2, the coring process can cause internal damage to the concrete in the core and impact measured material properties. The compressive strength of a core is expected to be lower than the compressive strength of a cylinder from the concrete it represents because of damage incurred during the coring process. Elastic modulus of a core may also be biased low for the same reason. However, for Approach 2, the concrete will have had decades of additional time to cure, which affects material properties, albeit at a slow rate. This factor increases the compressive strength relative to a 28-day cylinder and may also bias elastic modulus high for the same reason. These factors have opposite effects on the normalized material property and are potentially offsetting. The upcoming revision of MPR-4153 will include an evaluation of the combined effect of these factors.

While Approach 1 does not require coring to determine original elastic modulus, NextEra notes that the use of the ACI correlation in Approach 1 for calculating elastic modulus from compressive strength introduces uncertainty. ACI 318 states that this correlation provides a calculated elastic modulus to within ±20%. Calculation 0326-0062-CLC-01 (Appendix B of MPR-4153) demonstrated that this range was consistent with the data from the large scale test programs, which supports application of the ACI correlation to concrete at Seabrook Station.

Revision 2 of MPR-4153 will include expanded discussions of the above issues.

MPR-4153 Section 4.2 acknowledges the potential influence of uncertainty with the correlation between normalized modulus and expansion, focusing on the sensitivity of expansion to the measured modulus. This section notes that the sensitivity of the correlation is higher when normalized elastic modulus is less than [redacted], so uncertainty would have a greater impact in that region of the relationship.

3. As noted in RAI B.2.1.31A-5(a2), the uncertainty associated with Approach 1 from MPR-4153 may be different than the uncertainty associated with Approach 2. The factors associated with each approach will be considered in the application of the methodology at Seabrook Station to ensure that the estimate of expansion to date is conservative.

   Treatment of the compressive strength data as an input for the Approach 1 methodology for determining original elastic modulus will depend on the available information for the location in question.

   - If NextEra traces the 28-day cylinder compressive strength results from an original construction record to a particular concrete member, the average 28-day compressive strength value of those cylinders will be used. It is appropriate to use the mean as the objective is to estimate expansion to date; it is not used directly in a structural evaluation.
   - If a broader data set is applied (e.g., the statistical results for compressive strength for all concrete placements of a given mix design), then an appropriately conservative approach will be selected and justified (e.g., applying a compressive strength value higher than the average by a certain factor of the standard deviation).

4. Approach 1 requires that the input data for compressive strength of 28-day cylinders be representative of the concrete being evaluated.

- If NextEra establishes traceability from the original construction record to the specific concrete member being evaluated, then the data are sufficiently representative to enable use of the average compressive strength.
- If NextEra uses a broader data sample that is not directly linked to the specific concrete member being evaluated (e.g., compressive strength test results from other locations in the same building, or the statistical results for compressive strength for all concrete pours of a given mix design), then an evaluation for representativeness will be performed to ensure that the calculation is appropriately conservative. The specific criteria associated with this evaluation will vary depending on the data set and its intended application.

Ultimately, if NextEra concludes that the available data are not sufficiently representative, Approach 2 provides an alternative method to obtain the information on original elastic modulus.

NextEra has researched original construction records throughout its efforts to evaluate ASR-affected concrete at Seabrook Station, and has demonstrated that these records are available and retrievable. However, the experience to date indicates that the effort to identify the concrete batch for a specific location (i.e., building, wall, and elevation) and retrieve the specific test record may be impractical for all locations to be evaluated.

RAI B.2.1.31A-5(a3): *Representative Sample for Monitoring Through-wall Expansion*

Background:

The applicant's response to RAI B.2.1.31A-5(a), dated June 30, 2015, states that the ASR Monitoring Program will be enhanced (revised Commitment No. 83) to install borehole extensometers in at least 34 representative locations that the applicant has stated are representative of the ASR on site such that the program will monitor, trend, and assess ASR expansion in the out-of-plane (through-wall) direction.

Section A.1.2.3.4 "Detection of Aging Effects" of Appendix A.1 "Aging Management Review – Generic (Branch Technical Position RLSB-1) of SRP-LR states, in part:

> For a condition monitoring program, when sampling is used to represent a larger population of SCs, applicants should provide the basis for the inspection population and sample size. The inspection population should be based on such aspects of the SCs as a similarity of materials of construction, fabrication, procurement, design, installation, operating environment, or aging effects. The sample size should be based on such aspects of the SCs as the specific aging effect, location, existing technical information, system and structure design, materials of construction, service environment, or previous failure history. The

samples should be biased toward locations most susceptible to the specific aging effect of concern in the period of extended operation. Provisions on expanding the sample size when degradation is detected in the initial sample should also be included.

Section A.1.2.3.4 "Detection of Aging Effects" of the SRP-LR also states that this program element describes "when," "where," and "how" program data are collected (i.e., all aspects of activities to collect data as part of the program), including how frequently evaluated. The section further states that the discussion should provide information that links the parameters to be monitored or inspected to the aging effects being detected and managed prior to loss of function.

Issue:

1) The response to RAI B.2.1.31A-5(a), dated June 30, 2015, does not include an update to the "detection of aging effects" program element of the ASR Monitoring Program with the information recommended in Section A.1.2.3.4 of SRP-LR (as described in the Background section) with regard to the representative sample of locations and aspects of activities to collect and evaluate data in the program enhancement to monitor out-of-plane ASR expansion.

2) In the breakdown of number of instruments to be installed provided in the applicant's response to RAI B.2.1.31A-5(a), Issue No. 3, almost 50 percent of the extensometers are to be installed in "Tier 1" ASR locations and over 50 percent will be installed in "Ambient Weather Conditions." The staff needs additional information to determine whether the chosen locations and sample will be sufficient to manage through-wall cracking.

