FOIA/PA NO: ____2013-0332________

GROUP C
RECORDS BEING RELEASED IN PART

The following types of information are being withheld:

Ex. 1: ☐ Records properly classified pursuant to Executive Order 12,958
Ex. 2: ☐ Records regarding personnel rules and/or human capital administration
Ex. 3: ☐ Information about the design, manufacture, or utilization of nuclear weapons
☐ Information about the protection or security of reactors and nuclear materials
☐ Contractor proposals not incorporated into a final contract with the NRC
☐ Other____
Ex. 4: ☐ Proprietary information provided by a submitter to the NRC
☐ Other_____Licensee's file regarding subject and underlying complaint____
Ex. 5: ☑ Draft documents or other pre-decisional deliberative documents (D.P. Privilege)
☐ Records prepared by counsel in anticipation of litigation (A.W.P. Privilege)
☐ Privileged communications between counsel and a client (A.C. Privilege)
☐ Other____
Ex. 6: ☐ Agency employee PII, including SSN, contact information, birthdates, etc.
☑ Third party PII, including names, phone numbers, or other personal information
Ex. 7(A): ☐ Copies of ongoing investigation case files, exhibits, notes, ROI's, etc.
☐ Records that reference or are related to a separate ongoing investigation(s)
Ex. 7(C): ☐ Special Agent or other law enforcement PII
☐ PII of third parties referenced in records compiled for law enforcement purposes
Ex. 7(D): ☐ Witnesses' and Allegers' PII in law enforcement records
☐ Confidential Informant or law enforcement information provided by other entity
Ex. 7(E): ☐ Law Enforcement Technique/Procedure used for criminal investigations
☐ Technique or procedure used for security or prevention of criminal activity
Ex. 7(F): ☐ Information that could aid a terrorist or compromise security

Other/Comments:____
____

Lamb, John

From: Lamb, John
Sent: Monday, February 27, 2012 8:53 AM
To: Lamb, John; Khanna, Meena; Murphy, Martin; Marshall, Michael; Burritt, Arthur; Raymond, William; Thomas, George; Sheikh, Abdul; Conte, Richard; Galloway, Melanie; Cheok, Michael; Miller, Chris; Lund, Louise; Ennis, Rick
Subject: For the Meeting - DRAFT Slides (Rev. 3) for Chairman Brief regarding Seabrook ASR
Attachments: Seabrook ASR - Chairman Brief Slides_ March 2012 - Rev 3.pptx; MTG-POP - 02-27-2012 - Rev 1.docx

Importance: High

ADAMSAccessionNumber: ML120590564

Ladies & Gentlemen:

Attached are **DRAFT** slides (Revision 3 based on the technical input received to date) for the Chairman brief regarding Seabrook ASR.

The meeting/conference call is **TODAY** (Monday, February 27, 2012) at **10:00 am** (Eastern time). Attached is the POP for the meeting.

The purpose of the meeting will be to receive SES management direction and to discuss the agenda, the key messages, and the presenter(s). We will also want to prepare for any questions that we may receive from the Chairman during the presentation, e.g., why we do not have an immediate safety concern/operability determination, update on licensee's root cause evaluation, schedule of license renewal review, etc.

After we finalize the slides, we will then schedule a dry run.

ex6

The Bridge Line is **1-800-369-2060** with Passcode (b)(6) The Headquarters personnel will meet in Conference Room O-8B2 at 10:00 am (Eastern time) on Monday, February 27, 2012. There are 8 lines available: 1 for Conference Room O-8B2, 2 for NRR personnel working at home, 1 for Region 1 Office, 1 for Seabrook site, and 3 lines for Region 1 personnel working at home or on travel.

Thanks.
John

C1

Seabrook Concrete Degradation by Alkali Silica Reaction

NRC Staff Briefing to

Chairman Jaczko

March 8, 2012

Agenda

- Overview of Degradation Mechanism
- Licensee's Current Operability Determination
- Licensee Actions
- Current Staff Assessment
- NRC Staff Actions
- Summary

Overview of Alkali-Silica Reaction (ASR)

- Slow chemical process in which alkalis in the cement combine with certain reactive types of silica in the coarse aggregates, when moisture is present.
- Forms a gel that can absorb water and expands to cause cracking and disruption of concrete.
- Requires susceptible aggregate, high alkali content in cement, and adequate moisture.
- Changes mechanical properties of concrete.

Licensee's Current Operability Determination

- Licensee made two prompt operability determinations (PODs): (1) for the "B" Electrical Tunnel under the Control Building in September 2010, and (2) for four other affected Category 1 structures determined by the extent-of-condition in June 2011.
- Licensee updated both PODs in October 2011 in response to NRC questions.
- PODs concluded that the affected structures are operable but degraded. Systems and components housed within the buildings remain operable and capable of performing their design functions.
- ASR has resulted in reduction of elastic modulus of concrete and compressive strength in portions of below grade walls.

Licensee Actions

- Testing, Structural Assessment, and Engineering Evaluation to address short-term and long-term aspects of ASR-affected structures
  - Complete engineering evaluation by March 31, 2012
  - Root cause evaluation related to ASR issue
  - Periodic review and update of the two PODs as new information is obtained or in response to NRC questions, until corrective actions are completed.
- Large-scale testing (girder, embed blocks) at University of Texas and evaluation plan to manage ASR
  - Expect results from University of Texas testing in first quarter of calendar year 2013

Current Staff Assessment

- Based on inspection and review of licensee's current operability determination, the NRC staff found no apparent immediate safety concern from the existing ASR concrete degradation because:
  - Although there was degradation, there is still margin in the design,
  - No visible indication of significant deformation, distortion or relative movement caused by ASR expansion; cracking appears to be in localized sections,
  - Concrete compressive strength generally above design strength,
  - Consistent with existing non-nuclear operating experience and research of ASR, the degradation at Seabrook appears to be occurring slowly.
  - Affected structures are being monitored. Licensee is in the process of comprehensively addressing the issue to develop and implement corrective actions.

NRC Staff Actions

- Quarterly resident report issued May 12, 2011
  - NCV (green) on failure to adequately monitor the Control Building Electrical Tunnel for the recently discovered degradation.
  - NCV (green) on failure to include transition buildings as in-scope structures in Maintenance Rule monitoring program.

- License Renewal Inspection report issued May 23, 2011
  - Report noted that the aging management review for the ASR issue is incomplete

NRC Staff Actions

- Operating Experience group issued an internal communication in January 2011, and IFR 2011-11 is being developed.

- Generic communication (IN) 2011-20 was issued on November 18, 2011, to inform other licensees about the ASR potential in plants with groundwater leakage.

- R-I ASR Inspection report issued March 2012
  - Report noted that additional information is needed for the aging management review for the ASR issue
  - Report requests a response by the licensee in 30 days
  - Report offers a management meeting in 30 days

NRC Staff Actions

- Response being finalized to TIA 2011-13, between R-I and NRR, providing technical guidance to R-I on issues to be addressed by licensee for final resolution of OD with regard to ASR degradation in Part 50 space.
- License Renewal
  - Submitted June 1, 2010
  - Scheduled to issue SER in December 2012.
  - Scheduled for full ACRS in January 2013
  - Schedule for NRR Director decision is TBD
  - Schedule for Commission decision is TBD

Summary

- Degradation from ASR in Seabrook's concrete structures has no apparent immediate safety concern; detailed testing and evaluations to comprehensively address the issue in the short-term and long-term, including updated operability determinations are ongoing.
- NRC staff continues to monitor and assess licensee activities on the issue.
- The NRC staff continues to better understand and evaluate the effect of ASR on Seabrook's concrete structures for both functionality and aging effects.
- ASR issue may impact Seabrook Station license renewal schedule.

SEABROOK ASR CHAIRMAN BRIEF MEETING

February 27, 2012

10:00 AM

Conference Room O-8B2

PURPOSE

The purpose of the meeting will be to receive SES management direction and to discuss the agenda, the key messages, and the presenter(s) for the Chairman brief on March 8, 2012. We will also want to prepare for any questions that we may receive from the Chairman during the presentation, e.g., why we do not have an immediate safety concern/operability determination, update on licensee's root cause evaluation, schedule of license renewal review, etc.

EXPECTED OUTCOMES

Agreement on a path forward to finalize the slides.

PROCESS

Topic	Lead	Time
1. Introduction	**M. Khanna**	**10:00 - 10:05 AM**
2. SES Decisions and Directions to Staff	**R-I and NRR SES personnel**	**10:05 – 10:30 AM**
2. Agenda for Chairman brief	**R-I and NRR staff**	**10:30 – 10:45 AM**
3. Operability	**R-I and NRR staff**	**10:45 – 11:15 AM**
4. Key messages and presenters	**R-I and NRR staff**	**11:15 – 11:25 AM**
5. Path Forward	**R-I and NRR staff**	**11:25 – 11:30 AM**
Adjourn		**11:30 AM**

Lamb, John

From: Lamb, John
Sent: Thursday, March 01, 2012 6:43 AM
To: Conte, Richard; Khanna, Meena; Thomas, George; Sheikh, Abdul; Marshall, Michael; Burritt, Arthur
Cc: Murphy, Martin; Raymond, William; Wilson, Peter; Erickson, Alice; Cunanan, Arthur
Subject: RE: For Your Review - Rev 9 of DRAFT Slides for Chairman Brief
Attachments: Seabrook ASR - Chairman Brief Slides_ March 2012 - Rev 9.pptx

Importance: High

ADAMSAccessionNumber: ML120610038

Ladies & Gentlemen:

The purpose of the meeting will be to go through the latest version (Rev. 9) of the draft slides and finalize the slides and determine who is presenting what. We will also want to prepare for any questions that we may receive from the Chairman during the presentation, e.g., why we do not have an immediate safety concern/operability determination, update on licensee's root cause evaluation, schedule of license renewal review, etc. After we finalize the slides, we will then schedule a dry run.

The NRC Headquarters personnel will meet in O-8B2 at 10:00 am. The Bridge Line is **800-857-9647** and the Passcode is (b)(6) There are 8 lines available.
b6

All participants must use a touch-tone phone to participate in an Audio Conference. The following features are available for you to use on your phone during an active conference: ♦ Press *0 operator assistance (small fee may apply) ♦ Press *6 mute/unmute individual line

Rev. 9 will be the version that we discuss today at 10:00 am.

Thanks.
John

From: Lamb, John
Sent: Wednesday, February 29, 2012 2:18 PM
To: Conte, Richard; Khanna, Meena; Thomas, George; Sheikh, Abdul; Marshall, Michael; Burritt, Arthur
Cc: Murphy, Martin; Raymond, William; Wilson, Peter; Erickson, Alice
Subject: For Your Review - Rev 8 of DRAFT Slides for Chairman Brief
Importance: High

Ladies & Gentlemen:

Attached, for your review, is Rev. 8 of the DRAFT slides for the Chairman brief. Rev. 8 reflects all inputs; please make sure that I have cut and paste your input properly, because sometimes my paws do not work so well on the keyboard.

Rev. 8 will be the version that we discuss tomorrow at 10:00 am.

Thanks for the support.

C2

John

From: Lamb, John
Sent: Wednesday, February 29, 2012 12:37 PM
To: Conte, Richard; Khanna, Meena; Thomas, George; Sheikh, Abdul
Cc: Murphy, Martin; Marshall, Michael; Burritt, Arthur; Raymond, William; Wilson, Peter; Erickson, Alice
Subject: For Your Review - Rev 7 of DRAFT Slides for Chairman Brief

Ladies & Gentlemen:

Attached, for your review, is Rev. 7 of the DRAFT slides for the Chairman brief. Rev. 7 reflects all inputs; please make sure that I have cut and paste your input properly, because sometimes my paws do not work so well on the keyboard. Rev. 7 will be the version that we discuss tomorrow.

Thanks for the support.
John

From: Lamb, John
Sent: Wednesday, February 29, 2012 11:30 AM
To: Lamb, John; Conte, Richard; Khanna, Meena; Thomas, George; Sheikh, Abdul
Cc: Murphy, Martin; Marshall, Michael; Burritt, Arthur; Raymond, William; Wilson, Peter; Erickson, Alice
Subject: For Your Review - Rev 6 of DRAFT Slides for Chairman Brief
Importance: High

Ladies & Gentlemen:

Attached, for your review, is Rev. 6 of the DRAFT slides for the Chairman brief. Rev. 6 reflects the input that I have been provided to date; please make sure that I have cut and paste your input properly, because sometimes my paws do not work so well on the keyboard.

Thanks.
John

From: Lamb, John
Sent: Wednesday, February 29, 2012 8:18 AM
To: Conte, Richard; Khanna, Meena; Thomas, George; Sheikh, Abdul
Cc: Murphy, Martin; Marshall, Michael; Burritt, Arthur; Raymond, William; Wilson, Peter
Subject: For Your Review - Rev 5 of DRAFT Slides for Chairman Brief
Importance: High

Ladies & Gentlemen:

Attached, for your review, is Rev. 5 of the DRAFT slides for the Chairman brief. Rev. 5 reflects the input that I have been provided to date; please make sure that I have cut and paste your input properly, because sometimes my paws do not work so well on the keyboard.

Thanks.
John

From: Conte, Richard
Sent: Tuesday, February 28, 2012 5:07 PM

To: Lamb, John; Khanna, Meena; Thomas, George; Sheikh, Abdul
Cc: Murphy, Martin; Marshall, Michael; Burritt, Arthur; Raymond, William; Miller, Chris; Wilson, Peter
Subject: See Slides 6 and 7

Be careful I used the same title Rev 3, do not just replace. Best to just extract 6 and 7 by block and copy.

OR let me know how I failed by response email.

I put notes on the slides before 6 and 7 to check my understanding of where we were headed.

We are doing a discussion rather than dryrun on Thursday at 1000am

See notes on slide 7, it is a sense of direction from the licensee right now. They are working Friday if we need a status call with them. I revealed to them that we are briefing out Chair.

Rich Conte, EB-1 Branch Chief, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell) ex6

Seabrook Concrete Degradation by Alkali Silica Reaction

NRC Staff Briefing to

Chairman Jaczko

March 8, 2012

Agenda

- Current Status of ASR Affected Structures
- NRC Staff Actions
- Licensee Actions
- Path Forward

Current Status of ASR Affected Structures

- No immediate safety concern.
- The ASR structures are operable but degraded (below full qualification), and subject to corrective action because:
  - Field walk-downs confirm no visible indication of significant deformation, distortion, or displacement of structures,
  - No visible indication of rebar corrosion,
  - ASR identified at localized areas in the concrete walls,
  - Degradation due to ASR progressing slowly that is consistent with existing operating experience and published literature,
  - Cracks in the ASR structures are being monitored,
  - Laboratory tests performed so far indicate reduction in mechanical properties consistent with published literature,
  - Loads assumed in the original design are conservative and have safety load factors that need not be considered for operability evaluation, and
  - CLB design margin reduced by the loss of mechanical properties; however, the degraded structure will be able resist loads (without conservative safety load factors).

NRC Staff Actions

- Operating Experience group issued an internal communication in January 2011, and IFR 2011-11 is being developed.
- Generic communication (IN) 2011-20 was issued on November 18, 2011, to inform other licensees about the ASR potential in plants with groundwater leakage.
- Response being finalized to TIA 2011-13, between R-I and NRR, providing technical guidance to R-I on issues to be addressed by licensee for final resolution of OD with regard to ASR degradation in Part 50 space.

NRC Staff Actions

- Summary of Design Basis Work for TIA 2011-13:
  - Regulatory bases are in 10 CFR 50, Appendix A (GDC 1, 2, 4) and Appendix B (Criterion XVI, XI), 50.65 and UFSAR 3.8.4.
  - Structural design is based on ACI 318-71 ultimate strength method.
  - PODs are based on the implicit assumption that the empirical code relationships (based on tests of non-degraded concrete) between concrete compressive strength and other mechanical properties (shear, tensile, bond strengths, elastic modulus, etc) remain unaffected and valid for ASR-degraded concrete.
  - Licensee should validate the above assumption and address its impact on the short term and long term (thru end of current 40-year license) design basis evaluations and CLB by testing / use of published literature.
  - ASR affects concrete mechanical properties at different rates. The effect of ASR expansion and potential changes in properties thru the end of 40-year operating license should be factored in the design evaluations.

NRC Staff Actions

- Summary of R-I Standalone ASR Inspection Report
  - Issued March X, 2011 calling for a management meeting.
  - NextEra taking an apparent new direction.
  - Issues related to implicit assumptions of the design bases code summarized.
  - Other issues need to be considered on previous or new approach:
    - Sampling representativeness.
    - Non-Destructive testing before samples or cores are broken for compressive strength values.
    - Potential effects of other degradation mechanisms due to aggressive groundwater
  - Issues need to be factored into an comprehensive corrective action plan for a significant condition adverse to quality.

NRC Staff Actions

- Other Performance Issues Addressed in the R-1 Standalone Inspection Report
  - One unresolved item dealing with an engineering change from May 2011 was resolved and a finding was noted:
    - EC accepted the change in compressive strength and modulus of elasticity information on a "use-as-is" basis with only a 10CFR 50.59 screening.
    - Finding (Noncited Violation) noted in not following 10 CFR 50.59 in that a safety evaluation was needed – very low significance, EC was rescinded.
  - Another Unresolved item was updated:
    - The open prompt operability determination for the Control Building "B" Electrical Tunnel (with the issues noted in previous slide)
    - And the open prompt operability determination for Buildings in which there was an extent of condition review (with the issues noted in previous slide).
    - Finding (no violation) identified in not following a self imposed standard for conducting operability determinations – did not fully evaluate conditions identified by NRC staff based on known information
  - NRR support greatly appreciated in this effort

NRC Staff Actions

- License Renewal - The staff cannot issue SER for LRA until the applicant has:
  - Completed efforts (e.g., in-situ and laboratory testing) to establish the effect of ASR on concrete mechanical properties (i.e., compressive, bond, shear strength, and modulus of elasticity).
  - Demonstrate that the effects of aging will be adequately managed so that the intended functions of ASR affected concrete structures will be maintained. (10 CFR 54.21 (a)(1)(ii)(3))
    - Update existing design basis calculations to account for changes in the mechanical properties through the end of the PEO.
    - Account for deviation to ACI 318 empirical relationships for concrete mechanical properties due to ASR.
    - Supplement application, if change current CLB. (10 CFR 54.21 (b))
  - Provide an acceptable aging management program that includes consideration of ASR. (10 CFR 54.21 (d))

NRC Staff Actions

- License Renewal - LRA review schedule has been impacted due to the additional effort to study and analyze the effect of ASR.
  - Plan to acquire support of an ASR expert.
- Current Schedule
  - Issue SER in December 2012*
  - Schedule for full ACRS in January 2013*
  - Schedule for NRR Director decision is TBD*
  - Schedule for Commission decision is TBD*

- * This revised schedule assumes that the applicant will provide an adequate response to staff's questions concerning ASR by March 2012. The schedule was revised in July 2011.

Licensee Actions

- Licensee updated two prompt operability determinations (PODs): (1) for the "B" Electrical Tunnel under the Control Building in September 2010, and (2) for four other affected Category 1 structures determined by the extent-of-condition in October 2011 and concluded that the affected structures are operable but degraded.
- ASR has resulted in reduction of elastic modulus of concrete and compressive strength in portions of below grade walls.
- Expects to complete Engineering Evaluation to address short-term and long-term aspects of ASR-affected structures at end of March 2012 or early April 2012.
- Expects to complete large-scale testing (girder, embed blocks) at University of Texas and evaluation plan to manage ASR in first quarter of calendar year 2013.

Path Forward

- Degradation from ASR in Seabrook's concrete structures has no apparent immediate safety concern; detailed testing and evaluations to comprehensively address the issue in the short-term and long-term, including updated operability determinations are ongoing.
- NRC staff continues to monitor and assess licensee activities on the issue.
- The NRC staff and NextEra staff will have a management meeting in NRC Headquarters within the next 30 days.
- ASR issue has impacted Seabrook Station license renewal review.

Buford, Angela

From: Buford, Angela
Sent: Friday, June 15, 2012 1:29 PM
To: Thomas, George
Subject: RE: Contractor will not be there next week but for sure 7/16/12

Thanks!

From: Thomas, George
Sent: Friday, June 15, 2012 10:08 AM
To: Buford, Angela
Subject: RE: Contractor will not be there next week but for sure 7/16/12

Angie,

My cell phone number is (b)(6) Are you taking the same flights as me?

Please keep the NRC Senior Resident Inspector, Bill Raymond, phone number: 603-474 3580. He would be the best NRC contact, if needed. You can also keep Paul Willoughby's number – licensee contact.

Here are some directions based on my last visit in Sep 2011: Attached is the NRC visitors guide to Seabrook, which I got from the Resident during my last trip. This guide has a google map on the first page. Seabrook is on the very first exit off of I-95N, once you enter New Hampshire. See map in the visitor's guide - You would be entering the site from the Southgate (there will be a security guard station, show your NRC ID, they should have our names on the expected visitors list if things have been processed by Region 1, ask for any directions if you need it – the guards were very helpful). Then you would drive to Parking Lot A and park, and then walk to the building (Operations Support Building, which is outside the PA) designated for Badging in the map – this is outside the PA. Last time, licensee had someone (Vicky Brown) escort us from the parking lot near the OSB. Badging is processed in the OSB. The licensee usually assigns the NRC inspection team a room in the OSB to work from – Just ask someone if you need directions. Note that the Resident Inspector Office is inside the PA and that is not where we would be working from.

I think there is a toll after you get the rental car and exit the airport area. Also, I think there is a toll between Seabrook and Portsmouth if you take I-95 – I believe I-95 is a toll road in NH.

Please stop by if you have any questions. Thanks.

George

From: Buford, Angela
Sent: Friday, June 15, 2012 9:19 AM
To: Thomas, George
Subject: RE: Contractor will not be there next week but for sure 7/16/12

George, I may not be in sync with you since we both need to get our rental cars. When on site, where should I go and/or who to call?

Also, can you give me your cell phone number in case I need to reach you? My number is (b)(6)

Thanks,

C3

Angie

From: Thomas, George
Sent: Thursday, June 14, 2012 5:19 PM
To: Conte, Richard; Cook, William; Buford, Angela; Chaudhary, Suresh; Raymond, William
Subject: RE: Contractor will not be there next week but for sure 7/16/12

FYI – I plan to arrive at the site around 1:00pm on Monday (6/18) and leave site around 11:30 am on Thursday (6/21).

From: Conte, Richard
Sent: Thursday, June 14, 2012 4:40 PM
To: Cook, William; Buford, Angela; Chaudhary, Suresh; Raymond, William; Thomas, George
Subject: Contractor will not be there next week but for sure 7/16/12

Suresh will need to start looking at the initial assessment and how it applies to the Control Building POD.

I also asked Suresh to see what is in the initial assessment, mostly pictures, words, drawings etc. and how long will it be to get through it in a reasonable sampling way.

He will be prepared to discuss with the team his view on how to get tensile strength with more core sampling and triaxial tests – we will eventually need to come to a decision on that but it doesn't have to be next week.

The team should apply their VT test for ASR in a building without using petrography. Please test the VT on the crazed cracking in the primary containment. Bill Cook please go visit the annulus regions of this issue, Suresh or Bill Raymond will lead the way.

Bill Raymond please be ready to brief team and what to do on backfill and bedrock foundation for the buildings.

Bill will brief team on corrective action for a(1) MR violation, it may be appropriate in reviewing the root cause evaluation and the integrated corrective action plan.

Rich Conte, EB-1 Branch Chief, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Buford, Angela

From: Buford, Angela
Sent: Tuesday, July 31, 2012 11:02 PM
To: 'Willoughby, Paul'
Subject: Request for Document to be added to Certrec

Paul,

I don't see FP100730 in Certrec. If I've missed it let me know. If not, please provide that document on the Certrec website if possible.

Thank you,

Angie Buford

From: Willoughby, Paul [mailto:Paul.Willoughby@fpl.com]
Sent: Tuesday, June 19, 2012 2:41 PM
To: Buford, Angela
Subject: WiFI Access

Angela,

You now have wi fi access. Use 'seabrook guest network' for pass code.

Paul

(b)(6) [redacted]

paul.willoughby@nexteraenergy.com

C4

Buford, Angela

From: Marshall, Michael
Sent: Wednesday, August 15, 2012 8:42 PM
To: Cook, William; Conte, Richard
Cc: Buford, Angela
Subject: RESPONSE: Comments on Seabrook Site Visit Report

Hello Bill and Rich,

Sorry, I meant to send this last week. I had it drafted but forgot to send before leaving on vacation.

Below are RASB's comments on the report that was circulated prior to our call two weeks ago and you requested feedback.

Overall the paper is clear and well written. However, because of the comments listed below, RASB believes the report will either need to be revised or a fuller discussion is needed among internal stakeholders regarding some of the observations noted in the report prior to sharing the paper with licensee or other external stakeholders.

- Some of the position taken in the paper differ from current positions the staff has taken to date. If the intent is to use the paper as a basis for changing the current position, then a fuller discussion amongst the cognizant technical staff involved would be warranted. If the intent is not to change current position, then the paper could lead to undue confusion on the part of external stakeholders.
    - It is stated that the 25% potential reduction for out of plane shear capacity of walls, while conservative, is not warranted based on data cited. The applicant has used this reduction based on published data after considerable discussion and with and "prompting by" the staff.
    - It is stated that "the 25% 'potential strength reduction,' while conservative, is not warranted based on the data cited." The staff looks at this number in a "bounding" context, and encourage the use of bounding values.
    - It is stated (referring to FP 100716 Section 3.1.2) that ASR has not been conclusively established to have resulted in a reduction in in-situ compressive strength or modulus of elasticity. It is also stated, in the same section, to say that the reduction in modulus due to ASR is expected. There is considerable evidence in applicable research as well as in the licensee's testing that ASR has likely compromised the concrete material properties.

- In several places in the paper, a qualified acceptance or temporary agreement is explicitly stated or implied. Typically, these statements are indicated by the phrase "at this time." A more full explanation seems warranted to explain why a qualified or temporary acceptance or agreement is merited and under what condition it would no longer be acceptable.
    - It is started that due to nature of operational evaluation, applying the ACI 318-71 Vc = 2 sqrt Fc is appropriate and adequate for the Seabrook NPS structures at this time, including those areas affected by ASR. An explanation of the phrase "at this time" should be provided. Under what conditions is the use of the equation appropriate.
    - It is stated that "Based on the limited data available, the 40% reduction may be overly conservative at this time (extent of ASR deterioration). An explanation of the phrase "at this time" should be provided. Under what conditions is the use of the equation appropriate.
    - In the report concern is expressed regarding the applicant's seemingly haphazard anchor testing that was recently performed. It is stated that the pull-out testing may not be valid for the "Kwik bolts" because their performance relies on tightening torque and friction of the wedges, and the anchor tests using bolts that were installed post-ASR would not experience the same

C5

degradation as ones that were previously installed in concrete which developed and experienced the progression of ASR. The report implies a qualified acceptance by adding that this issue could perhaps be addressed in the UT-A test program.

- o

- Some statements are broad, but it seems that the statement may have limited applicability (e.g., to a single structure). It may be beneficial to ensure broad statements are truly intended to be broad. If not then additional context should be provided.

  - It is stated that the use of finite element analyses to assess the effects of ASR has little practical value. This statement seems too broad. FEA analysis of some structures is needed to determine the effects of ASR. For instance, parametric study of the containment enclosure building to determine the effect of reduced modulus of elasticity in needed,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Cook, William
Sent: Wednesday, July 25, 2012 11:51 AM
To: Burritt, Arthur; Marshall, Michael; Murphy, Martin; Khanna, Meena; Kobetz, Timothy; Trapp, James
Cc: Buford, Angela; Lamb, John; Conte, Richard; Cook, William; Raymond, William
Subject: Revised Agenda for today's ASR Working Group conference call at 2:00 pm

See Attached revised agenda and Dr. Kent Harries' report provided to focus/facilitate today's discussions.

Thanks,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) [redacted] (cell)

Marshall, Michael

From: Buford, Angela
Sent: Monday, August 20, 2012 11:26 AM
To: Marshall, Michael
Subject: RE: RESCINDING THE SEABROOK TIA

Michael,

Does this have any impact on the research we are doing on crack mapping?

-----Original Message-----
From: Marshall, Michael
Sent: Sunday, August 19, 2012 5:57 AM
To: Sheikh, Abdul; Buford, Angela; Erickson, Alice
Subject: FYI: RESCINDING THE SEABROOK TIA

No action needed.

From: Conte, Richard
Sent: Friday, August 17, 2012 11:28 AM
To: Burritt, Arthur; Cunanan, Arthur; Doutt, Clifford; Hogan, Rosemary; Jolicoeur, John; Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Morey, Dennis; Murphy, Martin; Ott, William; Raymond, William
Cc: Wilson, Peter; Miller, Chris; Roberts, Darrell; Clifford, James; Cook, William; Chaudhary, Suresh; Cruz, Holly; Lamb, John
Subject: RESCINDING THE SEABROOK TIA

I have completed my review on the question of rescinding the subject TIA. Key branch managers on the working group do not have objections. However the questions do need to be preserved and addressed perhaps in stages as developments occur.

A draft rescinding memo is attached to the attached position paper. I will summarize by way of confirmation and ask if there are any final thoughts, at the next ASR working group Wednesday August 22, 2012 so I can definitively state what the ASR working group recommendation is. The Lead Office in this matter is Region I.

I will proceed with the rescinding memo after I hear from the ASR working group on Wednesday or any of the cc's to the email.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

C6

Marshall, Michael

From: Khanna, Meena
Sent: Thursday, August 23, 2012 3:37 PM
To: Conte, Richard; Murphy, Martin; Burritt, Arthur; Trapp, James; Cook, William; Marshall, Michael; Kobetz, Timothy
Subject: RE: Brief for ASR Executives

I concur with delaying the briefing as well..thanks

From: Conte, Richard
Sent: Thursday, August 23, 2012 2:19 PM
To: Murphy, Martin; Burritt, Arthur; Khanna, Meena; Trapp, James; Cook, William; Marshall, Michael; Kobetz, Timothy
Subject: Re: Brief for ASR Executives

I would like a consensus view. One more vote no and I think we have enough to trash the effort. We can use the excuse that the dev memo is not ready. Please cast your vote before cob tomorrow.
Sent via Blackberry device

From: Murphy, Martin
To: Burritt, Arthur; Conte, Richard; Khanna, Meena; Trapp, James; Cook, William; Marshall, Michael; Kobetz, Timothy
Sent: Thu Aug 23 05:59:12 2012
Subject: RE: Brief for ASR Executives

I concur with delaying the briefing. I don't think there is that much new information to convey.

Marty

From: Burritt, Arthur
Sent: Wednesday, August 22, 2012 11:36 PM
To: Conte, Richard; Khanna, Meena; Trapp, James; Cook, William; Marshall, Michael; Murphy, Martin; Kobetz, Timothy
Subject: RE: Brief for ASR Executives

I recommend delaying the briefing until we have something more substantive to say. I strongly recommend not discussing item 4. Also we need to start holding the briefings within the normal business hours.

From: Conte, Richard
Sent: Wednesday, August 22, 2012 6:18 PM
To: Khanna, Meena; Burritt, Arthur; Trapp, James; Cook, William; Marshall, Michael; Murphy, Martin; Kobetz, Timothy
Subject: Brief for ASR Executives

It is scheduled for 400pm on Aug. 28. Let me know thoughts by COB Friday Aug. 24.

Will issue first thing Monday morning.

Most likely the brief with Eric Leeds currently scheduled for Aug. 30 will need to be postponed – its focus was the Dev Memo and satisfy the need to brief him periodically per ASR working group Charter

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

C7

Marshall, Michael

From: Kobetz, Timothy
Sent: Thursday, August 23, 2012 2:19 PM
To: Conte, Richard; Murphy, Martin; Burritt, Arthur; Khanna, Meena; Trapp, James; Cook, William; Marshall, Michael
Subject: RE: Brief for ASR Executives

I vote to delay.

From: Conte, Richard
Sent: Thursday, August 23, 2012 2:19 PM
To: Murphy, Martin; Burritt, Arthur; Khanna, Meena; Trapp, James; Cook, William; Marshall, Michael; Kobetz, Timothy
Subject: Re: Brief for ASR Executives

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Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

C8

Marshall, Michael

From: Galloway, Melanie
Sent: Thursday, August 30, 2012 9:52 AM
To: Marshall, Michael
Subject: FW: SB deviation

I asked Ho that we have a chance to look at—from the perspective of our understanding of the effort the agency is putting in to the ASR issue. Take a look and see if this is reflective of what we think is necessary for ASR and agency coordination. The problematic aspect may be more inspection program related but I wanted you to review and weigh in with Rani and/or Rich as necessary. Keep me posted please. Thanks.

