UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PENNSYLVANIA 19406-2713

December 3, 2012

Ms. Sandra Gavutis
Executive Director
C-10 Research and Education Foundation
44 Merrimac Street
Newburyport, MA 01950

Dear Ms. Gavutis:

I am responding to the September 13, 2012, letter to William Dean, from the C-10 Research and Education Foundation and the Union of Concerned Scientists that requested NRC require NextEra "to begin a complete structural integrity evaluation during its September 23, 2012, refueling outage to determine the status and extent of Alkali-Silica Reaction (ASR) degradation present in Seabrook's containment building, and any accompanying corrosion to the containment liner plate or other steel structures, including embedded concrete reinforcing steel." As a result of several discussions with you and other members of your organization, we understand that you requested a written response to the concerns raised in your letter, but did not want the letter to be considered by the NRC as an enforcement petition under Title 10 of the Code of Federal Regulations, Part 2.206.

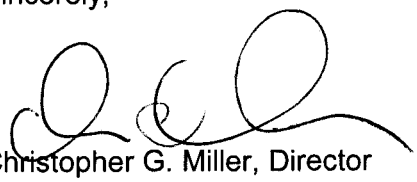
The NRC shares your belief in the importance of determining the extent of ASR and the impact on affected structures as soon as reasonably possible. To date, NextEra has made progress in assessing the extent of ASR in concrete at Seabrook and has developed plans for additional testing to confirm assumptions regarding the impact of ASR on affected structures. During the most recent refueling outage, NextEra performed inspections of areas of the plant, such as the steel containment liner, that are not easily accessable during normal plant operations. The NRC recently issued an inspection report that documents our observations regarding the ASR issue and provides answers to concerns raised in your letter. The report documents our observations regarding NextEra's ASR extent-of-condition review, assessment of reinforcement steel (rebar) and structural and operability evaluations of ASR-affected structures. A copy of the report is enclosed.

Based on our inspections to date, the NRC has concluded that NextEra has provided a reasonable basis to conclude that the ASR-affected structures, including the containment building, are currently operable but degraded. This conclusion was based on our extensive independent review of NextEra's structural analyses for the structures affected by ASR. The structural analyses used worse case assumptions for ASR degradation of concrete properties and assessed the impacts on the structural capacities of the buildings. NextEra plans to do additional testing to further evaluate the condition and progression of ASR at Seabrook. The NRC continues to monitor NextEra's testing and evaluations.

The NRC takes this matter very seriously and has assembled a team of dedicated professionals to thoroughly evaluate this issue. While we have completed the first phase of our review, we recognize that significantly more work is needed both to confirm continued integrity and operability of ASR-affected structures and to establish an effective structures monitoring process. We held a management meeting with NextEra and have issued a Confirmatory Action Letter to document NextEra's commitments to address this and other issues. To date, the NRC has conducted approximately 1900 hours of inspection of the Seabrook ASR issue. We have established a team of four inspectors, one of which is assigned at the Seabrook site. Our inspection team resources are supplemented with subject matter experts from our Headquarters Office and a professor from the University of Pittsburgh with expertise in structural engineering and mechanics. We plan to continue to commit the necessary resources to provide appropriate oversight of this issue until it is fully resolved.

We appreciate your organization's interest in these matters and will continue to keep you and other members of the public informed as we continue to assess this issue. If you have any questions regarding this response, please contact Mr. Richard Conte of my staff at 610-337-5183, or at Richard.Conte@nrc.gov. We have scheduled a meeting with the public on December 11, 2012, to discuss NRC's oversight of the ASR issue. I look forward to discussing this matter with you and members of your organization at that meeting.

Sincerely,



Christopher G. Miller, Director
Division of Reactor Safety

Enclosure:
NRC Inspection Report 05000443/2012009

Docket No. 50-443
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Sincerely,

/RA/

Christopher G. Miller, Director
Division of Reactor Safety

Enclosure:
NRC Inspection Report 05000443/2012009

Docket No. 50-443
License No. NPF-86

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ADAMS ACCESSION NUMBER: ML12339A204

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NAME	RConte*	JTrapp*	DSchroeder*	CMiller	
DATE	11/30/12	11/30/12	12/3/12	12/3/12	

* see previous concurrence

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ENCLOSURE

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 RENAISSANCE BOULEVARD, SUITE 100
KING OF PRUSSIA, PENNSYLVANIA 19406-2713

December 3, 2012

Mr. Kevin Walsh
Site Vice President
Seabrook Nuclear Power Plant
NextEra Energy Seabrook, LLC
c/o Mr. Michael O'Keefe
P.O. Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 - CONFIRMATORY ACTION LETTER FOLLOW-UP INSPECTION - NRC INSPECTION REPORT 05000443/2012009

Dear Mr. Walsh:

On November 2, 2012, the U. S. Nuclear Regulatory Commission (NRC) completed a team inspection at Seabrook Station, Unit No. 1. The enclosed inspection report documents the inspection results, which were discussed on November 2, 2012, with you and other members of your staff.

The team inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Specifically, the team reviewed selected procedures and records, observed activities, and interviewed station personnel regarding the adequacy of NextEra's actions to address the impact of Alkali-Silica Reaction (ASR) on reinforced concrete structures. The team reviewed selected Confirmatory Action Letter (CAL) 1-2012-002 commitments for adequacy and closure.

Based upon the inspection team (team) on site and in-office reviews, five CAL items were reviewed and closed, as documented in the enclosed report. The remaining six CAL items will be reviewed during our second planned follow-up inspection scheduled for early 2013.

The NRC determined that NextEra's methods for assessing operability of ASR-affected reinforced concrete structures were reasonable and generally comprehensive. NextEra conducted a margins analysis, using bounding ASR-affected concrete properties derived from research data, to demonstrate that Seabrook structures remained operable. The team concluded this margins assessment provided a reasonable operability basis and noted that further testing and engineering analyses are planned by NextEra to address this reinforced concrete structures non-conforming condition. The testing and additional analyses are expected to be completed by mid-2014. The NRC will review NextEra's proposed testing to address the uncertainties in evaluating the current level and progression of ASR on Seabrook Station reinforced concrete structures during the team's follow-up inspection.

It should be noted that the inspection team results are based solely on Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 requirements. The NRC is currently in the process of conducting a separate review of the ASR issue as part of the license renewal process in accordance with 10 CFR Part 54. As such, certain aspects of the ASR issue discussed may also have applicability to the license renewal review and involve additional consideration and require additional information beyond that discussed in this report.

In accordance with 10 CFR 2.390 of the NRCs "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of the NRC's document system (ADAMS). ADAMS is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

Christopher G. Miller, Director
Division of Reactor Safety

Docket No. 50-443
License No: NPF-86

Enclosures:
1. Inspection Report No. 05000443/2012009
   w/ Attachment: Supplemental Information
2. Confirmatory Action Letter 1-2012-002

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It should be noted that the inspection team results are based solely on Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 requirements. The NRC is currently in the process of conducting a separate review of the ASR issue as part of the license renewal process in accordance with 10 CFR Part 54. As such, certain aspects of the ASR issue discussed may also have applicability to the license renewal review and involve additional consideration and require additional information beyond that discussed in this report.