3) ASR damage is likely to progress more quickly in areas of high humidity and temperature. It is not clear, from the tables given in the RAI response, whether the most severe areas are well-represented. It is also not clear whether the areas that exhibit the highest combined crack index (CCI) are the most severely affected areas, and the criteria that will be used to determine if an increase in sample size is required.

4) The response to RAI B.2.1.31A-5(a) does not appear to address the durability and long-term reliability of the borehole extensometer proposed to be used to monitor out-of-plane expansion, and how the measurements would continue if an extensometer became non-functional in service. The response also does not discuss the data acquisition system that will be used to gather and process data from the proposed extensometers to ensure adequate aging management.

Request:

The staff requests information for resolution of the issues in the Issue section with regard to the representative sample for monitoring through-wall expansion. Also, the staff requests the applicant to update the "detection of aging effects" program element to the ASR Monitoring Program and UFSAR supplement, as applicable and appropriate (based on the response).

1) Provide an update to the "detection of aging effects" program element of the ASR Monitoring Program with information recommended in Section A.1.2.3.4 of SRP-LR (as stated in the background section) to describe the basis for (a) the inspection population and sample size and (b) all aspects of activities to collect data, including how frequently the data are sampled and evaluated, regarding representative sample of locations in the program enhancement to monitor out-of-plane ASR expansion.

2) Provide additional information to demonstrate the adequacy of sampling locations for through-wall cracking management (i.e., determination of whether the chosen locations and sample will be sufficient to manage through-wall cracking).

3) Provide additional information to demonstrate the bounding conditions of the aging management measures relative to (a) sampling most severe locations (correlation with CCI) and (b) triggering point for increasing sample size.

4) Provide additional information to demonstrate the reliability of the aging management measures relative to durability of supporting instrumentation (e.g., borehole extensometer and data acquisition system).

NextEra Energy Response to RAI B.2.1.31A-5(a3)

1. NextEra has revised the approach for monitoring through-thickness expansion to install extensometers in all Tier 3 locations. These values have CCI of greater than 1 mm/m, [redacted] The revised ASR AMP incorporates this change.

LRA Appendix A, Section A.3, Commitment #83 has been revised as follows:

83.	Alkali-Silica Reaction Monitoring	***Enhance the ASR AMP to install extensometers in Tier 3 areas of 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 through the period of extended operation.	A.2.1.31A	December 31, 2016.

As previously established for Tier 3 monitoring; NextEra plans to perform semiannual monitoring of extensometers to provide a baseline for variability in extensometer readings.

Specific thresholds for triggering additional evaluation will be identified following evaluation of the large scale test program results. A description of the monitoring approach and its basis are included in the response to RAI B.2.1.31A-5(a1).

2. As discussed above, the ASR AMP (Enclosure 4) has been updated to specify installation of extensometers at all Tier 3 locations. NextEra currently plans to install extensometers in all Tier 3 locations, which will ensure that the most limiting locations for ASR development are being monitored. NextEra also plans to install extensometers in selected locations where CCI is less than 1.0 mm/m.
3. As discussed above, the ASR AMP (Enclosure 4) has been updated to specify installation of extensometers at all Tier 3 locations. This change ensures that the locations with greatest ASR development are being monitored. A triggering point for increasing the sample size for extensometers in Tier 3 locations is not necessary, because all Tier 3 locations will be monitored.

4. NextEra will install Snap-Ring Borehole Extensometers (SRBEs) at Seabrook Station to monitor through-thickness expansion. The Instrument Evaluation Program evaluated performance of the SRBEs 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 specimen conditioning through temperature cycles and extended exposure to high humidity. Successful operation in these conditions demonstrates that the SRBEs will perform satisfactorily in 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 rod. There is no data acquisition system used to obtain measurements. 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), NextEra could install another SRBE nearby to the failed location and continue expansion monitoring.

RAI B.2.1.31A-5(a4): CCI as a surrogate for ASR expansion in the in-plane direction

Background:

The applicant's response to RAI B.2.1.31A-5(a), dated June 30, 2015, for Issue 1 states that "CCI [Combined Crack Index] is used as a surrogate for accumulated strain from ASR expansion in the in-plane directions."

In the changes to LRA Section B.2.1.31A by letter dated September 13, 2013, under "Program Description," the applicant provided the basis for use of the crack index methodology on page 8 of 18 of Enclosure 1. The applicant states "The total strain in the concrete can be approximated as the sum of the strain at crack initiation plus the crack index ($\varepsilon = \varepsilon_{cr} + CI$)..." The applicant provided an illustration in Figure A-1 of the expansion in ASR-affected concrete and goes on to conclude that "the Cracking Index (CI) provides a reasonable approximation of the total strain applied to the concrete after crack initiation." SRP-LR, Section A.1.2.3.3, states that the "parameters monitored or inspected" program element should provide a link between the parameters that will be monitored and how monitoring these parameters will ensure adequate aging management.

Issue:

While continued surface crack indexing may be a necessary component for a complete measure of ASR expansion, which is volumetric in nature, there is a lack of clarity in the ASR Monitoring Program with regard to the following.

- It is not clear whether the applicant's statement referenced in the "Background" section is indicating that the large-scale test program directly measures rebar strain and correlates to CCI. For its review, the staff needs additional information in support of the statement that CCI is a "surrogate for accumulated strain."