From: Franovich, Rani
Sent: Thursday, August 30, 2012 9:43 AM
To: Nieh, Ho; Lund, Louise; Galloway, Melanie
Subject: RE: SB deviation

Here it is... I plan to call Rich Conte in the next hour or so to go over some questions and comments with him. As it is currently written, I believe this deviation memo is problematic.
Rani

Deviation Memo
Seabrook ASR F....

-----Original Message-----
From: Nieh, Ho
Sent: Thursday, August 30, 2012 9:17 AM
To: Franovich, Rani
Subject: SB deviation

Hi Rani - can u pls fwd a copy of the Seabrook deviation memo to Louise Lund and Melanie Galloway for info?

Thanks.

Ho

Sent via BlackBerry

Ho Nieh
Director, Division of Inspection and Regional Support
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
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C9

Marshall, Michael

From: Galloway, Melanie
Sent: Monday, September 10, 2012 7:20 AM
To: Marshall, Michael; Lubinski, John
Cc: Morey, Dennis; Milano, Patrick; Cunanan, Arthur; Erickson, Alice; Sheikh, Abdul; Buford, Angela
Subject: RE: Status on Seabrook ASR Issue

Michael,

Outside of Scope

Oversight

C10

- R1 is working to closeout roughly half of the Seabrook ASR CAL items by the end of September 2012 or beginning of October 2012. The CAL items that they plan to closeout are:
  - Revise the prompt operability determination (POD) associated with AR581434 ..... by May 25,2012.....
  - Submit the root cause for the organizational causes associated ..... by May 25,2012.
  - Submit the evaluation, "Impact of ASR on Concrete Structures and Attachments," ..... by May 25,2012.
  - Submit the corrective action plan for the continued assessment of ASR ..... by June 8,2012.
  - Revise the POD associated with AR1664399, ... by June 30, 2012....

  The target for issuing the report documenting the closeout of these CAL items is November 2012.
- R1 is planning to conduct a public meeting on status of the ongoing inspection activities concerning the ASR issue at Seabrook the first week of December 2012 near the plant

Licensee/Applicant Activities

- A revised root cause report will be available by the end of September 2012.
- By the end of September 2012 or sometime in October 2012, the licensee should be ready to discuss the details of the test they "plan" to conduct at the University of Texas. The licensee's is currently conducting review of the "plan."

Outside of Scope

Scope of request

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Wednesday, September 05, 2012 8:11 AM
To: Roberts, Darrell; Clifford, James; Miller, Chris; Wilson, Peter
Cc: Burritt, Arthur; Cook, William; Hogan, Rosemary; Jolicoeur, John; Khanna, Meena; Lamb, John; Kobetz, Timothy; Marshall, Michael; Morey, Dennis; Milano, Patrick; Ott, William; Trapp, James; Murphy, Martin
Subject: Weekly Status on ASR

See attached as request per DRS Div. Man. - use as needed. It is mostly if not all factually based.

Other file is summary of status call that occurred in the week.

Rich Conte, Seabrook ASR Team Lead, Region I

(610) 337-5183 (Office)
(b)(6) (NRC cell)

Marshall, Michael

From: Buford, Angela
Sent: Tuesday, September 11, 2012 1:15 PM
To: Marshall, Michael
Subject: RE: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Michael, my comments are in red below.

From: Marshall, Michael
Sent: Tuesday, September 11, 2012 11:55 AM
To: Sheikh, Abdul; Buford, Angela; Erickson, Alice
Cc: Murphy, Martin
Subject: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Hello Abdul, Alice, and Angie,

Please, review the response that I plan to send to Bill Cook on behalf of RASB per our discussion yesterday. Please, let me know if you disagree, even in the slightest, with the statements below. Please, correct technical inaccuracy and mischarterizations.

Below are RASB's comments on the rebar and core sampling papers. RASB did not offer specific edits are comments on portion of the paper, but overarching comments related to the recommendations in each of the papers.

Rebar Paper

- Sampling of rebar: RASB does not believe it is necessary on a sampling basis to expose and conduct further "augmented" examinations of the rebar. RASB does agree that the condition of the concrete (i.e., ASR-related cracking) and the aggressive environment that some of the structures are exposed to may increase the problems listed in the paper. Our understanding is that the plant has a current structure monitoring program that includes inspection of the surface of the concrete for visual indications (e.g., spalling, staining) of corrosion of the rebar. Inspection of the concrete surface for visual indications of corrosion is effective and should provide sufficient time for the licensee to take corrective action. The occurrence of ASR will not prevent or impede the detection of those visual indications, and RASB does not believe there is added value in performing additional destructive examinations outside of the current structures monitoring program.

- Analysis of groundwater: The purpose of conducting additional groundwater analysis is unclear. If the intent is to determine whether conditions are present to cause ASR, we already know the answer is yes. If the intent is to determine whether the structure is in an aggressive environment, we already know the answer is yes. Given that the structures are known to be susceptible to ASR and the environment is aggressive, it would be expected that frequency of inspections conducted as part of the structure monitoring program (or ASR monitoring program) would increase beyond the norm. We are unsure if the progress or rate of ASR can be determined from an analysis of the groundwater.

Core Sampling Paper

- Confirmation of structural integrity: RASB does not believe taking and testing additional core bores will establish a suitable basis to determine the strength of the structure. Such test would only provide determination of the material properties of the concrete but may not be representative of the properties of the actual structural behavior. ~~If the concrete was not effected by concrete and known relationships~~

C11

~~were still valid, it would be acceptable to treat the properties of material as a surrogate for the structure.~~

- Establish an accurate baseline: RASB does believe additional core samples should be taken to confirm the licensees assertion that the ASR is worse in the electrical tunnel, and to properly baseline the actual extent of ASR on structures being monitored (as opposed to using visual examination to "rate" the initial determination of degradation for each structure). The use of core bores to confirm the ASR and to compare the severity of ASR from one location to another location would be one means to verify the acceptability of the use of one or a limited number of locations to trend the effect of ASR and would help to support the concept of using a FEA or other structural evaluation as a bounding analysis. The occurrence or pattern of cracking due to ASR on the surface of a structure may vary depending of several factors (e.g., presence/quantity of reinforcing steel, direction of exposure to moisture, wetting/drying cycles). Therefore, non-visual examination of the suspected area may be necessary to verify that areas identified as worst affected are truly worse ~~effected~~ affected.

- Other: Although the paper did not propose comparison of the concrete at the site with the tests that licensee plans to conduct, it seems as part of the licensees effort to demonstrate the applicability of the material and the condition of the material (e.g., artificial aging or re-creation of ASR) that additional cores of affected areas ~~would~~ should be taken ~~to~~ and compared to ~~the~~ cores taken from the test members to verify that the test members accurately reflect the concrete at the site. Testing for material properties of both concretes, as analyzed relative to one another, would be useful in determining that the concrete at the Texas testing site is/is not a reasonable representation of the Seabrook concrete.

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Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Cook, William
Sent: Wednesday, September 05, 2012 11:21 AM
To: Murphy, Martin; Marshall, Michael; Conte, Richard; Khanna, Meena; Kobetz, Timothy; Jolicoeur, John; Cunanan, Arthur; Burritt, Arthur; Trapp, James
Cc: Sheikh, Abdul; Buford, Angela; Milano, Patrick; Chaudhary, Suresh; Raymond, William; Philip, Jacob; Fuhrmann, Mark; Cartwright, William
Subject: Latest Drafts of the Rebar and Core Sampling Position Papers

All,

I have revised the attached papers with the feedback I have received, to date. I think we are getting closer to a product that we can develop a consensus on, but realize some of you have not had the opportunity to comment or provide feedback yet. I look forward to any and all edits, additions, opposing views, comments, etc. I believe the positions we develop for these two issues will support our judgment of the adequacy of the licensee's proposed Structures Monitoring Program, Revision 2, revised specifically to address the monitoring of ASR affected concrete structures.

Regards,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

Marshall, Michael

From: Erickson, Alice
Sent: Tuesday, September 11, 2012 4:08 PM
To: Sheikh, Abdul; Marshall, Michael; Buford, Angela
Cc: Murphy, Martin
Subject: RE: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Michael,

As Abdul highlighted, we are asking a question related to the first bullet under Rebar Paper. I'm not sure we (license renewal) should provide such a strong position on this point until the applicant has provided it's response, and we have had time to evaluate it. Additionally, I'm not sure that that I entirely agree with the first statement of the second bullet under the Core Sampling Paper. This is new information to me and I wasn't aware that that was our position.

Alice

From: Sheikh, Abdul
Sent: Tuesday, September 11, 2012 1:05 PM
To: Marshall, Michael; Buford, Angela; Erickson, Alice
Cc: Murphy, Martin
Subject: RE: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Following are my observations for your consideration:
Rebar Paper:
Please note that in one of the RAIs being sent to the applicant, the request is as follows:

a. Discuss any plans to expose additional areas of ASR affected concrete, and describe how these areas will be inspected and monitored for corrosion and loss of bond during the period of extended operation.
b. Describe how the embeds and anchors in the ASR affected structures will be inspected and monitored during the period of extended operation.

Core Sampling Paper

As a part of contract J-4287, Task Order 13, we have asked ORNL and University of California to identify the following:

1. Approaches that can be used for determining the extent and the rate of current degradation in compressive, tensile, shear, and bond strengths, and Poisson's ratio of the ASR affected concrete shear walls and slab structures.
2. In-situ tests, laboratory tests or analytical methods that can be used to establish the current and future expansion of the ASR affected concrete.
3. The effects of ASR on the shear and tensile capacity of the anchor bolts and concrete anchors.
4. Laboratory tests, field tests, or analytical methods that can be used to determine the shear and tensile capacity of the anchor bolts and concrete anchors.
5. Approaches that can be used to determine the long-term degradation in compressive, tensile, shear, and bond strengths, and Poisson's ratio of the ASR affected concrete shear walls and slab structures after all the expansion has taken place.
6. The appropriate sampling plan for concrete cores (number and size of cores) from ASR degraded concrete for different types of tests.

We will get a draft report from University of California by end of October, 2012.

C12

From: Marshall, Michael
Sent: Tuesday, September 11, 2012 11:55 AM
To: Sheikh, Abdul; Buford, Angela; Erickson, Alice
Cc: Murphy, Martin
Subject: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Hello Abdul, Alice, and Angie,

Please, review the response that I plan to send to Bill Cook on behalf of RASB per our discussion yesterday. Please, let me know if you disagree, even in the slightest, with the statements below. Please, correct technical inaccuracy and mischarterizations.

Below are RASB's comments on the rebar and core sampling papers. RASB did not offer specific edits are comments on portion of the paper, but overarching comments related to the recommendations in each of the papers.

Rebar Paper

- Sampling of rebar: RASB does not believe it is necessary on a sampling basis to expose and exam rebar. RASB does agree that the condition of the concrete (i.e., ASR-related cracking) and the aggressive environment that some of the structures are exposed may increase the problems listed in the paper. Our understanding is that the plant has a current structure monitoring program that includes inspection of the surface of the concrete for visual indications (e.g., spalling, staining) of corrosion of the rebar. Inspection of the concrete surface for visual indications of corrosion is effective and should provide sufficient time for the licensee to take corrective action. The occurrence of ASR will not prevent or impede the detection of those visual indications.

- Analysis of groundwater: The purpose of conducting additional groundwater analysis is unclear. If the intent is to determine whether conditions are present to cause ASR, we already know the answer is yes. If the intent is to determine whether the structure is in an aggressive environment, we already know the answer is yes. Given that the structures are known to be susceptible to ASR and the environment is aggressive, it would be expected that frequency of inspections conducted as part of the structure monitoring program (or ASR monitoring program) would increase beyond the norm. We are unsure if the progress or rate of ASR can be determined from an analysis of the groundwater.

Core Sampling Paper

- Confirmation of structural integrity: RASB does not believe taking and testing additional core bores will establish a suitable basis to determine the strength of the structure. Such test would only provide determination of the material properties of the concrete but may not be representative of the properties of the structure. If the concrete was not effected by concrete and known relationships were still valid, it would be acceptable to treat the properties of material as a surrogate for the structure.

- Establish an accurate baseline: RASB does believe additional core samples should be taken to confirm the licensees assertion that the ASR is worse in the electrical tunnel. The use of core bores to confirm the ASR and to compare the severity of ASR from one location to another location would be one means to verify the acceptability of use one or a limited number of locations to trend the effect of ASR. The occurrence or pattern of cracking due to ASR on the surface of a structure may vary depending of several factors (e.g., ...[Angie fill in]......). Therefore, non-visual examination of the suspected area may be necessary to verify that areas identified as worst affected are truly worse effected.

- Other: Although the paper did not propose comparison of the concrete at the site with the tests that licensee plans to conduct, it seems as part of the licensees effort to demonstrate the applicability of the material and the condition of the material (e.g., artificial aging or recreation of ASR) that additional cores of affected areas would be taken to compare to the cores taken from the test members to verify that the test members accurately reflect the concrete at the site.

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Sent: Wednesday, September 05, 2012 11:21 AM
To: Murphy, Martin; Marshall, Michael; Conte, Richard; Khanna, Meena; Kobetz, Timothy; Jolicoeur, John; Cunanan, Arthur; Burritt, Arthur; Trapp, James
Cc: Sheikh, Abdul; Buford, Angela; Milano, Patrick; Chaudhary, Suresh; Raymond, William; Philip, Jacob; Fuhrmann, Mark; Cartwright, William
Subject: Latest Drafts of the Rebar and Core Sampling Position Papers

All,

I have revised the attached papers with the feedback I have received, to date. I think we are getting closer to a product that we can develop a consensus on, but realize some of you have not had the opportunity to comment or provide feedback yet. I look forward to any and all edits, additions, opposing views, comments, etc. I believe the positions we develop for these two issues will support our judgment of the adequacy of the licensee's proposed Structures Monitoring Program, Revision 2, revised specifically to address the monitoring of ASR affected concrete structures.

Regards,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell) ex6

Marshall, Michael

From: Sheikh, Abdul
Sent: Thursday, September 13, 2012 10:58 AM
To: Marshall, Michael; Buford, Angela; Erickson, Alice
Subject: RE: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

Yesterday we discussed the items noted below. The document below states that

"RASB does believe additional core samples should be taken to confirm the licensees assertion that the ASR is worse in the electrical tunnel."

The following information is extracted from a write-up by Bill Raymond's email of August 24, 2012. It clearly shows that electrical tunnel does not have the worst cracking index or crack width.

Building	CI (mm/m)	Max width (mm)
Electric tunnel	0.75 mm/m	0.40 mm
BDG	0.60 mm/m	0.33 mm
EFW	0.95 mm/m	0.20 mm
CEVA	0.45 mm/m	0.25 mm
RHR	1.10 mm/m	0.20 mm

However, now core data has been obtain from the following areas with comparable or larger CIs (source FP 100705 MPR-3704):

Building	CI (mm/m)	Max width (mm)
MS/FW East	3.225 mm/m	0.40 mm
Cooling tower	1.75 mm/m	0.25 mm
SWPH	1.66 mm/m	0.40 mm
DTS (discharge)	1.45 mm/m	0.70 mm
MS/FW West	1.375 mm/m	0.50 mm
CST	1.275 mm/m	0.15 mm
ITS (intake)	0.975 mm/m	0.30 mm
FSB	0.875 mm/m	0.20 mm
SWYD	0.875 mm/m	0.20 mm
WPB	0.825 mm/m	0.30 mm
PAB	0.775 mm/m	0.20 mm

From: Marshall, Michael
Sent: Tuesday, September 11, 2012 11:55 AM
To: Sheikh, Abdul; Buford, Angela; Erickson, Alice
Cc: Murphy, Martin
Subject: RESPONSE: Latest Drafts of the Rebar and Core Sampling Position Papers

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C13

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Core Sampling Paper

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Subject: Latest Drafts of the Rebar and Core Sampling Position Papers

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Regards,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

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(b)(6) (cell) ex6

Buford, Angela

From:	Marshall, Michael
Sent:	Thursday, September 27, 2012 9:41 AM
To:	Erickson, Alice; Buford, Angela; Sheikh, Abdul
Subject:	Heads-Up: Save the Date December 12, 2012 Wednesday RE: Thank you: Venue for a Public Meeting

Hello Abdul, Alice, and Angie,

Please, plan on attending this tentatively scheduled meeting.

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Wednesday, September 19, 2012 9:33 PM
To: Raymond, William; Miller, Chris; Cook, William; Screnci, Diane; Chaudhary, Suresh; Thomas, George; Marshall, Michael; Bearde, Diane; Cass, Andrea; Farrar, Karl; Khanna, Meena
Cc: Sheehan, Neil; Tifft, Doug; McNamara, Nancy; Murphy, Martin; Spencer, Mary; Burritt, Arthur; Trapp, James; Morey, Dennis; Milano, Patrick; Lamb, John
Subject: Save the Date December 12, 2012 Wednesday RE: Thank you: Venue for a Public Meeting

If you are an addressee this is a tentative list of who we would expect to be at this ASR public meeting – Please save the date. We can discuss more later and why.

At the table staff would be: Chris Miller, Me, Bill cook and Raymond. Others would be there in support.

This visit to the high school this morning was a success. It looks very accommodating over the suggested Greek orthodox church, no parking/cafeteria, and firehouse playhouse, parking limited and handicap access through adjacent restaurant.

Student enrollment is 740. 90 parking spaces are on campus and plenty of local parking in adjacent streets – normal Seabrook attendance is about 50 and we are planning for 100.

Auditorium seats 700 with balcony (300-350 without balcony) and they have anti rooms that can seat 125 to 150 and another classroom style for 80 -

Overall the prospective facility is very well equipped for handicap access and to rest rooms and in a nice location of town, in a community. Good area outside auditorium for registration and reception in doors.

Food service can be provided for a price; janitor service is available for 4 hours to 1000pm, we can arrive at 500pm in the anti room for light dinner and final preps.

C14

Contacts provided with Superintendent of Schools, and Food Service and for local police to hire an off-duty office.

Student can provide audio visual fro $15/hours.

Tuesday the 11th is a basketball game and Thursday the 13 is College funding night. We need to lock in to the 12th by Oct.. 3.

Next step fill out form 30 and/or discuss with management more.

<u>Summary of Planned Expenses</u>:

$300-500, for auditorium with anti room.

$20-25/hr for janitor service for 4 hours or $80 to 100

XXX Food service can be paid by NRC participants.

$15/hour for 4 hours for audio visual

$Free or XX Police officer or off duty person

$XX local person to supplement audio visual – sound or video tape session but no transcript

Tent. Total without unknowns is $440 to 660

From: Raymond, William
Sent: Wednesday, September 19, 2012 12:47 PM
To: 'Michael parent'
Cc: Conte, Richard
Subject: Thank you: Venue for a Public Meeting

Michael,
Thank you again for taking the time to meet with Rich and I today.
I was a pleasure meeting you and touring your facilities.
Newburyport HS is a fine facility that would suit our needs very well.
Thank you for holding a date for us - December 12,th 5 pm to 10 pm.
We will get back to you soon as we agreed this morning, no later than October 3rd.

Thanks again,
Bill

William J. Raymond
Nuclear Engineer
US Nuclear Regulatory Commission
Seabrook Station
william.raymond@nrc.gov
work: 603-773-7037
Cell: (b)(6)

From: Raymond, William [mailto:William.Raymond@nrc.gov]
Sent: Wednesday, September 12, 2012 8:58 AM
To: 'Michael parent'

Cc: Conte, Richard
Subject: RE: Venue for a Public Meeting

Mike,
Rich Conte from NRC's Region I Office (Philadelphia) will be at Seabrook next week.
Can we schedule a meeting to see your facilities and discuss with you the possible use of the High School?
Rich and I will come to your office for a meeting that should take one-half hour or less.
I propose Tuesday morning, September 18th, say 10:30 am. Please propose an alternative if another time is more convenient for you.
Rich is in NH through mid-day on Friday; however, our schedule is full Thursday afternoon.

Thanks,
Bill

From: Michael parent [mailto:mparent@newburyport.k12.ma.us]
Sent: Tuesday, September 11, 2012 10:24 AM
To: Raymond, William
Subject: RE: Venue for a Public Meeting

Hi Bill,

I checked out our December schedule. Right now our auditorium is open pretty much the entire month. It will begin to fill up in the next month or so.
Let me know what date might work best for you. There would be a fee for use(I am not sure how much at this point) If it is on the weekend, there would be a charge for custodial personnel depending on the anticipated number of people who would attend.

Mike Parent

From: Raymond, William [mailto:William.Raymond@nrc.gov]
Sent: Tuesday, September 11, 2012 8:52 AM
To: 'mparent@newburyport.k12.ma.us'
Cc: Conte, Richard
Subject: Venue for a Public Meeting

Good Morning Mr. Parent,

My name in Bill Raymond. I work for the U.S. Nuclear Regulatory Commission (NRC).
The NRC regulates commercial nuclear power facilities, including the Seabrook Nuclear Station.
We are looking for a venue to hold a public meeting regarding Seabrook in the Newburyport area.
We would like to hold the meeting in December 2012 but have not yet picked the date.
Could we talk about whether Newburyport High School could be available and suitable for such a meeting?
My contact information is provided below. Please call me at your convenience.

Thank you,

Bill
William J. Raymond
Nuclear Engineer
US Nuclear Regulatory Commission

Seabrook Station
william.raymond@nrc.gov
work: 603-773-7037
Cell: (b)(6)

Thomas, George

From: Thomas, George
Sent: Thursday, October 04, 2012 2:46 PM
To: Murphy, Martin
Subject: RE: seabrook

Marty,

(b)(5)

Thanks.
George

From: Murphy, Martin
Sent: Thursday, October 04, 2012 2:23 PM
To: Thomas, George
Subject: RE: seabrook

Ok, thanks. Your estimate is dramatically larger than what was discussed yesterday.

From: Thomas, George
Sent: Thursday, October 04, 2012 10:26 AM
To: Murphy, Martin
Cc: Marshall, Michael; Manoly, Kamal
Subject: RE: seabrook

Marty,

(b)(5)

Thanks.
George

From: Murphy, Martin
Sent: Wednesday, October 03, 2012 2:20 PM
To: Thomas, George
Cc: Marshall, Michael; Manoly, Kamal
Subject: seabrook

George,

What is the total surface area of the containment structure that the 3 identified areas are part of ?

Marty

Marshall, Michael

From: Sheikh, Abdul
Sent: Wednesday, October 10, 2012 9:06 AM
To: Erickson, Alice; Marshall, Michael; Murphy, Martin; Thomas, George; Graves, Herman
Subject: RE: Discuss ACI 318 and applicability to ASR-Affected Structures

Another question that may be relevant is whether the following guidance provided in ACI 349 can be used in this case in conjunction with section 1.4 and commentary 1.4 of ACI 318 code

Definition:
authority having jurisdiction (AHJ)—a federal government agency (or agencies), such as the Nuclear Regulatory Commission, the Department of Energy, that is empowered to enforce regulations affecting the design, construction, and operation of nuclear facilities.

1.4—Approval of special systems of design or construction
Sponsors of any system of design or construction within the scope of this Code, the adequacy of which has been shown by successful use or by analysis or test, but which does not conform to or is not covered by this Code, shall have the right to present the data on which their design is based to the AHJ for review and approval. The AHJ may investigate the data so submitted, and may require tests and formulate rules governing design and construction of such systems to meet the intent of this Code.

ACI 318 Code Section

1.4 — Approval of special systems of design or construction
Sponsors of any system of design or construction within the scope of this Code, the adequacy of which has been shown by successful use or by analysis or test, but which
does not conform to or is not covered by this Code, shall have the right to present the data on which their design is based to the building official or to a board of examiners
appointed by the building official. This board shall be composed of competent engineers and shall have authority to investigate the data so submitted, to require
tests, and to formulate rules governing design and construction of such systems to meet the intent of this Code. These rules, when approved by the building official and promulgated, shall be of the same force and effect as the provisions of this Code.
R1.4 — Approval of special systems of design or construction
New methods of design, new materials, and new uses of materials should undergo a period of development before being specifically covered in a code. Hence, good systems
or components might be excluded from use by implication if means were not available to obtain acceptance. For special systems considered under this section, specific
tests, load factors, deflection limits, and other pertinent requirements should be set by the board of examiners, and should be consistent with the intent of the Code. The provisions of this section do not apply to model tests used to supplement calculations under 1.2.2 or to strength evaluation of existing structures under Chapter 20.

Another item to consider is that ACI 349 was not published until after the Seabrook design was completed. Therefore, the ACI 318 was used in the design.

C16

From: Erickson, Alice
Sent: Wednesday, October 10, 2012 8:35 AM
To: Marshall, Michael; Murphy, Martin; Sheikh, Abdul; Thomas, George; Graves, Herman
Subject: Discuss ACI 318 and applicability to ASR-Affected Structures
When: Wednesday, October 10, 2012 10:00 AM-11:00 AM.
Where: HQ-OWFN-11B02-12p

When: Wednesday, October 10, 2012 10:00 AM-11:00 AM (GMT-05:00) Eastern Time (US & Canada).
Where: HQ-OWFN-11B02-12p

Note: The GMT offset above does not reflect daylight saving time adjustments.

~~*~*~*~*~*~*~*~*

In this meeting, I hope to discuss the applicability of ACI 318, and to address interpretations/questions related to the ACI Code and the ASR issue. I am still putting together a list of questions, but if you have any that you think we should discuss, please send them to me. Ultimately, I hope to reflect the staff's position in the paper I am writing.

CONFERENCE CALL #: 888-950-5922
Passcode: (b)(6) ef6

Draft Questions to Discuss

1. Who is considered the "sponsors" of any system of design, and who is considered the "building official?"
2. If there is doubt that a part or all of a structure meets the safety requirements of the Code (i.e. concrete degradation due to alkali-silica reaction), are the provisions provided in Chapter 20 the best approach for assessing the structure or is there guidance that would better suit this situation?
3. Are there any provisions of ACI 318 that would allow model testing to demonstrate that an existing structure affected by ASR still meets the Code requirements?
4. Does the NRC view the proposed testing at Texas as an acceptable method of evaluation to demonstrate operability?
5. Should ACI design and construction material property relationships be used as the standard for operability of aged/cured concrete and/or ASR affected concrete?

Buford, Angela

From: Buford, Angela
Sent: Wednesday, October 24, 2012 8:12 AM
To: Conte, Richard
Subject: RE: Status Call for 1030am Wednesday Oct. 24 (Tomorrow)

I'll participate on the call.

From: Conte, Richard
Sent: Tuesday, October 23, 2012 5:17 PM
To: Thomas, George; Buford, Angela
Subject: FW: Status Call for 1030am Wednesday Oct. 24 (Tomorrow)

Not sure you have time to join us George. Angie, How about you?

From: Conte, Richard
Sent: Tuesday, October 23, 2012 4:55 PM
To: 'Willoughby, Paul'; 'OKeefe, Michael'; Noble, Rick; Brown, Brian; Vassallo, Theodore
Cc: Raymond, William; Burritt, Arthur; Buford, Angela; Cook, William; Chaudhary, Suresh; Raymond, William
Subject: Status Call for 1030am Wednesday Oct. 24 (Tomorrow)

1. Miscellaneous Administrative matters:

   a. NRC staff would like to set date for public meeting Dec. 11 – NextEra participate in poster session 6-7, then meeting with NRC staff presentation 7-9 – at liberty place in NH.

   b. Status of brief for and when change of commitment for Prism Test will be in?

   c. We need a week to review material on certrec for R&D material and construction specs along with the overview document. Can we do the brief by teleconference on the First Wednesday after a week as gone by.

   d. When will Phase III walkdowns be completed.

   e. Status of sample review of areas with CCI between 1.0 mm/m and 1.5mm/m.

   f. Readiness for next week inspection final week and exit/outbrief.

2. We still have questions as to why NextEra's OD procedure was not followed for the 4 areas of primary containment potentially affected by ASR: 1)safety margins appear to be reduced even if by conservative bounding calcs.; 2) cracking in the area has yet to be established as passive, therefore, it must be assumed to be active unless proven otherwise; 3) pattern cracking along with the other experience of ASR confirmed in other structures seem to point to degradation.

3. Other technical details with the Eng. Evaluation from team.including what more needs to be done beside monitoring per the Structures Monitoring Program.

4. We are still looking at your IWL process used in October 2012, please have report available for inspection next week – it appears that the only passive crack criterion is 40 mils for further evaluation.

C17

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) [redacted] (NRC cell)

Buford, Angela

From: Cook, William
Sent: Tuesday, October 30, 2012 12:04 PM
To: Buford, Angela
Subject: RE: Change in plan due to weather
Attachments: Draft Notes from NRR Regarding FP Structural Eval.docx

As requested. See you tomorrow. Call if you need anything further.
Bill

From: Buford, Angela
Sent: Sunday, October 28, 2012 3:37 PM
To: Conte, Richard; Cook, William
Cc: Marshall, Michael
Subject: Change in plan due to weather

Hi Bill and Rich,

After my flight to NH being cancelled and a couple of unsuccessful attempts to switch airlines, it appears Airline service is suspended from BWI for tomorrow (Monday) and for some portion of Tuesday. For now I am having the travel service reschedule me for a flight Tuesday midday, and hopefully the weather will cooperate.

I plan to be in the office tomorrow unless conditions are such that they close NRC HQ.

I can be reached at (b)(6)

Thanks,

Angie

C18

Buford, Angela

From: Cook, William
Sent: Thursday, October 25, 2012 3:47 PM
To: Buford, Angela
Subject: RE: Schedule for Next Week
Attachments: Actual Capacity Rev 2.docx

No problem. After talking with Bill Raymond, revised the "cartoon" for Operability Determination Margins Approach. Please take a look and I'll give you a call.

From: Buford, Angela
Sent: Thursday, October 25, 2012 3:33 PM
To: Cook, William
Subject: RE: Schedule for Next Week

(b)(6) (so I haven't gotten a chance to check my messages if you called my desk) Sorry about that! Feel free to dial my cell – (b)(6)

From: Cook, William
Sent: Thursday, October 25, 2012 3:24 PM
To: Buford, Angela
Subject: RE: Schedule for Next Week

Are you work at home today?

From: Buford, Angela
Sent: Thursday, October 25, 2012 3:21 PM
To: Cook, William
Subject: RE: Schedule for Next Week

Are you going to the site on Friday? Or will that just be a travel day?

Weather permitting – I hope we miss that hurricane!

From: Cook, William
Sent: Thursday, October 25, 2012 3:19 PM
To: Buford, Angela
Subject: RE: Schedule for Next Week

Planning to fly up Monday morning, weather permitting and flying out Friday am.

From: Buford, Angela
Sent: Thursday, October 25, 2012 3:15 PM
To: Cook, William
Subject: Schedule for Next Week

Hi Bill,

Marshall, Michael

From: Sheikh, Abdul
Sent: Tuesday, November 13, 2012 7:58 AM
To: Marshall, Michael
Subject: RE: QUESTION: Seabrook ASR Meeting Notice for Public Meeting Dec. 11, 2012

I can attend if needed.

From: Marshall, Michael
Sent: Tuesday, November 13, 2012 7:54 AM
To: Erickson, Alice; Sheikh, Abdul
Subject: QUESTION: Seabrook ASR Meeting Notice for Public Meeting Dec. 11, 2012

Hello Abdul and Alice,

I would like one you to plan on attending this meeting, are you available? My preference is for Abdul.

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Sunday, November 11, 2012 8:19 AM
To: R1DRSWORKFLOW RESOURCE; Bearde, Diane
Cc: Cook, William; Raymond, William; Chaudhary, Suresh; Burritt, Arthur; Trapp, James; Marshall, Michael; Murphy, Martin; Khanna, Meena; Wilson, Peter; Miller, Chris; Trapp, James; Sheehan, Neil; Screnci, Diane; Tifft, Doug; McNamara, Nancy; Lamb, John
Subject: Seabrook ASR Meeting Notice for Public Meeting Dec. 11, 2012

Diane, nice job on initial draft, you went to the right model.

Workflow please keep at subdirectory in below link. Go to final format for final concurrence until we get to the ADAMS point.