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Sincerely,

/RA/

Christopher G. Miller, Director
Division of Reactor Safety

Docket No. 50-443
License No: NPF-86

Enclosures:
1. Inspection Report No. 05000443/2012009
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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket No.:	50-443
License No.:	NPF-86
Report No.:	05000443/2012009
Licensee:	NextEra Energy Seabrook, LLC
Facility:	Seabrook Station, Unit No. 1
Location:	Seabrook, New Hampshire 03874
Dates:	June 18, 2012 to November 2, 2012
Inspectors:	W. Cook, Team Leader, Division of Reactor Safety (DRS) S. Chaudhary, Reactor Inspector, DRS W. Raymond, Senior Resident Inspector A. Buford, Structural Engineer, Division of License Renewal, Office of Nuclear Reactor Regulation (NRR) G. Thomas, Structural Engineer, Division of Engineering, NRR
Accompanied by:	Dr. Kent Harries, Associate Professor of Structural Engineering and Mechanics, University of Pittsburgh
Approved by:	Richard Conte, ASR Project Manager Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000443/2012009; 06/18/2012 - 11/02/2012; Seabrook Station, Unit No. 1; Confirmatory Action Letter (CAL) Follow-up Inspection Report.

This report covered three weeks of onsite inspection and four months of in-office review by region based inspectors and headquarters reviewers to assess the adequacy of actions taken by NextEra to address the occurrence of Alkali-Silica Reaction (ASR) in reinforced concrete structures at Seabrook Station. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

Cornerstone: Mitigating Systems

During this inspection the team examined six of the eleven commitments identified in CAL No. 1-2012-002, dated May 16, 2012. These commitments involve actions taken and planned by NextEra to address the degradation of reinforced concrete structures at Seabrook Station due to ASR. Based upon the team's onsite inspection activities and detailed in-office reviews, the team closed CAL Items #1, #3, #5, #6, and #10. The team reviewed CAL Item #2, but did not close this item based upon additional actions needed by NextEra to appropriately address and document this issue. The details of the team's review of each CAL item and the observations pertaining to the adequacy of NextEra's actions to address commitments to the NRC are documented in the enclosed report.

The team determined during this inspection that NextEra does not plan to finalize its structural evaluations and operability assessments until: 1) the degree of ASR degradation on station reinforced concrete structures is appropriately reconciled with the station design and licensing basis; and 2) the progression of ASR is appropriately monitored to ensure structural integrity and operability is maintained for the duration of the current operating license. Further, the team determined that NextEra's current position is that no reinforced concrete structure at Seabrook Station will be precluded from monitoring for the effects of ASR until a satisfactory petrographic examination has been completed on that structure to confirm the absence of ASR.

The team acknowledged NextEra's plans to conduct structural performance testing of large scale test specimens (both control and ASR-affected) and then apply the test data to evaluate the current impact of ASR on Seabrook Station concrete structures and to develop appropriate actions for the continued monitoring of the ASR-affected structures. The adequacy of NextEra's proposed test program will be evaluated as part of the review of CAL Item #8 during the second CAL follow-up inspection. The adequacy of NextEra's current Structures Monitoring Program will be evaluated coincident with the team's review of CAL Item #9.

As discussed in Section 9.0 of the enclosed report, the team identified additional issues for follow-up during the second inspection. These issues and the remaining CAL items will be examined and assessed for adequacy prior to the closeout of CAL 1-2012-002.

REPORT DETAILS

1.0 Background

Alkali-Silica Reaction (ASR) is a chemical reaction occurring in hardened concrete that can change the physical properties of the concrete and potentially affect structural performance. In June 2009, NextEra identified potential degradation in below-grade concrete structures at Seabrook. In August 2010, NextEra completed petrographic evaluation of concrete core samples, which confirmed ASR as the degradation mechanism. The degraded condition in Seabrook Category I structures was evaluated in the Corrective Action Program via a prompt operability determination (POD) in September 2010, and revised in April 2011, September 2011 and May 2012. The initial PODs (Revisions 0 and 1) addressed the B electric tunnel (AR 581434) where ASR was first discovered. Five other buildings were identified as part of the extent-of-condition (EOC) review and the evaluation of core samples taken from these structures (AR 1664399). The PODs were updated as new information became available and revised analytical techniques were incorporated.

NextEra initially used the results of mechanical testing of concrete cores to assess the degree of structural degradation due to ASR. This is the traditional method described in American Concrete Institute (ACI) 228.1R for assessing existing concrete structures. NextEra tested the cores for compressive strength and elastic modulus. NextEra used the methods defined in construction and design code ACI 318-1971 to evaluate the structural capacity (operability) of the ASR-affected buildings. However, the mathematical relationships in ACI-318 are based on empirical data from testing of non-degraded concrete, and these relationships may not hold true for all stages of ASR-affected concrete.

After further review of industry experience and literature pertaining to ASR, NextEra engineering concluded that the core test data was not indicative of structural performance of ASR-affected reinforced concrete structures. NextEra's engineering evaluation stated that once the cores are removed from the structure, concrete core samples are no longer subject to the strains imposed by the ASR-related expansion or restraints imposed by the steel reinforcing cage. The engineering evaluation also stated that confinement provided by steel reinforcing bars (rebar) and other restraints limit ASR expansion of the concrete within the structure and thereby limit the adverse impact on structural performance. Therefore NextEra engineering concluded that the reduction of mechanical properties observed in mechanical testing of cores was not representative of in-situ concrete performance. NextEra's current position is that the testing of core is only useful as a diagnostic tool to confirm the presence of ASR. Based on this engineering judgment, NextEra stopped taking core samples to evaluate the concrete mechanical properties of structures impacted by ASR and revised the operability assessment approach. NextEra's current approach for assessing structural integrity and operability is to compare available design margins to an assumed reduction in structural capacity due to ASR.

The extent of ASR at Seabrook was documented in an extent-of-condition walkdown review of station structures. The review identified the visual signs of ASR through the presence of crack patterns, ASR gel in wet and powder forms, and/or discoloration and dark staining. NextEra's walkdown objectives were to: identify and assess apparent ASR degradation including estimated expansion; identify the condition of concrete in the vicinity of supports that show ASR

distress; and identify the current or past areas of water intrusion. The walkdown results were entered into the corrective action program (AR 1757861), in conjunction with six-month crack indexing measurements on selected structures, to trend the progression of ASR and possibly establish a rate of expansion.

NextEra's operability evaluations were based upon an examination of available design margins and a presumed ASR-caused reduction in structural design capacity for critical limit states. The details of this methodology and related assumptions were developed in NextEra's Interim Assessment (FP 100716). The assessment assumed lower bound values of structural capacity for ASR-affected concrete for limit states based on research test data, primarily from test specimens. The assessment focused on the structural limit states that are the most sensitive to ASR effects (i.e., out-of-plane shear capacity, lap splice development length, and anchorage capacity). The assessment determined the structures were suitable for continued service. A final operability assessment will be conducted by NextEra following evaluation of structural performance based on a proposed large scale testing program of beam specimens representative of Seabrook reinforced concrete structures. The test program has been initiated at the Ferguson Structural Engineering Laboratory at the University of Texas at Austin (UT-A), with testing targeted to be completed in 2013 and the results reported in 2014.