- In order to maintain strain compatibility between concrete and rebar in ASR-affected concrete, the strain in the rebar will be equal to the strain applied to the concrete. Therefore, a CCI of 1 mm/m (which is the acceptance criteria used in the program to distinguish between Tier 2 and Tier 3 criteria for initiation of a structural evaluation corresponds to 1 millistrain of expansion resulting in rebar stress of 29 ksi. The staff is concerned that this may represent a significant magnitude of rebar stress due to ASR expansion that has not been or will not be accounted for during the period of extended operation. The program does not address rebar strain limits as compared to ASR progression through the period of extended operation to ensure the concrete maintains its design functionality.

- The current AMP uses the Tier 1-2-3 approach to determine monitoring frequency and it relies upon CCI in two directions. It is not clear if and how CCI will be used to characterize ASR progression during the period of extended operation. Also, there is lack of clarity with regard to the correlation of CCI with anchor bolt capacity.

- It is not clear whether in-plane cracking measurements will be used, qualitatively or quantitatively, in conjunction with through-wall expansion measurement data, to characterize ASR severity or progression.

Request:

The staff requests information for resolution of the issues in the Issue section.

1) Clarify the physical significance of CCI as a surrogate for strain in rebar due to ASR as explained in the applicant's revision to LRA Section B.2.1.31A by letter dated September 13, 2013, and whether and how the corresponding rebar stress is accounted for.

2) Clarify whether the large-scale test program directly measures rebar strain and correlates to CCI. Provide the technical basis as to how CCI correlates to stress in the rebar and how rebar stress is quantified.

3) Describe the role of CCI in the large scale test program with regard to correlating the test results to Seabrook structures and components, including evaluating impact on anchor capacity.

4) Clarify, with supporting basis, if and how the program will account for information gained from the elastic modulus testing in terms of comparison of ASR severity for monitoring purposes.

5) Clarify whether in-plane cracking measurements will be used, qualitatively or quantitatively, in conjunction with through-wall expansion measurement data, to characterize ASR severity or progression.

6) Update program elements and UFSAR supplement, as applicable, based on the responses.

NextEra Energy Seabrook Response to RAI B.2.1.31A-5(a4)

For ASR-affected surfaces at Seabrook Station, NextEra will monitor volumetric effects of ASR expansion by obtaining measurements in both the in-plane and through-thickness directions. Specifically, the ASR AMP specifies monitoring combined cracking index (CCI) for in-plane expansion and extensometer measurements for through-thickness expansion.

1. Concrete has minimal capacity to expand before cracking. Therefore, measurement of concrete expansion can be well approximated by crack width summation (e.g., CCI). While true engineering strain is represented by the sum of material elongation and crack widths, the crack width term rapidly dominates the overall expansion.

   As shown in response to RAI B.2.1.31A-5(a1); Figure 20, CCI values agree closely with the observed expansion from embedded pins. The expansion values measured using embedded pins are a better measure of true engineering strain because these measurements reflect both material elongation and crack width. However, because of the close agreement with CCI, results from the large-scale test program for expansion monitoring support use of CCI as an approximation for in-plane expansion.

   The bond between the concrete and the reinforcement prevents relative displacement (i.e., slip), so expansion of a reinforced concrete member will have an equal effect on the concrete and the reinforcement. Concrete expansion and rebar expansion are therefore identical, and CCI is also a reasonable approximation for rebar strain.

   In reinforced concrete, expansion of concrete due to ASR is restrained by the steel reinforcement. As ASR develops, the result is a tensile stress in the reinforcement and a compressive stress in concrete, which is necessary for structural equilibrium. External tensile loading will not result in increased tensile stress in rebar until the concrete compressive stress is overcome. This effect is known as pre-stressing.

   The structural tests inherently account for rebar strain, which has occurred in the ASR-affected test specimens. However, structural test results from the large-scale test programs indicate no loss of shear capacity or reinforcement anchorage due to ASR at expansion levels observed in the test programs. This observation demonstrates the effect of ASR-induced pre-stressing, which results in no loss of structural capacity even though rebar strain has occurred. A more specific treatment of the pre-stressing effect will be included in the test report of the shear and reinforcement anchorage test programs. This report will be published after completion of the test programs in December 2015.

2. The large-scale test programs include measurements of CCI on the concrete surfaces parallel to the reinforcement mats in addition to direct measurement of concrete expansion using embedded pins. As discussed in the response to Request #1, these CCI measurements provide a reasonable approximation of the total strain in the concrete and the embedded reinforcement

in the in-plane directions after crack initiation. The large scale test programs did not include a direct measurement of rebar strain.

Rebar stress in the test specimens can be determined based on the CCI and the steel elastic modulus. However, the key quantitative measure from the large scale test programs was structural capacity of the reinforced concrete test specimens. As discussed in the response to Request #1, ASR-induced expansion did not result in a reduction in structural capacity, even though ASR-induced expansion does result in rebar stress. The reason for this observation is the pre-stressing effect.

3. CCI was one of the methods for monitoring expansion in test specimens in the large-scale test program. At Seabrook Station, CCI will be used for initial screening of locations potentially affected by ASR and for evaluating the capacity of anchors in ASR-affected concrete. CCI will not be used for evaluation of ASR-affected concrete for shear capacity or reinforcement anchorage. See response to Request #2 of RAI B.2.1.31A-5(a1) for additional discussion.

4. Elastic modulus testing of cores obtained during installation of extensometers at Seabrook Station will be used to calculate through-thickness expansion to date of the concrete component being evaluated. The calculated pre-instrument expansion will be added to the measurement obtained from the extensometer to determine total expansion. NextEra will compare this total expansion to the specific threshold defined in the ASR AMP to determine if additional structural evaluation is necessary.