G:\DRS\Seabrook Concrete\Media-Pub\Dec 11 Meeting 2012\2012 Seabrook ASR public meeting notice .docx

Marty and Michael I am assuming you are coming. Michele Evans and Chris Miller are the only Executives that I am aware of unless your managers want to come. We can arrange to give Michele a nonRad tour of affected areas on the day of the event in the morning. I do not believe she has recently been there. File is attached for your review as well as for others.

Please review by Wednesday's ASR Working Group Nov. 14, 200pm.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) NRC cell

C19

Buford, Angela

From: Buford, Angela
Sent: Monday, November 19, 2012 12:40 PM
To: Cook, William
Subject: Comments on 2012-009
Attachments: IR_2012-009_11-13-12 BUFORD.docx

Bill, attached are my comments on 2012-009. I also provided them to Michael Marshall.

There is one part I'd like to discuss with you that I would rather convey verbally instead of as a comment in the document, with regards to anchorage (right now I have a comment there that is just a bunch of question marks) – When you have time, give me a call to discuss that part.

I'm working from home today: (b)(6) nd will be in the office tomorrow.

From: Buford, Angela
Sent: Monday, November 19, 2012 8:37 AM
To: Marshall, Michael
Subject: As Requested: FW: Inspection Report Comments

Michael, please see my comments on the inspection report.

From: Angela Buford (b)(6)
Sent: Monday, November 19, 2012 8:36 AM
To: Buford, Angela
Subject: Inspection Report Comments

C20

Marshall, Michael

From: Buford, Angela
Sent: Monday, November 19, 2012 8:37 AM
To: Marshall, Michael
Subject: As Requested: FW: Inspection Report Comments
Attachments: IR_2012-009_11-13-12 BUFORD.docx

Michael, please see my comments on the inspection report.

From: Angela Buford (b)(6)
Sent: Monday, November 19, 2012 8:36 AM
To: Buford, Angela
Subject: Inspection Report Comments

CZ1

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

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 - CONFIMATORY 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 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 completion in early 2013.

The inspection team identified NextEra's methods for assessing the impact of ASR on reinforced concrete structures technically sound and generally thorough. The approach of comparing the available design and as-built construction margins to a conservatively established lower bound ASR affect, on these established margins, was appropriate. The team concluded the assumed lower bound values, developed from research data, provide a reasonable interim operability basis until further testing and engineering analysis supports a final operability determination and addresses the uncertainties in identifying the current level and progression of ASR at Seabrook Station.

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

cc w/encl: Distribution via ListServ

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

cc w/encl: Distribution via ListServ

Distribution w/encl:
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RidsNrrDorlLpl1-2 Resource
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DOCUMENT NAME: G:\DRS\Seabrook Concrete\Oper-funct - TIAs\CAL FU 92702 Report 1\IR 2012-009 11-13-12.docx
ADAMS Accession No.: ML

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OFFICE mmt	RI/DRS	RI/DRP	RI/DRS	RI/DRS	RI/DRS
NAME	WCook/	ABurritt/	RConte/	JTrapp/	CMiller/
DATE					

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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, Professor of Structural Engineering, University of Pittsburg
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 identification 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 Confirmatory Action Letter 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 during this inspection of CAL items, 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 work 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 their commitments to the NRC, to date, are documented in the enclosed report.

The team acknowledged NextEra's plans to conduct performance testing of large scale test specimens (both control and ~~ASR-affected~~ASR-affected) and then apply the 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-~~ASR-affected structures. Information from the test program will also be used to make appropriate modifications to the existing structural monitoring program for ASR susceptible structures. The adequacy of NextEra's proposed test program will be evaluated during the second CAL Follow-up inspection, consistent with CAL Item #8. The team verified during this inspection that NextEra~~'s~~ will not finalize ~~their~~ its Interim Assessment and Prompt Operability Determinations until: 1) the degree of ASR degradation on station reinforced concrete structures is established within the design and licensing basis; 2) definitive margins are established to the design basis limits; and 3) the progression of ASR is appropriately monitored and demonstrated to ensure adequate margins are maintained for the duration of the current operating license.

The team also clarified NextEra's current position that no structure at Seabrook Station will be precluded from continued monitoring for the affects of ASR until a satisfactory petrographic examination has been completed on that structure to confirm the absence of ASR or that ASR is no longer active. The adequacy of NextEra's Structures Monitoring Program will be evaluated in the second follow-up inspection, consistent with CAL Item #9.

As highlighted 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 in concrete that can change the physical properties. 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 (AR581434) where ASR was first discovered. Five other buildings were identified via the extent of condition (EOC) review and the evaluation of core samples taken from these structures (AR1664399). 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-~~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~~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-~~ASR-affected reinforced concrete structures. NextEra's engineering evaluation states that once removed from the structure, concrete cores are no longer subject to the strains imposed by the ASR-related expansion or restraints imposed by the reinforcing cage. ~~Confinement~~ The engineering evaluation also states that confinement provided by steel reinforcing ~~steel~~ bars (rebar) and other restraints limits ASR expansion of the concrete within the structure, ~~which reduces the extent of deleterious cracking~~ and the resulting reduction of concrete material properties. Therefore, NextEra concluded that the reduction of mechanical properties observed in mechanical testing of cores is not representative of in-situ concrete performance. NextEra's current position is that the ~~mechanical test~~testing of cores~~s are~~ is only useful as a diagnostic tool to confirm the presence of ASR. Based on the above, NextEra stopped taking cores to evaluate mechanical properties of structures impacted by ASR and revised ~~their~~ its 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 a baseline walkdown review of station structures. The review identified the visual signs of ASR through the presence of crack patterns, ASR ~~powder and~~ gel in wet and powder forms, and/or discoloration/dark staining. The 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 (AR1757861) and have established NextEra's current baseline condition assessment of Seabrook structures, in conjunction with six-month crack indexing measured on selected structures to trend the progression of ASR and thereby establish a rate of degradation.

As stated above, NextEra's operability evaluations are based upon an examination of available design margins and a presumed ASR reduction in structural design capacity. The details of this methodology and related assumptions are developed in NextEra's Interim Assessment (FP 100716). The assessment assumed lower bound values for potential reductions in concrete material properties based on industry test data of small scale test specimens. The assessment focused on the ~~structural design attributes~~engineering properties that are the most sensitive to ASR affects (i.e., out-of-plane shear capacity, lap splice development length, and anchorage depth). Compressive strength of concrete is also affected, but less so in the early stages of ASR. The assessment determined the structures were suitable for continued service pending further evaluation of structural performance based on a proposed full-scale testing program representative of Seabrook concrete structures. The test programs have been initiated at the Ferguson Structural Engineering Laboratory at the University of Texas, with testing 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 with regard to planned actions to evaluate the degradation of Seabrook reinforced concrete structures due to ASR. In response to the CAL, NextEra committed to provide information to the NRC for the 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. 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 Inspection Report 2012-010.

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

3.1 Inspection Scope

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 concrete properties, 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, and 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and Criterion XI, "Test Control," as the regulatory basis to assess the adequacy of NextEra's actions to address ASR affects on safety-related Category 1 and in scope Maintenance Rule reinforced concrete structures. The team also used the established code relationships from ACI 318-1971 to independently assess the engineering calculations and analyses performed by NextEra. Lastly, 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 PODs (Revisions 0 and 1) addressed five buildings (AR 1664399) using the mechanical testing data gathered from concrete core samples. These five structures include 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 ~~ASR affected~~ASR-affected concrete in both Category 1 and Maintenance Rule structures 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), and the waste processing building (AR1757861).

Comment [A1]: Do we need to resolve a potential area of confusion where we say earlier that NextEra says the only value of the cores is to confirm the presence of ASR, and then we say they used the data from the cores for the Finite element analysis

The team also conducted a detailed review of Foreign Print (FP) 100716, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 1, which is the initial evaluation of concrete structures at Seabrook Station and provides the basis for continued operability of affected structures for an interim period. As documented in FP 100716, this interim evaluation will be followed by a second evaluation that "will assess the long-term adequacy of the concrete structures considering the results of the full-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 of a number of supporting calculations, the team determined NextEra's interim operability bases were appropriate. Given the current extent of ASR, there is reasonable expectation that the affected reinforced concrete structures at Seabrook Station will remain capable of performing their intended functions for an interim period, while NextEra continues to monitor the condition and complete detailed testing and further engineering analyses. Noteworthy observations pertaining to the team's review of the PODs and Interim Assessment follow:

3.2.1 Operable, but Degraded/Nonconforming

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/nonconforming. NextEra demonstrated that the structures maintained structural integrity for design basis loads and load combinations for normal, accident and environmental extreme conditions (including seismic).

The team indentified no inadequacies in the conclusion that ASR impacted structures were currently operable, but degraded or nonconforming.

The team observed that 24 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. Per the Structures Monitoring Program (ES 1807.031), 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 team prior to the completion of the inspection period (see Section 3.2.8). However, the evaluations for the remaining locations are yet to be completed. Based upon team review of the competed structural evaluations, to date, there is a reasonable expectation that structural integrity (and operability) of the locations yet to be evaluated by NextEra will be sufficiently demonstrated. Notwithstanding, the team will examine these evaluations in the next CAL follow-up inspection report.

Near the conclusion of this inspection period, NextEra completed the POD for containment (AR 1804477). Preliminary review by the team identified a few areas for follow-up during the second CAL follow-up inspection. Specifically, the team will pursue NextEra's evaluation of the potential for chemical pre-stressing of rebar (reference Section 3.2.8) and review NextEra's future plans for monitoring the localized areas (three) of presumed ASR (not petrographically verified) on the containment outer wall (reference Section 6.0).

3.2.2 Concrete Material Properties - Compressive Strength and Elasticity Modulus

In Revision 2 of POD 581434 for the B Electrical Tunnel, NextEra 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), which showed an average strength of 5143 pounds-per-square-inch (psi) for the ~~ASR affected~~ASR-affected cores and 4880 psi for the control cores. 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. Team review of the supporting concrete core data did not validate NextEra's conclusion.

Concrete compressive strength can vary due to variations in in-place concrete strength. The team determined that 12 cores were obtained from six locations in an ASR suspect wall in the B electrical tunnel. Testing produced compressive strength values ranging from a low of 4220 psi to a high of 6610 psi. The mean strength value of these samples is 5143 psi with a standard deviation of 630 psi. The three cores taken from a control area (presumed ASR free) measured 4630, 5350 and 4660 psi. The mean value of these samples was 4880 psi, with a standard deviation of 580 psi. Team review of the B electrical tunnel data determined that the compressive strength measured in 2011 is about 2 percent lower than the measured cylinder strength values from 1979. ~~These values do not show an increase in strength over 25 years, as would be expected as concrete continues to cure~~Contrarily, concrete strength is expected to increase with age and curing. However, given the inherent variability in concrete material properties and the significant variation in the data from the B electric tunnel, the team could not conclude that there was a significant loss of compressive strength or that the affect of the ASR was to increase the compressive strength. In addition, 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. In contrast to the B electric tunnel results, the measured compressive strength values in the other ~~ASR affected~~ASR-affected buildings suggest a different trend. In general, the measured core sample compressive strengths in the RCA walkway, EFW pump house, RHR EV and EDG buildings in 2011 were higher than the original compressive strength values in 1979 (as expected). This 2011 core sample data shows an average increase of 56 percent.

For modulus of elasticity, although individual cores showed a modulus that was reduced (compared to design), the average modulus value in the RCA walkway, RHR EV, EFW pump house and DGB was within 20 percent of the design modulus value (±20 percent is acceptable by ACI 318). For the CEB, the average modulus was just beyond (low) the 20 percent allowable. The team noted that modulus values at individual core locations could be lower than design and that NextEra had conservatively used these lower measured modulus values to assess the implications of ASR on structural performance.

Based on the above, the team determined that the core sampling and material property testing completed, to date by NextEra, has not conclusively established the current impact of ASR on concrete material properties (specifically for compressive strength and modulus of elasticity). However, an adverse trend in concrete material properties is indicated and supported by a literature review and available research data. Notwithstanding, review of the core sample data does indicate that the concrete compressive strength remains considerably above the specified design strength value of 3000 psi (or 4000 psi, where used in construction). The team plans to examine this area further in the second follow-up inspection with respect to adequacy of the Structures Monitoring Program.

Comment [A2]: Fine/good

3.2.3 Flexural Capacity and Dynamic Response

NextEra completed a study of the Containment Enclosure Building (CEB) (FP 100714 and FP 100715) which evaluated the effects of varying elastic modulus. Modulus values used in the study were based on field investigation of CEB concrete that correlated a visual rating of ASR with core test results (FP100696 and FP 100700). The CEB study included a parametric analysis that: evaluated 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 before and after ASR damage; calculated the section capacities; calculated demand-to-capacity ratios (DCRs); and, compared the DCRs of ASR degraded walls to undamaged walls. The analyses showed that the seismic acceleration profiles, the in-structure response spectrum, and the distribution of forces and moments were

Comment [A3]: Maybe state why NextEra chose the CEB to bound all the structures for Dynamic Response not significantly impacted by ~~ASR-affected~~ASR-affected properties. Similarly, the effect of the reduced modulus on the response of below-grade, ASR-impacted structures was evaluated. For below grade structures, NextEra determined that the structural response remained in the rigid range with no appreciable amplification of the ground response spectra. The seismic response of the structure along with the attached equipment (cable trays and supports) and anchor loads remained unchanged, with no affect on operability due to ASR. The team noted that these studies validated previous analyses that the reduced modulus of elasticity had minimal impact on the seismic response of walls and attached equipment. The team concluded that NextEra's assessment of this ~~ASR-affected~~ASR-affected design attribute was appropriate for the interim operability determination.

Comment [A4]: Bounding conditions used in FEA need to be addressed for final evaluation. We disagreed with their assumptions

3.2.4 Shear Capacity

NextEra analyzed the impact of ASR on the B Electric Tunnel using a FEA to compare the shear capacity versus demand for seismic and hydrodynamic loads. The FEA used the ACI-318 Code, Section 11.4.1 equation for shear stress which relates shear stress to the square root of compressive strength. NextEra assumed a lower bound 25 percent reduction in out-of-plane shear capacity due to the affects of ASR. 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 the design shear capacity. However, the FEA 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 approximates the assumed 25 percent lower bound value ASR affect on out-of-plane shear capacity. The licensee identified additional conservatism in their analysis based upon the B electrical tunnel average measured core sample compressive strength value of 5140 psi. NextEra's FEA concluded that adequate margin was available. The team acknowledges 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 assumed 25 percent reduction in shear capacity is conservative because of the uncertainty with respect to the actual impact of ASR on concrete tensile strength during the early stages of ASR. The team viewed the use of a FEA to assess lower bound ASR affects as appropriate and insightful, but not conclusive, pending further testing and engineering analysis planned by NextEra.

3.2.5 Anchorage

NextEra evaluated the impact of ~~ASR-affected~~ASR-affected concrete on the performance of anchors, including cast in place anchors, drilled in anchors and reinforcing steel anchorage. The potential impact of micro-cracking caused by ASR can negatively impact anchorage capacity ~~by affecting the distribution of shear stresses~~. Petrographic analysis of Seabrook concrete cores showed that concrete quality was good with relatively small cracks indicating minimal impacts on stress distribution. NextEra's evaluation was supported by anchor performance testing conducted on ASR degraded specimens (FP100718). The tests showed satisfactory performance of the anchors in concrete test specimens, although dissimilar in composition and compressive strength compared to Seabrook structures. NextEra's evaluations illustrated that the assumed reductions in capacity due to ASR degradation were offset by established design margins (FP100716). The team concluded that NextEra's interim anchorage operability assessment was satisfactory. However, based upon the limitations of the

Comment [A5]: ???

testing performed, to date, NextEra plans to conduct further testing. Planned testing involves anchors installed in ~~ASR affected~~ASR-affected test specimens that more accurately reflect the reinforced concrete structures and anchor configurations at Seabrook.

3.2.6 Review of Finite Element Analysis Modeling

As discussed in Sections 3.2.3 and 3.2.4, NextEra used finite element analysis to evaluate the affects 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/dimensions were correlated 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 ratio was derived exclusively from industry 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~~ASR-affected values. The team concluded this FEA approach was useful and insightful for providing reasonable expectation of operability for the interim period, but not conclusive with respect to the current or projected state of ASR impact on the CEB. As discussed in Section 9.0, the parametric analysis results will have to be reevaluated following testing and prior to finalizing the PODs.

Comment [A6]: Staff did not agree with the boundary conditions indicated in the licensee's finite element analysis. Technical justification or modification of the boundary condition assumptions is needed, but doesn't affect operability.

3.2.7 Lap Splice Strength

Section 6.3 of the Interim Assessment addressed reinforcement lap splice degradation as another design attributed 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 affect. NextEra was able to recover margin by adjusting the ACI Code 318 prescribed design load factors for predicted dead load and/or hydrostatic loads. The team examined this method for margin recovery and found it satisfactory for the interim operability assessment, but concluded it would not be acceptable for a final operability determination under the current licensing basis.

3.2.8 Concrete Confinement and Rebar Pre-Stressing

Team review of FP 100716, Sections 2.1.2 and 4.1.3, identified that the interim engineering evaluation 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 observes that restraint to ASR expansion, from concrete confinement by reinforcement and/or other external constraints, causes chemical pre-stress in the structural members. The consequence is increased compressive stresses in concrete and increased tensile stresses in the rebar cage, as long as the restraint is sustained. The team observed that this ASR-induced pre-stress has been addressed only qualitatively in the Interim Assessment and containment structural evaluation (AR 1804477). The team finds this acceptable for interim operability determinations. However, the team's preliminary engineering judgment is that a quantitative evaluation is more appropriate for a final operability assessment of this 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 through the service life of the affected structure.

The team concludes that chemical pre-stress, if sustained, may show some beneficial effect in terms of stiffness and gross ultimate structural strength, but it may also result in an increase in structural demand on the concrete and reinforcement. As stated above, the team's judgment is 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 chemical pre-stress, is similar to accounting for (and monitoring for losses) the pre-stress load in pre-stressed concrete design. This issue will be reviewed by the team in the second follow-up inspection.

Comment [A7]: Any potential beneficial aspects of ASR should not be considered. Consider re-wording to 1. Not acknowledge benefits in structural capacity; 2. State assertively that chemical prestress caused by ASR adds (not "may add", but definitely adds) unanalyzed stress demand on the in-plane reinforcement

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 purposefully removed an area of surface concrete in the B Electrical Tunnel (chronically wet) 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 drill nicked rebar. Examination of the rebar sections removed determined the steel to be in excellent condition (unaffected by ASR or moisture). Preliminarily, the condition of rebar in ASR degraded concrete should be unaffected until the cracking becomes deleterious and exposes the rebar to oxidation mechanisms. Otherwise, the alkaline condition within the concrete should prevent any erosion or 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 ASR Root Cause Evaluation (CAL Item #2)

4.1 Inspection Scope

The team reviewed NextEra's response to this CAL Item, "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."

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 team made some observations regarding the clarity and completeness of NextEra's root cause evaluation.
The team acknowledges that the first licensee identified root cause involved the 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). The ASTM standard was subsequently revised 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, consistent with their CAL Item #2 commitment. The team will review this revision in the next CAL follow-up inspection report.

The team also noted that NextEra excluded a significant 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 in-leakage was more of an operational nuisance than a structural integrity concern. This station and engineering staff view prevented a more timely and thorough investigation and examination of the affected concrete reinforced structures on site. NextEra acknowledged this observation.

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

5.1 Inspection Scope

The team reviewed the results of NextEra 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. The licensee initiated the testing to establish and compare the reaction rates of ~~ASR affected~~ASR-affected concrete to non-~~ASR affected~~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~~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. 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 >0.1 percent indicates reactive aggregate, per ASTM C1260. Test results identified that the non-~~ASR-affected~~ASR-affected specimens exceeded the 0.1 percent threshold in five days and the ~~ASR-affected~~ASR-affected specimens exceeded the 0.1 percent threshold in seven 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 a similar, but 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 concluded that NextEra's basis to revise their commitment to conduct Prism Testing was reasonable.

6.0 Review of Crack Indexing (CAL Item #10)

6.1 Inspection Scope

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. NextEra's commitment to this methodology is captured in CAL Item #10. The team used 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," to evaluate the adequacy of this process. The team's review was limited in scope, in that, the adequacy of this process, as the sole means of monitoring ASR progression in Seabrook structures, is still under NRC review. The team will evaluate this aspect as part of the review of CAL Item #9, the Maintenance Rule Structures Monitoring Program, 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 supervising NextEra staff. The team noted that NextEra found ASR patterned cracking in many areas within Seismic Category I and Maintenance Rule structures, but only a limited number of these areas have sufficient ASR degradation to merit continued monitoring and detailed evaluations. The ASR walkdown identified 131 locations with some level of pattern cracking. Of the 131 locations, 26 exceeded an initial screening criteria of a combined crack index greater that 1.0 mm/m. 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 CAL Item #10 is closed. The team noted that the periodic crack indexing 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 (SMP)," Attachment 3, Revision 2. As stated above, additional NRC review of the SMP 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/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. The team determined that 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 summary table with each numeric rating and its definition is documented in the Supplemental Information attachment to this report.

7.0 Review of Alkali-Silica Reaction Structures Walkdown/Baseline 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. 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 1 and some in scope Maintenance Rule structures. 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/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 assess the extent of ASR throughout the plant with the primary objectives of: identifying and assessing any apparent degradation from ASR, including: estimating in-situ expansion (Crack Indexing); 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 include: typical patterned surface cracks in concrete; crack dimensions (width, length, orientation); evidence of water ingress/out-seepage (past/present); 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 ~~embodiments~~ embedments located within five feet of the area of interest were examined and documented. The licensee considers their ASR walkdown efforts and observations a baseline condition assessment. This baseline will be used for monitoring the progression of ASR for the duration of the current operating license.

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~~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~~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 inference, 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 remove any of the identified structures from continued ASR monitoring without confirmation via petrography that ASR is nonexistent or no longer active.

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) exposure 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 IWL examination of containment was being credited for part of the Phase 1 ASR walkdown baseline. 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 adequate examination criteria (i.e., active or pattern cracking) for identification of ASR. As evidence of this shortcoming 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 inspectors. NextEra acknowledged this oversight in crediting the IWL examination and initiated action (AR 1819069) per the Corrective Action Plan, to address the need to revise the Phase 3 plan. In addition to review of the revisions to the Phase 3 walkdown areas during the second CAL follow-up inspection, the NRC plans to examine the adequacy of the proposed Phase 3 implementation schedule.

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 were as documented in Inspection Reports 2011-03 and 2011-10 related to: 1) 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 pipe 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 tray supports; and, 4) 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 the reviews in Inspection 2011-10, the unresolved item remained open pending NRC review of additional information from NextEra on the effects on cable and pipe support anchors (number 3) and the effects on the CEB response (number 4).

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. The revised POD addressed the changes in modulus on building frequency; flexural response and capacity; shear capacity; and support anchors. The revised POD incorporated the results of the Interim Assessment (FP100716) 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 POD 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~~ASR-affected concrete. The test results showed that the anchor capacities remained above the theoretical capacity at crack indices well above the maximum CI observed in Seabrook structures. Finally, the revised POD for the ET also included consideration of a detailed evaluation of the CEB, chosen for detailed analysis because it conservatively bounds other structures in size and exhibits the highest reduction in modulus of elasticity due to ASR. This included how the induced stresses would shift between the concrete and the steel in adjoining sections of the structure. These issues were factored into the analytical model (finite element analysis) to reanalyze the CEB using the measured elastic modulus applied to ASR impacted sections.

Further NRC review of this area is described in Sections 3.0 and 4.0 of this report. 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, and addressed broadly by the NRC in Finding FIN 05000443/2011-10-02. Unresolved Item 05000443/2011003-03 is closed.

8.2 (Closed) URI 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 impacted concrete, NextEra determined that the core test data was not indicative of structural performance of the ~~ASR affected~~ASR-affected structures. 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 (FP100697, Structural Assessment of ASR-State of the Art). Since the reduction of mechanical properties derived from testing of cores is not necessarily representative of the structural performance, NextEra changed its approach. NextEra no longer relies on further core sampling to characterize the current and future condition of ~~ASR affected~~ASR-affected structures. Instead, the licensee will monitor structures via Crack Indexing and pursue large scale testing of concrete components more representative of the Seabrook conditions. The testing will be conducted at the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas Austin (UT-A).

Given the interplay between expansive ASR degradation and structural restraint, NextEra provided an Interim Assessment of the Seabrook structures impacted by ASR which relies on structural proof testing rather than testing of concrete cores removed from the structure. The Interim Assessment was based on available industry data on small scale test specimens having ASR degradation worse than that observed at Seabrook.

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 will provide a baseline by which to judge 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 test program described in CAL Item #8, is currently under review by the NRC regional and headquarters staffs. Unresolved Item 05000443/2011-010-01 is closed.

9.0 Conclusions and Follow-Up Issues

The team determined, based upon the review of the PODs and supporting engineering analyses documented in the Interim Assessment, that the PODs will not be finalized until: 1) the degree of ASR degradation on station reinforced concrete structures is established within the design and licensing basis; 2) definitive margins are established to the design basis limits; and 3) the progression of ASR is appropriately monitored and demonstrated to ensure adequate margins are maintained for the duration of the current operating license.

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 conservatism of the assumed lower bound affects of ASR (Section 3)
- Review of pending structural evaluations and follow-up on containment POD observations (Section 3.2.1)
- Review of core sample compressive strength and SMP (Section 3.2.2)
- Review quantification of pre-stressing affects 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 of Crack Indexing for SMP application (Section 6.2)
- Review the revision 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

Opened/Closed/Update

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

FP100348, Statistical Analysis-Concrete Compression Test Data (PTL)
FP 100642, Scope for Alkali-Silica Reaction Walkdowns
FP 100641, Procedure for ASR Walkdowns and Assessment Checklist
FP100661, Compression Testing Concrete Cores (WJE)
FP100696, Material Properties of ASR-Affected Concrete
FP 100700, Field Investigation
FP100705, Structure ASR Walkdown Report (MPR 0326-0058-58)
FP100714, Three Dimensional Dynamic Analysis of Containment Enclosure Building
FP100715, ASR Impact Study on Containment Enclosure Building
FP100716, Interim Assessment: Impact of ASR on Structures (MPR-3727)
FP100717, ACI 318-71 Perspectives
FP100718, Anchor Test Report (MPR-3722)
FP100720, Crack Index and Expansion Measurement
FP100738, 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
CCI	Combined Crack Index
CFR	Code of Federal Regulations
CW	Circulating Water
DG	Diesel Generator
DRP	Division of Reactor Projects
DRS	Division of Reactor Safety
EDG	Emergency Diesel Generator
EPRI	Electric Power Research Institute
FEA	Finite Element Analysis
FP	Foreign Print
FPL	Florida Power and Light
FSEL	Franklin Structural Engineering Laboratory
IMC	Inspection Manual Chapter
IP	[NRC] Inspection Procedure
MPR	MPR Associates, Inc.
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
P&ID	Piping and Instrument Diagram
PM	Preventative Maintenance
PRA	Probabilistic Risk Assessment
QA	Quality Assurance
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	Ultrasonic Testing
WO	Work Orders

NextEra Crack Rating Chart

Assessment of Severity of ASR in Hardened Concrete by Petrographic Examination

This rating system is based on a modified "best practice" procedure initially developed at tehe Building Research Establishment (BRE) in the United Kingdom, using ASR identification critieria first set out in the British Concrete Association report titled "The Diagnosis of Alkali-Silica Reaction," (1992).

Rating	Description
0	No cracking detected
1	Very slight cracking (no evidence of deleterious ASR)
2	Slight cracking (minor or trace evidence of deleterious ASR)
3	Moderate cracking (moderate evidence of deleterious ASR)
4	Severe cracking (severe evidence of deleterious ASR)
5	Very severe ASR-related cracking
6	Heavily fractured ASR-related damage

Marshall, Michael

From: Murphy, Martin
Sent: Tuesday, November 20, 2012 11:55 AM
To: Conte, Richard; Cook, William
Cc: Marshall, Michael; Buford, Angela
Subject: RE: Seabrook ASR Executive Brief at 100 pm to 200pm 11-20-2012

Mike and I had some significant challenges with this or a similar graphical representation and an extensive discussion with Angie. I would suggest holding off on its use until more completely vetted.

Marty

From: Conte, Richard
Sent: Tuesday, November 20, 2012 10:00 AM
To: Ali, Syed; Buford, Angela; Burritt, Arthur; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Murphy, Martin; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Cc: Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Trapp, James; Wilson, Peter
Subject: RE: Seabrook ASR Executive Brief at 100 pm to 200pm 11-20-2012

For today's briefing it might helpful to have this slide available. The team developed it as they fully examined NextEra's process for the margins review and how they recovered margin.

From: Conte, Richard
Sent: Monday, November 19, 2012 10:56 AM
To: Ali, Syed; Buford, Angela; Burritt, Arthur; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Murphy, Martin; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Subject: FW: Seabrook ASR Executive Brief at 100 pm to 200pm 11-20-2012

FYI – latest brief package – correct time is 100-200pm tomorrow.

From: Conte, Richard
Sent: Monday, November 19, 2012 10:56 AM
To: R1DRSWORKFLOW RESOURCE; Bearde, Diane
Subject: Seabrook ASR Executive Brief at 100 pm to 200pm 11-20-2012

Please place in appointment for executive brief and resend

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) [redacted] (NRC cell)

C22

Marshall, Michael

From: Thomas, George
Sent: Wednesday, November 21, 2012 8:34 AM
To: Cook, William
Cc: Buford, Angela; Conte, Richard; Trapp, James; Raymond, William; Chaudhary, Suresh; Murphy, Martin; Marshall, Michael
Subject: RE: Revised Margins Approach Cartoon

Bill,

Even the green "Operable" oval in your chart could be "Operable but degraded/non-conforming" for the case when the licensee takes credit for increased capacity above Code Design Strength in the operability evaluation (for assessing available margins against assumed degradation), such as the licensee's claim of 50% conservatism in code for shear capacity, 23% for conservatism in code for development length, increased insitu compressive strength of concrete from specified etc.

Thanks.
George

From: Cook, William
Sent: Tuesday, November 20, 2012 6:12 PM
To: Murphy, Martin; Marshall, Michael
Cc: Buford, Angela; Thomas, George; Conte, Richard; Trapp, James; Raymond, William; Chaudhary, Suresh
Subject: Revised Margins Approach Cartoon

Marty and Michael,

Hopefully, this revision will better facilitate the "Operable, but degraded" and "Inoperable" arrows placement discussion tomorrow morning.

This revision is meant to better represent the licensee's POD and Interim Assessment "lower bound Effect of ASR" (gray arrows pointing down from the Design Capacity line) with the impact on the available margins. The use of "recovery" on the earlier version was misleading, but it is the terminology used by NextEra for "backing out" the Load Factors from the design load calcs (for selected loads) to gain margin for an interim operability assessment. Recognize the "lower bound effect of ASR" values (Table 6-4 of FP100716, page 49) are assumed impacts on selected Limit States (axial compression, flexure, one-way shear, reinforcement anchorage, etc) based upon literature search and associated small specimen test data. The test specimens and data generally represent more advanced stages of ASR (and therefore, more conservatively established lower bound values).

The feedback this afternoon was helpful, looking forward to tomorrow morning's discussion.

Regards,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

C23

(610) 337-5074 (work)
(b)(6) (cell)

Buford, Angela

From: Buford, Angela
Sent: Wednesday, November 21, 2012 1:58 PM
To: Sheikh, Abdul
Subject: RE: Action Requested: Crack Mapping Paper

My understanding of the scope of this paper was not to relate the Seabrook program and criteria within, but to assess whether using crack mapping alone is sufficient to (1) determine the severity of ASR (2) monitor for ASR progression over time.

Assessing the licensee's structures monitoring program (including the adequacy of the tier 1,2, and 3 values and what to be done for each tier) in my mind falls under the umbrella of the inspection CAL item for structures monitoring and staff review of the Structures Monitoring AMP. I believe we will review the adequacy of the acceptance criteria and associated actions during the LR review and CAL inspection.

From: Sheikh, Abdul
Sent: Wednesday, November 21, 2012 1:49 PM
To: Buford, Angela
Subject: RE: Action Requested: Crack Mapping Paper

On a quick glance, I find one missing item. It is the Tier 1, 2, 3 criteria and what should be done to evaluate structures for each tier.