2.0 Confirmatory Action Letter 1-2012-002

Confirmatory Action Letter (CAL) 1-2012-002, dated May 16, 2012, was written to confirm commitments by NextEra (established during a meeting with NRC management and staff on April 23, 2012) with regard to planned actions to evaluate ASR-affected reinforced concrete structures at Seabrook Station. In response to the CAL, NextEra committed to provide information to the NRC staff to assess the adequacy of NextEra's corrective actions to address this significant condition adverse to quality. CAL 1-2012-002 is provided as an Enclosure to this report. The NRC staff also formed a working group to provide appropriate oversight of NextEra's activities to address ASR and to coordinate NRC inspection and review activities. The ASR Working Group Charter (ML121250588) outlines the regulatory framework and general acceptance criterion for NRC oversight and review of this issue.

Based on the results of this inspection, CAL Items #1, #3, #5, #6, and #10 are closed; CAL Item #2 is updated; and CAL Items #4, #7, #8, #9, and #11 remain open pending NRC review in the second CAL follow-up inspection (Report No. 05000443/2012010).

3.0 Review of Operability Determinations and the Interim Assessment (CAL Items #1, #3, and #5)

3.1 Inspection Scope

CAL No. 1-2012-002 documented NextEra's commitment to submit the revised PODs for the B electrical tunnel (CAL Item #1) and the additional buildings identified as having indications of ASR, based upon NextEra's corrective action to identify other affected structures (CAL Item #5). The team reviewed the PODs for the B Electric Tunnel of the Control Building (POD 581434) and buildings identified in NextEra's extent-of-condition review (PODs 1664399 and 1757861). As discussed in Section 1.0 above, these PODs were revised to reflect a change in the

approach taken by NextEra to evaluate the structural integrity of the station reinforced concrete buildings. Revision 2 of the PODs provides the current quantitative and qualitative analyses of the ASR-induced changes in structural performance, as further detailed in the licensee's Interim Assessment. The team reviewed the supporting documentation for each significant structural design attribute and conducted multiple interviews and discussions with the responsible NextEra engineering staff and consultants. The team used 10 CFR Part 50, Appendix A (General Design Criteria 1, 2, and 4), and 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and Criterion XI, "Test Control," and UFSAR, Section 3.8 as the regulatory basis to assess the adequacy of NextEra's actions to address ASR effects on safety-related Category I reinforced concrete structures that were considered in-scope for the Maintenance Rule. The team used NRC Inspection Manual, "Part 9900 – Operability Determination and Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety," to evaluate the licensee's approach to assessing this significant condition adverse to quality.

The extent-of-condition POD (Revisions 0 and 1) initially addressed five structures (AR 1664399). These five structures included the containment enclosure building (CEB), the access tunnel to the radiologically controlled areas (RCAW), the emergency feedwater (EFW) pump house, the residual heat removal (RHR) equipment vault (EV), and the diesel generator building (DGB). During implementation of ASR Structures Walkdown (FP 100705), NextEra identified additional structures with localized areas of patterned cracking, including: the condensate storage tank enclosure, the control building air east intake, the service water cooling tower, the A electrical tunnel, the fuel storage building, the east pipe chase, the west pipe chase, the pre-action valve room, the primary auxiliary building, the service water pump house, the mechanical penetration area (which includes portions of the outer containment wall, AR 1804477), and the waste processing building (AR 1757861).

The team conducted a detailed review of Foreign Print (FP) 100716, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 1. FP 100716 is the initial evaluation of concrete structures at Seabrook Station and provides the basis for continued operability of ASR-affected structures. This document was submitted to the NRC for review per CAL Item #3. As documented in FP 100716 (also referred to by NextEra as the Interim Assessment), this evaluation will be followed by a second evaluation that "will assess the long-term adequacy of the concrete structures considering the results of the large scale structural testing program, other in-progress test programs, and results from periodic monitoring of the structures."

3.2 Findings and Observations

The team identified no findings in this area, and CAL Items #1, #3 and #5 are closed. Based on a detailed review of the PODs, referenced white papers and associated engineering analyses, including an independent verification by the team of a number of supporting calculations, the team determined NextEra's operability bases were appropriate. Given the current known extent of ASR, there is reasonable expectation that the affected reinforced concrete structures at Seabrook Station will remain capable of performing their intended functions while NextEra continues to monitor the condition and complete detailed testing and further engineering analyses (expected to be completed by mid-2014) per the Corrective Action Program (CAP).

The team noted that the areas identified by NextEra to be affected by ASR are generally localized (i.e., part of a wall, not the entire wall or structural member exhibits evidence of ASR). Even though the identified ASR areas are localized, NextEra's engineering evaluations conservatively assume the entire structure or structural member (wall) is adversely affected. Assuming an entire structural member is affected allows for a direct comparison to the original design calculations of record. Noteworthy observations pertaining to the team's review of the PODs and Interim Assessment follow.

3.2.1 Operable, but Degraded and Non-Conforming

Based upon a detailed review of the quantitative and qualitative analyses documented in the PODs and Interim Assessment, the team determined NextEra had appropriately demonstrated that the ASR-impacted structures were operable, but degraded and non-conforming. NextEra adequately demonstrated that the structures would maintain structural integrity for design basis loads and load combinations for normal, accident and environmental extreme conditions (including seismic). The degraded and non-conforming ASR-affected structures are being addressed through NextEra's CAP and the planned UT-A testing program.

The team observed that 26 locations (including containment) had been identified via NextEra's ASR Structures Walkdown as having patterned cracking with a combined crack index (CCI) of greater than 1.0 mm/m. CCI is an ASR expansion monitoring method that sums the crack widths measured along a fixed rectangular grid line. The sum of the crack widths is then divided by the length (perimeter) of the grid to obtain the index value. Per the Structures Monitoring Program (EDS 36180, Revision 2), Attachment 3, revised in July 2012, a CCI of >1.0 mm/m requires a structural evaluation. NextEra's Interim Assessment, Section 2.1.2 documents an engineering judgment that biased the performance of detailed structural evaluations to the 11 locations with a CCI > 1.5 mm/m. Although not explicitly stated in Section 2.1.2, the team learned from discussions with NextEra engineers that the locations with a CCI of between 1.0 and 1.5 mm/m (13 locations) were considered bounded by the 11 areas subjected to a detailed evaluation. The lack of a documented structural evaluation for the 13 locations with a CCI of between 1.0 and 1.5 mm/m was considered a minor performance deficiency. NextEra acknowledged this procedural implementation error and entered the issue into their Corrective Action Program (AR 1804477 and AR 1819080). A structural evaluation was completed for containment and reviewed by the NRC prior to the completion of the inspection period (see Section 3.2.8). However, the evaluations for the remaining locations were not completed by NextEra before the end of the inspection. The team will examine these evaluations in the second CAL follow-up inspection.