   Because direct measurement of the extensometer will be used for monitoring in the future, monitoring for degradation of elastic modulus is not required beyond the initial coring at the time of extensometer installation. Specific limits on elastic modulus are also not required, since the total expansion criterion will address the monitored parameter (i.e., expansion) that elastic modulus test results are used to determine. Additionally, the elastic modulus values obtained at the time of extensometer installation will not be used as part of structural evaluations, because they are not representative of structural performance of ASR-affected reinforced concrete components.

5. As previously discussed, NextEra will monitor volumetric effects of ASR expansion by obtaining measurements in both the in-plane and through-thickness directions. Specifically, the ASR AMP specifies monitoring combined cracking index (CCI) for in-plane expansion and extensometer measurements for through-thickness expansion.

   The ASR AMP specifies that NextEra will continue monitoring ASR in all locations where an extensometer is installed. However, the criterion associated with shear capacity and reinforcement anchorage is based exclusively on through-thickness expansion. As discussed in the response to Request #2 in RAI B.2.1.31A-5(a1), combination of the in-plane and through-thickness values is not necessary because the in-plane expansion represents such a small proportion of the overall expansion.

6. NextEra has performed a complete revision of the ASR AMP (Enclosure 4) to incorporate the most up-to-date information on plans for managing ASR at Seabrook Station. This latest revision incorporates portions of the discussion above. NextEra has also updated the associated UFSAR Supplement (Enclosure 3) to reflect the responses above.

References

1. U.S. Nuclear Regulatory Commission Letter, "Request for Additional Information Related to the Review of the Seabrook Station License Renewal Application - Set 25 (TAC No. ME4028)," dated October 2, 2015.
2. NextEra Energy letter SBK-L-15024, "Response to Requests for Additional Information for the Review of the Seabrook Station, License Renewal Application - SET 23 (TAC NO. ME 4028) Relating to the Alkali-Silica Reaction (ASR) Monitoring Program," dated February 23, 2015.
3. NextEra Energy letter SBK-L-15107, "Response to Requests for Additional Information for the Review of the Seabrook Station, License Renewal Application - SET 23 (TAC NO. ME 4028) Relating to the Alkali-Silica Reaction (ASR) Monitoring Program," dated June 30, 2015.
4. NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," Revision 2.
5. MPR-3727, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 1. (Seabrook FP# 100716)
6. MPR-4153, "Seabrook Station - Approach for Determining Through-Thickness Expansion from Alkali-Silica Reaction," Revision 1. (Seabrook FP# 100918)

Enclosure 3 to SBK-L- 15202

Seabrook Station Updated Final Safety Analysis Report

Supplement Section A.2.1.31A for Alkali-Silica Reaction

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.

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

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

A Combined Cracking Index (CCI) is established at thresholds at which structural evaluation is necessary (see table below). The Cracking Index (CI) is the summation of the crack widths on the horizontal or vertical sides of 20-inch by 30-inch grid on the ASR-affected concrete surface. The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. A CCI of less than the 1.0 mm/m can be deemed acceptable with deficiencies (Tier 2). Deficiencies determined to be acceptable with further review are trended for evidence of further degradation. The change from qualitative monitoring to quantitative monitoring occurs when the Cracking Index (CI) of the pattern cracking equals or is greater than 0.5 mm/m in the vertical and horizontal directions.. Concrete crack widths less than 0.05 mm cannot be accurately measured and reliably repeated with standard, visual inspection equipment. A CCI of 1.0 mm/m or greater requires structural evaluation (Tier 3). All locations meeting Tier 3 criteria will be monitored via CCI on a ½ year (6-month) inspection frequency and added to the through-thickness expansion monitoring via extensometers. All locations meeting the Tier 2 structures monitoring criteria will be monitored on a 2.5 year (30-month) frequency. CCI correlates well with strain in the in-plane directions and the ability to visually detect cracking in exposed surfaces making it an effective initial detection parameter. 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 acceptance criterion of 1 mm/m a used provides sufficient margin.

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

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

Enclosure 4 to SBK-L- 15202

Seabrook Station Updated License Renewal Application Section

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

Aging Management Program

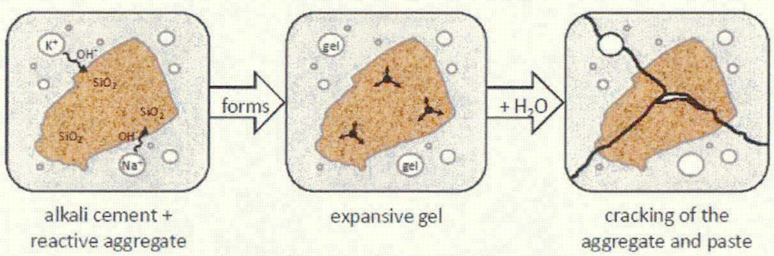
B.2.1.31A ALKALI-SILICA REACTION MONITORING PROGRAM

PROGRAM DESCRIPTION

NextEra Energy Seabrook Operating Experience (OE) indicates that Alkali-Silica Reaction (ASR) is present in concrete structures and will require monitoring though the Period of Extended Operation (PEO).

Alkali-Silica Reaction

ASR is an aging mechanism that may occur in concrete under certain circumstances. It was first identified and reported by Thomas Stanton in the late 1930s in the State of California. It is a reaction between the alkali ions in the concrete pore solution and reactive forms of silicate material (if present) in the aggregate. The reaction, which requires the presence of 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 cement paste. ASR is typically characterized by the presence of "map" or "pattern" cracking accompanied by dark staining.