From: Buford, Angela
Sent: Wednesday, November 21, 2012 1:41 PM
To: Marshall, Michael; Thomas, George; Erickson, Alice; Sheikh, Abdul
Cc: Murphy, Martin
Subject: Action Requested: Crack Mapping Paper

All,

Attached is the draft crack mapping position paper. We have been asked to provide this paper to the Region on Wednesday, so there is a quick turnaround to receive any comments from NRR to incorporate.

I have left out the "References" section, as I am still working on the citations. If during the course of your review you would like me to provide you one of the references, please email me.

Please provide your comments to me by Tuesday so that I can incorporate and send to the region. Any feedback would be greatly appreciated.

Angie

From: Angela Buford (b)(6)
Sent: Wednesday, November 21, 2012 1:31 PM
To: Buford, Angela
Subject: Crack Mapping Paper

C24

Buford, Angela

From: Buford, Angela
Sent: Wednesday, November 21, 2012 1:41 PM
To: Marshall, Michael; Thomas, George; Erickson, Alice; Sheikh, Abdul
Cc: Murphy, Martin
Subject: Action Requested: Crack Mapping Paper
Attachments: Crack Mapping and DRI 11-21-12.docx

All,

Attached is the draft crack mapping position paper. We have been asked to provide this paper to the Region on Wednesday, so there is a quick turnaround to receive any comments from NRR to incorporate.

I have left out the "References" section, as I am still working on the citations. If during the course of your review you would like me to provide you one of the references, please email me.

Please provide your comments to me by Tuesday so that I can incorporate and send to the region. Any feedback would be greatly appreciated.

Angie

From: Angela Buford (b)(6)
Sent: Wednesday, November 21, 2012 1:31 PM
To: Buford, Angela
Subject: Crack Mapping Paper

USNRC

In situ Monitoring of ASR-affected Concrete

A study on crack indexing and damage rating index to assess the severity of ASR and to monitor ASR progression

Angela Buford
11/21/2012

Key Messages:

1. Surface cracking may not be indicative of the conditions of the concrete through the section, and crack indexing measurements may not consistently indicate the level of ASR severity from one structure to another. For each group of similar (i.e., reinforcement detail, size, environmental conditions) structures, additional examinations are necessary to correlate crack measurements to severity of ASR degradation.

2. Crack mapping results should be correlated to actual strains (and therefore stresses) in the concrete and rebar in order to accurately represent the effect of ASR-induced stresses in engineering evaluations for structural behavior.

3. Damage Rating Index (DRI) is a more accurate measure of ASR severity than crack indexing, and alleviates many of the pitfalls of the crack indexing method. DRI should be considered as a method to assess damage related to ASR.

<u>Alkali-Silica Reaction (ASR)</u>

ASR is a chemical reaction that occurs in concrete between alkali hydroxides dissolved in the cement pore solution and reactive silica phases in the aggregates. The product of the reaction is an expansive gel around the aggregate particles, which imbibes water from the pore fluid, and, having much larger volume than the reacting components, triggers a progressive damage of the material (Winnicki and Pietruszczak 2008). The pressures imparted by the gel onto the concrete can exceed the tensile strength of the aggregates and the cement paste and cause microcracking and macrocracking in the aggregate and surrounding paste. With the presence of moisture, the gel expands and can cause destructive cracking and deleterious expansion of the concrete. The extent of the concrete deterioration depends on aggregate reactivity, high levels of alkalinity, availability of moisture, temperature, and structural restraint (Williams, Choudhuri, and Perez 2009). Concrete expansion and cracking can lead to serious operational and serviceability problems in concrete structures (Rivard et al. 2002).

<u>Surface Cracking and Expansion</u>

The Federal Highway Administration (FHWA) Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures states that "in concrete members undergoing internal expansion due to ASR and subject to wetting and drying cycles (cyclic exposure to sun, rain, wind, etc.), the concrete often shows surface cracking because of induced tension cracking in the 'less expansive' surface layer (because of variable humidity conditions and leaching of alkalis) under the expansive thrust of the inner concrete core (with more constant humidity and pH conditions)." Cracks first form as three or four-pronged star patterns resulting from expansion of the gel reacting with the aggregate. If the concrete is not subject to directional stress, the crack pattern developed forms irregular polygons, commonly referred to as map cracking (Swamy 1992). This cracking is usually enough to relieve the pressure and accommodate the resulting volume increase (Figg 1987; reported by Farny et. Al. 2007).

Map cracking is one of the most commonly reported visual signs associated with ASR. The pattern and severity of cracking vary depending on the type and quantity of reactive aggregate used, the alkali content of the concrete, exposure conditions, distribution of stresses, and degree of confinement in the concrete (Smaoui et al. 2004). ASR can also be characterized by longitudinal cracking, surface discoloration, aggregate pop-out, and surface deposits (gel or efflorescence) (Williams, Choudhuri, and Perez 2009). Although pattern cracking is a characteristic visual indication that ASR may be present in the concrete, ASR can exist in concrete without indications of pattern cracking. Newman (2003) noted that "while superficial cracking patterns can often be reminiscent of ASR, it is important to be aware that reliable diagnosis can never be adequately based on the appearance of surface cracking alone." This consideration is also emphasized by Barnes (2001), whose research cites examples where cracking was thought to be and diagnosed as ASR, and also examples in which ASR gel and associated cracked aggregate particles were found in concrete that was uncracked. In addition, in ASR-affected structures with reinforcement close to the surface or in heavily reinforced structures, surface cracking may be suppressed while internal damage exists throughout the section. The presence and extent of surface cracking is not a conclusive indication that ASR is present or measure of concrete degradation due to ASR.

Crack Mapping/Indexing

In order to determine the effect of ASR on the performance of a concrete structure, it is important that there be an understanding of current concrete condition (ASR damage reached to-date) and the rate of expansion. Crack indexing is a method that is proposed to measure crack widths and expansion of cracks over time. For this visual examination individual crack widths are measured over a defined grid and the total amount of cracking is quantified. The examination is repeated over regular intervals and the results are compared over time, with a goal of establishing a rate of ASR progression. The Institute of Structural Engineers (ISE 1992) proposed a method for crack mapping that consists of measuring the ASR crack widths along five parallel lines that are each 1 m long. Lines are traced directly onto the concrete structure. The total width of intersecting cracks along each line is summed and divided by the length of the line to determine the severity of ASR cracking, and then over time to determine the rate of expansion. Another method, suggested by Laboratoire Central des Ponts et Chaussees (LCPC 1997) consists of measuring the widths of all cracks intersecting two perpendicular 1m lines originating from the same point and their two diagonals 1.4 m long. The total crack index is determined as a value in millimeters per meter and compared to criteria that correspond to action levels.

Summary of General Discussion on Crack Mapping

It is stated throughout ASR research that crack mapping is somewhat limited in its applicability. Saint-Pierre et al. (2007) note that compared to other non-destructive methods developed for assessing the damage induced by ASR, the semi-quantitative surface methods like crack mapping appear to be less effective. It is generally agreed that while results of crack indexing can potentially give some indication of how ASR is progressing over time, establishing an absolute trend that directly correlates expansion levels to ASR progression may not be a reliable practice. ASR research also indicates that using crack measurement alone to characterize the current state of ASR degradation would not be advised, since the practice relies on the assumption that the surface cracking on the face of a structure is wholly congruent to ASR severity. In the 2010 Addendum to its report titled "Structural Effects of Alkali-Silica Reaction - Technical guidance on the Appraisal of Existing Structures," ISE stated that the crack summation procedures for estimating expansion to date work well in directions where there is little restraint from structural stress, reinforcement, or prestress. This suggests that in structures with higher restraint, this would not be the case. In addition, crack mapping is limited in that it can only give data on two-way crack measurements and does not capture cracking in the out-of-plane direction. It is suggested that further activities be carried out for assessing current condition of the concrete and current expansion rate, as well as correlating the expansion to structural integrity.

In addition, crack indexing evaluation criteria should not be universally applied to all structures because surface cracking may not give a reliable indication of the ASR degradation to the structure. Due to variability in size, location, environment, reinforcement detailing, and relative severity of ASR damage, it may be necessary to obtain an understanding of the ASR effects for each individual structure or group of structures with similar physical properties and environments. Indeed, Newman (2003) stated "it is important to relate cracking patterns variously to structural geometry and/or design, apparent concreting sequence, localized detailing (especially where cracking may be coincident with water leakage) and both environmental and in-service conditions."

Surface Cracking vs. Internal ASR Damage

The correlation between surface cracking and ASR deterioration may be closer to unity for specimens used in the laboratory that are only allowed to deteriorate due to ASR conditions. However, for concrete in the field, the surface indications sometimes poorly correlate to the extent of ASR degradation within the concrete. Since conditions are so variable from one region to another, and even from one place to another in the same structure, poor correlations are often observed between the severity of surface cracking and the presence of the internal signs of ASR (i.e., reaction products, micro-cracking, and expansion) (Nishibayashi et al. 1989 and Stark 1990 reported by Smaoui et al. 2002). Development of cracking on the surface depends strongly on the amount of reinforcement close to the surface (Smaoui et al. 2002) and also depends on external environmental conditions such as wetting-drying, freezing-thawing, and exposure to saline solutions (Smaoui et al. 2002). Two examples of situations in which external conditions can affect the surface cover concrete such that the surface features are not indicative of the actual ASR degradation of the structure are presented here for consideration. In one case, presence and extent of surface cracking can depend on the pH of the surface which can be affected by leaching and carbonation. As such, wetting-drying cycles can affect the features of ASR, as conditions at the surface layer could be less favorable to the development of ASR, due to the [lower] humidity during the drying periods and the leaching of alkalis during the wetting periods (Poitevin 1983 and Swamy 1995, reported by Smaoui et al. 2004). In other words, if the outer surface layer of concrete is exposed to conditions that would cause the ASR severity or development to be lower, but conditions inside the concrete remain conducive to ASR development (i.e., high relative humidity); surface conditions would not be representative of the ASR within the concrete section. Crack indexing efforts would incorrectly characterize the level of ASR degradation as minor, when within the section the ASR degradation might be more severe

Another example in which environmental conditions have caused surface conditions to be different than conditions within the concrete is the subject of a study done by Berube et al (2002). In this study, an attempt was made to correlate ASR expansion with type of exposure to moisture. Results showed that in specimens exposed to wetting-drying cycles saw more surface cracking but less actual expansion than specimens that were always exposed to humidity. In this case, the larger amount of surface cracking evident in the specimens exposed to wetting-drying cycles did not show to correlate well to the actual expansion due to ASR, with the ASR expansion being less severe than the cracking would indicate. Conversely (and perhaps more ominously), the specimens that showed less surface cracking saw a greater expansion due to ASR, which shows that visual examination of surface cracking alone may not be adequate.

Smaoui et al. (2004) state that although the intensity of surface cracking on ASR-affected concrete in service can help to assess the severity of ASR, quantitative measurement of this intensity [i.e., crack mapping] [could] lead to values that generally underestimate the true expansion attained, except maybe when the surface concrete layer does not suffer any ASR expansion at all. If the concrete surface layer undergoes ASR expansion that is less than that of the inner concrete, according to Smaoui et al. (2004), "the measurement of surface cracking will tend to give expansion values lower than the overall expansion of the concrete element under study." This research indicates that the degree of correlation between surface cracking and actual ASR expansion or degradation tends to vary with the level of exposure, which means that crack indexing over a number of structures with varying environmental conditions may not conclusively measure the extent or severity of ASR degradation. It should also be noted here that periodic crack indexing measurements also have the potential to be misleading since crack sizes can vary seasonally.

ASR-induced Stresses

The ISE (2010) noted that for some structures exposed to ASR, internal damage occurs through the depth [of the section] but visible cracking is suppressed by heavy reinforcement. In reinforced concrete structures, expansion of ASR cracks generates tensile stresses in the reinforcing steel while also causing compressive stresses in the concrete surrounding the rebar (this phenomenon is often likened to prestress in the concrete and noted to temporarily improve structural behavior). According to Smaoui et al., 2004, the most useful information in the structural evaluation of an ASR-affected concrete member is the state of the stresses in the concrete, but more importantly in the steel reinforcement. The ASR-induced stresses increase the structural demand on the steel and concrete, but this new design load has likely not been accounted for in the original design or in further structural evaluations. According to Multon et al. (2005), "assessment models have to take into consideration the property of stresses to modify ASR-induced expansions and their effect on the mechanical response of ASR-damaged structures..." Crack mapping alone to determine ASR effects on the structure does not allow for the consideration of rebar stresses. Visual examination and measurement of crack growth should be correlated to strain measurements taken of ASR-affected concrete and the reinforcing steel. In similar structures, then, the visual indications of expansion due to ASR can relate to stresses in the concrete and reinforcing steel in order to apply ASR-induced stress as an additional load in structural evaluations. Smaoui et al., 2004 propose that if it is not possible to do a destructive examination (i.e., exposing the rebar or taking deep cores) of the structure in question, "an indirect method is based on the expansion accumulated to date...Assuming that this expansion corresponds to that of the reinforcement steel, the stresses within the reinforcement and the concrete could thus be determined from the modulus of elasticity of the steel and the corresponding sections of the concrete elements under investigation." For determining added stresses in in situ structures, once correlation has been made with respect to size and rebar configuration between the in situ structure and a test specimen, it would be appropriate to use crack mapping as a measure of ASR degradation when introducing the additional ASR-induced stresses on concrete and reinforcing steel in structural evaluations.

Discussion on Applicability of Crack Indexing

This report is not intended to present the position that crack indexing and resulting data should not be part of a structural monitoring program to assess the ongoing effects of ASR in concrete. In fact, crack indexing is recommended by the Federal Highway Administration (FHWA 2010) "to obtain a quantitative rating of the 'surface' deterioration of the structure as a whole" (it should be noted that in the FHWA document, the word "surface" is emphasized with quotation marks, which implies recognition that crack indexing measurements alone provide information limited only to what is occurring at the concrete surface). This report's position is that crack mapping can only be useful once there is an understanding of how the conditions inside the concrete, (i.e., relative humidity, presence and severity of cracking, and added stresses in the concrete, reinforcing detail) correlate to the cracking observed at the surface. The FHWA (2010) document agrees, indicating that to obtain an understanding of the current state of ASR degradation and in order to correlate the surface cracking to the actual effects of ASR-induced expansion on the structure, other investigations of the in-situ structure are necessary. In addition to crack indexing, FHWA recommendations that apply to nuclear structures include taking stress [strain] measurements in reinforcing steel, obtaining temperature and humidity readings, and performing non-destructive testing such as pulse velocity measurements (the recommendation to use pulse velocity measurements is in agreement with the experimental findings of Saint-Pierre et al. 2007). The Institution of Structural Engineers (ISE 2010) suggests that expansion to date and severity of ASR should be evaluated using examination and testing of cores for changes in modulus of elasticity and development of hysteresis (stiffness deterioration). It is also proposed that strain sensors be used as a method of monitoring ASR progression (Harries 2012) in order to monitor and quantify out-of-plane expansion.

In addition to provisions for monitoring (or predicting) progression of ASR, it is recommended that each structure or group of similar structures undergo petrographic analysis to determine the current state of ASR damage, in order to provide an accurate baseline from which to understand the current severity level and monitor ASR progression. A discussion of the Damage Rating Index method for assessing ASR severity is discussed in Appendix A of this report.

Appendix A: Damage Rating Index

The damage rating index (DRI) was developed by Grattan-Bellew and Danay in 1992 (Reported by Smaoui et al. 2004) as a method to determine the extent of internal damage in concrete affected by ASR (Rivard et al. 2002). The DRI is a method for quantifying both qualitative and quantitative observations and determining severity of ASR using petrographic analysis of polished sections of concrete. It is based on the recognition of a series of petrographic features that are commonly associated with ASR (Rivard et al. 2002). The DRI accounts for defects observed in the concrete, such as the presence and distribution of reaction products, existence of internal microcracking, and location of microcracking (within the aggregate vs. through the cement paste) by assigning a weighting factor to each and quantifying overall damage. When the factors are normalized to an area of 100 cm^2, the resulting number is the DRI. Rivard et. Al. (2000) noted that the abundance of individual defects and the overall DRI values increased with regularity with increased ASR expansion. It should be noted that the specimens used by Rivard et. Al. were comprised of reactive aggregates with different reaction mechanisms, but ASR expansion indeed correlated with DRI measures of ASR severity. Rivard et al. noted a possible limitation of the DRI method: that weighting factors assigned to each defect may not universally apply to all types of reactive aggregates (reported by Smaoui et al. 2004) and that weighting factor adjustments may be appropriate depending on the aggregate being examined. Other than that, research supports that this method is a more effective way to assess severity of ASR than crack indexing.

Smaoui et al. (2004) performed damage rating indexing on specimens from five concrete mixes using different reactive aggregates to determine if there was a reliable and accurate correlation between ASR damage determined by DRI and ASR expansion measurements. They noted that there exists a potential error in estimating expansion of ASR concrete in the field and establishing a DRI-expansion relationship with laboratory testing. In some of the lab specimens, relatively similar DRI values were obtained for very different expansion levels for cylinders which had been cast with the same concrete mix (and progressed ASR over time). The tests indicated that expansion levels (of in situ structures compared to laboratory specimens) may not be the best indication of ASR degradation. For example, the presence of air bubbles in the proximity of reactive aggregates [in field concrete] usually has the effect of reducing the expansion due to ASR (Landry 1994, Reported by Smaoui et al. 2004). In other words, air bubbles that exist in the in situ concrete structure could result in a smaller expansion of the structure as concluded under crack mapping activities while more severe ASR damage could be present in the structure because ASR features have "room" to grow inside the existing structure before extensive cracking is notable on the concrete surface. Smaoui et al. (2004) concluded that "for evaluating the expansion attained to date by ASR-affected concrete, it may be necessary to reconsider the relevant defects and their respective weighting factors and take into account a certain number of factors such as the presence or absence of entrained air and preexisting cracks and alteration rims" to assess the severity of ASR in structures. It is notable that the research done by Rivard et al. (2000) showed that DRI correlated well with actual ASR expansion, while subsequent work done by Smaoui et al. (2004) proposed that in some cases lack of gross expansion did not correlate to low ASR degradation, and that air bubbles prevented macro-level expansion even though ASR effects were severe. Crack indexing would not have identified this severe ASR progression since that method only measures expansion of cracks.

The DRI has been shown to be a relatively inexpensive and effective method for assessing the damage level of ASR-affected structures.

References

(coming soon)

Marshall, Michael

From: Buford, Angela
Sent: Saturday, November 24, 2012 5:54 PM
To: Marshall, Michael
Subject: RE: As Requested: FW: Inspection Report Comments

Yes I did. I hope that was okay, as I figured you would utilize my comments to help form the DLR feedback, where I wanted him to capture a couple of points that I considered inspection team-type feedback.

From: Marshall, Michael
Sent: Friday, November 23, 2012 11:10 AM
To: Buford, Angela
Subject: RE: As Requested: FW: Inspection Report Comments

Angie,

As part of the inspection team, did you send these comments directly to Bill?

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Buford, Angela
Sent: Monday, November 19, 2012 8:37 AM
To: Marshall, Michael
Subject: As Requested: FW: Inspection Report Comments

Michael, please see my comments on the inspection report.

From: Angela Buford (b)(6) [redacted]
Sent: Monday, November 19, 2012 8:36 AM
To: Buford, Angela
Subject: Inspection Report Comments

C25

Marshall, Michael

From: Khanna, Meena
Sent: Monday, November 26, 2012 4:57 PM
To: Marshall, Michael; Murphy, Martin
Subject: FW: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)
Attachments: IR 2012-009 11-26-12.docx

Mike and Marty, do you want to look at this version, which includes incorporation of your comments? I know that they are looking for a quick turnaround..thanks!

From: Cook, William
Sent: Monday, November 26, 2012 4:29 PM
To: Khanna, Meena; Raymond, William
Cc: Conte, Richard; Buford, Angela; Trapp, James
Subject: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)

Bill and Meena,

I would appreciate another quick review before we put this in final concurrence. If you don't have Michael's or Marty's comments, let me know, I'll forward them to you.

Thanks in advance.
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

C26

From: Thomas, George
Sent: Tuesday, November 27, 2012 8:25 AM
To: Cook, William
Subject: RE: Draft Seabrook ASR Inspection Report 2012009 for review
Attachments: IR 2012-009 11-13-12GTcomments.docx

Bill,
Please use this version – I have some additional edits (in a different track changes color) on page 1 of cover letter and pages 2, 3, 6 & 7.
Thanks.
George

From: Cook, William
Sent: Tuesday, November 27, 2012 7:21 AM
To: Murphy, Martin; Thomas, George
Subject: RE: Draft Seabrook ASR Inspection Report 2012009 for review

Thanks Marty and George. Good edits, better clarity, thanks for taking the time.
Bill

From: Murphy, Martin
Sent: Tuesday, November 27, 2012 7:00 AM
To: Cook, William
Subject: FW: Draft Seabrook ASR Inspection Report 2012009 for review

Looked over George's comments nothing really new but attached

From: Thomas, George
Sent: Monday, November 19, 2012 1:02 PM
To: Murphy, Martin
Subject: RE: Draft Seabrook ASR Inspection Report 2012009 for review

Marty,
Attached for your review are my comments/edits marked-up using Track Changes. I have also placed a copy on the G drive as below, in case you are not able to view the Track Changes – I seem to have some problem with Track changes when the file is attached to Outlook.

G:\ADES\DE\EMCB\Thomas\Seabrook ASR

Thanks.
George

From: Murphy, Martin
Sent: Friday, November 16, 2012 7:23 AM
To: Thomas, George
Subject: FW: Draft Seabrook ASR Inspection Report 2012009 for review

Comments to me before sending out

C27

We'll discuss Monday afternoon since you are work at home on Tuesday

From: Cook, William
Sent: Thursday, November 15, 2012 3:46 PM
To: Murphy, Martin; Marshall, Michael; Khanna, Meena; Kobetz, Timothy; Lamb, John; Milano, Patrick
Cc: Raymond, William; Buford, Angela; Chaudhary, Suresh; Thomas, George; Harries, Kent A; Conte, Richard; Trapp, James; Sheikh, Abdul
Subject: Draft Seabrook ASR Inspection Report 2012009 for review

ASR Working Group,

Please find the draft report for your review and comment. I welcome any and all edits. Marty and Michael, I'm counting on you and your staffs to ensure those sections your folks contributed to remained technically correct. If you run across a significant problem or error, please let me, or Bill Raymond, or Rich Conte know ASAP! Heads-up, we have taken some minor liberties with the standard IMC 0612 inspection formatting, but we think it makes the whole report read a little better.

I would like to get your feedback (however is easiest for you) no later than COB 11/20, but I understand my priorities aren't necessarily yours. John or Pat, if either of you want to collect the edits and comments for NRR, I'd welcome that, but if it is not practical, no problem.

Thanks in advance.
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

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

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 - CONFIMATORY 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 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 completion in early 2013.

The inspection team identified NextEra's methods for assessing the impact of ASR on reinforced concrete structures technically ~~sound~~ reasonable and generally ~~thorough~~comprehensive. The approach of comparing the available design and as-built construction margins to a conservatively established lower bound ~~ASR~~ ASR-affected structural capacity, on these established margins, was appropriate for the interim assessment. The team concluded the assumed worst-case values defining lower bound values ASR effects for critical structural limit states, developed from research data, provide a reasonable interim operability basis until further testing and engineering analysis supports a final operability determination and addresses the uncertainties in identifying the current level and progression of ASR at Seabrook Station.

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

cc w/encl: Distribution via ListServ

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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NAME	WCook/	ABurritt/	RConte/	JTrapp/	CMiller/
DATE					

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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, Professor of Structural Engineering, University of Pittsburg
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 identification 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 Confirmatory Action Letter 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 during this inspection of CAL items, 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 work 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 their commitments to the NRC, to date, are documented in the enclosed report.

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 data to evaluate the current and potential future impact of ASR on Seabrook Station concrete structures and to develop appropriate actions for the continued monitoring of the ASR affected structures. Information from the test program will also be used to make appropriate modifications to the existing structural monitoring program for ASR susceptible structures. The adequacy of NextEra's proposed test program will be evaluated during the second CAL Follow-up inspection, consistent with CAL Item #8. The team verified during this inspection that NextEra's will not finalize their Interim Assessment and Prompt Operability Determinations until: 1) the degree of ASR degradation and its potential impact on station reinforced concrete structures during the service life is established within the design and licensing basis; 2) definitive margins are established to the design basis limits; and 3) the progression of ASR is appropriately monitored and demonstrated to ensure adequate margins are maintained for the duration of the current operating license.

The team also clarified NextEra's current position that no structure at Seabrook Station will be precluded from continued monitoring for the ~~affects~~ effects of ASR until a satisfactory petrographic examination has been completed on that structure to confirm the absence of ASR or that ASR is no longer active. The adequacy of NextEra's Structures Monitoring Program will be evaluated in the second follow-up inspection, consistent with CAL Item #9

As highlighted 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 in concrete that can change the physical properties and could 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 (AR581434) where ASR was first discovered. Five other buildings were identified via the extent of condition (EOC) review and the evaluation of core samples taken from these structures (AR1664399). 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 states that once removed from the structure, concrete cores are no longer subject to the strains imposed by the ASR-related expansion or restraints imposed by the reinforcing cage. Confinement provided by reinforcing steel rebar and other restraints limit ASR expansion of the concrete within the structure, which reduces the extent of deleterious cracking and the resulting reduction of concrete material properties Therefore, NextEra concluded that the reduction of mechanical properties observed in mechanical testing of cores is not representative of in-situ concrete performance. NextEra's current position is that the mechanical tests are only useful as a diagnostic tool to confirm the presence of ASR. Based on the above, NextEra stopped taking cores to evaluate structures impacted by ASR and revised their 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 a baseline walkdown review of station structures. The review identified the visual signs of ASR through the presence of crack patterns, ASR powder and gel, and/or discoloration/dark staining. The 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 (AR1757861) and have established NextEra's current baseline condition assessment of Seabrook structures, in conjunction with six-month crack indexing measured on selected structures to trend the progression of ASR and thereby establish a rate of degradation.

As stated above, NextEra's operability evaluations are based upon an examination of available design margins and a presumed ASR reduction in structural design capacity for critical limit states. The details of this methodology and related assumptions are developed in NextEra's Interim Assessment (FP 100716). The assessment assumed lower bound values ~~for potential reductions in~~ASR-reduced structural capacity of concrete for critical structural limit states ~~material properties~~ based on ~~industry~~ research test data, of primarily small scale test specimens, from literature. The assessment focused on structural design attributes that are the most sensitive to ASR ~~affects~~ effects (i.e., out-of-plane shear capacity, lap splice development length, and anchorage ~~depth~~capacity). Compressive strength of concrete is also affected, but less so in the early stages of ASR. The assessment determined the structures were suitable for continued service pending further evaluation of structural performance based on a proposed ~~full~~large-scale testing program of beam specimens representative of Seabrook concrete structures. The test programs have been initiated at the Ferguson Structural Engineering Laboratory at the University of Texas, with testing 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 with regard to planned actions to evaluate the degradation of Seabrook reinforced concrete structures due to ASR. In response to the CAL, NextEra committed to provide information to the NRC for the 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. 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 Inspection Report 2012-010.

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

3.1 Inspection Scope

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 concrete properties, 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 (GDC 1, 2, 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 ~~affects~~ effects on safety-related Category 1 and in scope Maintenance Rule reinforced concrete structures. ~~The team also used the established code relationships from ACI 318-1971 to independently assess the engineering calculations and analyses performed by NextEra.~~ Lastly, 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 PODs (Revisions 0 and 1) addressed five buildings (AR 1664399) using the mechanical testing data gathered from concrete core samples. These five structures include 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 ASR affected concrete in both Category 1 and Maintenance Rule structures 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), and the waste processing building (AR1757861).

The team also conducted a detailed review of Foreign Print (FP) 100716, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 1, which is the initial evaluation of concrete structures at Seabrook Station and provides the basis for continued operability of affected structures for an interim period. As documented in FP 100716, this interim evaluation will be followed by a second evaluation that "will assess the long-term adequacy of the concrete structures considering the results of the ~~full~~ large-scale structural testing program, other in-progress test programs, and results from periodic monitoring of the structures."

Comment [g1]: This may have to be defined at some point

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 of a number of supporting calculations, the team determined NextEra's interim operability bases were appropriate. Given the current extent of ASR, there is reasonable expectation that the affected reinforced concrete structures at Seabrook Station will remain capable of performing their intended functions for an interim period, while NextEra continues to monitor the condition and complete detailed testing and further engineering analyses. Noteworthy observations pertaining to the team's review of the PODs and Interim Assessment follow:

3.2.1 Operable, but Degraded/Nonconforming

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/nonconforming. NextEra demonstrated that the structures maintained structural integrity for design basis loads and load combinations for normal, accident and environmental extreme conditions (including seismic). The team indentified no inadequacies in the conclusion that ASR impacted structures were currently operable, but degraded or nonconforming.

The team observed that 24 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. Per the Structures Monitoring Program (EDS ~~1807-03~~136180, Rev 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 team prior to the completion of the inspection period (see Section 3 2 8). However, the evaluations for the remaining locations are yet to be completed. Based upon team review of the competed structural evaluations, to date, there is a reasonable expectation that structural integrity (and operability) of the locations yet to be evaluated by NextEra will be sufficiently demonstrated. Notwithstanding, the team will examine these evaluations in the next CAL follow-up inspection report.

Near the conclusion of this inspection period, NextEra completed the POD for containment (AR 1804477). Preliminary review by the team identified a few areas for follow-up during the second CAL follow-up inspection. Specifically, the team will pursue NextEra's evaluation of the potential for chemical pre-stressing of rebar (reference Section 3.2.8) and review NextEra's future plans for monitoring the localized areas (three) of presumed ASR (not petrographically verified) on the containment outer wall (reference Section 6.0).

3.2.2 Concrete Material Properties - Compressive Strength and Elasticity Modulus

In Revision 2 of POD 581434 for the B Electrical Tunnel, NextEra 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), which showed an average strength of 5143 pounds-per-square-inch (psi) for the ASR affected cores and 4880 psi for the control cores 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. Team review of the supporting concrete core data did not validate NextEra's conclusion.

Concrete compressive strength can vary due to variations in in-place concrete strength. The team determined that 12 cores were obtained from six locations in an ASR suspect wall in the B electrical tunnel. Testing produced compressive strength values ranging from a low of 4220 psi to a high of 6610 psi. The mean strength value of these samples is 5143 psi with a standard deviation of 630 psi. The three cores taken from a control area (presumed ASR free) measured 4630, 5350 and 4660 psi. The mean value of these samples was 4880 psi, with a standard deviation of 580 psi. Team review of the B electrical tunnel data determined that the compressive strength measured in 2011 is about 2 percent lower than the measured cylinder strength values from 1979. These values do not show an increase in strength over 25 years, as would be expected as concrete continues to cure. However, given the inherent variability in concrete material properties and the significant variation in the data from the B electric tunnel, the team could not conclude that there was a significant loss of compressive strength or that the affect of the ASR was to increase the compressive strength. In addition, 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. In contrast to the B electric tunnel results, the measured compressive strength values in the other ASR affected buildings suggest a different trend. In general, the measured core sample compressive strengths in the RCA walkway, EFW pump house, RHR EV and EDG buildings in 2011 were higher than the original compressive strength values in 1979 (as expected). This 2011 core sample data shows an average increase of 56 percent.

For modulus of elasticity, although individual cores showed a modulus that was reduced (compared to design), the average modulus value in the RCA walkway, RHR EV, EFW pump house and DGB was within 20 percent of the design modulus value ($\pm$20 percent is acceptable by ACI 318). For the CEB, the average modulus was just beyond (low) the 20 percent allowable. The team noted that modulus values at individual core locations could be lower than design and that NextEra had conservatively used these lower measured modulus values to assess the implications of ASR on structural performance.