Near the conclusion of this inspection, NextEra completed a POD for containment (AR 1804477). Preliminary review by the team identified areas for follow-up during the second CAL follow-up inspection. Specifically, the team plans to assess NextEra's evaluation of the potential for ASR-induced pre-stressing of rebar (reference Section 3.2.8) and to review NextEra's future plans for monitoring the localized areas (three) of presumed ASR (not verified by a petrographic exam) on the containment outer wall. NextEra's current monitoring plans for the containment wall areas are documented in FP 100647, "Crack Index Determination." (See Section 6.0 of this report for additional information and team observations concerning Crack Indexing.)

3.2.2 Concrete Material Properties - Compressive Strength and Elasticity Modulus

As discussed in Section 1.0, NextEra stopped taking core samples to evaluate ASR-affected structures. Notwithstanding, Revision 2 of POD 581434 for the B electrical tunnel, concluded that there is no loss of concrete compressive strength due to ASR. This conclusion was based on testing of 15 cores (12 ASR-affected concrete and 3 control locations). NextEra concluded that ASR had increased the stiffness of the electric tunnel walls because the compressive strength in the ASR impacted concrete was higher than in the control core samples. [The team notes that this conclusion is different than the 22 percent measured compressive strength reduction (compared to the 1979 cylinder test results) that had been previously identified by NextEra from initial core sample results and reported in NRC Inspection Report 05000443/2011007.] Team review of the available supporting concrete core data during this inspection did not validate NextEra's current conclusion, as discussed below.

As-built concrete compressive strength can vary due to variations in the mixture (aggregate, sand, cement, and water) and the curing process. Consequently, design and construction specifications were developed to ensure, in spite of this variability, that concrete specified and used in reinforced concrete structures meets acceptable standards of performance. In addition, concrete strength is expected to increase with age and curing. The team also noted that additional inaccuracies are introduced via the core sampling process and associated testing methods. Accordingly, team examination of the 2011 core sample compressive strength values and measured cylinder strength values from 1979 (two percent lower), led the team to conclude there is neither a significant loss or increase in compressive strength in the ASR-affected B electrical tunnel concrete material properties. Team review of core sample-measured modulus of elasticity values identified that although individual cores showed a modulus that was reduced (compared to design), the average modulus value in the RCA walkway, RHR equipment vault, EFW pump house, and DGB was within 20 percent of the design modulus value ($\pm$20 percent is acceptable by ACI 318). Based upon available core sample results, the team considered the ASR effect on elasticity modulus inconclusive, also.

Overall, the team concluded that the core sampling and associated mechanical testing completed, to date, has not conclusively established the current impact of ASR on concrete material properties. While the team acknowledges that the core sample results may not represent in-situ concrete structural performance, as NextEra has concluded, the core samples and test results (mechanical and petrography) may still provide valuable information and insights relative to the impact (relative degree and progression) of ASR on reinforced concrete structures. Consequently, the team plans to examine core sampling in the second CAL follow-up inspection, with respect to core sample test results being used to understand ASR effects on ACI Code relationships and the overall adequacy of the Structures Monitoring Program.

3.2.3 Flexural Capacity and Dynamic Response

NextEra completed a comparative study of the Containment Enclosure Building (CEB) (FP 100714 and FP 100715), which evaluated the effects of reduced elastic modulus on seismic response. The CEB parametric study included: an evaluation of the building in a static, three-dimensional finite element analysis (FEA) to determine the response (forces and

moments) to operating basis earthquake and safe shutdown earthquake seismic loads without and with current ASR damage; a calculation of the wall section capacities; a calculation of demand-to-capacity ratios (DCR); and, a comparison of the DCRs of ASR-affected walls to unaffected walls. Based upon assumed boundary conditions and the assumed current state of ASR degradation used in the FEA model, the analyses showed that the seismic acceleration profiles, in-structure response spectrum, and distribution of forces and moments were not significantly impacted. The effect of the lower modulus values on the response of other below-grade, ASR-impacted structures was evaluated in Calculation C-S-1-10163. For these below grade structures, NextEra determined that the dynamic structural response remained in the rigid range with no appreciable amplification of the ground response spectra.

Based upon the above, NextEra concluded that the seismic response of the CEB, along with the attached equipment (cable trays and supports) and anchor loads, remained practically unchanged due to the assumed ASR effects. The team concluded that NextEra's assessment of this ASR-affected structural design attribute was appropriate to demonstrate operability.

3.2.4 Shear Capacity

NextEra analyzed the impact of ASR on the B electric tunnel using an FEA in calculation FP 100730 to determine refined structural demand and to compare the shear capacity versus demand for seismic and hydrodynamic loads. NextEra assumed a 25 percent reduction in out-of-plane concrete shear capacity due to the effects of ASR on walls without shear reinforcement. The team noted that NextEra's design calculation (CD-20, dated 3/28/83) used the average 28-day compressive strength value (5459 psi) to establish that the design shear capacity exceeded the design load/demand. However, the FEA-based calculation used the specified design concrete strength of 3000 psi to compare the available design capacity to design load. The use of the 3000 psi vice 5458 psi value in the FEA provided results that indicated adequate margin was available using the as-built specified concrete compressive strength. The team noted that the FEA is a more precise computational design method than the manual methods used in the 1983 design calculation. The team notes that NextEra identified, but did not credit, additional conservatism in their margins analysis based upon the B electrical tunnel average measured core sample compressive strength value of 5140 psi. NextEra's FEA-based evaluation concluded that adequate margin was available to account for the lower bound ASR effect on out-of-plane concrete shear capacity. The inspection team acknowledged that: 1) some additional margin may be credited due to the compressive strength of core samples exceeding the design minimum value of 3000 psi; and 2) the use of a 25 percent reduction in shear capacity, as a lower bound ASR effect, was appropriate for the assessment of this limit state. The team found the use of an FEA to assess shear capacity and the lower bound ASR effects as appropriate to demonstrate operability.

3.2.5 Review of Finite Element Analysis Modeling

As discussed in Sections 3.2.3 and 3.2.4 above, NextEra used a linear elastic FEA to evaluate the effects of ASR on certain structures and design attributes. The team noted that the input data for the compressive strength and modulus of elasticity for the CEB model were determined based on a visual examination of CEB walls and only a few directly obtained core sample material properties. The observed crack patterns and dimensions on the CEB were correlated

by NextEra to a damage rating index (DRI) and associated concrete material properties from test data obtained from core samples taken from several different structures. The input data for Poisson's ratio was derived exclusively from research data. NextEra acknowledged the limitations of this input data, but in FP 100696 deemed the approach justified because the analysis was a parametric study of the CEB seismic response, comparing design values to ASR-affected values. The team concluded NextEra's application of the FEA to a parametric analysis was useful for providing a reasonable expectation of operability, but not conclusive with respect to identifying a current or projected state of ASR impact. For example, the team noted that the boundary conditions used at and below elevation zero-foot of the CEB FEA model may need to be re-evaluated and better justified, considering the seismic isolation of the walls (separated from the concrete backfill by the waterproofing membrane).