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 and C227 standards, these standards were subsequently identified as limited in their ability to predict long term ASR for moderate to low reactive aggregates.

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 and potential local dimensional changes.

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 strength and elasticity values, and subjected to petrographic examinations. While the results showed that both strength and elasticity values had declined, they remained within the design margin. 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 groundwater impacted portions of below-grade structures, with limited impact to exterior surfaces of above grade structures.

Large-Scale Testing Program

The interim structural assessment (Reference document MPR-3727) 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. Based on the lack of representative literature data, Seabrook initiated large-scale test programs to evaluate shear capacity, reinforcement anchorage, and anchor bolt capacity of ASR-affected reinforced concrete. The large scale test programs are being executed by MPR Associates and the Ferguson Structural Engineering Laboratory (FSEL) at The University of Texas at Austin.

The large-scale test programs were designed to maximize representativeness of reinforced concrete structures at Seabrook Station using a reasonable number of test specimens. The specimens were designed to be representative of a reference location (i.e., the B electrical tunnel). To enable application of the results to other structures, the test results are compared to provisions in ACI 318-71 to determine an appropriate reduction factor to reflect ASR development for the structural capacity calculated using code equations. This approach is appropriate, because the test program methodology is consistent with the experimental methods used to generate the data on which the code equations from ACI 318 are based.

Seabrook Station includes many reinforced concrete structures and the specific configuration of structural components within those structures varies widely. Because the approach for the test programs supplemented (rather than replaced) the design code, results from appropriately representative test specimens may be applied for reinforced concrete structures throughout Seabrook Station. Additionally, the test specimen design represents actual structures at Seabrook Station to the maximum extent practical. The design of the test specimens considered many factors to maximize representativeness including, but not limited to, the following:

- Large specimen sizes to represent actual structures
- Reinforcement configuration representative to Seabrook
- Restraint to mimic context of an actual structure
- Concrete mix design based on Seabrook specifications

Results from the large-scale testing program can also be used to support evaluations of structures subjected to deformation. Specifically, the large-scale testing program provides insights on expansion behavior that can be used for engineering evaluations. For structural evaluations of components affected by deformation, the large scale testing program can be used in support of assessments for shear capacity, reinforcement anchorage, and anchor capacity. Building deformation could affect the function of structures and equipment in many ways (e.g., creating interferences between components, closing or widening seismic gaps, degrading fire seals or seismic gap seals, displacing piping, ducting or conduit). If such impacts occur, NextEra will address them based on the specific equipment configuration in the location of interest.

Monitoring Program

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.

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

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

A Combined Cracking Index (CCI) is established at thresholds at which structural evaluation is necessary (see table below). The Cracking Index (CI) is the summation of the crack widths on the horizontal or vertical sides of 20-inch by 30-inch grid on the ASR-affected concrete surface. The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. A CCI of less than the 1.0 mm/m can be deemed acceptable with deficiencies (Tier 2). Deficiencies determined to be acceptable with further review are trended for evidence of further degradation. The change from qualitative monitoring to quantitative monitoring occurs when the Cracking Index (CI) of the pattern cracking equals or is greater than 0.5 mm/m in the vertical and horizontal directions.. Concrete crack widths less than 0.05 mm cannot be accurately measured and reliably repeated with standard, visual inspection equipment. A CCI of 1.0 mm/m or greater requires structural evaluation (Tier 3). All locations meeting Tier 3 criteria will be monitored via CCI on a ½ year (6-month) inspection frequency and added to the through-thickness expansion monitoring via extensometers. All locations meeting the Tier 2 structures monitoring criteria will be monitored on a 2.5 year (30-month) frequency. CCI correlates well with strain in the in-plane directions and the ability to visually detect cracking in exposed surfaces making it an effective initial detection parameter. 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 acceptance criterion of 1 mm/m a used provides sufficient margin.

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

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

Acceptance Criteria
The ASR Monitoring Program can essentially be broken down into three (3) subsections, as follows:

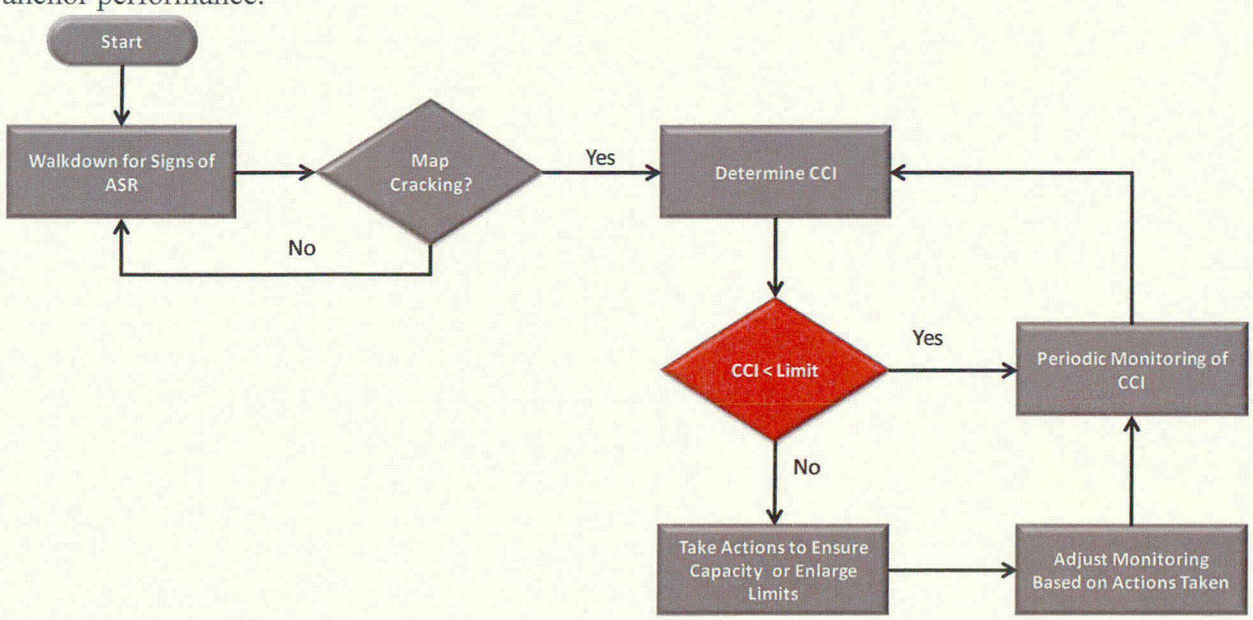
- Expansion monitoring – Anchors
- Expansion monitoring – Structural Capacity
- Expansion monitoring – Building Deformation