Based on the above, the team determined that the core sampling and material property testing completed, to date by NextEra, has not conclusively established the current impact of ASR on concrete material properties (specifically for compressive strength and modulus of elasticity). However, an adverse trend in concrete material properties is indicated and supported by a literature review and available research data. Notwithstanding, review of the core sample data does indicate that the concrete compressive strength remains considerably above the specified design strength value of 3000 psi (or 4000 psi, where used in construction). The team plans to examine this area further in the second follow-up inspection with respect to 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 ~~varying~~ reduced elastic modulus on seismic response Modulus values used in the study were based on field investigation of CEB concrete that correlated a visual rating of ASR with core test results (FP100696 and FP 100700). The CEB study included a parametric analysis that: evaluated 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 before and after ASR damage; calculated the section capacities; calculated demand-to-capacity ratios (DCRs); and, compared the DCRs of ASR degraded walls to undamaged walls. The analyses showed that, for the current observed state of ASR-degradation, the seismic acceleration profiles, the in-structure response spectrum, and the distribution of forces and moments were not significantly impacted by ASR affected properties ~~Similarly~~Also, the effect of the reduced modulus on the response of below-grade, other ASR-impacted wall structures was previously 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~~increase in the seismic forces. The seismic response of these structures along with the attached equipment (cable trays and supports) and anchor loads remained practically unchanged, ~~with~~ and had ~~no~~ minimal ~~affect~~ effect on operability due to ASR. ~~The team noted that these studies validated previous analyses that the reduced modulus of elasticity had minimal impact on the seismic response of walls and attached equipment.~~ The team concluded that NextEra's assessment of this ASR affected design attribute was appropriate for the interim operability determination.

3.2.4 Shear Capacity

NextEra analyzed the impact of ASR on the B Electric Tunnel using a FEA in calculation FP 100730 to determine refined structural demand and compare the shear capacity versus demand for seismic and hydrodynamic loads. The ~~FEA~~ calculation used the ACI-318 Code, Section 11.4.1 equation for shear stress which relates shear stress to the square root of compressive strength. NextEra assumed a lower bound 25 percent reduction in out-of-plane concrete shear capacity due to the ~~affects~~ effects of ASR for 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 the design shear capacity. 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 approximates the assumed 25 percent lower bound value ASR ~~affect~~ effect on out-of-plane shear capacity. The licensee identified additional conservatism in their analysis based upon the B electrical tunnel average measured core sample compressive strength value of 5140 psi. NextEra's FEA concluded that adequate margin was available. The team acknowledges 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 assumed 25 percent reduction in shear capacity is conservative because of the uncertainty with respect to the actual impact of ASR on concrete tensile strength during the early stages of ASR. The team viewed the use of a FEA to assess lower bound ASR affects as appropriate and insightful, but not conclusive, pending further testing and engineering analysis planned by NextEra.

3.2.5 Anchorage

NextEra evaluated the impact of ASR affected concrete on the performance of anchors, including cast in place anchors, drilled in anchors and reinforcing steel anchorage. The potential impact of micro-cracking caused by ASR can impact the structural capacity of anchorages ~~capacity~~and embedments supporting safety-related components ~~by affecting the distribution of shear stresses~~. Petrographic analysis of Seabrook concrete cores showed that concrete quality was good with relatively small cracks indicating minimal impacts on stress distribution. NextEra's evaluation was supported by anchor performance testing conducted on ASR degraded specimens (FP100718). The tests showed satisfactory performance of the anchors in concrete test specimens, although dissimilar in composition and compressive strength compared to Seabrook structures. NextEra's evaluations illustrated that the assumed reductions in capacity due to ASR degradation were offset by established design margins (FP100716). The team concluded that NextEra's interim anchorage operability assessment was satisfactory. However, based upon the limitations of the testing performed, to date, NextEra plans to conduct further testing. Planned testing involves anchors installed in ASR affected test specimens that more accurately reflect the reinforced concrete structures and anchor configurations at Seabrook.

3.2.6 Review of Finite Element Analysis Modeling

As discussed in Sections 3.2.3 and 3.2.4, NextEra used linear elastic finite element analysis to evaluate the ~~affects~~ effects of ASR, at its current observed state, 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/dimensions were correlated 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 ratio was derived exclusively from ~~industry~~ 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 this FEA approach was useful and insightful for providing reasonable expectation of operability for the interim period, but is subjective and not conclusive with respect to the current or projected state of ASR impact on the CEB. As discussed in Section 9.0, the parametric analysis results will have to be reevaluated following testing and prior to finalizing the PODs. Also, the boundary conditions used at and below EL 0 ft of CEB structure model ~~may~~ needs to be re-evaluated and justified considering the seismic isolation of the structure wall between the waterproofing membrane and concrete backfill.

Comment [g2]: Section 9.0 needs to include this as a followup.

3.2.7 Lap Splice Strength

Section 6.3 of the Interim Assessment addressed reinforcement lap splice degradation as another design attributed 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 ~~affect~~effect. NextEra was able to recover margin for operability considerations by adjusting the ACI Code 318 prescribed design load factors for predicted dead load and/or hydrostatic loads in the controlling service load combination. The team examined this method for margin recovery and found it satisfactory for the interim operability assessment, but concluded it would not be acceptable for a final operability determination under the current licensing basis.

3.2.8 Concrete Confinement and Rebar Pre-Stressing

Team review of FP 100716, Sections 2.1.2 and 4.1.3, identified that the interim engineering evaluation 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 observes that restraint to ASR expansion, from concrete confinement by reinforcement (in two or three dimensions) and/or other external constraints, causes internal chemical pre-stress in the structural members. The consequence is increased compressive stresses in concrete and increased tensile stresses in the rebar cage, as long as the restraint is sustained. The team observed that this ASR-induced pre-stress has been addressed only qualitatively in the Interim Assessment and containment structural evaluation (AR 1804477). The team finds this acceptable for interim operability determinations. However, the team's preliminary engineering judgment is that a quantitative evaluation is more appropriate for a final operability assessment of this 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 through the service life of the affected structure, and therefore, any potential beneficial effect should not be relied upon or credited in design.

The team concludes that chemical pre-stress, if sustained, may show some beneficial effect in terms of stiffness and gross ultimate structural strength, but it may would also result in an increase in structural demand on the concrete and reinforcement. As stated above, the team's judgment is 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 chemical pre-stress, is similar to accounting for ~~(and monitoring for losses)~~ the pre-stress load in pre-stressed concrete design. This issue will be reviewed by the team in the second 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 purposefully removed an area of surface concrete in the B Electrical Tunnel (chronically wet) 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 drill nicked rebar. Examination of the rebar sections removed determined the steel to be in excellent condition (unaffected by ASR or moisture). Preliminarily, the condition of rebar in ASR degraded concrete should be unaffected until the cracking becomes deleterious and exposes the rebar to oxidation mechanisms. Otherwise, the alkaline condition within the concrete should prevent any erosion or 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 ASR Root Cause Evaluation (CAL Item #2)

4.1 Inspection Scope

The team reviewed NextEra's response to this CAL Item, "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."

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 team made some observations regarding the clarity and completeness of NextEra's root cause evaluation.
The team acknowledges that the first licensee identified root cause involved the 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). The ASTM standard was subsequently revised 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, consistent with their CAL Item #2 commitment. The team will review this revision in the next CAL follow-up inspection report.

The team also noted that NextEra excluded a significant 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 in-leakage was more of an operational nuisance than a structural integrity concern. This station and engineering staff view prevented a more timely and thorough investigation and examination of the affected concrete reinforced structures on site. NextEra acknowledged this observation.

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

5.1 Inspection Scope

The team reviewed the results of NextEra 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. 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. 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 >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 five days and the ASR affected specimens exceeded the 0.1 percent threshold in seven 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 a similar, but 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 concluded that NextEra's basis to revise their commitment to conduct Prism Testing was reasonable.

6.0 Review of Crack Indexing (CAL Item #10)

6.1 Inspection Scope

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. NextEra's commitment to this methodology is captured in CAL Item #10. The team used 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," to evaluate the adequacy of this process. The team's review was limited in scope, in that, the adequacy of this process, as the sole means of monitoring ASR progression in Seabrook structures, is still under NRC review. The team will evaluate this aspect as part of the review of CAL Item #9, the Maintenance Rule Structures Monitoring Program, 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 supervising NextEra staff. The team noted that NextEra found ASR patterned cracking in many areas within Seismic Category I and Maintenance Rule structures, but only a limited number of these areas have sufficient ASR degradation to merit continued monitoring and detailed evaluations The ASR walkdown identified 131 locations with some level of pattern cracking. Of the 131 locations, 26 exceeded an initial screening criteria of a combined crack index greater that 1.0 mm/m. 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 CAL Item #10 is closed. The team noted that the periodic crack indexing 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 (SMP)," Attachment 3, Revision 2. As stated above, additional NRC review of the SMP 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/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. The team determined that 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 summary table with each numeric rating and its definition is documented in the Supplemental Information attachment to this report.

7.0 Review of Alkali-Silica Reaction Structures Walkdown/Baseline 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. 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 1 and some in scope Maintenance Rule structures. 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/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 assess the extent of ASR throughout the plant with the primary objectives of: identifying and assessing any apparent degradation from ASR, including: estimating in-situ expansion (Crack Indexing); 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 include: typical patterned surface cracks in concrete; crack dimensions (width, length, orientation); evidence of water ingress/out-seepage (past/present); 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 ~~embodiments~~ embedments located within five feet of the area of interest were examined and documented. The licensee considers their ASR walkdown efforts and observations a baseline condition assessment. This baseline will be used for monitoring the progression of ASR for the duration of the current operating license.

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 inference, 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 remove any of the identified structures from continued ASR monitoring without confirmation via petrography that ASR is nonexistent or no longer active.

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) exposure 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 IWL examination of containment was being credited for part of the Phase 1 ASR walkdown baseline. 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 adequate examination criteria (i.e., active or pattern cracking) for identification of ASR. As evidence of this shortcoming 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 inspectors. NextEra acknowledged this oversight in crediting the IWL examination and initiated action (AR 1819069) per the Corrective Action Plan, to address the need to revise the Phase 3 plan. In addition to review of the revisions to the Phase 3 walkdown areas during the second CAL follow-up inspection, the NRC plans to examine the adequacy of the proposed Phase 3 implementation schedule.

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 were as documented in Inspection Reports 2011-03 and 2011-10 related to: 1) 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 pipe 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 tray supports; and, 4) 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 the reviews in Inspection 2011-10, the unresolved item remained open pending NRC review of additional information from NextEra on the effects on cable and pipe support anchors (number 3) and the effects on the CEB response (number 4).

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. The revised POD addressed the changes in modulus on building frequency; flexural response and capacity; shear capacity, and support anchors. The revised POD incorporated the results of the Interim Assessment (FP100716) 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 POD 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 well above the maximum CI observed in Seabrook structures. Finally, the revised POD for the ET also included consideration of a detailed evaluation of the CEB, chosen for detailed analysis because it conservatively bounds other structures in size and exhibits the highest reduction in modulus of elasticity due to ASR. This included how the induced stresses would shift between the concrete and the steel in adjoining sections of the structure. These issues were factored into the analytical model (finite element analysis) to reanalyze the CEB using the measured elastic modulus applied to ASR impacted sections.

Further NRC review of this area is described in Sections 3.0 and 4.0 of this report. 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, and addressed broadly by the NRC in Finding FIN 05000443/2011-10-02. Unresolved Item 05000443/2011003-03 is closed.

8.2 (Closed) URI 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 impacted concrete, NextEra determined that the core test data was not indicative of structural performance of the ASR affected structures. 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 (FP100697, Structural Assessment of ASR-State of the Art). Since the reduction of mechanical properties derived from testing of cores is not necessarily representative of the structural performance, NextEra changed its approach. NextEra no longer relies on further core sampling to characterize the current and future condition of ASR affected structures. Instead, the licensee will monitor structures via Crack Indexing and pursue large scale testing of concrete components more representative of the Seabrook conditions. The testing will be conducted at the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas Austin (UT-A).

Given the interplay between expansive ASR degradation and structural restraint, NextEra provided an Interim Assessment of the Seabrook structures impacted by ASR which relies on structural proof testing rather than testing of concrete cores removed from the structure. The Interim Assessment was based on available industry data on small scale test specimens having ASR degradation worse than that observed at Seabrook.

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 will provide a baseline by which to judge 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 test program described in CAL Item #8, is currently under review by the NRC regional and headquarters staffs. Unresolved Item 05000443/2011-010-01 is closed.

9.0 Conclusions and Follow-Up Issues

The team determined, based upon the review of the PODs and supporting engineering analyses documented in the Interim Assessment, that the PODs will not be finalized until: 1) the degree of ASR degradation and its potential impact on station reinforced concrete structures during the service life is established within the design and licensing basis; 2) definitive margins are established to the design basis limits; and 3) the progression of ASR is appropriately monitored and demonstrated to ensure adequate margins are maintained for the duration of the ~~current~~ operating license.

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 conservatism of the assumed lower bound ~~affects~~ effects of ASR (Section 3)
- Review of pending structural evaluations and follow-up on containment POD observations (Section 3.2.1)
- Review of core sample compressive strength and SMP (Section 3.2.2)
- Review quantification of pre-stressing ~~affects~~ 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 of Crack Indexing and its physical significance for SMP application (Section 6.2)
- Review the revision 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

Opened/Closed/Update

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

FP100348, Statistical Analysis-Concrete Compression Test Data (PTL)
FP 100642, Scope for Alkali-Silica Reaction Walkdowns
FP 100641, Procedure for ASR Walkdowns and Assessment Checklist
FP100661, Compression Testing Concrete Cores (WJE)
FP100696, Material Properties of ASR-Affected Concrete
FP 100700, Field Investigation
FP100705, Structure ASR Walkdown Report (MPR 0326-0058-58)
FP100714, Three Dimensional Dynamic Analysis of Containment Enclosure Building
FP100715, ASR Impact Study on Containment Enclosure Building
FP100716, Interim Assessment: Impact of ASR on Structures (MPR-3727)
FP100717, ACI 318-71 Perspectives
FP100718, Anchor Test Report (MPR-3722)
FP100720, Crack Index and Expansion Measurement
FP100730, Shear Load Calculation for B Electrical Tunnel West Wall Room CBST1
FP100738, 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
CCI	Combined Crack Index
CFR	Code of Federal Regulations
CW	Circulating Water
DG	Diesel Generator
DRP	Division of Reactor Projects
DRS	Division of Reactor Safety
EDG	Emergency Diesel Generator
EPRI	Electric Power Research Institute
FEA	Finite Element Analysis
FP	Foreign Print
FPL	Florida Power and Light
FSEL	Franklin Ferguson Structural Engineering Laboratory
IMC	Inspection Manual Chapter
IP	[NRC] Inspection Procedure
MPR	MPR Associates, Inc.
NRC	Nuclear Regulatory Commission
PARS	Publicly Available Records
P&ID	Piping and Instrument Diagram
PM	Preventative Maintenance
PRA	Probabilistic Risk Assessment
QA	Quality Assurance
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	Ultrasonic Testing
WO	Work Orders

A-4

NextEra Crack Rating Chart

Assessment of Severity of ASR in Hardened Concrete by Petrographic Examination

This rating system is based on a modified "best practice" procedure initially developed at tehe Building Research Establishment (BRE) in the United Kingdom, using ASR identification critieria first set out in the British Concrete Association report titled "The Diagnosis of Alkali-Silica Reaction," (1992).

Rating	Description
0	No cracking detected
1	Very slight cracking (no evidence of deleterious ASR)
2	Slight cracking (minor or trace evidence of deleterious ASR)
3	Moderate cracking (moderate evidence of deleterious ASR)
4	Severe cracking (severe evidence of deleterious ASR)
5	Very severe ASR-related cracking
6	Heavily fractured ASR-related damage

Thomas, George FINAL INSPECTION REPORT PUBLICLY AVAILABLE. – ML 123[illegible]

From:	Thomas, George
Sent:	Wednesday, November 28, 2012 12:54 PM
To:	Cook, William; Buford, Angela; Raymond, William
Subject:	RE: Latest revision of the Seabrook ASR report for your review.
Attachments:	IR 2012-009 11-26-12 gt.docx

Bill,
I did a quick review of Sections 1 and 3. My comments/edits are marked-up on cover letter, and pages 2, 3, 5, 6, 7,8 and A-2. My 2 comments are on pages 2 and 5.
Thanks.
George

From: Cook, William
Sent: Wednesday, November 28, 2012 10:34 AM
To: Buford, Angela; Raymond, William; Khanna, Meena; Thomas, George
Cc: Conte, Richard
Subject: Latest revision of the Seabrook ASR report for your review.

See attached. Any comments or edits, please get to me ASAP.

Thanks,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) [redacted] (cell)

C28

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

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 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 completion in early 2013.

The inspection team determined that NextEra's methods for assessing interim operability of ASR-affected reinforced concrete structures were technically ~~sound~~ reasonable and generally comprehensive. NextEra compared the available design and as-built construction margins to lower bound ASR effects on selected structural design attributes. The team concluded this margins assessment provided a reasonable interim operability basis, until further testing and engineering analysis supports a final operability determination, expected to be completed by mid-2014. The team 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 in the second follow-up inspection.

In accordance with Title 10 of the *Code of Federal Regulations* (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

cc w/encl: Distribution via ListServ

In accordance with Title 10 of the *Code of Federal Regulations* (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

cc w/encl: Distribution via ListServ

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DATE					

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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 identification 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 11 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 their commitments to the NRC, to date, are documented in the enclosed report.

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 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 affects 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 during the second CAL follow-up inspection, in accordance with CAL Item #8. 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 cores 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 a baseline 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/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) and have established NextEra's current baseline condition assessment of Seabrook structures, 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 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 potential reductions in structural design properties~~ (for various limit states) based on research test data from primarily small scale test specimens. The assessment focused on the structural ~~design properties~~ 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 pending further 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.

Comment [G1]: General Comment In using the term "lower bound value(s)" through out the report, using the example of the shear limit state, please understand that the assumed 25% potential reduction in shear capacity due to ASR effect is an "upper-bound" value of potential reduction in shear capacity. This in turn would result in a reduced shear capacity of 0.75 times the shear capacity of unaffected concrete, which is a "lower-bound" value of shear capacity for ASR-affected concrete The term "limit state" refers to structural modes of failure such as axial compression/tension flexure, shear, bond etc.

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

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 and in scope Maintenance Rule reinforced concrete structures. 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, which is the initial evaluation of concrete structures at Seabrook Station and provides the basis for continued operability of affected structures for an interim period. As documented in FP 100716, NextEra's interim evaluation will be followed by a second evaluation that "will assess the long-term adequacy of the concrete structures considering the results of the ~~full~~ 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 interim 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 for an interim period, while NextEra continues to monitor the condition and complete detailed testing and further engineering analyses (expected to be completed by mid-2014).

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 (Below Full Qualification)

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 below full qualification. NextEra demonstrated that the structures would maintain structural integrity for design basis loads and load combinations for normal, accident and environmental extreme conditions (including seismic) for an interim period.

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. 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 team prior to the completion of the inspection period (see Section 3.2.8). However, the evaluations for the remaining locations are yet to be completed by NextEra. The team will examine these evaluations in the next CAL follow-up inspection report.

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-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 notes 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), lead 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 (±20 percent is acceptable by ACI 318). For the CEB, the average modulus was just beyond (low) the 20 percent allowable. 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 was chosen for detailed analysis because it conservatively bounds other site structures due to its relative size and dynamic loading~~ 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 ~~before~~ without and ~~after~~ 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~~ing~~ conditions and the assumed current state of ASR degradation used in the FEA

Comment [G2]: I do not agree with this statement. The CEB analysis only speaks for the CEB and not other structures. The effect of ASR-reduced E on seismic/dynamic response of many other below-grade wall structures were evaluated in Calculation C-S-1-10163 Most of these other below grade walls are by design isolated from the main structure that goes above grade - for example, the B tunnel is below the foundation of the Control Building and isolated from the CB. So it experiences only the ZPA acceleration at the rock and can be evaluated by idealizing it as a plate with appropriate boundary condition. The CB itself on the other hand has a detailed seismic analysis using a lumped mass finite element model.

model, the analyses showed that the seismic acceleration profiles, in-structure response spectrum, and distribution of forces and moments were not significantly impacted . It is noted that 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 for an interim operability determination.

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 ~~lower~~ upper bound 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 identified that adequate margin was available using the as-built specified concrete compressive strength. The team notes 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 team acknowledges 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 viewed the use of an FEA to assess shear capacity and the lower bound ASR effects as appropriate for the interim operability assessment.

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, as currently observed, 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/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 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 the application of the FEA to a parametric analysis was useful for providing a reasonable expectation of operability for the interim period, 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 structure wall (separated from the concrete backfill by the waterproofing membrane). The team concluded that the use of a FEA or numerical model with more accurate concrete material property data including kinetics of ASR and more representative boundary conditions may be appropriate for a final operability assessment.

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 interim 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 lower bound reduction in capacity due to ASR was offset by established anchor manufacturer's design margins (FP 100716). The team concluded that NextEra's interim anchorage operability assessment was satisfactory. 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.

3.2.7 Lap Splice Strength

Section 6.3 of NextEra's Interim Assessment addressed reinforcement lap splice degradation as another design attributed 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 affect. 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 ~~calculations~~ loads and load combinations and determining the accuracy and potential variability of the predicted loads; if the predicted load ~~can be more~~ is well defined and accurately quantified and subject to minimum variability (such as dead load, 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 providing increased design margins for service load conditions/combinations. The team examined this method and found it satisfactory for the interim 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

Team 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/or other external constraints, may cause internal chemically-induced pre-stress in the structural member. The consequence may increase compressive stresses in 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's preliminary engineering judgment is that a quantitative evaluation is more appropriate for a final operability assessment of this 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's judgment is 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 purposefully removed an area of surface concrete in the B electrical tunnel (chronically wet) 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 drill nicked 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-Silicon Reaction Root Cause Evaluation (CAL Item #2)

4.1 Inspection Scope

The team reviewed NextEra's response to this CAL Item, "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."

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 team made observations regarding the level of detail and clarity of NextEra's root cause evaluation.

The team acknowledges that the first licensee identified root cause involved the use of susceptible aggregate in the concrete mix design that was undetected by the testing specified by American Society for Testing and Materials (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 view prevented a more timely and thorough investigation and examination of the affected concrete reinforced structures on site. NextEra acknowledged this observation

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

5.1 Inspection Scope

The team reviewed the results of NextEra 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. 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 >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

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. NextEra's commitment to this methodology is documented in CAL Item #10. 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 this process, as the sole means of monitoring ASR progression in Seabrook structures, is still under NRC review. The team will evaluate this aspect as part of the review of CAL Item #9, the Maintenance Rule Structures Monitoring Program, 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 supervising NextEra staff. The team noted that NextEra found ASR patterned cracking in many areas within Seismic Category I and Maintenance Rule structures, 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 established 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 CAL Item #10 is closed. The team noted that the periodic crack indexing 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 SMP 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/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. The team determined that 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). A summary table with each numeric rating and its definition is documented in the Supplemental Information attachment to this report.

7.0 Review of Alkali-Silica Reaction Structures Walkdown/Baseline 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. 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 in scope Maintenance Rule structures. 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/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 assess the extent of ASR throughout the plant with the primary objectives of: identifying and assessing any apparent degradation from ASR, including: estimating in-situ expansion (Crack Indexing); 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 include: typical patterned surface cracks in concrete; crack dimensions (width, length, orientation); evidence of water ingress/out-seepage (past/present); 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 licensee considers their ASR walkdown efforts and observations a baseline condition assessment. This baseline will be used for monitoring the progression of ASR for the duration of the current operating license.

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 inference, 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 nonexistent.

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) exposure 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 IWL examination of containment was being credited for part of the Phase 1 ASR walkdown baseline. 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 inspectors. NextEra acknowledged this oversight in crediting the IWL examination and initiated action (AR 1819069) per the Corrective Action Plan. NextEra plans to revise the Phase 3 plan to address this concern. The team plans to examine the adequacy of the proposed Phase 3 changes and implementation schedule during the second CAL follow-up inspection.

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 were as documented in Inspection Reports 2011-03 and 2011-10 related to 1) 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 pipe 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 tray supports; and, 4) 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 the reviews in Inspection 2011-10, the unresolved item remained open pending NRC review of additional information from NextEra on the effects on cable and pipe support anchors (number 3) and the effects on the CEB response (number 4).

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. The revised POD addressed the changes in modulus on building frequency; flexural response and capacity; 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 POD 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 well above the maximum CI observed in Seabrook structures. Finally, the revised POD for the ET also included consideration of a detailed evaluation of the CEB, chosen for detailed analysis because it conservatively bounds other structures in size and exhibits the highest reduction in modulus of elasticity due to ASR

Further NRC review of this area is described in Sections 3.0 and 4.0 of this report. 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 part of the interim operability assessment. This issue was also addressed broadly by the NRC in Finding FIN 05000443/2011-10-02. Unresolved Item 05000443/2011003-03 is closed.

8.2 (Closed) URI 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. 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 is not necessarily representative of the structural performance, NextEra changed its approach For the interim operability assessment, NextEra compared the structural design capacities to design loads/demands and an assumed lower bound ASR effects. This interim 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 components that are representative of the Seabrook ASR conditions to demonstrate overall structural performance and operability. The 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 will 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. Unresolved Item 05000443/2011-010-01 is closed.

9.0 Conclusions and Follow-Up Issues

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 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)
- Review 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
FP100730, Shear Load Calculation for B Electrical Tunnel West Wall Room CBST1
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
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

NextEra Crack Rating Chart

Assessment of Severity of ASR in Hardened Concrete by Petrographic Examination

This rating system is based on a modified "best practice" procedure initially developed at tehe Building Research Establishment (BRE) in the United Kingdom, using ASR identification critieria first set out in the British Concrete Association report titled "The Diagnosis of Alkali-Silica Reaction," (1992).

Rating	Description
0	No cracking detected
1	Very slight cracking (no evidence of deleterious ASR)
2	Slight cracking (minor or trace evidence of deleterious ASR)
3	Moderate cracking (moderate evidence of deleterious ASR)
4	Severe cracking (severe evidence of deleterious ASR)
5	Very severe ASR-related cracking
6	Heavily fractured ASR-related damage

Buford, Angela

From: Murphy, Martin
Sent: Wednesday, November 28, 2012 7:28 AM
To: Buford, Angela
Subject: FW: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)
Attachments: IR 2012-009 11-26-12.docx

From: Khanna, Meena
Sent: Monday, November 26, 2012 4:57 PM
To: Marshall, Michael; Murphy, Martin
Subject: FW: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)

Mike and Marty, do you want to look at this version, which includes incorporation of your comments? I know that they are looking for a quick turnaround..thanks!

From: Cook, William
Sent: Monday, November 26, 2012 4:29 PM
To: Khanna, Meena; Raymond, William
Cc: Conte, Richard; Buford, Angela; Trapp, James
Subject: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)

Bill and Meena,

I would appreciate another quick review before we put this in final concurrence. If you don't have Michael's or Marty's comments, let me know, I'll forward them to you.

Thanks in advance.
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6)

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Buford, Angela

From: Murphy, Martin
Sent: Wednesday, November 28, 2012 10:41 AM
To: Galloway, Melanie
Cc: Buford, Angela; Marshall, Michael
Subject: Inspection Report

Melanie,

Sorry, I was on a call this morning when you called and have calls all afternoon.

(b)(5)

FYI, it was a pleasure talking and discussing the topic with Angie this morning, she is doing a great job.

I will be at my desk at 11:00 or a little before if you can call again x3969 or my cell is (b)(6) and we can discuss.

Thanks for following up,
Marty

Buford, Angela

From: Buford, Angela
Sent: Wednesday, November 28, 2012 12:03 PM
To: Khanna, Meena
Subject: RE: Latest revision of the Seabrook ASR report for your review.

Should we email this to Marty? I know he was looking for the final version but noticed he wasn't on this email...

From: Cook, William
Sent: Wednesday, November 28, 2012 10:34 AM
To: Buford, Angela; Raymond, William; Khanna, Meena; Thomas, George
Cc: Conte, Richard
Subject: Latest revision of the Seabrook ASR report for your review.

See attached. Any comments or edits, please get to me ASAP.

Thanks,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

C30

Buford, Angela

From: Buford, Angela
Sent: Wednesday, November 28, 2012 11:42 AM
To: Cook, William
Subject: RE: Latest revision of the Seabrook ASR report for your review.

Bill, looking at it now. Thanks for hanging in there

From: Cook, William
Sent: Wednesday, November 28, 2012 10:34 AM
To: Buford, Angela; Raymond, William; Khanna, Meena; Thomas, George
Cc: Conte, Richard
Subject: Latest revision of the Seabrook ASR report for your review.

See attached. Any comments or edits, please get to me ASAP.

Thanks,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

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Thanks for following up,
Marty

C31

Buford, Angela

From: Murphy, Martin
Sent: Wednesday, November 28, 2012 7:28 AM
To: Buford, Angela
Subject: FW: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)
Attachments: IR 2012-009 11-26-12.docx

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Subject: FW: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)

Mike and Marty, do you want to look at this version, which includes incorporation of your comments? I know that they are looking for a quick turnaround..thanks!

From: Cook, William
Sent: Monday, November 26, 2012 4:29 PM
To: Khanna, Meena; Raymond, William
Cc: Conte, Richard; Buford, Angela; Trapp, James
Subject: Michael and Marty's Comments addressed in draft ASR Report - attached (w/ revisions is RED)

Bill and Meena,

I would appreciate another quick review before we put this in final concurrence. If you don't have Michael's or Marty's comments, let me know, I'll forward them to you.

Thanks in advance.
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

From: Conte, Richard
To: Ali, Syed; Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Murphy, Martin; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stucnell, Sheldon; Thomas, George; Trapp, James
Subject: Documents to Review for the Dec. 18th Conference AND Working Group Meeting Dec. 19 at 200pm
Date: Wednesday, December 12, 2012 8:23:55 PM
Attachments: Assessment of ACI 318-71 as Design Basis - AErickson ASheikh HGraves GThomas MMarshall (11-9-2012).doc

The discussion on the R&D testing for Dec. 18th was firmed up for 800am on Tuesday Dec. 18. Conference call number is forthcoming and the licensee is looking into go-to-meeting format.

Tentative schedule for the day is :

800a – 1100a, Presentation on Sheer and Lap Slice testing with breaks.

1100a – 1200 noon if needed with Q&As.

1200noon to 200pm, Working lunch but separate caucus for NRC separate from NextEra. (we can break for lunch and caucus on a separated NRC bridge 100-200pm.

200pm, regroup with Licensee, if needed. Bill Cook and Angie will be on site and they can tell NextEra if we need the 200pm session.

Documents to review beforehand from the licensee are on certrec with id nos.:

1. ID 98, FP 100759, Rev 1, Spec. for Bean Shear and Anchor (Lap Splice) Testing (ID 94 is Rev 000 of the same document)
2. ID 97, FP 100760, Tech Eval Beam Shear and Anchor (Lap Splice)Testing.
3. ID 95, FP 100758, Commercial Grade Acceptance Plan – not needed for now but if NRC staff to review, it is available.

The power point presentation will be available late Monday.

The overview document apparently won't be available until after the presentation.

We decided to go with the conference for staff to start coming up to speed. Not sure if we will have time to develop hard technical questions on this short notice and not having the full set of documents.

Reminder that working group meeting is scheduled for Wed. Dec. 19 to

1. Go over established inspection schedule from this week for 2013.
2. Debrief on Dec. 18 conference.
3. Review Position Paper on Building code official.
4. Need to reduce frequency of Working Group conferences to Monthly – Consensus

C32

after collaboration.

Michael Marshall is the attached the latest for the position paper on building code official

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Assessment of ACI 318-71 as Design Basis for Category I Concrete Structures Affected by Alkali-Silica Reaction at Seabrook Station

Written By:

Alice K. Erickson

Peer Reviewed By:

Abdul Sheikh

Herman Graves

George Thomas

November 9, 2012

BACKGROUND

Historically, Seabrook Station has experienced groundwater infiltration through below grade portions of concrete structures. In the early 1990's, an evaluation was conducted to assess the effect of groundwater infiltration on the serviceability of concrete walls and concluded that there would be no deleterious effect, based on the design and placement of the concrete and on the non-aggressive nature of the groundwater. However, in 2009, NextEra tested seasonal groundwater samples to support the development of the License Renewal Application (LRA) and the results showed that pH values were between 5.8 and 7.5, chloride values were between 19 ppm and 3900 ppm, and sulfate values between 10 ppm and 100 ppm, indicating that the groundwater had become aggressive [pH < 5.5, chlorides > 500 ppm, or sulfates > 1500 ppm]. Subsequently, in conducting a comprehensive review of the possible effects on concrete structures, in early to mid-2010, the licensee performed in-situ penetration resistance testing (PRT) and compression testing of concrete cores from the affected areas in the "B" electrical tunnel of the control building. The results showed a reduction in compressive strength and modulus of elasticity of the affected concrete. In September 2010, the applicant confirmed the presence of Alkali-Silica Reaction (ASR) through petrographic examination of samples taken from the concrete cores of the "B" electric tunnel.