3.2.6 Anchorage

NextEra evaluated the impact of ASR-affected concrete on the performance of anchorage, including both expansion and undercut post-installed anchors. The potential impact of micro-cracking caused by ASR can negatively impact the structural capacity of anchorages and embedments supporting safety-related components. NextEra's operability evaluation was supported by anchor performance testing conducted on ASR degraded UT-A test specimens (FP 100718). The tests showed satisfactory performance of the anchors in ASR-affected concrete. NextEra's evaluation illustrated that the assumed reduction in capacity due to ASR was offset by established anchor manufacturer's design margins (FP 100716). However, based upon the limitations of the testing performed, to date, (on ASR-affected test specimens of different composition and compressive strength than Seabrook structures) NextEra plans to conduct further testing. Planned testing involves anchors installed in ASR-affected test specimens that more closely reflect the reinforced concrete structures and anchor configurations at Seabrook. The team concluded that NextEra's anchorage operability assessment was satisfactory.

3.2.7 Lap Splice Strength

Section 6.3 of NextEra's Interim Assessment addressed reinforcement lap splice degradation as another design attribute impacted by ASR. In accordance with the licensee's lower bound value of a 40 percent reduction in lap splice strength, NextEra's review of design calculations identified several structures with insufficient margin to accommodate this assumed ASR effect. NextEra was able to "recover" margin by adjusting the ACI 318 prescribed design load factors for well predicted dead load and/or hydrostatic load. NextEra's term "recover" represents examining the design loads and load distributions and determining the accuracy and potential variability of the predicted loads. If the predicted load is well defined, accurately quantified, and subject to minimum variability (such as dead load and hydrostatic load), then it is appropriate to remove the load factor (LF) from the associated load/demand calculation. By ACI 318 ultimate strength design, the LFs account for the uncertainty in accurately predicting the structural loads and provide increased design margins for service load conditions/combinations. The team examined this method and found it satisfactory for the operability assessment, but concluded it would not be acceptable for a final operability determination under the current licensing basis. The final operability assessment requires full conformance with the ACI design methodology or revision to the licensing basis.

3.2.8 Concrete Confinement and Rebar Pre-Stressing

The team's review of FP 100716, Sections 2.1.2 and 4.1.3, identified that the Interim Assessment stated, "Since ASR has a negligible impact on structural demand, the impact of ASR on structures and structural attachments can be assessed solely on the basis of changes in capacities." The team observed that restraint to ASR expansion, from concrete confinement by reinforcement (in two or three dimensions) and other external constraints, may cause internal pre-stress in the structural member. The consequence is to increase compressive stresses in the concrete and increase tensile stresses in the rebar, as long as the restraint is sustained. The team observed that NextEra has only addressed this ASR-induced pre-stress qualitatively in FP 100716 and in the containment structural evaluation (AR 1804477). The team determined that a quantitative evaluation of this pre-stress is needed to resolve this aspect of the non-conforming condition. Further, it should be recognized that the ASR-induced pre-stress varies with time, depending on the degree of restraint and may not be sustained throughout the service life of an affected structure. Accordingly, any potential beneficial effect should not be relied upon or credited in design.

The team acknowledges NextEra's conclusion that ASR-induced pre-stress may result in some beneficial effects in terms of structural stiffness. However, the team determined that this structural demand should be quantified (if practicable) and accounted for in the design calculations as a known load. Quantifying, or otherwise approximating the ASR-induced pre-stress, is similar to accounting for the pre-stress load in pre-stressed concrete design. This issue will be reviewed by the team in the second CAL follow-up inspection.

3.2.9 Condition of Rebar

The team examined information gathered and assessed by NextEra with regards to the condition of rebar and any potential erosion or corrosion due to ASR and water in leakage through below grade reinforced concrete structures. The team observed that NextEra had removed an area of surface concrete in the B electrical tunnel to examine the condition of the rebar. The engineering staff identified no degradation of the rebar (no oxidation or signs of distress). The team also learned that in the course of removing core samples, in two instances the sample included minor amounts of rebar. Examination of the rebar sections removed determined the steel to be in excellent condition (unaffected by ASR or moisture).

Preliminarily, NextEra has concluded that the condition of rebar in ASR-degraded concrete should be unaffected unless the cracking becomes deleterious and exposes the rebar to oxidation mechanisms. Otherwise, the alkaline condition within the concrete should prevent any corrosion mechanisms. The NRC continues to evaluate the need for any additional rebar intrusive monitoring or testing, and will evaluate this issue in the second CAL follow-up inspection.

4.0 Review of Alkali-Silica Reaction Root Cause Evaluation (CAL Item #2)

4.1 Inspection Scope

The team reviewed NextEra's response to CAL Item #2, "Submit the root cause for the organizational causes associated with the occurrence of ASR at Seabrook Station and related corrective actions by May 25, 2012." The licensee submitted their root cause evaluation (RCE) via letter dated May 24, 2012. The purpose of the team's review was to assess the adequacy of the licensee's evaluation of the root cause for the ASR issue at Seabrook and the significant contributing causes. The team also examined the methodology and thoroughness of the licensee's evaluation and associated corrective actions as outlined in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action." The team made observations regarding the level of detail and clarity of NextEra's root cause evaluation.

4.2 Findings and Observations

This CAL Item will remain open pending NRC review of NextEra's final RCE. NextEra identified two root causes: 1) ASR developed because the concrete mix design unknowingly utilized an aggregate that was susceptible; and 2) the monitoring program for plant systems and structures does not contain a process for periodic reassessment of failure modes. A contributing cause identified by NexEra was the failure to prioritize groundwater elimination or mitigation resulting in more concrete areas exposed to moisture.

The first licensee-identified root cause involved the licensee's use of susceptible aggregate in the concrete mix design that was undetected by the testing specified by ASTM construction standards, at the time (late 1970's). Since this time, the role of slow-reacting aggregate in ASR has been identified in the construction industry and standard tests are now available to ensure slow reactive aggregates would be properly identified prior to use in construction. The team concluded that this causal factor was beyond the licensee's control.

The team concluded that the second root cause was not adequately characterized in NextEra's May 24, 2012, submittal. Specifically, NextEra did not clearly state the personnel and organizational factors that led to inadequacies in the Structures Monitoring Program (SMP). The team discussed the absence of any human performance aspects in the description of this causal factor, and NextEra initiated a revision to the RCE to more appropriately develop and characterize this second root cause and the associated corrective actions. NextEra plans to submit the revised RCE for NRC review. The team will review this revision in the next CAL follow-up inspection report.

The team also noted that NextEra excluded a contributing cause, identified in the RCE, from the evaluation executive summary and May 24, 2012, letter. As stated in the RCE, this contributing cause involved the longstanding "organizational mindset" that groundwater infiltration was more of an "operational nuisance" than a structural integrity concern. This station and engineering staff "mindset" prevented a more timely and thorough investigation and examination of the effected concrete reinforced structures on site. NextEra acknowledged this observation and agreed to address it in the revision to the RCE.

5.0 Review of Mortar Bar Testing (CAL Item #6)

5.1 Inspection Scope

CAL Item #6 committed NextEra to submit the results of short term aggregate expansion testing to the NRC. The team reviewed the results of NextEra's recently completed short term expansion testing of mortar bar specimens per test procedures SGH-Z001-12 and SGH-Z002-12. The results of the testing were evaluated per ASTM C1260, "Mortar Bar Expansion Test." The licensee initiated the testing to establish and compare the reaction rates of ASR-affected concrete to non-ASR affected concrete on site. The tests were performed by a consultant at an offsite facility. The mortar bar specimens were made using the aggregate extracted from core samples taken from ASR-affected structures and non-affected concrete from a slab removed from the waste processing building. NextEra noted that the non-affected concrete slab used for aggregate extraction had shown no visible indications of ASR and was not petrographically examined. The details of the testing are documented in SGH Report 120110-RPY-01 (FP 100734). The team reviewed the SGH report and associated test documents to ascertain the adequacy and technical validity of the testing.