Expansion Monitoring– Anchor Performance
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, the ASR AMP specifies that if the CCI exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the anchors. The specific threshold will be defined by the results from the large scale test program, which will be available at a later date.

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.

The flowchart below describes the approach for monitoring expansion to confirm satisfactory anchor performance.



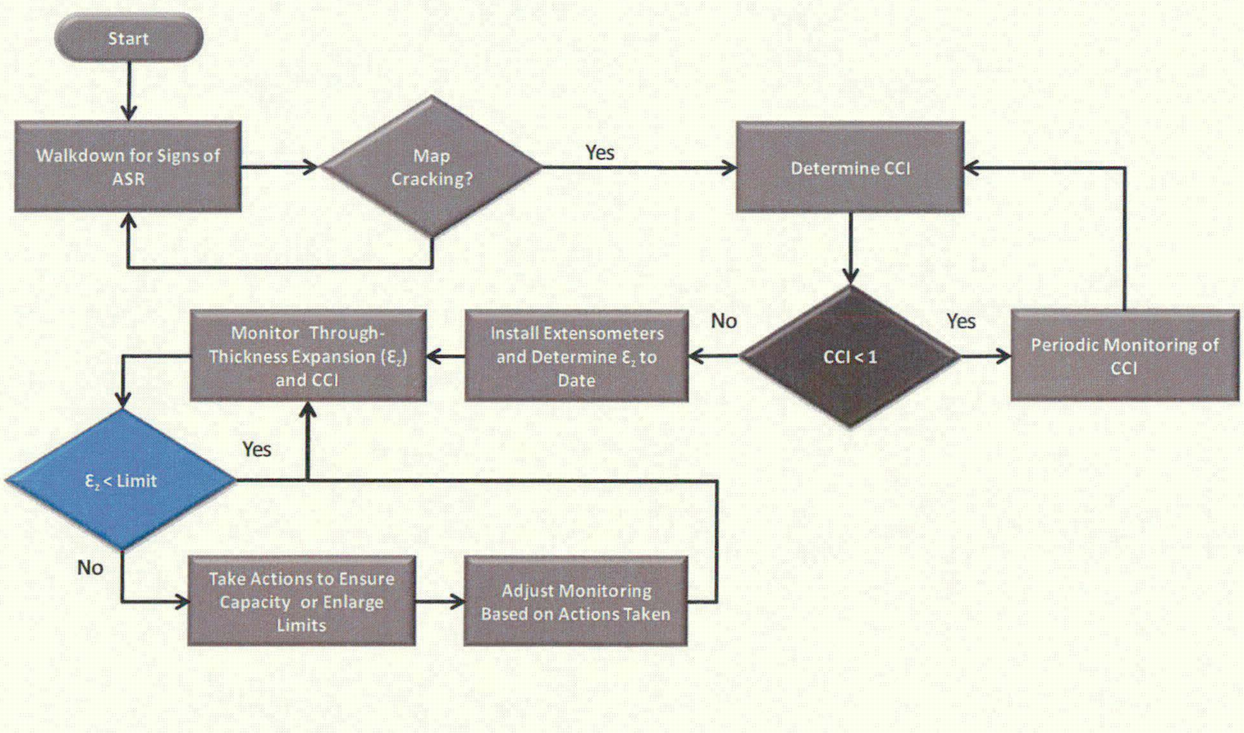
Expansion Monitoring– Structural Capacity

All Tier 3 locations require a structural evaluation to assess the condition of the structure against the design basis. The structural evaluation will include an assessment of shear capacity and reinforcement anchorage, and other applicable limit states.

For shear and reinforcement anchorage performance, the large scale test programs show that, for concrete elements without transverse reinforcement, ASR does not have an adverse effect until at least the maximum through-thickness expansion observed in the test programs. Therefore, if through-thickness expansion in elements without transverse reinforcement exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the structure. The specific threshold will be defined by the results of the large scale test program, which will be available at a later date. Seabrook will determine through-thickness expansion from the sum of the calculated pre-instrument expansion (using the methodology of MPR-4153) and subsequent measurements with an extensometer.

This approach is based on the observed expansion behavior of the test specimens, in which expansion in the through-thickness direction was dominant. It is not necessary to have expansion criteria that also incorporate in-plane expansion, which represents a very small proportion of the volumetric strain.

The flowchart below describes the approach for monitoring expansion to confirm shear and reinforcement anchorage performance.