The licensee has made two prompt operability determinations (PODs) to address the effects of this issue for potentially affected structures. The first addresses the reduced concrete properties below grade in the "B" electrical tunnel exterior wall, and the second addresses the reduced concrete modulus of elasticity below grade in the containment enclosure building (CEB), residual heat removal (RHR) equipment vaults, emergency feedwater (EFW) pumphouse, diesel generator fuel oil tank rooms, and some additional other Catergory I Structures. These additional Category I structures, identified as having the potential presence of ASR as a result of an extent of condition survey, include the condensate storage tank enclosure, control building makeup air intake, service water cooling tower, "A" electrical tunnel, fuel storage building, east pipe chase, west pipe chase, pre-action valve room, primary auxiliary building, service water pump house, mechanical penetration area, and waste process building. Except for the primary containment structure, the Seabrook concrete structures that have been identified thus far as affected or potentially affected by ASR generally fall under the classification of "Other Category 1 Structures" described in UFSAR Section 3.8.4. As of June 2012, both PODs conclude that the ASR-affected structures are *operable but degraded*, and *below full qualification*. NUREG-1430, "Standard Technical Specifications," defines *operable/operability* as "...capable of performing its specified safety function." RIS 2005-20, Revision 1, which includes NRC Inspection Manual Part 9900 as an attachment, defines *degraded condition* as "one in which the qualification of an SSC or its functional capability is reduced." It further defines *full qualification* of an SSC as one that "conforms to all aspects of its CLB, including all applicable codes and standards, design criteria, safety analyses assumptions and specifications, and licensing commitments." Based on the definitions provided in Inspection Manual Part 9900, the "below full qualification" aspect of Seabrook Station's operability determination suggests that Seabrook Station is not meeting some aspect of its CLB. The licensee will have to resolve the current PODs with respect to the CLB, in accordance with its procedures for operability determinations and functionality assessments, as part of its action plan to comprehensively address and manage the ASR degradation issue at the site.

This paper is not intended to cover all requirements that must be met for compliance with the CLB, but to focus on understanding the applicability of American Concrete Institute (ACI) 318-

71, "Building Code Requirements for Structural Concrete," to which the affected structures were designed.

ACI 318-71 DOCUMENTED AS DESIGN BASIS

Seabrook Station's Updated Final Safety Analysis Report (UFSAR) Section 3.8, "Design of Category I Structures," identifies the 1971 version of American Concrete Institute 318 (ACI 318-71), "Building Code Requirements for Reinforced Concrete (with Commentary)" as the applicable Construction Code for Category I structures, exclusive of the containment structure. UFSAR Subsection 1.8, "Conformance to NRC Regulatory Guides" indicates that although compliance with Regulatory Guide 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)" was not required and that ACI 349-76, "Code Requirements for Safety-Related Structures" was not used as a design and construction standard, the design and construction of the structures do fulfill the intent of the requirements set forth in the publication and in Regulatory Guide 1.142. Further, UFSAR Subsection 1.8 clearly indicates that the "loads and load combinations were taken directly from the USNRC Standard Review Plan and ACI 318[-71]" and that "structural analysis and design were consistent with the requirements of the [USNRC] Standard Review Plan (SRP) [NUREG-0800] and ACI 318[-71]."

The Seabrook Station UFSAR clearly documents the [ultimate] strength design method of ACI 318-71 Code along with the NUREG-0800 SRP as the design basis for the Category I Structures, except the primary containment. The basic load combinations considered in the design basis of each seismic Category 1 structure are given in UFSAR Table 3.8-16. Therefore, demonstration that those structures now affected by ASR still meet the strength design requirements of ACI 318-71 under design basis loads and load combinations in the UFSAR, should be sought for compliance with Seabrook Station's current licensing basis (CLB).

DISCUSSION ON ACI 318-71

ACI 318-71 is a Construction Code written in the context of new design and construction. The empirical relationships between concrete compressive strength and other material/mechanical properties (such as tensile strength, shear strength, bond, modulus of elasticity etc.), defined in this Code and relied upon for design, are based on performance and test data of normal concrete. These equations do not account for the effects of ASR; and therefore, should not be relied upon to demonstrate that the Code requirements are satisfied, unless proven otherwise. The technical basis for establishing design adequacy of reinforced concrete structural systems with ASR degradation is not covered by the ACI 318-71 Code. However, ACI 318-71 Chapter 20, "Strength Evaluation of Existing Structures" does provide guidance for structural assessments when doubt develops concerning the safety of a structure. Although ACI 318-71 is a Construction Code, a review of this Code identified two sections as being useful in considering NextEra's approach to demonstrating that the ASR-affected structures continue to meet the intent of ACI 318-71.

ACI 318-71 Chapter 1, Section 1.4, "Approval of Special Systems of Design or Construction," states that "[t]he sponsors of any system of design or construction within the scope of this Code, the adequacy of which has been shown by successful use or by analysis or test, but which does not conform to or is not covered by this Code, shall have the right to present the data on which their design is based to a board of examiners appointed by the Building Official. This board shall be composed of competent engineers and shall have the authority to investigate the data so submitted, to require test, and to formulate rules governing the design and construction of such systems to meet the intent of this Code. These rules when approved by the Building Official and promulgated shall be of the same force and effect as the provisions of this Code." Section 1.2.3 of the Code defines the Building Official as "the officer or other designated authority charged with the administration and enforcement of this Code, or his duly authorized representative." By law, the NRC has the regulatory jurisdiction over commercial nuclear power plants in the US. Concrete structures important-to-safety have been licensed by the NRC to ACI 318-71 for several earlier plants. Therefore, in the context of the Code, the NRC would logically be considered the Building Official in this situation. Also, even though ACI 349 "Code Requirements for Nuclear Safety-Related Concrete Structures" was not published until after Seabrook Station's design was completed, Section 1.4, which is equivalent to Section 1.4 in ACI 318-71, replaced the term "building official" with "authority having jurisdiction." This is because the ACI 349 Code adapted and applied most of its provisions from ACI 318 specifically for nuclear safety-related structures (with exception of containment) and, therefore, explicitly identifies the NRC as having this authority in the definitions section of the Code. Regardless, it is important to note that the commentary for ACI 318-71, Section 1.4, clarifies that the provisions of this section do not apply to strength evaluation of existing structures under Chapter 20.

ACI 318-71 Chapter 20, "Strength Evaluation of Existing Structures," Section 20.1 states that "if doubt develops concerning the safety of a structure or member, the Building Official may order a structural strength investigation by analysis or by means of load tests, or by a combination of these methods." The general requirements for analytical investigations provided for in Section 20.2 states that "a thorough field investigation shall be made of the dimensions and details of the members, properties of the materials, and other pertinent conditions of the structure as actually built." This means that the data relied upon in the analytical investigation must be based on measured properties of the in-situ conditions of the structure. Section 20.3 provides general requirements for load tests on the built structure and Section 20.4 provides requirements for load test on flexural members. The provisions of Chapter 20, especially the load tests, are generally in the context of acceptability of concrete quality of the as-built structure at the time of original construction. Never the less, load tests on the as-built structure does not seem like a practicable approach for the Seabrook Station ASR issue, especially for the affected below-grade structures and for performance assessment in shear, bond and anchorages for embeds and supports.

INTENT OF TESTING BEING CONDUCTED

In a public meeting held on April 23, 2012 to discuss the plans and schedule regarding concrete degradation due to ASR, NextEra presented several statements in their slides that provide some insight as to the intent of the testing being conducted at the University of Texas. The following statements indicate that the testing will be used to support resolution of the PODs and to provide some basis for demonstrating that the effects of aging will be adequately managed for license renewal:

> Ongoing full scale testing is expected to validate assumptions and identify additional margin.
>
> Testing is anticipated to show that the performance of ASR-affected concrete structures is not compromised.

Design parameters for ASR affected concrete [derived from ASR-affected and control beams] will be compared to ACI Construction Code requirements and reconciled with Seabrook design basis calculations.

AMP criteria and frequency will be revised as the full-scale concrete beam test program develops.

Ongoing testing programs are expected to identify additional structural margin.

Based on this information, the staff understands that the testing being conducted at the University of Texas will be used in the resolution of the PODs. However, the details as to how the testing will support the resolution of the PODs remain unclear to the staff. The staff also understands that the testing will no longer serve as a basis for the development of their aging management program; however, the results of the testing may inform certain elements of the program that NextEra is currently proposing.

ASSESSMENT

As was stated earlier, Seabrook Station's UFSAR clearly indicates that the Seismic Category I concrete structures, exclusive of the containment structure, were designed to meet the strength design requirements of ACI 318-71. As such, this Code is applicable in that it is the Construction Code-of-Record that forms the current licensing design basis for the Category I structures.

The intent of this paper is to communicate that the strength design provisions of ACI 318-71 must be satisfied in order for Seabrook Station to demonstrate that the ASR-affected concrete structures will perform their intended safety function within the CLB; however, unless proven otherwise, the empirical relationships in the design provisions of the Code should be treated with caution and should not be relied upon for strength evaluation because those empirical relationships do not account for the effects of ASR. Additionally, because ACI 318-71 does not provide a technical basis for establishing the design adequacy of ASR-affected reinforced concrete structural systems using its strength design provisions, and because NextEra's approach to demonstrating Code compliance is not consistent with the guidance described in Chapter 20 for strength evaluations, the technical basis by which NextEra demonstrates the ability of the ASR-affected structures to perform their intended safety function may require a change to the current licensing basis in the resolution of the current PODs. However, it is the licensee's responsibility to make this determination by evaluating its proposed approach in establishing the long-term design adequacy of ASR-affected structures with respect to the ACI 318-71 code and the regulatory requirements contained in 10 CFR 50.59 "Changes, tests and experiments."

At this time, it does not seem necessary to seek clarification from the American Concrete Institute because, as presented in this paper, the staff has a generally agreed upon position and understanding of the ASR issue as it relates to the ACI 318-71 Code requirements.

From:	Conte, Richard
To:	Dean, Bill; Lew, David; Holody, Daniel; McLaughlin, Marjorie; Crisden, Cherie
Cc:	Ali, Syed; Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Murphy, Martin; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James; Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Trapp, James; Wilson, Peter
Subject:	FW: SBK-L-12257, Seabrook Station Response to Confirmatory Action Letter
Date:	Monday, December 17, 2012 9:29:01 AM
Attachments:	SBK-L-12257.pdf

We were expecting this changes. We will need time to digest what they are saying and review for adequacy and we will need a CAL rev. to No. 2012-002.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, December 17, 2012 8:06 AM
To: Brown, Brian; Vassallo, Theodore; Raymond, William; Cliche, Richard; Conte, Richard
Subject: FW: SBK-L-12257, Seabrook Station Response to Confirmatory Action Letter

Commitment change letter submitted.

(b)(6)

From: Sweeney, Shirley
Sent: Friday, December 14, 2012 11:20 AM
To: Hamrick, Steven; Dryden, Mark; Brown, Alison; Noble, Rick; Connolly, James; Brown, Victoria - Seabrook Station Licensing Dept; Cloutman, Sarah; Griffith, Alan; Legendre, Al; Pascucci, Vincent; STROUT, SABRE; Vehec, Thomas; Walsh, Kevin; Willoughby, Paul
Subject: SBK-L-12257, Seabrook Station Response to Confirmatory Action Letter

Attached is an electronic copy of the subject letter.

Shirley Sweeney
Licensing
603-773-7371

C33

NEXTERA ENERGY
SEABROOK

December 13, 2012

SBK-L-12257
Docket No. 50-443

Mr. William Dean, Administrator
U.S. Nuclear Regulatory Commission
Region I
2100 Renaissance Boulevard
Renaissance Park
King of Prussia, PA 19406

Seabrook Station
Response to Confirmatory Action Letter

References:

1. NRC letter to NextEra Energy Seabrook, CAL No. 1-2012-002, Confirmatory Action Letter (CAL), Seabrook Station, Unit 1 – Information Related to Concrete Degradation Issues, dated May 16, 2012. (ML121254172)
2. NextEra Energy Seabrook Letter to NRC, SBK-L-12122, Response to Confirmatory Action Letter, dated June 8, 2012. (ML12171A277)

In Reference 1, the NRC-issued Confirmatory Action Letter (CAL) No. 1-2012-002 which confirmed commitments NextEra Energy Seabrook, LLC (NextEra Energy Seabrook) made regarding planned actions to address alkali silica reaction (ASR) in certain structures at Seabrook Station, and required NextEra Energy Seabrook to notify the NRC Region 1 Administrator if, for any reason, NextEra Energy Seabrook cannot complete any of the actions or commitments within the specified schedule and to advise the Administrator in writing of the modified schedule. In Reference 2, NextEra Energy Seabrook submitted its integrated corrective action plan which provided details related to some of the CAL required actions associated with the implications of ASR on structures at Seabrook Station. NextEra Energy Seabrook has completed nine of the eleven CAL actions within the committed dates.

The purpose of this letter is to notify the Administrator of revisions to two of the remaining commitments, actions 7 and 11, related to planned actions in Reference 2. These revisions are based on additional information discovered as part of NextEra Energy Seabrook's ongoing actions to assess the impact of ASR on structures at Seabrook Station. These changes and the basis for the changes have been discussed with the NRC Working Group on ASR during NRC inspection activities.

CAL action 7 states that NextEra will, "Complete long term aggregate expansion testing (ASTM C 1293 Concrete Prism Test) by June 30, 2013." This action along with CAL action 6 was intended to evaluate the potential for additional ASR expansions to occur in plant structures that exhibit ASR and to determine if the ASR reaction is self limiting at some future date. Action 6 stated; "Complete short term aggregate expansion testing (ASTM C 1260 Mortar Bar Expansion Test) by June 30, 2012." This action has been completed and the test results and conclusions have been discussed with and reviewed by NRC staff. The Mortar Bar Expansion testing conducted by Simpsom, Gumpertz & Heger (SG&H) for NextEra Energy Seabrook exceeded the expansion limits specified in the ASTM C 1260 test method. The testing was conducted with coarse aggregates removed from onsite plant structures that exhibited ASR expansion (i.e., reacted aggregates) as well as similar coarse aggregates which did not have features of ASR expansion (previously un-reacted aggregates). The test was extended several months beyond the specified 14-day test period in order to gain additional insight into the future reaction and expansion potential of the aggregates. The results of these tests showed that there was minimal difference in the expansion rate of the reacted and un-reacted aggregate samples and that the aggregates remained reactive even when the test was extended several months. From this test data, NextEra Energy Seabrook and our independent engineering consultants (SG&H) concluded that the coarse aggregates contain sufficient reactive silica for the ASR reaction and expansion to continue long-term under existing environmental conditions. Since the ASTM C 1260 Mortar Bar Expansion test results demonstrated that the ASR reaction would continue long-term without reaching a plateau or exhaustion of reactive silica, the results of the ASTM C 1293 Concrete Prism test, required by action 7, would not provide any useful expansion rate data or additional insights. Additionally, NextEra Energy Seabrook will complete the second, 6-month inspection campaign of Combined Crack Index (CCI) monitoring in December 2012. The first campaign evaluated the CCI after six months and demonstrated that the reaction rate is slow and there has been negligible change in expansion. The additional planned CCI monitoring will provide a direct indication of any progression of ASR that the ASTM test method cannot provide. Thus, NextEra Energy Seabrook requests that the commitment to perform the ASTM C 1293 Concrete Prism test be deleted.

CAL action 11 states that NextEra Energy Seabrook will, "Complete anchor test program by December 31, 2012." The concrete anchor testing program is currently in progress at the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas at Austin. The concrete test beams for the anchor testing have been fabricated and are undergoing accelerated ASR aging. To be consistent with the approach taken with CAL action 8, NextEra Energy Seabrook is requesting that the commitment be changed to read, "Submit technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013."

If you have any questions of a technical nature, please contact Mr. Richard Noble, ASR Project Manager at (603) 773-7308.

Should you have any questions regarding this letter, please contact Mr. Michael O'Keefe, Licensing Manager at (603) 773-7745.

Sincerely,

NextEra Energy Seabrook, LLC

Kevin T. Walsh
Site Vice President

cc:

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

J. G. Lamb, NRC Project Manager
NRC Senior Resident Inspector

Mr. Christopher M. Pope
Director, Homeland Security and Emergency Management
New Hampshire Department of Safety
Division of Homeland Security and Emergency Management
Bureau of Emergency Management
33 Hazen Drive
Concord, NH 03305

Mr. John Giarrusso, Jr., Nuclear Preparedness Manager
The Commonwealth of Massachusetts
Emergency Management Agency
400 Worcester Road
Framingham, MA 01702-5399

Buford, Angela

From: Buford, Angela
Sent: Monday, December 17, 2012 11:22 AM
To: Conte, Richard
Subject: RE: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

I did, sorry I had deleted it but just wasn't sure if you included all the working group parties on it.

Thanks, Angie

From: Conte, Richard
Sent: Monday, December 17, 2012 11:21 AM
To: Buford, Angela
Subject: RE: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

I thought I already did that last week in email. Did you not get the email.

From: Buford, Angela
Sent: Monday, December 17, 2012 10:02 AM
To: Conte, Richard
Subject: RE: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

Rich, maybe you can let the folks who plan on participating and have access to Certrec know the documents that the licensee will reference with regards to the texas testing so that they can prepare (I'm referring to the foreign prints you made a list of last week)

From: Conte, Richard
Sent: Monday, December 17, 2012 9:59 AM
To: Ali, Syed; Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Murphy, Martin; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Subject: FW: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

I need to know by noon today who would like access to the Live Meeting session. The conference bridge is below

I would suggest NRR (could be two locations) and Research (third location) be given access in a room for which you can discuss on mute and share the view on the slides.

We will try to establish a central location in Region I, either Ellis Island Room or Shandoah Room on third floor in DRS area.

I am hoping the slides will be on Certrec some time today.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, December 17, 2012 7:13 AM
To: Conte, Richard; Noble, Rick; OKeefe, Michael; Vassallo, Theodore; Brown, Brian
Cc: Raymond, William; Cook, William; Trapp, James
Subject: RE: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

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We will use the usual bridge number for voice communications: 305-552-3000 passcode (b)(6)

I have set up a "Live Meeting" session as well so participants will be able to see the power point slides as they are being presented.

Please provide the names and e-mail addresses of the participants so I can forward the participant passcode, instructions, etc.

Thanks

Paul

(b)(6)
paul.willoughby@nexteraenergy.com

From: Conte, Richard [mailto:Richard.Conte@nrc.gov]
Sent: Monday, December 17, 2012 7:06 AM
To: Willoughby, Paul; Noble, Rick; OKeefe, Michael
Cc: Raymond, William; Cook, William; Trapp, James
Subject: Status of Communicaiton Medium for Tomorrow's Session on the Seabrook ASR R&D Effort

Do you have any developments in terms of conference bridge number and/or go-to-meeting session.

Please confirm that we are starting at 800am.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Marshall, Michael

From: Marshall, Michael
Sent: Wednesday, January 02, 2013 2:24 PM
To: Sheikh, Abdul; Buford, Angela
Cc: Erickson, Alice
Subject: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group
Attachments: Seabrook ASR CAL2012-002 Rev DEC 29 2012.docx; SBK-L-12257.pdf

Hello Abdul and Angie,

Please, review the proposed response to NextEra concerning NextEra's request to modify the CAL concerning Seabrook ASR Issue. Let me know if you have any technical or regulatory concerns/questions. I would appreciate a response by close of business on Thursday, January 3, 2013.

Best Regards,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Friday, December 28, 2012 4:01 PM
To: Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Murphy, Martin
Cc: Lamb, John; Milano, Patrick; Morey, Dennis; Trapp, James
Subject: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

For Addressees Only: The response letter is for NextEra revision to two of the CAL commitments. They are self explanatory.

I am requesting a NTO review.

Since new CAL no. 11 is being modeled off of CAL No. 8 it should be ok. What they need to submit on the docket for technical details should come as we interact with them in the ensuing months. They will most likely need to revise what was already submitted for CAL No. 8

The second file is the incoming from Dec. 13. We can't wait for next working group on Jan 9 since we are trying to issue this before Friday Jan. 11.

It is making its way around for concurrence up to enforcement specialists in the region for now.

Please prioritize on this when you get back and respond by COB Jan 3 NLT noon Jan 4.

Cc's: FYI

Rich Conte, Seabrook ASR Team Lead, Region I

C35

(610) 337-5183 (Office)
(b)(6) NRC cell)

Marshall, Michael

From: Marshall, Michael
Sent: Wednesday, January 02, 2013 2:38 PM
To: Conte, Richard
Subject: RE: Your Perspective if you have time

Hello Rich,

From the 1st paragraph and the 4th paragraph, I think the basis the memo should be clear. Not sure about the second question, I will call you to get clarification.

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Thursday, December 27, 2012 12:59 PM
To: Cook, William; Marshall, Michael
Subject: Your Perspective if you have time

Please see the attached deviation memorandum that was approved.

1. Is it obvious to you reading it along with your perspective on the project, what the cause of the deviation was?

Here is a hard one that should not be evident from the attached deviation memo and I would ask you to be brutally honest with me from when you came into the project:

2. What caused the region to so much delay getting to a management meeting and CAL from end of summer 2010 when ASR was confirmed to April 2012 in order to start the process to finally get an adequate POD for the affected structures at Seabrook.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

C36

Marshall, Michael

From: Marshall, Michael
Sent: Wednesday, January 02, 2013 3:40 PM
To: Buford, Angela
Subject: RE: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Hello Angie,

Thanks for the quick response. Yes, we can meet prior to our 9:00 am meeting.

Michael

From: Buford, Angela
Sent: Wednesday, January 02, 2013 3:31 PM
To: Marshall, Michael
Subject: RE: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Michael, I have done a preliminary review of the revised CAL, and the staff position on the two items to be revised is written as we discussed on site with the licensee. There are a few grammatical elements that need to be changed, but I have no technical objection to the letter, especially since it mostly references the Inspection Report for the staff's bases for acceptance of the revisions.

I have a couple of philosophical comments, however. I won't be able to talk this afternoon, but maybe if you have time we can meet before our 9am Scoping discussion.

Thanks,

Angie

From: Marshall, Michael
Sent: Wednesday, January 02, 2013 2:24 PM
To: Sheikh, Abdul; Buford, Angela
Cc: Erickson, Alice
Subject: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Hello Abdul and Angie,

Please, review the proposed response to NextEra concerning NextEra's request to modify the CAL concerning Seabrook ASR Issue. Let me know if you have any technical or regulatory concerns/questions. I would appreciate a response by close of business on Thursday, January 3, 2013.

Best Regards,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal

C37

Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Friday, December 28, 2012 4:01 PM
To: Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Murphy, Martin
Cc: Lamb, John; Milano, Patrick; Morey, Dennis; Trapp, James
Subject: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

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Please prioritize on this when you get back and respond by COB Jan 3 NLT noon Jan 4.

Cc's: FYI

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Marshall, Michael

From: Sheikh, Abdul
Sent: Wednesday, January 02, 2013 5:08 PM
To: Marshall, Michael
Subject: RE: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

1. CAL item 7 – ASTM C1293 Test. It is OK to stop the test since the results will not provide any useful information and data. However, you may want to consider asking NextEra to perform a modified C 1293 prism test as recommended by Professor Monterio in his report.
2. CAL Item 11 - New commitment, "Submit the technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013." We may want to be clear if we want this information for review prior to the tests or not. The applicant has already performed some tests. Were these tests performed without any plans. Also, I have not reviewed the anchor test data that the site team reviewed to OK the operability evaluation and cannot make any observations about it.

From: Marshall, Michael
Sent: Wednesday, January 02, 2013 2:24 PM
To: Sheikh, Abdul; Buford, Angela
Cc: Erickson, Alice
Subject: REQUEST: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Hello Abdul and Angie,

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Best Regards,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Friday, December 28, 2012 4:01 PM
To: Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Murphy, Martin
Cc: Lamb, John; Milano, Patrick; Morey, Dennis; Trapp, James
Subject: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

For Addressees Only: The response letter is for NextEra revision to two of the CAL commitments. They are self explanatory.

I am requesting a NTO review.

C38

Since new CAL no. 11 is being modeled off of CAL No. 8 it should be ok. What they need to submit on the docket for technical details should come as we interact with them in the ensuing months. They will most likely need to revise what was already submitted for CAL No. 8

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Please prioritize on this when you get back and respond by COB Jan 3 NLT noon Jan 4.

Cc's: FYI

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Marshall, Michael

From: Buford, Angela
Sent: Friday, January 04, 2013 11:21 AM
To: Marshall, Michael
Subject: HEADS UP: FW: Plan for Week at U of T
Attachments: NextEra Cntrl ASRTesting-Contractors Jan to April 2013.docx

Michael, attached is the plan for the activities at University of Texas facility, the first taking place the last week of January.

From: Conte, Richard
Sent: Friday, January 04, 2013 11:02 AM
To: Cook, William; Buford, Angela; Raymond, William; Chaudhary, Suresh
Cc: Trapp, James
Subject: Plan for Week at U of T

See attached. Let us know of any other considerations or comments.

This is at Link in Region I LAN:

G:\DRS\Seabrook Concrete\Oper-funct - TIAs\CAL FU 92702 Report 2\NextEra Cntrl ASRTesting-Contractors Jan to April 2013.docx

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) [redacted] (NRC cell)

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INSPECTION PLAN FOR
NEXTERA CONTROL OF TESTING AND CONTRACTOR SUPPORT
FOR ASR ISSUES
Jan to April , 2013

Revision 0 – 1/4/13

Resource Estimate:

1. Two inspection weeks (60 hrs direct inspection), one for last week in Jan. 2013 and perhaps one additional week if anchor/embedment testing is delayed.
2. Time charge to 92702 CAL Follow-up , OA; prep and doc OAP and OAD
3. Report No. 05000443/2012010, 2nd CAL followup report
4. Outside R1 support: A. Buford, NRR
5. All issues of concern should be brought the attention of Region I, Suresh Chaudhary (610-337-5335) or Richard Conte (610-337-5183)

Inspection Criteria:

1. Procurement control documents (some available in Licensee CERTEX system and other yet to be identified)
2. Submitted topical NextEra QA Plan, Revison 12, June 2012 (submitted on docket July 3, 2012), IAW 50.54(a)(2) which requires that measures be implemented along with and ANSI N 45.2.11, Procurement Control (exceptions should be noted)

Scope of review:

Priority of review: observe implementation as it occurs or review activity completion/test results, the adequacy of plans/procedures should be sampled as it undercuts both of the above areas – do not rely on plans and procedure alone and no draft material will be used.

1. Review any updated NEXTERA/MPR/Uof T procurement documents that exhibit control of contractor and work products – with financial information redacted.

2. Review any updated NEXTERA/MPR specifications for either the R&D Effort on Anchors/Embedments (priority) and/or R&D effort for Shear Testing and Lap-splice testing at the Ferguson Engineering Lab at the University of Texas.

3. Continue review and status of Crazed Cracking on one section of Primary Containment and if details for longer term monitoring are available.

4. If available review "White Paper" on overarching view of how testing in testing is correlated to in-situ building conditions at Seabrook.

5. Review results and NextEraMPR review of Testing completed in 2012 at U of T in support of the Prompt Operability Determinations or for the selection of material for construction of test specimens to date or planned.

6. Tour facility and review test equipment along with selected calibration records (load cells, strain gages, etc.

7. If laboratory testing is conducted place emphasis on:
    a. Calibration of test equipments,
    b. Proper implementation of Procurement Documents and Test Procedures,
    c. Observe set-up and test conditions are consistent with test procedures and standards,
    d. Observe and assure that the failure modes or critical test data is properly documented.
    e. Review and assure that test personnel are properly qualified and certified.

<u>End of Week Brief:</u>

Summarize the status of the review as an "out brief" not "exit," to be coordinated with any team members on site at Seabrook.

Marshall, Michael

From: Marshall, Michael
Sent: Friday, January 04, 2013 2:58 PM
To: Erickson, Alice; Buford, Angela
Cc: Sheikh, Abdul; Marshall, Michael
Subject: REQUEST: Participation in This Week's ASR Issue Working Group Meeting
Attachments: ASR WGM of 01-09-2013.docx

Hello Alice and Angie,

Please, plan on attending (via telephone) the Seabrook ASR Issue Working Group on Wednesday, January 9, 2013. The teleconference should start at 2:00 pm. Please, be ready to summarize the paper you prepared with an emphasis on key messages/points. If you have received any question on the paper prior to the call, please, go ahead and address those questions as part of your presentation.

Abdul, please, plan to attend.

I will reserve a conference room for us to gather.

Thanks,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Friday, January 04, 2013 11:35 AM
To: Cook, William; Buford, Angela; Raymond, William; Erickson, Alice; Trapp, James
Cc: Chaudhary, Suresh; Marshall, Michael; Floyd, Niklas
Subject: Your Thoughts by COB Today on Agenda/Talking Points for Working Group Meeting Jan 9 Next Week

Addressees you are slated to lead a discussion.

Any input or changes.

All, any comments.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

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Thomas, George

From: Thomas, George
Sent: Wednesday, January 09, 2013 8:40 AM
To: Murphy, Martin
Subject: RE: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Yes, it will be reviewed as part of Region's inspection of all CAL submittals (as is being done for Item #8 for shear and lap-splice testing) to understand licensee test plan details and approach and how the results will be used to support final or long-term continuing operability. The results of all testing (Items 8 and 11) will be used to support long-term operability in licensee's final OD expected to completed late in 2014. Interim or current operability has already been addressed by the PODs (CAL Item 1 and 5) based on MPR's interim bounding evaluation (CAL Item 3) of affected structures . With regard to anchors, for interim evaluation, MPR did have UT do some testing of anchors they installed (post-ASR) in ASR-affected girder specimens that were already available at UT from their previous work for TxDOT. The difference between #11 and the previous testing essentially is that #11 would use specimens that is more closely representative of Seabrook concrete and conditions, and the anchors will be installed prior to the specimens being ASR-affected, as was done in original Seabrook construction. Hope this helps.
Thanks.

From: Murphy, Martin
Sent: Wednesday, January 09, 2013 8:05 AM
To: Thomas, George
Subject: RE: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

OK, I agree with the first one. A follow-up question for the second would then be what do we intend to do with the test program information – review it? What does it provide us wrt understanding the current and continuing operability of the plant?

From: Thomas, George
Sent: Tuesday, January 08, 2013 5:55 PM
To: Murphy, Martin
Subject: FW: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Marty,

I have not seen the NRC letter previously. Having looked at it now, it seems OK and have no comments.

Regarding your questions:

for item #7, do we feel that item #6 provided the input we were looking for from item #7? Did we expect to get different information from item #6 and #7.

The purpose of both Item 6 (short-duration accelerated ASTM C1260 test) and Item 7 (longer-duration ASTM C1293 test) tests were to qualitatively establish residual reactivity potential of the aggregate from affected areas in comparison to those from unaffected areas. From the results of Item6 test (which was also extended for several months beyond required short duration for additional insights), the licensee concluded that the aggregates from the affected areas are reactive with substantial residual reactivity remaining. The Item 7 C1293 test is considered a better test, and typically used as a supplement or confirmatory test to the C1260 test. For Seabrook, I would insist on the Item 7 test if the Item 6 test showed no or minimal residual reactivity

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potential, but this has not been the case. So, I am OK with the licensee choosing not to do the Item 7 test. In general, you could get a negative result in the C1260 test and a positive in the C1293 test and vice versa.

For item #11, do we want the technical details of the test program, or do we want a summary of the results?

For the purpose of the CAL, we want the technical details of the test program in the near future. Item #11 provided a commitment to complete the anchor testing at UT by 12/31/12. The technical details of the anchor testing would have been included in #8 (Provide technical details of testing planned at the contracted research facility) but at the time of the April 2012 management meeting, the licensee felt they would complete the anchor testing at UT by Dec, and so included a separate Item 11 specifically for anchor testing. Therefore, in response to Item 8, only the technical information of only the shear and lap-splice testing were provided. The Item 11 testing is now delayed since the specimens did not undergo accelerated cracking as expected due to cooler weather conditions in Texas. This testing is not expected to be completed in the near future. The comprehensive results of all the UT testing is expected to be available only in 2014. So, revising #11 (anchor testing) to make it similar to #8 seems logical.