5.2 Findings and Observations

No findings were identified and CAL Item #6 is closed. The test results indicated that both affected and non-affected concrete specimens contained ample reactive aggregate to sustain ASR. The team notes that normal test duration is 14 days and that a specimen expansion of greater than 0.1 percent indicates reactive aggregate, per ASTM C1260. Test results identified that the non-ASR-affected specimens exceeded the 0.1 percent threshold in 5 days and the ASR-affected specimens exceeded the 0.1 percent threshold in 7 days. NextEra allowed the test to extend to 103 days and both specimen types continued to demonstrate active expansion due to ASR. Accordingly, NextEra concluded that there remains the potential for future volumetric expansion due to ASR in concrete structures at Seabrook.

Based upon the Mortar Bar Testing results, NextEra plans to revise their commitment to conduct Prism Testing. Prism Testing is similar to Mortar Bar Testing, but a longer term test of the susceptibility to ASR of aggregate used in concrete. NextEra had hoped to establish, via the Mortar Bar Test, a difference in the remaining versus available concrete constituents for ASR in the specimens. The results demonstrated ample reactive materials in both specimen types and NextEra concluded the Prism Test will not provide any additional ASR insights. The team had no additional observations and will review the revised Prism Testing commitment when it is submitted.

6.0 Review of Crack Indexing (CAL Item #10)

6.1 Inspection Scope

CAL Item #10 involved NextEra's commitment to perform the initial six-month interval crack measurements and crack indexing at 20 locations in areas that exhibit the highest crack indices by July 15, 2012, and provide the results for NRC review. The team conducted a review of FP 100647, "Crack Index Determination," Revision 1, to understand the methodology for NextEra's

monitoring of ASR progression in selected reinforced concrete structures. The team used 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," to evaluate the implementation and adequacy of the procedural guidance. The team's review was limited in scope, in that, the adequacy of crack mapping, as the sole means of monitoring ASR progression in Seabrook structures, is still under NRC review. The team will evaluate the adequacy of the Structures Monitoring Program, which includes crack indexing as a component of the overall program, during the review of CAL Item #9, "Update the Maintenance Rule Structures Monitoring Program to include monitoring requirements for selected locations in areas that exhibit ASR," during the second CAL follow-up inspection.

The team observed field measurements taken on June 20, 2012, by the responsible contractor and discussed the general methodology and procedural guidance with the individuals performing the crack indexing measurements and the supervising NextEra staff. The team noted that NextEra found ASR patterned cracking in many areas of Seismic Category I structures and structures in-scope within the Maintenance Rule, but only a limited number of these areas have sufficient ASR degradation to merit continued monitoring and detailed evaluations. The ASR walkdowns identified 131 locations with some level of pattern cracking. Of the 131 localized areas, 26 exceeded the initial screening criteria of a combined crack index greater than 1.0 millimeter per meter (mm/m). The 1.0 mm/m threshold was contained in the Structures Monitoring Program, Attachment 3, for conducting a structural evaluation. These 26 areas will continue to be monitored at six-month intervals, per FP 100647.

6.2 Findings and Observations

No findings were identified and the CAL Item #10 commitment is closed. The team noted that the periodic crack indexing currently provides the principle method selected by NextEra to monitor the progression of ASR on reinforced concrete structures. The six-month interval measurements are currently planned until a reliable trend of ASR progression can be established, per Structural Engineering Standard Technical Procedure 36180, "Structures Monitoring Program," Attachment 3, Revision 2. As stated above, additional NRC review of the Structures Monitoring Program will be conducted in the second CAL follow-up inspection.

The team also reviewed the current methods and terminology used by NextEra to characterize the degree of ASR pattern cracking, previously addressed in NRC Inspection Report 05000443/2011007. When ASR was initially identified in the B electrical tunnel in mid-to-late 2010, the licensee referred to the Federal Highway Administration (FHWA) guidance document FHWA-HIF-09-004 for crack and damage characterization. Three major categories were identified: mild, moderate, and severe, with ratings such as mild to moderate and moderate to severe, also used. Per FHWA-HIF-09-004, these categories were used to define the recommended remedial actions to be taken once ASR was identified. At that time, NextEra labeled the observed cracking as "severe." Per the FHWA guidance, this category requires "further investigation for selecting remedial actions." This characterization was repeated in the above referenced inspection report. NextEra revised their crack characterization scheme prior to the implementation of the structures extent-of-condition review. The revised crack rating system was based upon "best practices" taken from the Building Research Establishment (BRE) in the United Kingdom (UK). The revised numeric rating system range is from 0 (no cracking detected) to 6 (heavily fractured ASR-related damage). FP 100636, "Petrographic Examination

PE Reports," Revision 0, lists the material property results of all core samples taken and petrographically analyzed. FP 100636 also provides the BRE crack rating for each specimen examined. The crack ratings for the specimens examined range from 0 to 4 (a rating of 4 represents severe cracking). The team determined NextEra's revised crack rating scheme is more informative.

7.0 Alkali-Silica Reaction Structures Walkdown – Extent of Condition Assessment

7.1 Inspection Scope

The team examined NextEra's program documents FP 100642, "ASR Walkdown Scope," Revision 1, and FP 100705, "Seabrook Station: Summary of Alkali Silica Reaction Walkdown Results," Revision 0, to assess the adequacy of the licensee's extent of condition assessment, per the Seabrook Station Corrective Action Program (CAP). The team reviewed the walkdown scope and examination criteria and the associated field data, photographic evidence, and analysis of NextEra's observations, as documented in FP 100705. The walkdown scope included Seismic Category I and some structures in scope within the Maintenance Rule. NextEra's walkdown is being conducted in three phases. Phase 1 involved examination of readily accessible areas of interest; Phase 2 included examination of coated surfaces identified during Phase 1 inspections (coatings had to be removed to expose the concrete surfaces); and Phase 3 examines normally inaccessible structures and areas (e.g. high radiation, manholes, etc.) which have or will be inspected as the opportunity presents itself (e.g. routine maintenance or outage activities).

The walkdowns assessed the extent of ASR throughout the plant with the primary objectives of: identifying and assessing any apparent degradation from ASR (including measurement of ASR expansion via CCI); assessing whether concrete in the vicinity of supports for safety-related systems or components show any indications of ASR distress; and documenting and characterizing water intrusion or evidence of previous water intrusion, based upon water being a key contributor to concrete deterioration and distress caused by ASR. The visual criteria for documenting potential ASR indications included: typical patterned surface cracks in concrete; crack dimensions (width, length, orientation); evidence of water ingress and/or out-seepage; visual evidence of salt deposit and/or ASR gel; and indications of surface deterioration (i.e., pop-outs and/or spalling). Also, any expansion anchors or structural embedments located within 5 feet of the area of interest were examined and documented.