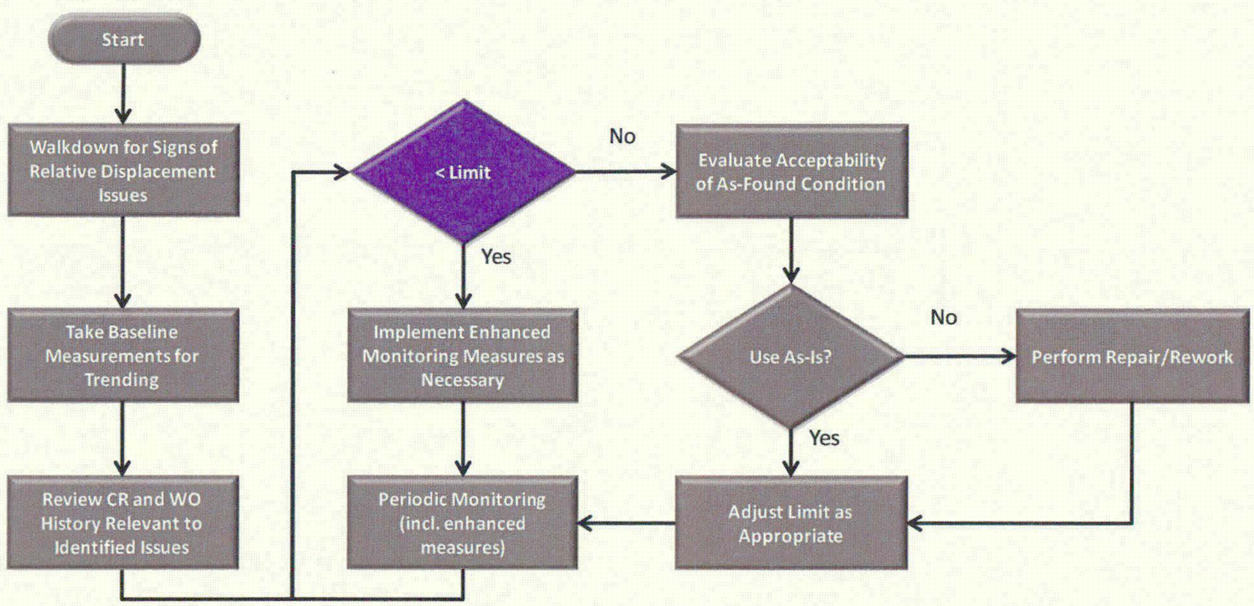
Expansion Monitoring– Building Deformation

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 are required. Specific criteria for selecting effective corrective actions will be evaluated on a location-specific basis.



Evaluation
Evaluations are performed to ensure impacted structures are in compliance with the Current Licensing Basis. These evaluations are documented in the Corrective Action Program. Additionally, Corrective Actions requiring repair are entered in the Work Control Program for implementation. Deficiencies determined to be acceptable by engineering review are trended for evidence of further degradation.

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.

Deformation caused by ASR will be monitored by taking location-specific measurements. These measurements will be compared against location-specific criteria to evaluate acceptability of the condition.

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.

PROGRAM ELEMENTS

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 License Renewal Structures Monitoring Program. License Renewal 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

- 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

The Seabrook Station Alkali-Silica Reaction (ASR) Monitoring Program manages the effects of cracking due to expansion and reaction with aggregates.

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 strength 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, Security Rounds, 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.

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.

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."

Expansion

For ASR-affected surfaces at Seabrook Station, NextEra will monitor volumetric 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 and 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 horizontal and vertical CIs are then averaged to obtain a Combined Cracking Index (CCI) for each area of interest. 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."

Data analysis from the large-scale test programs is ongoing and monitoring thresholds will be developed based on the test reports. However, 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).

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.

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.

Shear and Reinforcement Anchorage Performance Monitoring Parameter

For shear and reinforcement anchorage performance, the large scale test programs show that ASR does not have an effect until at least the maximum through-thickness expansion observed in the test programs. Therefore, if through-thickness expansion exceeds a specified threshold, additional evaluation must be performed to justify continued acceptability of the structure. NextEra will determine through-thickness expansion from the sum of the calculated pre-instrument expansion (using the methodology of MPR-4153) and subsequent measurements with an extensometer.

This approach is based on the observed expansion behavior of the test specimens, in which expansion in the through-thickness direction was dominant. It is not necessary to also incorporate in-plane expansion, which represents a very small proportion of the volumetric strain.

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 A-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 (ε_{bc}) is minimal.

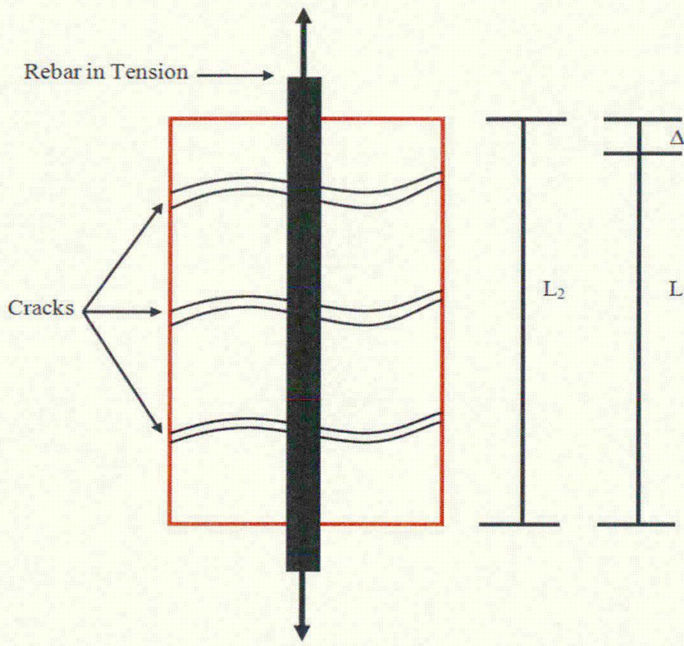


Figure A-1. Concrete Specimen put in Tension

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.