Thanks.
George

From: Murphy, Martin
Sent: Tuesday, January 08, 2013 3:04 PM
To: Thomas, George
Subject: FW: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Have you seen this? Did you have comments?

My questions; for item #7, do we feel that item #6 provided the input we were looking for from item #7? Did we expect to get different information from item #6 and #7. For item #11, do we want the technical details of the test program, or do we want a summary of the results?

From: Conte, Richard
Sent: Saturday, January 05, 2013 11:06 AM
To: Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Murphy, Martin
Cc: Lamb, John; Milano, Patrick; Morey, Dennis; Trapp, James; Floyd, Niklas; Cook, William
Subject: RE: Requesting a No Technical Objections (NTO) Review from Key Members of the Working Group

Haven't heard from addressees on the response to the CAL commitment changes. I know these are lean times with annual leave due to the to the holidays. The issue is on the agenda for the working group meeting for Jan. 9 at 200pm. If you can't make the meeting please get your official alternate, see Charter, it may or may not be a staff in your branch.

Here is the latest since it has undergone concurrence in the region – we will change that Dec 29 date on the file. He is on Chris Miller's desk and he awaits working group review as he comes up to speed on the package.

Again we are looking for a "no technical objections" review NOT concurrence, you can always submit changes to address technical and grammatical errors.

We have NLO from OGC. Second file is the incoming.

Please respond to Nik Floyd for minor changes or questions and cc Jim Trapp. (b)(6)
(b)(6)

From: Conte, Richard
Sent: Friday, December 28, 2012 4:01 PM
To: Khanna, Meena; Kobetz, Timothy; Marshall, Michael; Murphy, Martin
Cc: Lamb, John; Milano, Patrick; Morey, Dennis; Trapp, James
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Cc's: FYI

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
2100 Renaissance Boulevard
KING OF PRUSSIA, PENNSYLVANIA 19406-1415

CAL No. 1-2012-002 (Revision 1)

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

SUBJECT: REVISION TO CONFIRMATORY ACTION LETTER, SEABROOK STATION, UNIT 1 - INFORMATION RELATED TO CONCRETE DEGRADATION ISSUES

Dear Mr. Walsh:

This letter confirms receipt of your letter of December 13, 2012, related to the NRC Confirmatory Action Letter (CAL) issued to NextEra Energy Seabrook, LLC (NextEra) on May 16, 2012 (ADAMS Accession Number ML12125A172). The CAL confirmed actions planned to be taken by NextEra in regard to the degradation of concrete in certain structures due to an Alkali-Silica Reaction (ASR). In the December 13, 2012, letter, you requested changes to two of the commitments (CAL Items Nos. 7 and 11). We accept your proposed changes as discussed below:

<u>CAL Item No. 7</u> - You requested the deletion of this commitment, which required that NextEra conduct a long term aggregate expansion test (ASTM C 1293 Concrete Prism Testing) by June 30, 2013. Your letter states that the Mortar Bar Expansion testing conducted in accordance with CAL Item No. 6 identified that the coarse aggregates contain sufficient reactive silica for the ASR reaction and expansion to continue long-term under existing environmental conditions. Therefore, the results of the Mortar Bar Expansion Testing have obviated the need to conduct additional aggregate expansion testing. Further information regarding this issue is provided in NRC Inspection Report No. 05000443/2012009, Section 5 (ADAMS Accession Number ML12338A283). Accordingly, the NRC has concluded that NextEra's commitment to complete long term aggregate expansion testing by June 30, 2013, may be deleted.

<u>CAL Item No. 11</u> – You requested that the NRC change this commitment from completing the anchor test program by December 31, 2012, to "submit the technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013." You requested this change because the anchor testing program, while in progress, would not be complete by December 31, 2012. NextEra's committed date for completing the anchor testing was based on the best available projected test schedule in May 2012, and did not fully anticipate all the complexities involved in completing the test program. NextEra has completed some limited testing of anchor performance of ASR-affected concrete as described in

Section 2.3.6, of NRC Inspection Report No. 05000443/2012009. These tests results demonstrated satisfactory performance of the anchors and were used to support NextEra's prompt operability evaluation. Based on our findings regarding anchor performance, the NRC finds the requested commitment change acceptable.

The original Confirmatory Action Letter 2012-002 issued May 2012 remains in effect except as modified for CAL Items 7 and 11, above.

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 2.390 of the NRC's "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 System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room). To the extent possible, your response, if you choose to provide one, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

If you have any questions, please contact Richard J. Conte at (610) 337-5183 or e-mail richard.conte@nrc.gov.

Sincerely,

Christopher G. Miller, Director
Division of Reactor Safety

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

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Section 2.3.6, of NRC Inspection Report No. 05000443/2012009. These tests results demonstrated satisfactory performance of the anchors and were used to support NextEra's prompt operability evaluation. Based on our findings regarding anchor performance, the NRC finds the requested commitment change acceptable.

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If you have any questions, please contact Richard J. Conte at (610) 337-5183 or e-mail richard.conte@nrc.gov.

Sincerely,

Christopher G. Miller, Director
Division of Reactor Safety

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DOCUMENT NAME: G:\DRS\Seabrook Concrete\Proj Man\CAL\Revison Dec 2012\Seabrook ASR CAL2012-002 Rev DEC 29 2012.docx
ADAMS ACCESSION NUMBER:

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DATE	12/28/12	1/2/13	12/28/12	1/3/13	1/3/13	

*see previous concurrence

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ML12...

SEABROOK

December 13, 2012

SBK-L-12257
Docket No. 50-443

Mr. William Dean, Administrator
U.S. Nuclear Regulatory Commission
Region I
2100 Renaissance Boulevard
Renaissance Park
King of Prussia, PA 19406

Seabrook Station
Response to Confirmatory Action Letter

References:

1. NRC letter to NextEra Energy Seabrook, CAL No. 1-2012-002, Confirmatory Action Letter (CAL), Seabrook Station, Unit 1 – Information Related to Concrete Degradation Issues, dated May 16, 2012. (ML12125A172)
2. NextEra Energy Seabrook Letter to NRC, SBK-L-12122, Response to Confirmatory Action Letter, dated June 8, 2012. (ML12171A277)

In Reference 1, the NRC-issued Confirmatory Action Letter (CAL) No. 1-2012-002 which confirmed commitments NextEra Energy Seabrook, LLC (NextEra Energy Seabrook) made regarding planned actions to address alkali silica reaction (ASR) in certain structures at Seabrook Station, and required NextEra Energy Seabrook to notify the NRC Region I Administrator if, for any reason, NextEra Energy Seabrook cannot complete any of the actions or commitments within the specified schedule and to advise the Administrator in writing of the modified schedule. In Reference 2, NextEra Energy Seabrook submitted its integrated corrective action plan which provided details related to some of the CAL required actions associated with the implications of ASR on structures at Seabrook Station. NextEra Energy Seabrook has completed nine of the eleven CAL actions within the committed dates.

The purpose of this letter is to notify the Administrator of revisions to two of the remaining commitments, actions 7 and 11, related to planned actions in Reference 2. These revisions are based on additional information discovered as part of NextEra Energy Seabrook's ongoing actions to assess the impact of ASR on structures at Seabrook Station. These changes and the basis for the changes have been discussed with the NRC Working Group on ASR during NRC inspection activities.

CAL action 7 states that NextEra will, "Complete long term aggregate expansion testing (ASTM C 1293 Concrete Prism Test) by June 30, 2013." This action along with CAL action 6 was intended to evaluate the potential for additional ASR expansions to occur in plant structures that exhibit ASR and to determine if the ASR reaction is self limiting at some future date. Action 6 stated; "Complete short term aggregate expansion testing (ASTM C 1260 Mortar Bar Expansion Test) by June 30, 2012." This action has been completed and the test results and conclusions have been discussed with and reviewed by NRC staff. The Mortar Bar Expansion testing conducted by Simpsom, Gumpertz & Heger (SG&H) for NextEra Energy Seabrook exceeded the expansion limits specified in the ASTM C 1260 test method. The testing was conducted with coarse aggregates removed from onsite plant structures that exhibited ASR expansion (i.e., reacted aggregates) as well as similar coarse aggregates which did not have features of ASR expansion (previously un-reacted aggregates). The test was extended several months beyond the specified 14-day test period in order to gain additional insight into the future reaction and expansion potential of the aggregates. The results of these tests showed that there was minimal difference in the expansion rate of the reacted and un-reacted aggregate samples and that the aggregates remained reactive even when the test was extended several months. From this test data, NextEra Energy Seabrook and our independent engineering consultants (SG&H) concluded that the coarse aggregates contain sufficient reactive silica for the ASR reaction and expansion to continue long-term under existing environmental conditions. Since the ASTM C 1260 Mortar Bar Expansion test results demonstrated that the ASR reaction would continue long-term without reaching a plateau or exhaustion of reactive silica, the results of the ASTM C 1293 Concrete Prism test, required by action 7, would not provide any useful expansion rate data or additional insights. Additionally, NextEra Energy Seabrook will complete the second, 6-month inspection campaign of Combined Crack Index (CCI) monitoring in December 2012. The first campaign evaluated the CCI after six months and demonstrated that the reaction rate is slow and there has been negligible change in expansion. The additional planned CCI monitoring will provide a direct indication of any progression of ASR that the ASTM test method cannot provide. Thus, NextEra Energy Seabrook requests that the commitment to perform the ASTM C 1293 Concrete Prism test be deleted.

CAL action 11 states that NextEra Energy Seabrook will, "Complete anchor test program by December 31, 2012." The concrete anchor testing program is currently in progress at the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas at Austin. The concrete test beams for the anchor testing have been fabricated and are undergoing accelerated ASR aging. To be consistent with the approach taken with CAL action 8, NextEra Energy Seabrook is requesting that the commitment be changed to read, "Submit technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013."

If you have any questions of a technical nature, please contact Mr. Richard Noble, ASR Project Manager at (603) 773-7308.

Should you have any questions regarding this letter, please contact Mr. Michael O'Keefe, Licensing Manager at (603) 773-7745.

Sincerely,

NextEra Energy Seabrook, LLC

Kevin T. Walsh
Site Vice President

cc.

U.S. Nuclear Regulatory Commission
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The Commonwealth of Massachusetts
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Thomas, George

From: Thomas, George
Sent: Thursday, November 29, 2012 10:21 AM
To: Buford, Angela
Cc: Murphy, Martin; Marshall, Michael; Erickson, Alice; Sheikh, Abdul
Subject: RE: Action Requested: Crack Mapping Paper
Attachments: Crack Mapping and DRI 11-21-12 gt.docx

Angie,
Attached are some brief comments on the paper for your consideration.
Thanks.
George

From: Buford, Angela
Sent: Wednesday, November 21, 2012 1:41 PM
To: Marshall, Michael; Thomas, George; Erickson, Alice; Sheikh, Abdul
Cc: Murphy, Martin
Subject: Action Requested: Crack Mapping Paper

All,

Attached is the draft crack mapping position paper. We have been asked to provide this paper to the Region on Wednesday, so there is a quick turnaround to receive any comments from NRR to incorporate.

I have left out the "References" section, as I am still working on the citations. If during the course of your review you would like me to provide you one of the references, please email me.

Please provide your comments to me by Tuesday so that I can incorporate and send to the region. Any feedback would be greatly appreciated.

Angie

From: Angela Buford [mailto:(b)(6)
Sent: Wednesday, November 21, 2012 1:31 PM
To: Buford, Angela
Subject: Crack Mapping Paper

USNRC

In situ Monitoring of ASR-affected Concrete

A study on crack indexing and damage rating index to assess the severity of ASR and to monitor ASR progression

Angela Buford
11/21/2012

Key Messages:

1. Surface cracking may not be indicative of the conditions of the concrete through the section, and crack indexing measurements may not consistently indicate the level of ASR severity from one structure to another. For each group of similar (i.e., reinforcement detail, size, environmental conditions) structures, additional examinations are necessary to correlate crack measurements to severity of ASR degradation.

2. Crack mapping results should be correlated to actual strains (and therefore stresses) in the concrete and rebar in order to accurately represent the effect of ASR-induced stresses in engineering evaluations for structural behavior.

3. Damage Rating Index (DRI) is a more accurate measure of ASR severity than crack indexing, and alleviates many of the pitfalls of the crack indexing method. DRI should be considered as a method to assess damage related to ASR.

Alkali-Silica Reaction (ASR)

ASR is a chemical reaction that occurs in concrete between alkali hydroxides dissolved in the cement pore solution and reactive silica phases in the aggregates. The product of the reaction is an expansive gel around the aggregate particles, which imbibes water from the pore fluid, and, having much larger volume than the reacting components, triggers a progressive damage of the material (Winnicki and Pietruszczak 2008). The pressures imparted by the gel onto the concrete can exceed the tensile strength of the aggregates and the cement paste and cause microcracking and macrocracking in the aggregate and surrounding paste. With the presence of moisture, the gel expands and can cause destructive cracking and deleterious expansion of the concrete. The extent of the concrete deterioration depends on aggregate reactivity, high levels of alkalinity, availability of moisture, temperature, and structural restraint (Williams, Choudhuri, and Perez 2009). Concrete expansion and cracking can lead to serious operational and serviceability problems in concrete structures (Rivard et al. 2002).

Surface Cracking and Expansion

The Federal Highway Administration (FHWA) Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures states that "in concrete members undergoing internal expansion due to ASR and subject to wetting and drying cycles (cyclic exposure to sun, rain, wind, etc.), the concrete often shows surface cracking because of induced tension cracking in the 'less expansive' surface layer (because of variable humidity conditions and leaching of alkalis) under the expansive thrust of the inner concrete core (with more constant humidity and pH conditions)." Cracks first form as three or four-pronged star patterns resulting from expansion of the gel reacting with the aggregate. If the concrete is not subject to directional stress, the crack pattern developed forms irregular polygons, commonly referred to as map cracking (Swamy 1992). This cracking is usually enough to relieve the pressure and accommodate the resulting volume increase (Figg 1987; reported by Farny et. Al. 2007).

Map cracking is one of the most commonly reported visual signs associated with ASR. The pattern and severity of cracking vary depending on the type and quantity of reactive aggregate used, the alkali content of the concrete, exposure conditions, distribution of stresses, and degree of confinement in the concrete (Smaoui et al. 2004). ASR can also be characterized by longitudinal cracking, surface discoloration, aggregate pop-out, and surface deposits (gel or efflorescence) (Williams, Choudhuri, and Perez 2009). Although pattern cracking is a characteristic visual indication that ASR may be present in the concrete, ASR can exist in concrete without indications of pattern cracking. Newman (2003) noted that "while superficial cracking patterns can often be reminiscent of ASR, it is important to be aware that reliable diagnosis can never be adequately based on the appearance of surface cracking alone." This consideration is also emphasized by Barnes (2001), whose research cites examples where cracking was thought to be and diagnosed as ASR, and also examples in which ASR gel and associated cracked aggregate particles were found in concrete that was uncracked. In addition, in ASR-affected structures with reinforcement close to the surface or in heavily reinforced structures, surface cracking may be suppressed while internal damage exists throughout the section The presence and extent of surface cracking is not a conclusive indication that ASR is present or measure of concrete degradation due to ASR.

Crack Mapping/Indexing

Comment [g1]: The FHWA report has aanother scheme of crack indexing described in Section 4.2 and App B, which is what the licensee has adapted Maybe that scheme should also be briefly described in this section.

In order to determine the effect of ASR on the performance of a concrete structure, it is important that there be an understanding of current concrete condition (ASR damage reached to-date) and the rate of expansion. Crack indexing is a method that is proposed to measure crack widths and expansion of cracks over time. For this visual examination individual crack widths are measured over a defined grid and the total amount of cracking is quantified. The examination is repeated over regular intervals and the results are compared over time, with a goal of establishing a rate of ASR progression. The Institute of Structural Engineers (ISE 1992) proposed a method for crack mapping that consists of measuring the ASR crack widths along five parallel lines that are each 1 m long. Lines are traced directly onto the concrete structure. The total width of intersecting cracks along each line is summed and divided by the length of the line to determine the severity of ASR cracking, and then over time to determine the rate of expansion. Another method, suggested by Laboratoire Central des Ponts et Chaussees (LCPC 1997) consists of measuring the widths of all cracks intersecting two perpendicular 1m lines originating from the same point and their two diagonals 1.4 m long. The total crack index is determined as a value in millimeters per meter and compared to criteria that correspond to action levels.

Summary of General Discussion on Crack Mapping

It is stated throughout ASR research that crack mapping is somewhat limited in its applicability. Saint-Pierre et al. (2007) note that compared to other non-destructive methods developed for assessing the damage induced by ASR, the semi-quantitative surface methods like crack mapping appear to be less effective. It is generally agreed that while results of crack indexing can potentially give some indication of how ASR is progressing over time, establishing an absolute trend that directly correlates expansion levels to ASR progression may not be a reliable practice. ASR research also indicates that using crack measurement alone to characterize the current state of ASR degradation would not be advised, since the practice relies on the assumption that the surface cracking on the face of a structure is wholly congruent to ASR severity. In the 2010 Addendum to its report titled "Structural Effects of Alkali-Silica Reaction - Technical guidance on the Appraisal of Existing Structures," ISE stated that the crack summation procedures for estimating expansion to date work well in directions where there is little restraint from structural stress, reinforcement, or prestress. This suggests that in structures with higher restraint, this would not be the case. In addition, crack mapping is limited in that it can only give data on two-way crack measurements and does not capture cracking in the out-of-plane direction. It is suggested that further activities be carried out for assessing current condition of the concrete and current expansion rate, as well as correlating the expansion to structural integrity. Such activities could also include installing reference pins on the surface (such as those used for crack indexing), establishing the topographical location of each pin and measure its movement in three orthogonal directions over time.

In addition, crack indexing evaluation criteria should not be universally applied to all structures because surface cracking may not give a reliable indication of the ASR degradation to the structure. Due to variability in size, location, environment, reinforcement detailing, and relative severity of ASR damage, it may be necessary to obtain an understanding of the ASR effects for each individual structure or group of structures with similar physical properties and environments. Indeed, Newman (2003) stated "it is important to relate cracking patterns variously to structural geometry and/or design, apparent concreting sequence, localized detailing (especially where cracking may be coincident with water leakage) and both environmental and in-service conditions."

Surface Cracking vs. Internal ASR Damage

The correlation between surface cracking and ASR deterioration may be closer to unity for specimens used in the laboratory that are only allowed to deteriorate due to ASR conditions. However, for concrete in the field, the surface indications sometimes poorly correlate to the extent of ASR degradation within the concrete. Since conditions are so variable from one region to another, and even from one place to another in the same structure, poor correlations are often observed between the severity of surface cracking and the presence of the internal signs of ASR (i.e., reaction products, micro-cracking, and expansion) (Nishibayashi et al. 1989 and Stark 1990 reported by Smaoui et al. 2002). Development of cracking on the surface depends strongly on the amount of reinforcement close to the surface (Smaoui et al. 2002) and also depends on external environmental conditions such as wetting-drying, freezing-thawing, and exposure to saline solutions (Smaoui et al. 2002). Two examples of situations in which external conditions can affect the surface cover concrete such that the surface features are not indicative of the actual ASR degradation of the structure are presented here for consideration. In one case, presence and extent of surface cracking can depend on the pH of the surface which can be affected by leaching and carbonation. As such, wetting-drying cycles can affect the features of ASR, as conditions at the surface layer could be less favorable to the development of ASR, due to the [lower] humidity during the drying periods and the leaching of alkalis during the wetting periods (Poitevin 1983 and Swamy 1995, reported by Smaoui et al. 2004). In other words, if the outer surface layer of concrete is exposed to conditions that would cause the ASR severity or development to be lower, but conditions inside the concrete remain conducive to ASR development (i.e., high relative humidity); surface conditions would not be representative of the ASR within the concrete section. Crack indexing efforts would incorrectly characterize the level of ASR degradation as minor, when within the section the ASR degradation might be more severe.

Another example in which environmental conditions have caused surface conditions to be different than conditions within the concrete is the subject of a study done by Berube et al (2002). In this study, an attempt was made to correlate ASR expansion with type of exposure to moisture. Results showed that in specimens exposed to wetting-drying cycles saw more surface cracking but less actual expansion than specimens that were always exposed to humidity. In this case, the larger amount of surface cracking evident in the specimens exposed to wetting-drying cycles did not show to correlate well to the actual expansion due to ASR, with the ASR expansion being less severe than the cracking would indicate. Conversely (and perhaps more ominously), the specimens that showed less surface cracking saw a greater expansion due to ASR, which shows that visual examination of surface cracking alone may not be adequate.

Smaoui et al. (2004) state that although the intensity of surface cracking on ASR-affected concrete in service can help to assess the severity of ASR, quantitative measurement of this intensity [i.e., crack mapping] [could] lead to values that generally underestimate the true expansion attained, except maybe when the surface concrete layer does not suffer any ASR expansion at all. If the concrete surface layer undergoes ASR expansion that is less than that of the inner concrete, according to Smaoui et al. (2004), "the measurement of surface cracking will tend to give expansion values lower than the overall expansion of the concrete element under study." This research indicates that the degree of correlation between surface cracking and actual ASR expansion or degradation tends to vary with the level of exposure, which means that crack indexing over a number of structures with varying environmental conditions may not conclusively measure the extent or severity of ASR degradation. It should also be noted here that periodic crack indexing measurements also have the potential to be misleading since crack sizes can vary seasonally.

ASR-induced Stresses

The ISE (2010) noted that for some structures exposed to ASR, internal damage occurs through the depth [of the section] but visible cracking is suppressed by heavy reinforcement. In reinforced concrete structures, expansion of ASR cracks generates tensile stresses in the reinforcing steel while also causing compressive stresses in the concrete surrounding the rebar (this phenomenon is often likened to prestress in the concrete and noted to temporarily improve structural behavior). According to Smaoui et al., 2004, the most useful information in the structural evaluation of an ASR-affected concrete member is the state of the stresses in the concrete, but more importantly in the steel reinforcement. The ASR-induced stresses increase the structural demand on the steel and concrete, but this new design load has likely not been accounted for in the original design or in further structural evaluations. According to Multon et al. (2005), "assessment models have to take into consideration the property of stresses to modify ASR-induced expansions and their effect on the mechanical response of ASR-damaged structures..." Crack mapping alone to determine ASR effects on the structure does not allow for the consideration of rebar stresses. Visual examination and measurement of crack growth should be correlated to strain measurements taken of ASR-affected concrete and the reinforcing steel. In similar structures, then, the visual indications of expansion due to ASR can relate to stresses in the concrete and reinforcing steel in order to apply ASR-induced stress as an additional load in structural evaluations. Smaoui et al., 2004 propose that if it is not possible to do a destructive examination (i.e., exposing the rebar or taking deep cores) of the structure in question, "an indirect method is based on the expansion accumulated to date...Assuming that this expansion corresponds to that of the reinforcement steel, the stresses within the reinforcement and the concrete could thus be determined from the modulus of elasticity of the steel and the corresponding sections of the concrete elements under investigation." For determining added stresses in in situ structures, once correlation has been made with respect to size and rebar configuration between the in situ structure and a test specimen, it would be appropriate to use crack mapping as a measure of ASR degradation when introducing the additional ASR-induced stresses on concrete and reinforcing steel in structural evaluations. Establishing a measured displacement field of selected points on the surface, such as the reference pins used for crack indexing, could also help find the stress field within the structure.

Discussion on Applicability of Crack Indexing

This report is not intended to present the position that crack indexing and resulting data should not be part of a structural monitoring program to assess the ongoing effects of ASR in concrete. In fact, crack indexing is recommended by the Federal Highway Administration (FHWA 2010) "to obtain a quantitative rating of the 'surface' deterioration of the structure as a whole" (it should be noted that in the FHWA document, the word "surface" is emphasized with quotation marks, which implies recognition that crack indexing measurements alone provide information limited only to what is occurring at the concrete surface). This report's position is that crack mapping can only be useful once there is an understanding of how the conditions inside the concrete, (i.e., relative humidity, presence and severity of cracking, and added stresses in the concrete, reinforcing detail) correlate to the cracking observed at the surface. The FHWA (2010) document agrees, indicating that to obtain an understanding of the current state of ASR degradation and in order to correlate the surface cracking to the actual effects of ASR-induced expansion on the structure, other investigations of the in-situ structure are necessary. In addition to crack indexing, FHWA recommendations that apply to nuclear structures include installing demec points to take displacement and relative movement measurements, taking stress [strain] measurements in reinforcing steel, obtaining temperature and humidity readings, and performing non-destructive testing such as pulse velocity measurements (the recommendation to use pulse velocity measurements is in agreement with the experimental findings of Saint-Pierre et al. 2007). The Institution of Structural Engineers (ISE 2010) suggests that expansion to date and severity of ASR should be evaluated using examination and testing of cores for changes in modulus of elasticity and development of hysteresis (stiffness deterioration). It is also proposed that strain sensors be used as a method of monitoring ASR progression (Harries 2012) in order to monitor and quantify out-of-plane expansion.

In addition to provisions for monitoring (or predicting) progression of ASR, it is recommended that each structure or group of similar structures undergo petrographic analysis to determine the current state of ASR damage, in order to provide an accurate baseline from which to understand the current severity level and monitor ASR progression. A discussion of the Damage Rating Index method for assessing ASR severity is discussed in Appendix A of this report.

Appendix A: Damage Rating Index

The damage rating index (DRI) was developed by Grattan-Bellew and Danay in 1992 (Reported by Smaoui et al. 2004) as a method to determine the extent of internal damage in concrete affected by ASR (Rivard et al. 2002). The DRI is a method for quantifying both qualitative and quantitative observations and determining severity of ASR using petrographic analysis of polished sections of concrete. It is based on the recognition of a series of petrographic features that are commonly associated with ASR (Rivard et al. 2002). The DRI accounts for defects observed in the concrete, such as the presence and distribution of reaction products, existence of internal microcracking, and location of microcracking (within the aggregate vs. through the cement paste) by assigning a weighting factor to each and quantifying overall damage. When the factors are normalized to an area of 100 cm^2, the resulting number is the DRI. Rivard et. Al. (2000) noted that the abundance of individual defects and the overall DRI values increased with regularity with increased ASR expansion. It should be noted that the specimens used by Rivard et. Al. were comprised of reactive aggregates with different reaction mechanisms, but ASR expansion indeed correlated with DRI measures of ASR severity. Rivard et al. noted a possible limitation of the DRI method: that weighting factors assigned to each defect may not universally apply to all types of reactive aggregates (reported by Smaoui et al. 2004) and that weighting factor adjustments may be appropriate depending on the aggregate being examined. Other than that, research supports that this method is a more effective way to assess severity of ASR than crack indexing.

Smaoui et al. (2004) performed damage rating indexing on specimens from five concrete mixes using different reactive aggregates to determine if there was a reliable and accurate correlation between ASR damage determined by DRI and ASR expansion measurements. They noted that there exists a potential error in estimating expansion of ASR concrete in the field and establishing a DRI-expansion relationship with laboratory testing. In some of the lab specimens, relatively similar DRI values were obtained for very different expansion levels for cylinders which had been cast with the same concrete mix (and progressed ASR over time). The tests indicated that expansion levels (of in situ structures compared to laboratory specimens) may not be the best indication of ASR degradation. For example, the presence of air bubbles in the proximity of reactive aggregates [in field concrete] usually has the effect of reducing the expansion due to ASR (Landry 1994, Reported by Smaoui et al. 2004). In other words, air bubbles that exist in the in situ concrete structure could result in a smaller expansion of the structure as concluded under crack mapping activities while more severe ASR damage could be present in the structure because ASR features have "room" to grow inside the existing structure before extensive cracking is notable on the concrete surface. Smaoui et al. (2004) concluded that "for evaluating the expansion attained to date by ASR-affected concrete, it may be necessary to reconsider the relevant defects and their respective weighting factors and take into account a certain number of factors such as the presence or absence of entrained air and preexisting cracks and alteration rims" to assess the severity of ASR in structures. It is notable that the research done by Rivard et al. (2000) showed that DRI correlated well with actual ASR expansion, while subsequent work done by Smaoui et al. (2004) proposed that in some cases lack of gross expansion did not correlate to low ASR degradation, and that air bubbles prevented macro-level expansion even though ASR effects were severe. Crack indexing would not have identified this severe ASR progression since that method only measures expansion of cracks.

The DRI has been shown to be a relatively inexpensive and effective method for assessing the damage level of ASR-affected structures.

References

(coming soon)

Buford, Angela

From:	Fuhrmann, Mark
Sent:	Tuesday, January 15, 2013 11:41 AM
To:	Buford, Angela
Subject:	RE: are you looking for comments on the paper "In-situ Monitoring of ASR-affected Concrete"?

Ok, thanks....i am reading the paper now.... it is good. There is an ASR Sharepoint site here in RES....could you drop copies of the references in that?

Mark Fuhrmann, Ph.D.
Geochemist
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Mail Stop CSB 2C-07m
11555 Rockville Pike
Rockville, MD 20852-2738

mark.fuhrmann@nrc.gov
Phone: 301-251-7472
Fax: 301-251-7410

From: Buford, Angela
Sent: Tuesday, January 15, 2013 11:07 AM
To: Fuhrmann, Mark
Subject: RE: are you looking for comments on the paper "In-situ Monitoring of ASR-affected Concrete"?

No. If you see one you need, let me know and I'll get it for you. I plan to have that section done this week, and I think Friday was the deadline for the group to provide comments. When I finish it, I'll send to you (and Herman, I'm sure he'd be interested in the references as well)

From: Fuhrmann, Mark
Sent: Tuesday, January 15, 2013 10:44 AM
To: Buford, Angela
Subject: RE: are you looking for comments on the paper "In-situ Monitoring of ASR-affected Concrete"?

Ok, I'll take a look at it...do you have the references put together yet?

Mark Fuhrmann, Ph.D.
Geochemist
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Mail Stop CSB 2C-07m
11555 Rockville Pike
Rockville, MD 20852-2738

mark.fuhrmann@nrc.gov
Phone: 301-251-7472
Fax: 301-251-7410

C42

The attached position paper and memo captures all the comments I have received, to date. Thanks to those who provided feedback and edits. I expect to outline this paper on the next conference call. Please note the latest revisions are in red and that the initial licensee response/reaction has been added

Any additional feedback is always welcome.

Regards,
Bill

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) [redacted] (cell)

Marshall, Michael

From: Marshall, Michael
Sent: Friday, January 25, 2013 4:27 PM
To: Lubinski, John; Galloway, Melanie
Cc: Morey, Dennis
Subject: RESPONSE: Input for Expanded ET/LT Stand-Up

- During the week of January 28th, DLR (i.e., Angie) will be supporting R1 inspection of NextEra-sponsored testing at the University of Texas at Austin. The testing is intended to help the licensee finalize the operability determination associated with the alkali-silica reaction issue at Seabrook. The inspectors will be focusing on the quality assurance associated with the testing program. In addition the inspectors will be observing large-scale concrete beam testing and anchor testing.

Outside scope of

- Outside of Scope

e

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C43

Outside of Scope

Buford, Angela

From: Raymond, William
Sent: Friday, February 01, 2013 7:54 AM
To: Cook, William; Conte, Richard; Trapp, James; Buford, Angela; Floyd, Niklas
Subject: RE: Some food for thought - see attached DRAFT

Bill
This is very well stated. I endorse each point
Can I quote you in the 5059 paper?
Bill

From: Cook, William
Sent: Thursday, January 31, 2013 5:53 PM
To: Conte, Richard; Raymond, William; Trapp, James; Buford, Angela; Floyd, Niklas
Subject: Some food for thought - see attached DRAFT

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) [redacted] (cell) ex6

C44

Buford, Angela

From: Raymond, William
Sent: Friday, November 02, 2012 8:37 AM
To: Cook, William; Conte, Richard; Trapp, James; Miller, Chris; Chaudhary, Suresh
Cc: Buford, Angela; Thomas, George
Subject: RE: Exit Notes for IR 2012009

Good message, Bill.

From: Cook, William
Sent: Friday, November 02, 2012 8:22 AM
To: Conte, Richard; Trapp, James; Miller, Chris; Chaudhary, Suresh
Cc: Raymond, William; Buford, Angela; Cook, William; Thomas, George
Subject: FW: Exit Notes for IR 2012009

Ideas for a message: Considerable uncertainty about the affect of ASR on the structures; no clear, well defined codes or standards available on how best to deal with ASR; obvious need to apply our and NextEra's best engineering judgments. In the face of uncertainty, need to ensure we follow our established processes; our team and the ASR Working Group is attempting to ensure those processes are being followed and in a consistent way.