The team performed a number of independent walk-through inspections to verify and assess the thoroughness of the licensee's efforts. The team independently evaluated the extent-of-condition of ASR-affected structures that are readily accessible. The team used the expertise of a consulting structural engineer to assist in the team's review of the current condition of ASR-affected reinforced concrete structures at Seabrook Station.

7.2 Findings and Observations

The team identified no findings. On a sampling basis, the team's independent walkdown observations were consistent with the licensee's observations and assessments. At Seabrook, the presence of ASR has been conclusively established by petrography in certain buildings

(where core samples were obtained) and in other buildings by visual comparison, using visual examination criteria. The team confirmed that NextEra's position is that all reinforced concrete structures on site are susceptible to ASR, dependent upon the exposure to moisture. Therefore, NextEra does not intend to exclude any structures from ASR monitoring without confirmation via petrography that ASR is non-existent.

The complete list of structures and localized areas of ASR identified, to date, is documented in FP 100705, Revision 1. The team noted that the results of the walkdown inspection by NextEra were appropriately documented with extensive observation narratives and well supported by clear sketches and photographs. As NextEra completes Phase 3 examinations, the licensee plans to capture the additional observations through revisions to FP 100705. The team noted that the majority of localized areas of ASR are: 1) below grade walls subjected to either ground water intrusion, or particularly high spatial humidity; or 2) structures exposed to precipitation and high ambient humidity (some exterior above grade structures).

Based upon the team's review of the Phase 1 and 2 ASR walkdown results and via discussions with responsible engineers overseeing the proposed Phase 3 walkdown areas and tentative schedule, the team identified a minor oversight in the Phase 3 walkdown plan. Specifically, the upper elevations of the containment outer wall were not adequately examined for ASR during the Phase I review and not included in the proposed Phase 3 walkdown schedule. The team identified from discussion with the NextEra engineering staff that the 2010 examination of containment, per American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section 11, Subsection IWL, was being credited for part of the Phase 1 ASR walkdown. The team's detailed review of the 2010 IWL inspection results and associated visual examination attributes (reference implementing procedure, ES 1807.031, "Inservice Inspection Procedure Primary Containment Section XI IWL,") identified that the 2010 IWL exam did not include sufficient examination criteria (i.e., active or pattern cracking) for identification of ASR. As evidence of the absence of ASR identification criteria in the IWL examination, during the subsequently performed Phase 1 ASR walkdown by consulting engineers, three locations of ASR-related pattern cracking were identified on areas of the containment previously examined by the IWL examiners. NextEra acknowledged this oversight in crediting the IWL examination and initiated action (AR 1819069), per the CAP, to revise Phase 3.

During the second CAL follow-up inspection, the team plans to examine the adequacy of the Phase 3 changes. The team also plans to discuss the Phase 3 implementation schedule for completion of the ASR-affected structures extent-of-condition review.

8.0 Follow-up of Open Items

8.1 (Closed) Unresolved Item 05000443/2011003-03 - Open Operability Determinations for Safety-Related Structures Affected by Alkali-Silica Reaction

This item was open pending NRC review of NextEra actions to revise operability determinations for the electric tunnel and other structures addressed in the extent of condition review for ASR. The open aspects, as documented in Inspection Reports 2011-03 and 2011-10, were related to: 1) the effect of the reduced modulus of elasticity on natural frequency of the structures; 2) the

effect of the modulus of elasticity on structure flexural response as related to components attached to the structures, such as piping and cable supports and their anchor bolts; 3) related effects from increased flexure of building on the loading and seismic effects on safety-related pipes and cable trays; and, 4) the effect of reduced parameters on the whole building (global) response of the CEB structure to seismic loads including further information of the effect on stress and strain in the concrete and rebar system. Following inspector review in Inspection Report 2011-10, the unresolved item remained open pending NRC review of additional information from NextEra on aspects number 3 and 4, above.

The team reviewed the revised operability determinations for the safety related structures listed below and as described in POD 1664399, Revision 2.

- Control Building – "B" Electrical Tunnel,
- Containment Enclosure Building,
- Diesel Generator Building,
- Residual Heat Removal Equipment Vaults, and
- Emergency Feedwater Pump House

As part of the ASR extent of condition review, NextEra provided structural assessments for the RCA tunnel and other ASR impacted buildings (reference Calculation C-S-1-10168).

The open aspects of numbers 3 and 4 were resolved after NextEra provided additional information. Revision 2 of POD 581434 for the B electric tunnel (ET) provided additional quantitative and qualitative analyses with consideration of ASR-induced changes in concrete properties. As discussed in Sections 3.2.3 thru 3.2.6, the revised PODs addressed the impact of changes in modulus on building frequency; flexure capacity and dynamic response; shear capacity; and support anchors. The revised POD incorporated the results of the Interim Assessment (FP 100716) relative to the performance of reinforcing steel anchorage to show that postulated reductions in capacities were offset by conservatisms in ACI 318 Code and the assumed loads. The revised PODs also incorporated the testing at the Ferguson Structural Engineering Laboratory (FP 100718) of cast-in-place and drilled-in anchors to assess the impact of anchor performance in ASR-affected concrete. The test results showed that the anchor capacities remained above the theoretical capacity at crack indices (CI) well above the maximum CI observed in Seabrook structures.

The team concluded that the initial failure of NextEra to adequately consider the ASR impacts on structural performance, relative to support anchors and dynamic response, were examples of minor performance deficiencies, in that, upon further evaluation these issues were determined to be acceptable, as documented in NextEra's operability assessment. Additional inspector review of this issue was documented in Finding FIN 05000443/2011-10-02. This unresolved item is closed.

8.2 (Closed) Unresolved Item 2011-010-01 – Adequacy of Calculation Methods for ASR

NextEra initially pursued mechanical testing of concrete cores because that was the traditional method as described in ACI 228.1R for determining properties of existing concrete structures. Upon further review of industry experience and literature for ASR-affected concrete, NextEra

determined that the core test data was not indicative of structural performance of the ASR-affected structures. NextEra's position is that once removed from the structure, the concrete in the cores is no longer subject to the strains imposed by the ASR-related expansion or restraints imposed by the reinforcing cage. Confinement provided by reinforcing steel and other restraints (e.g., deadweight of the structure) limits ASR expansion of the concrete within the structure, which reduces the extent of deleterious cracking and associated reduction of concrete material properties. NextEra has determined that the structural evaluations based on mechanical properties derived from core samples may under-predict structural performance (FP 100697, Structural Assessment of ASR-State of the Art). Since the reduction of mechanical properties derived from testing of cores may not necessarily be representative of the structural performance, NextEra changed its approach. For the current operability assessment, NextEra compared the structural design capacities to design loads and demands and an assumed lower bound ASR effects. This operability assessment was based on available industry data from small scale test specimens having ASR degradation worse than that observed at Seabrook. For the final operability assessment, NextEra plans to monitor structures via Crack Indexing and pursue large scale testing of concrete specimens that are representative of the Seabrook ASR conditions to demonstrate overall structural performance and operability. This large scale testing will be conducted at the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas, Austin (UT-A).