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 though-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.

MPR developed a correlation relating expansion to reduction in elastic modulus. The correlation developed from the large scale testing program data 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; it will be used as a constant in the total expansion calculation.

Deformation

With ASR induced deformation the aging effects of concern are mostly component functionality and structural interferences. Extent of condition walkdowns are in progress with a focus on safety-relates 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 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

These features may indicate irreversible deformation of the affected component.

Seabrook will update the walkdown guidance document as necessary to accommodate new Operating Experience (OE) identified during the walkdowns.

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, frequency 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). Discovery of ASR in an area lends itself to a minimum of a 2.5 year (30-month) inspection frequency.

In-Plane Expansion

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.

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). Expansion in the in-plane direction plateaus at low levels, while expansion in the through-thickness direction continues to increase.

Elastic Modulus

To determine expansion prior to 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.

All Tier 3 locations will have a sufficient amount of concrete cores removed for the material testing. A minimum of two cores for both compression testing and modulus testing will be provided (total of a minimum of four cores). The approximate dimensions of the cores needed for testing are 4" diameter × 8" length. The cores will be taken perpendicular to the reinforcement mat.

A visual examination of the cores will confirm there is no mid-plane crack and a petrographic exam will be performed to confirm the presence of ASR.

Snap-Ring Borehole Extensometer

Seabrook will install Snap-Ring Borehole Extensometers (SRBEs) at the station to monitor through-thickness expansion. The Instrument Evaluation 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 metal 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 one of the core bore holes at each location that are produced by the removal of the concrete cores being used for material testing. The elastic modulus will only be measured at the time of core removal to determine pre-instrument expansion.

Deformation

The baseline walkdowns to identify the potential effects caused by building deformation due to ASR are in progress. Subsequent monitoring will be performed as part of future Structural Monitoring Program (SMP) walkdowns. A 2.5 year (30-month) inspection frequency will be applied in location where symptoms of deformation are identified; otherwise, the inspection frequency will follow the requirements of the SMP.

ELEMENT 5- Monitoring and Trending

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.

Deformation

Location-specific measurements will be compared against location-specific criteria to evaluate acceptability of the condition. NextEra will determine appropriate criteria based on the walkdown results and the particular geometry and configuration in the area of interest. The limit will include margin to trigger action prior to loss of intended function.
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.

ASR is a slow progressing phenomenon. Seabrook will consider the rate at which a location is approaching the deformation criteria and take appropriate action to ensure continued component functionality.

ELEMENT 6- Acceptance Criteria

Identification of the typical symptoms indicative of ASR generates the need to initially start monitoring the area using CCI.

In-Plane

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). CCI is also used to inform the deformation evaluation.

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 will be identified in the large scale test program test reports, which will be available at a later date.

Deformation

Location-specific criteria based on the current design basis, particular configuration and applicable indications. Future walkdowns will be compared to the baseline walkdowns that are currently in-progress.

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

NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 8 Confirmation Process. (Ref: LRA A.1.5 and B.1.3.)

ELEMENT 9- Administrative Controls

NextEra Energy Quality Assurance Program and Nuclear Fleet procedures will be utilized to meet Element 9 Administrative Controls. (Ref: LRA A.1.5 and B.1.3.)

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.

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.

ASR Identification

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. While 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.

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 the engineering firm of Simpson, Gumpertz, and Heger Inc. (SG&H), 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. SG&H was contracted to perform parametric studies using a linear finite element model of the CEB with boundary conditions modeling parameters appropriate for estimating structural deflections and deformed shapes. 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 are ongoing in identifying the above symptoms that may have been missed during the Structural Monitoring Program Walkdowns that were conducted prior to this discovery. The items identified are being tracked via Seabrook's Corrective Action Program.

Seabrook is in the process of revising the structural analysis of the CEB to include the effect of ASR expansion, using the deformations observed during the walkdowns as validation.

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.

Newly Identified Operating Experience (OE)

Seabrook will update the Aging Management Program for any new plant-specific or industry OE.

Enclosure 5 to SBK-L-15202

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	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.
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	No later than December 31, 2015.
68.	Structures Monitoring Program	Perform sampling at the leakoff collection points for chlorides, sulfates, pH and iron once every three months.	A.2.1.31	Quarterly Preventive Maintenance Activity Implemented
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	Implement the Alkali-Silica Reaction (ASR) Monitoring Program. 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	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 Tier 3 areas of 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 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 RCPs 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 Monitoring	***Enhance the ASR Aging Management 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 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	***March 15, 2020***

Enclosure 6 to SBK-L-15202

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, LLC

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

County of Rockingham)
)
State of New Hampshire)

I, Dean Curtland, 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 Enclosures 1 of NextEra Energy Seabrook's letter SBK-L-15202, Dean Curtland (NextEra Energy Seabrook) to U.S. Nuclear Regulatory Commission, entitled "Seabrook Station 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," dated November 30, 2015. The NextEra Energy Seabrook proprietary information in Enclosure 1 of SBK-L-15202 is identified by enclosing boxes ([__]).

(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.

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

Subscribed and sworn to before me
this 3rd day of December, 2015.

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

VICTORIA S. BROWN
MY COMMISSION EXPIRES OCT. 17, 2017
NOTARY PUBLIC
NEW HAMPSHIRE