NextEra responded to CAL Item #8 by letter dated June 21, 2012, and provided a broad overview of the testing planned at FSEL, which will include a shear test program, a lap splice test program, and an anchor test program. The test program will include control specimens that are intended to provide a baseline by which to determine the reductions in capacity due to ASR and to quantify the margins available as calculated using ACI-318. NextEra plans to use the test program to reconcile the ASR condition with the licensing design basis, to inform the Structures Monitoring Program, and to evaluate potential mitigation strategies. NextEra's actions, approach and methods used to resolve the ASR issue, including the proposed test program, will be evaluated by the team in the second CAL follow-up inspection. Based upon team review of the issues associated with this unresolved item, no violation of regulatory requirements or performance deficiency was identified. This unresolved item is closed.

9.0 Conclusions and Follow-Up Issues

The team concluded that NextEra provided sufficient bases to close CAL Items #1, #3, #5, #6 and #10. CAL Item #2 was reviewed, but remains open, pending completion of revisions to the root cause evaluation by NextEra. The team determined during this inspection that NextEra does not plan to finalize their structural evaluations and operability assessments until: 1) the degree of ASR degradation on station reinforced concrete structures is appropriately reconciled with the station design and licensing bases; and 2) the progression of ASR is appropriately monitored to ensure structural integrity and operability is maintained for the duration of the current operating license. Further, the team determined that NextEra's current position is that no reinforced concrete structure at Seabrook Station will be precluded from monitoring for the affects of ASR until a satisfactory petrographic examination has been completed on that structure to confirm the absence of ASR. As discussed in the above sections, NextEra's corrective actions to address the non-conforming ASR-affected reinforced concrete structures include plans to complete performance testing of large scale test specimens and use the test

results to finalize the structural operability assessments and modify the Structures Monitoring Program.

The team plans to conduct a second CAL follow-up inspection to review the remaining open CAL items and the open issues documented in this report and listed below:

- Review of pending structural evaluations, including follow-up of the containment POD observations (Section 3.2.1);
- Review of core sample material property testing and SMP (Section 3.2.2);
- Review quantification of pre-stressing effects of ASR expansion (Section 3.2.8);
- Assess the need for any further rebar examinations or testing (Section 3.2.9);
- Review revised RCE submittal (Section 4.2);
- Confirm revised commitment to CAL Item #7 (Section 5.2);
- Review Crack Indexing and its physical significance for SMP application (Section 6.2); and,
- Review adequacy of revisions to the Phase 3 walkdown plans and schedule (Section 7.2).

10.0 Meetings, Including Exit

On November 2, 2012, the team conducted an exit meeting to discuss the preliminary findings and observations with Mr. Kevin Walsh, Site Vice President, and other members of Seabrook Station staff. The inspectors verified that no proprietary information was retained by the inspectors or documented in this report.

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee Personnel
B. Brown, Design Engineering Manager
A. Chesno, Performance Improvement Manager
K. Chew, License Renewal Engineer
R. Cliché, License Renewal Project Manager
M. Collins, Design Engineering Manager
J. Connolly, Site Engineering Director
R. Noble, Project Manager
M. O'Keefe, Licensing Manager
T. Vassallo, Principal Design Engineer
K. Walsh, Site Vice President
P. Willoughby, Licensing Engineer

LIST OF ITEMS OPENED, CLOSED, DISCUSSED, AND UPDATED

Updated
None

Opened
None

Closed

05000443/2011-010-01	URI	Adequacy of Calculation Methods for ASR
05000443/2011-003-03	URI	Open Operability Determinations for Safety-Related Structures Affected by Alkali-Silica Reaction

LIST OF DOCUMENTS REVIEWED

Procedures
Maintenance Rule Scoping Document, Revision 0
EDS 36180, Structures Monitoring Program, Revision 0, 1, 2

Corrective Action Documents (AR)
1651969, 1629504, 574120, 581434, 1636419, 1673102, 1647722, 1664399, 1677340, 1687932, 1692374, 1698739, 1755727, 1757861, 1819080, 1804477, 1819069

Drawings

Licensing and Design Basis Documents and Calculations
Seabrook Station UFSAR, Revision 14
ACI 318-71
Calculation CD-20
Calculation CD-18
Calculation C-S-1-10168

Miscellaneous Documents
FP 100348, Statistical Analysis-Concrete Compression Test Data (PTL)
FP 100642, Scope for Alkali-Silica Reaction Walkdowns
FP 100641, Procedure for ASR Walkdowns and Assessment Checklist
FP 100661, Compression Testing Concrete Cores (WJE)
FP 100696, Material Properties of ASR-Affected Concrete
FP 100700, Field Investigation
FP 100705, Structure ASR Walkdown Report (MPR 0326-0058-58)
FP 100714, Three Dimensional Dynamic Analysis of Containment Enclosure Building
FP 100715, ASR Impact Study on Containment Enclosure Building
FP 100716, Interim Assessment: Impact of ASR on Structures (MPR-3727)
FP 100717, ACI 318-71 Perspectives
FP 100718, Anchor Test Report (MPR-3722)
FP 100720, Crack Index and Expansion Measurement
FP 100738, Measurements for ASR Crack Indexing on Concrete Structures
FP 100697, MPR 0326-0058-53, White Paper on Structural Implications of ASR: State of the Art, Revision 1
MPR 0326-0058-83, Shear Screening Criteria Used in MPR-3727
FHWA-HIF-09-004, Federal Highway Administration, "Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures."

LIST OF ACRONYMS

ACI	American Concrete Institute
ADAMS	Agencywide Documents Access and Management System
AMP	Aging Management Program
AR	Action Request
ASME	American Society of Mechanical Engineers
ASR	Alkali-Silica Reaction
BRE	Building Research Establishment
CAL	Confirmatory Action Letter
CCI	Combined Crack Index
CEB	Containment Enclosure Building
CFR	Code of Federal Regulations
CW	Circulating Water
DCR	Demand to Capacity Ratios
DGB	Diesel Generator Building
DRI	Damage Rating Index
DRP	Division of Reactor Projects
DRS	Division of Reactor Safety
EDG	Emergency Diesel Generator
EFW	Emergency Feedwater
EPRI	Electric Power Research Institute
EOC	Extent-of-Condition
ET	Electric Tunnel
EV	Equipment Valve
FEA	Finite Element Analysis
FHWA	Federal Highway Administration
FP	Foreign Print
FPL	Florida Power and Light
FSEL	Franklin Structural Engineering Laboratory
IMC	Inspection Manual Chapter
IP	[NRC] Inspection Procedure
LF	Load Factor
MPR	MPR Associates, Inc.
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
P&ID	Piping and Instrument Diagram
PM	Preventative Maintenance
POD	Prompt Operability Determination
PRA	Probabilistic Risk Assessment
psi	pounds per square inch
QA	Quality Assurance
RCA	Radiologically Controlled Areas
RCE	Root Cause Evaluation
RHR	Residual Heat Removal
SDP	Significance Determination Process
SG&H	Simpson, Gumpertz & Heger

SMP	Structures Monitoring Program
SRI	Senior Resident Inspector
UFSAR	Updated Final Safety Analysis Report
UT-A	University of Texas - Austin
UK	United Kingdom
WO	Work Orders