Revised exit notes attached.

Regards,
Bill

From: Cook, William
Sent: Thursday, November 01, 2012 8:35 PM
To: Cook, William; Raymond, William; (b)(6)
Subject: Exit Notes for IR 2012009

FYI

Buford, Angela

From: Willoughby, Paul <Paul.Willoughby@nexteraenergy.com>
Sent: Tuesday, February 05, 2013 10:51 AM
To: Cook, William
Cc: Vassallo, Theodore; Brown, Brian; Noble, Rick; Conte, Richard; Raymond, William; Chaudhary, Suresh; Floyd, Niklas; Buford, Angela
Subject: RE: ASR Conference Call

UE &C Specification 244171_18-17, Installation of Concrete Expansion Anchors, has been uploaded to CERTREC.

[illegible]
(b)(6) [redacted]
[illegible]
paul.willoughby@nexteraenergy.com

From: Cook, William [mailto:William.Cook@nrc.gov]
Sent: Tuesday, February 05, 2013 9:58 AM
To: Willoughby, Paul
Subject: RE: ASR Conference Call

Paul,
Any luck with locating the UE&C specification??
Thanks,
Bill

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Tuesday, February 05, 2013 9:56 AM
To: Conte, Richard; Noble, Rick; Vassallo, Theodore; Brown, Brian; OKeefe, Michael
Cc: Cook, William; Raymond, William; Chaudhary, Suresh; Buford, Angela; Trapp, James; Floyd, Niklas
Subject: RE: ASR Conference Call

Added to agenda...

[illegible]
(b)(6) [redacted]
[illegible]
paul.willoughby@nexteraenergy.com

C45

From: Conte, Richard [mailto:Richard.Conte@nrc.gov]
Sent: Tuesday, February 05, 2013 9:53 AM
To: Willoughby, Paul; Noble, Rick; Vassallo, Theodore; Brown, Brian; OKeefe, Michael
Cc: Cook, William; Raymond, William; Chaudhary, Suresh; Buford, Angela; Trapp, James; Floyd, Niklas
Subject: RE: ASR Conference Call

Can we add a fifth item to tomorrow's call? You may not be ready to give dates right now but for immediate future like next week. Here is our interest:

5. Tentative Future Dates:

Date???, Revised summary on RCE per CAL # 2.

2/28/13, Response due on CAL#11, technical details of anchor testing program with commitment related to when license amendment would be submitted.

Date???, Revised response for CAL#8 related to technical details beam testing program (shear and lap-splice length) (3/31/13????, modeled off of anchor submittal) along with overarching document with commitment on when license amendment would be submitted.

Date ???, Revised SMP per CAL 9 given latest considerations.

Date ???, Revised integrated corrective action plan per CAL # 4 (to reflect integrated plan covering corrective actions for CAL 2, 8, 9, and 11)

Date ???, On schedule for completion of Phase 3 extent of conditions.

3/31/13, Evaluation of 13 areas of CCI 1.0 to 1.5 mm/m to ensure still bounding from evaluations on areas with CCI > 1.5mm/m.

Date ??? (5/1/13????), 6 months from outage end UFSAR update, when and how ASR issue will be addressed covering evaluations to date and the fact that the POD have transverse several operating cycles.

Week of 4/29/13 – Tentative Inspection No. 2 Report Exit (05000443/2012010) 4/30 or 5/1.

-----Original Appointment-----
From: Willoughby, Paul
Sent: Tuesday, February 05, 2013 8:36 AM
To: Willoughby, Paul; Conte, Richard; Cook, William; Raymond, William; Chaudhary, Suresh; Buford, Angela; Trapp, James; Floyd, Niklas
Subject: ASR Conference Call
When: Wednesday, February 06, 2013 10:30 AM-11:30 AM (GMT-05:00) Eastern Time (US & Canada).
Where: OSB Engineering Managers Conference Room

call in number 305-552-3000, passcode (b)(6) ex 6

Tentative Agenda:

1. What constitutes sufficient technical detail for Anchor Test Program submittal due Feb. 28 per CAL supplement.
2. What will be addressed in upcoming 5071(e) submittal in light of PODs traversing several operating cycles on ASR issue.
3. Revisit where they are with respect to Chapter 20 of ACI 318-1971, any new developments.
4. Revisit any other issues from inspection weeks 1/21 and 1/28

Buford, Angela

From: Buford, Angela
Sent: Wednesday, February 06, 2013 1:56 PM
To: Cook, William; Raymond, William
Cc: Trapp, James; Conte, Richard; Floyd, Niklas
Subject: RE: Some food for thought - see attached DRAFT

Bill, Sorry for the late response – Just getting through my emails from last week and being out the beginning of this week.

I had the same comment regarding item #4, and agree with adding verbiage along the lines as what is stated below, but I'd like to discuss whether we should be asking up front for a plan for the licensee to "baseline" the current condition of structures/ASR severity prior to CCI or monitoring efforts, and prior to completion of testing in Texas. Regardless of the anticipated conclusions/results of the testing, the SMP should include provisions to understand the relationship between the visual survey and the ASR beneath the surface.

If you have time, give me a call to discuss.

From: Cook, William
Sent: Friday, February 01, 2013 9:15 AM
To: Raymond, William
Cc: Trapp, James; Conte, Richard; Buford, Angela; Floyd, Niklas; Cook, William
Subject: RE: Some food for thought - see attached DRAFT

If it works for you, no problem for me.

Jim and I talked this morning and item #4 may need to be revised. Specifically, we (the team and ASR Working Group) may be able to accept a revision to the SMP for CAL item closure (Revision 3, as we outlined with NextEra last week), but accept it with a stated (documented in the report) understanding that the SMP may be revised after the testing is completed, that validates the structural performance and the adequacy of the CCI methodology for non-destructive monitoring, and/or as a result of the license renewal process.

Bill

From: Raymond, William
Sent: Friday, February 01, 2013 7:54 AM
To: Cook, William; Conte, Richard; Trapp, James; Buford, Angela; Floyd, Niklas
Subject: RE: Some food for thought - see attached DRAFT

Bill
This is very well stated. I endorse each point.
Can I quote you in the 5059 paper?
Bill

From: Cook, William
Sent: Thursday, January 31, 2013 5:53 PM
To: Conte, Richard; Raymond, William; Trapp, James; Buford, Angela; Floyd, Niklas
Subject: Some food for thought - see attached DRAFT

C46

William A. Cook
Senior Reactor Analyst,
USNRC, Region I

(610) 337-5074 (work)
(b)(6) (cell)

Thomas, George

From: Thomas, George
Sent: Thursday, February 07, 2013 2:54 PM
To: Khanna, Meena
Subject: RE: Seabrook ASR and 10 CFR 50.55a

Meena,
Just for completeness and since Rich seems to be confused about relief requests, I added a sentence shown in red font below for your use.
Thanks.
George

From: Khanna, Meena
Sent: Thursday, February 07, 2013 1:18 PM
To: Thomas, George
Cc: Lamb, John; Manoly, Kamal; Murphy, Martin; McMurtray, Anthony
Subject: RE: Seabrook ASR and 10 CFR 50.55a

Great, thanks George, this is helpful, thanks again!

From: Thomas, George
Sent: Thursday, February 07, 2013 9:58 AM
To: Khanna, Meena
Cc: Lamb, John; Manoly, Kamal; Murphy, Martin; McMurtray, Anthony
Subject: RE: Seabrook ASR and 10 CFR 50.55a

Meena,

(b)(5)

C47

If you have any further questions, please call.
Thanks.
George

From: Khanna, Meena
Sent: Wednesday, February 06, 2013 6:15 PM
To: Thomas, George
Cc: Lamb, John; Manoly, Kamal; Murphy, Martin
Subject: Seabrook ASR and 10 CFR 50.55a

George,
I have an action item to get back to Region 1 regarding whether 10 CFR 50.55a applies to Seabrook with respect to the ASR issue. Could we pls meet for a few mins, when you have some time, to discuss, please.

Thanks,

Meena Khanna, Branch Chief
LPL 1-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation
(301)415-2150
meena.khanna@nrc.gov

Buford, Angela

From: Buford, Angela
Sent: Tuesday, February 12, 2013 8:44 AM
To: Erickson, Alice; Sheikh, Abdul; Thomas, George
Cc: Marshall, Michael
Subject: FYI: Photos of cracking in transverse direction FW: Upload to CERTREC

FYI: Licensee at Seabrook has posted photos of the transverse cracking on beam test specimens on Certrec.

If you are interested in viewing and are unable, let me know.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, February 11, 2013 3:08 PM
To: Conte, Richard; Raymond, William; Cook, William; Floyd, Niklas; Buford, Angela; Chaudhary, Suresh
Cc: Noble, Rick; Brown, Brian; Vassallo, Theodore; OKeefe, Michael
Subject: Upload to CERTREC

Photos of the UT Test Specimens have been uploaded to CERTREC

Note that there are two files: Specimen AN 01 and Specimen AN 04.

As they are large files (multiple photos each), they take a while to open, so please be patient.

Paul

[illegible]
(b)(6)
[illegible]
paul.willoughby@nexteraenergy.com

C48

Thomas, George

From: Thomas, George (b)(6)
Sent: Wednesday, February 13, 2013 3:14 PM
To: McMurtray, Anthony
Subject: RE: Update of 1-pagers in preparation for the RIC 2013
Attachments: Alkali Silica Reaction (ASR) in Concrete_RIC2013.docx

Tony,

Attached is the final updated one-pager for the Seabrook ASR issue. This was coordinated with Region 1 (Conte) and NRR/DLR (Marshall) and incorporates their input and comments. Please review and if you are OK forward to Carla. This is due to Carla by 2/15 (Friday).
Thanks.

George

From: Murphy, Martin (b)(6)
Sent: Tuesday, January 22, 2013 1:21 PM
To: Thomas, George; Li, Yong; Hoang, Dan
Cc: Roque-Cruz, Carla
Subject: FW: Update of 1-pagers in preparation for the RIC 2013

Outside of Scope

out of scope

George – work with Region I and DLR to make sure the ASR 1-pager is up to date and that there is a single 1 pager to be used by all offices

Outside of Scope

See below for due dates.

Marty

Outside of Scope

out of scope

C49

Outside of Scope

Outside of Scope

Seabrook - Alkali Silica Reaction in Concrete

February 2013

Goals:

With an operability review of ASR-affected concrete structures satisfactorily completed, NRC staff continues efforts to complete the technical review of alkali silica reaction (ASR) concrete degradation issues identified at Seabrook Station and incorporate insights into the need for a license amendment review. And, close the ASR open item identified during the Seabrook license renewal application review.

Status:

Reactor Oversight

- NextEra (the licensee) continues with detailed large-scale testing, crack monitoring and evaluations to comprehensively address and manage the Seabrook ASR-issue in the long-term.
- NextEra's completion of CAL commitments were documented in letters dated May 25, 31, June 8, 21, 28, 2012.
- The CAL follow-up inspection began June 18, 2012, and was completed in December 2012 NRC Inspection Report No. 050004432012009 and it was accompanied by a meeting with the public on the ASR issue on December 11, 2012.
- In response to a NextEra request, dated December 13, 2012 to change two CAL items: 1) delete No. 7 to do a prism test as being unnecessary; and, 2) change CAL item No.11 related to anchor testing at the research and development facility, the NRC in a letter dated January 14, 2013 accepted the changes. The licensee now commits to submit technical details on the anchor test program by February 28, 2013.
- The NRC staff is currently conducting a second CAL followup inspection to verify actions related to the Structures Monitoring Program and the testing of specimens to reconcile the ASR issue with the design and licensing basis along with open issues identified in the first CAL followup report.
- The NRC's review of this issue to date has determined that there are no immediate safety concerns due, in part, to existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review includes a review of the NextEra's operabilitiy determinations for various structures affected by ASR and the results of the staff's review was documented in the above noted NRC inspection report.

License Renewal Application (LRA): (accepted for review June 2010)

- The discovery of ASR concrete degradation at Seabrook Station is a concern for the ongoing license renewal review because the aging effects of ASR on the affected structures may be different in character and/or magnitude after the term of the current operating license, and the staff has questions about the adequacy of proposed actions to manage the aging effects during the period of extended operation.

- On May 31, 2012, the NRC staff sent a letter to inform NextEra (the applicant) that the review schedule for the Seabrook LRA was being changed. The last two public milestones (i.e., issuance of final SER and ACRS full committee meeting) have been changed to TBD.
- To date, after three rounds of RAI and responses, the applicant has not provided a sufficient technical basis to support the adequacy of the proposed actions to manage the aging effects of ASR.
- A public meeting is planned for late February 2013 for the NRR/DLR staff and the applicant to discuss and develop a shared understanding of the specific aging effects that need to be managed and the information that needs to be provided to support the applicant's proposed plant-specific, first-of-kind ASR aging management program.

Background/Additional Information:

- ASR is a slow chemical process that can occur over time in hardened concrete and adversely impact the mechanical properties of concrete and has the potential to affect structural performance. The reaction requires reactive aggregate, high alkali content in cement, and adequate moisture to form a gel that expands and results in a network of microcracks.
- In August 2010, during a license renewal assessment, Seabrook reported the presence of ASR degradation of concrete in below-grade walls of several Category 1 structures with groundwater intrusion. Seabrook is the first plant to report ASR degradation in the U.S. nuclear power industry. Initial testing of core samples indicated a reduction in compressive strength and elastic modulus properties.
- Seabrook continued with detailed testing, crack monitoring and evaluations to comprehensively address and manage the issue in the short- and long-term. Following the public meeting with NextEra on April 23, 2012, the NRC staff issued a confirmatory action letter (CAL No. 1-2012-002) to NextEra on May 16th to confirm licensee commitments to address the issue. These actions were focused on assuring operability of the structures pending a review a formal root cause analysis, short-and long- term monitoring action while research and development occurred in order to address a final operability determination and corrective actions.

Buford, Angela

From: Buford, Angela
Sent: Tuesday, February 19, 2013 10:10 AM
To: Conte, Richard; Cook, William
Cc: Trapp, James
Subject: RE: No Testing in Texas until March

Rich and Bill,

I'd like to stay posted on testing plans. I have some questions with regards to the anchor testing program and its potential applicability to part 50 and 54 structures monitoring programs. I also would like to have a better understanding of how the licensee plans to monitor structures for anchorage integrity. We need to try to have one voice with regards to management of anchors for part 50 and 54 structures monitoring programs.

I won't be going on next week's inspection because I am working on another inspection activity in region II, but I plan on attending in March.

From: Conte, Richard
Sent: Tuesday, February 19, 2013 8:06 AM
To: Cook, William
Cc: Buford, Angela; Chaudhary, Suresh; Trapp, James; Raymond, William; Floyd, Niklas
Subject: No Testing in Texas until March

I just heard from Ted Vassalo that the upcoming two weeks are clear for anchor testing at FSEL in Austin.

They are preoccupied with meeting this week in Headquarters. Next week (2/25) they are ready to receive you Bill for the monthly inspection.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) [redacted] (NRC cell)

C50

Thomas, George

From: Thomas, George
Sent: Monday, February 25, 2013 12:11 PM
To: Conte, Richard
Subject: FW: Input on Concrete Degradation for the 2013 U. S. National Report for the Convention on Nuclear Safety
Attachments: ASR Concrete Degradation at Seabrook for 2013 CNS Report.doc

Rich – do you have any comments on this?
Thanks.
George

Outside of Scope

C51

Outside of Scope

Tony

Alkali-Silica Reaction Concrete Degradation at Seabrook Station

Alkali-Silica Reaction (ASR) is a slow chemical process that could occur over time in hardened concrete. For ASR to occur, it is necessary for the concrete to have reactive aggregate, high alkali content in cement, and adequate moisture to form a gel. The gel expands by absorbing water resulting in a network of micro-cracks in concrete. Depending on the severity, ASR can reduce/affect mechanical properties of concrete (compressive, tensile, shear, and bond strengths, elastic modulus, poisson ratio) used in design to different extents, and could also affect empirical code relationships between mechanical properties in the ACI design/construction codes. ASR could potentially affect structural performance over time.

In August 2010, during an assessment for license renewal, the licensee (NextEra) of Seabrook Station reported the presence of ASR-degradation of concrete in below-grade walls of several Category 1 structures with groundwater intrusion. Seabrook is the first plant to report ASR degradation in the US nuclear power industry. Initial testing of core samples by the licensee indicated reduction in compressive strength and elastic modulus properties from that at construction consistent with published literature. The licensee's root cause analysis determined that, along with other causal factors, ASR developed in the concrete used at Seabrook Station primarily because the concrete mix design unknowingly utilized an aggregate that was susceptible and slow-reacting. The potential reactivity of this aggregate was undetected by the testing specified by ASTM construction standards (e.g. C227, C289), at the time of construction (late 1970s). Since this time, the role of slow-reacting aggregate in ASR has been identified in the construction industry and improved standard tests (such as ASTM C1260, C1293, etc.) are now available to ensure slow reactive aggregates could be better identified prior to use in construction.

The NRC is actively engaged in overseeing and reviewing the first-of-a-kind ASR concrete degradation issue at Seabrook currently under two regulatory processes: (i) Reactor Oversight Process under 10 CFR Part 50, and (ii) License Renewal Application Review under 10 CFR Part 54. The oversight/reviews are focused on ensuring that the ASR issue at Seabrook are comprehensively addressed and managed such that there is reasonable assurance that affected structures will continue to perform their intended safety functions through its service life. The current status of NRC activities under the two regulatory processes is summarized below.

Reactor Oversight: Seabrook Station continued with detailed testing, walkdowns, crack monitoring and evaluations to comprehensively address and manage the issue in the short- and long-term. Following the public meeting with NextEra (the licensee) on April 23, 2012, the NRC staff issued a confirmatory action letter (CAL) No. 1-2012-002 dated May 16, 2012 (ADAMS Accession No. ML12125A172), which was revised on December 13, 2012 (ADAMS Accession No. ML12362A323), to NextEra to confirm licensee commitments to address this issue. These actions were focused on assuring operability of the structures pending a review of a formal root cause analysis, short-and long- term monitoring actions while research and development, which include large-scale testing in the structural context, occurred in order to address long-term structural performance, a final operability determination and corrective actions.

NextEra's completion and/or revisions of CAL commitments were documented in letters dated May 25, and 31, June 8, 21, and 28, and December 13, 2012. The NRC follow-up inspection of the CAL began June 18, 2012, and was documented in the December 3, 2012 NRC Inspection Report No. 050004432012009 (ADAMS Accession No. ML112241029). On December 11, 2012, a public meeting was held near the site on the ASR issue and NRC inspection results. The NRC staff is currently conducting a second CAL followup inspection to verify actions related to the Structures Monitoring Program and the proposed large-scale testing of beam specimens to reconcile the ASR issue with the design and licensing basis. Also, open issues identified in the first CAL followup report are being reviewed.

The NRC's review of this issue to date (February 2013) has determined that there are no immediate safety concerns based on existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review has included an evaluation of NextEra's operability determinations for various structures affected by ASR. The results of the staff's review was documented in the December 2012 NRC inspection report, noted above. The NRC staff continues efforts to complete the technical review of ASR concrete degradation issues identified at Seabrook Station and incorporate insights into the need for a license amendment review.

License Renewal Application: The discovery of ASR concrete degradation at Seabrook Station is a concern for the ongoing license renewal application (LRA) review (accepted for review in June 2010) because the aging effects of ASR on the affected structures may be different in character and/or magnitude after the term of the current operating license. The NRC staff has questions about the adequacy of proposed actions to manage the aging effects during the period of extended operation. On May 31, 2012, the NRC staff sent a letter to inform NextEra that the review schedule for the Seabrook LRA was being changed. The last two public milestones (i.e., issuance of final SER and ACRS full committee meeting) have been changed to TBD.

To date, after three rounds of requests for additional information (RAIs) and responses, the applicant has not provided a sufficient technical basis to support the adequacy of the proposed actions to manage the aging effects of ASR. A public meeting is planned for February 21, 2013 for the NRC staff and NextEra to discuss and develop a shared understanding of the specific ASR-related aging effects that need to be managed and the information that needs to be provided to support adequacy of the applicant's proposed plant-specific, first-of-kind ASR aging management program.

The NRC has engaged and will continue engaging external stakeholders and public participation in addressing the ASR issue at Seabrook Station through public meetings and written communications under the reactor oversight and license renewal processes. On November 18, 2011, the NRC issued information notice (IN) 2011-20 "Concrete Degradation by Alkali-Silica Reaction" (ADAMS Accession No. ML112241029) to inform holders of US operating reactor licenses of the occurrence of ASR-induced concrete degradation of seismic Category 1 structures at Seabrook Station.

Thomas, George

From: Marshall, Michael NRR
Sent: Monday, February 25, 2013 2:45 PM
To: Thomas, George
Subject: RE: Input on Concrete Degradation for the 2013 U. S. National Report for the Convention on Nuclear Safety
Attachments: ASR Concrete Degradation at Seabrook for 2013 CNS Report (RASB Comments).doc

Hello George,

Please, see attached edits.

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

Outside of Scope

C52

Outside of Scope

Outside of Scope

Alkali-Silica Reaction Concrete Degradation at Seabrook Station

Alkali-Silica Reaction (ASR) is a slow chemical process that could occur over time in hardened concrete. For ASR to occur, it is necessary for the concrete to have reactive aggregate, high alkali content in cement, and adequate moisture to form a gel. The gel expands by absorbing water resulting in a network of micro-cracks in concrete. Depending on the severity, ASR can reduce/affect mechanical properties of concrete (compressive, tensile, shear, and bond strengths, elastic modulus, poisson ratio) used in design to different extents, and could also affect empirical code relationships between mechanical properties in the ACI design/construction codes. ASR could potentially affect structural performance over time.

In August 2010, during an assessment for license renewal, the licensee (NextEra) of Seabrook Station reported the presence of ASR-degradation of concrete in below-grade walls of several Category 1 structures with groundwater intrusion. Seabrook is the first plant to report ASR degradation in the US nuclear power industry. Initial testing of core samples by the licensee indicated reduction in compressive strength and elastic modulus properties from that at construction consistent with published literature. The licensee's root cause analysis determined that, along with other causal factors, ASR developed in the concrete used at Seabrook Station primarily because the concrete mix design unknowingly utilized an aggregate that was susceptible and slow-reacting. The potential reactivity of this aggregate was undetected by the testing specified by ASTM construction standards (e.g. C227, C289), at the time of construction (late 1970s). Since this time, the role of slow-reacting aggregate in ASR has been identified in the construction industry and improved standard tests (such as ASTM C1260, C1293, etc.) are now available to ensure slow reactive aggregates could be better identified prior to use in construction.

The NRC is actively engaged in overseeing and reviewing the first-of-a-kind ASR concrete degradation issue at Seabrook currently under two regulatory processes: (i) Reactor Oversight Process under 10 CFR Part 50, and (ii) License Renewal Application Review under 10 CFR Part 54. The oversight/reviews are focused on ensuring that the ASR issue at Seabrook are comprehensively addressed and managed such that there is reasonable assurance that affected structures will continue to perform their intended safety functions through its service life. The current status of NRC activities under the two regulatory processes is summarized below.

Reactor Oversight: Seabrook Station continued with detailed testing, walkdowns, crack monitoring and evaluations to comprehensively address and manage the issue in the short- and long-term. Following the public meeting with NextEra (the licensee) on April 23, 2012, the NRC staff issued a confirmatory action letter (CAL) No. 1-2012-002 dated May 16, 2012 (ADAMS Accession No. ML12125A172), which was revised on December 13, 2012 (ADAMS Accession No. ML12362A323), to NextEra to confirm licensee commitments to address this issue. These actions were focused on assuring operability of the structures pending a review of a formal root cause analysis, short-and long- term monitoring actions while research and development, which include large-scale testing in the structural context, occurred in order to address long-term structural performance, a final operability determination and corrective actions.

NextEra's completion and/or revisions of CAL commitments were documented in letters dated May 25, and 31, June 8, 21, and 28, and December 13, 2012. The NRC follow-up inspection of the CAL began June 18, 2012, and was documented in the December 3, 2012 NRC Inspection Report No. 050004432012009 (ADAMS Accession No. ML112241029). On December 11, 2012, a public meeting was held near the site on the ASR issue and NRC inspection results. The NRC staff is currently conducting a second CAL followup inspection to verify actions related to the Structures Monitoring Program and the proposed large-scale testing of beam specimens to reconcile the ASR issue with the design and licensing basis. Also, open issues identified in the first CAL followup report are being reviewed.

The NRC's review of this issue to date (February 2013) has determined that there are no immediate safety concerns based on existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review has included an evaluation of NextEra's operability determinations for various structures affected by ASR. The results of the staff's review was documented in the December 2012 NRC inspection report, noted above. The NRC staff continues efforts to complete the technical review of ASR concrete degradation issues identified at Seabrook Station and incorporate insights into the need for a license amendment review.

License Renewal Application: The discovery of ASR concrete degradation at Seabrook Station is a concern for the ongoing license renewal application (LRA) review (accepted for review in June 2010) because the aging effects of ASR on the affected structures may be different in character and/or magnitude after the term of the current operating license. The NRC staff has questions about the adequacy of proposed actions to manage the aging effects during the period of extended operation. Specifically, the applicant needs to enhance the information in the applicantion on the technical basis for the adequacy of the applicant's proposed plant-specific, first-of-kind ASR aging management program.

The NRC has engaged and will continue engaging external stakeholders and public participation in addressing the ASR issue at Seabrook Station through public meetings and written communications under the reactor oversight and license renewal processes. On November 18, 2011, the NRC issued information notice (IN) 2011-20 "Concrete Degradation by Alkali-Silica Reaction" (ADAMS Accession No. ML112241029) to inform holders of US operating reactor licenses of the occurrence of ASR-induced concrete degradation of seismic Category 1 structures at Seabrook Station.

OUT-OF-SCOPE

Thomas, George

From: Thomas, George
Sent: Friday, March 01, 2013 12:34 PM
To: McMurtray, Anthony
Subject: RE: Input on Concrete Degradation for the 2013 U. S. National Report for the Convention on Nuclear Safety
Attachments: ASR Concrete Degradation at Seabrook for 2013 CNS Report Final 3-1-13.doc

Tony,
Here is the final version. Thanks.
George

Outside of Scope

C53

OUT - OF - SCOPE

Outside of Scope

OUT-OF-SCOPE

Outside of Scope

OUT - OF - SCOPE

Outside of Scope

Alkali-Silica Reaction Concrete Degradation at Seabrook Station

Alkali-Silica Reaction (ASR) is a slow chemical process that can occur over time in hardened concrete. For ASR to occur, it is necessary for the concrete to have reactive aggregate, high alkali content in the cement, and adequate moisture to form a gel. The gel expands by absorbing water resulting initially in a network of micro-cracks in concrete. Depending on the progression and severity, ASR can reduce/affect mechanical properties of concrete (i.e., compressive, tensile, shear, and bond strengths, elastic modulus, and the poisson ratio) used in design to different extents, and could also affect empirical code relationships between mechanical properties in the American Concrete Institute (ACI) design/construction codes. ASR can potentially affect structural performance over time.

In August 2010, during an assessment for license renewal by the Seabrook Station (Seabrook) in Seabrook, New Hampshire, NextEra Energy (the licensee) identified the presence of ASR-degradation of concrete in below-grade walls of several safety-related structures with groundwater intrusion. Seabrook is the first nuclear plant in the US nuclear power industry to identify ASR degradation. Initial testing of core samples by the licensee indicated a reduction in compressive strength and elastic modulus properties from the properties that existed at the time of construction. The licensee's root cause analysis determined that, along with other causal factors, ASR developed in the concrete used at Seabrook primarily because the concrete mix design unknowingly utilized an aggregate that was susceptible and slow-reacting. The potential reactivity of this aggregate was undetected by the testing specified by the applicable American Society for Testing and Materials (ASTM) construction standards (e.g. C227, C289), at the time of construction in the late 1970s. Since this time, the role of slow-reacting aggregate in ASR has been identified in the construction industry and improved standard tests (such as ASTM C1260, C1293, etc.) are now available to ensure slow reactive aggregates can be better identified prior to use in construction.

Seabrook has continued with detailed testing, walkdowns, crack monitoring and evaluations to comprehensively address and manage the issue in the short-term and the long-term. On May 16, 2012, the NRC staff issued a letter to NextEra Energy to confirm licensee commitments to comprehensively address this issue. These actions were focused on assuring operability of the affected structures pending a review of a formal root cause analysis and short-term and long-term monitoring actions while plant-specific ASR research and development occurred. The research and development includes large-scale testing, in the structural context, of specimens with different levels of ASR and conservatively enveloping Seabrook conditions. The results of the research and development will be used to address long-term effects on structural performance and management of the issue, and to provide the technical basis for the final operability determination and corrective actions (if required).

The discovery of ASR concrete degradation at Seabrook is a concern for the ongoing license renewal application review under Title 10 of the Code of Federal Regulations (10 CFR) Part 54 because the aging effects of ASR on the affected structures may be different in character and/or magnitude after the term of the current operating license. The NRC staff has questions about the adequacy of proposed actions to manage the aging effects during the period of extended operation. Specifically, NextEra Energy needs to enhance the information in their license renewal application on the technical basis for the adequacy of the proposed plant-specific, first-of-kind ASR aging management program.

The NRC staff's oversight reviews under 10 CFR Part 50 are focused on ensuring that the ASR issue at Seabrook is comprehensively addressed and managed such that there is reasonable assurance that the affected structures will continue to perform their intended safety functions through the expected service life. The staff has performed detailed inspections to verify and assess the adequacy of NextEra Energy's interim operability basis and actions and commitments to address the impact of ASR on reinforced concrete structures at Seabrook. The staff continues to review NextEra's proposed large-scale testing and other activities to address the uncertainties in evaluating the current level and progression of ASR on Seabrook reinforced concrete structures through follow-up inspections. These follow-up inspections will verify adequacy of actions related to the ASR-specific Structures Monitoring Program for long term management of the issue, and the proposed large-scale testing of beam specimens to reconcile the ASR issue with the design and licensing basis.

The NRC has also engaged with external stakeholders and the public while addressing the ASR issue at Seabrook through public meetings and written communications under the reactor oversight and license renewal processes. On November 18, 2011, the NRC issued Information Notice 2011-20 "Concrete Degradation by Alkali-Silica Reaction" to inform holders of US operating reactor licenses of the occurrence of ASR-induced concrete degradation of safety-related structures at Seabrook.

The NRC's oversight review of this issue to date (February 2013) has determined that there are no immediate safety concerns based on existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review has included an evaluation of NextEra's prompt operability determinations for various structures affected by ASR. The results of the NRC staff's review are documented in a December 2012 NRC inspection report for Seabrook.

Marshall, Michael

From: Lubinski, John
Sent: Friday, March 01, 2013 10:51 AM
To: Leeds, Eric
Cc: Marshall, Michael; Galloway, Melanie; Uhle, Jennifer; Dorman, Dan
Subject: RE: Direct Report's Meeting Feedback

Eric,

In response to the DEDR question about another IN on ASR, we will consider another IN once we receive feedback about the Univ of Texas testing that is being done to support Seabrook. The following impacts the timing:

- NextEra's original test schedule was very optimistic and they have already incurred and accounted for multi-month delay. So, the information for an IN may not be available until CY2014.

- There are two distinctly different parts to the NextEra sponsored tests at the University of Texas - (1) Beam tests, which are longer term (i.e., complete later this year or next year) and directed at ASR impact on structures and (2) anchor test, which are shorter term (i.e., complete this year) and directed on ASR impact on anchorage. The beam test would be of most interest.

- Although the test methods/approach being used are sound (i.e., using well established methods), the NRC still has questions whether (1) the test specimens being used are appropriate, which depends somewhat on use of the results and (2) seemingly small number of tests being conducted.

- In addition to the completion of the test program next year, NextEra should have multiply inspections of number of ASR affected areas and may have visual insights into progression. At that point in time is may be about two years of data collected every six month. This additional information might be worth sharing in an IN.

Let us know if you need additional information.
John

From: Leeds, Eric
Sent: Tuesday, February 26, 2013 12:47 PM
To: Abraham, Susan; Bahadur, Sher; Cheok, Michael; Davis, Jack; Evans, Michele; Galloway, Melanie; Giitter, Joseph; Hiland, Patrick; Howe, Allen; Kokajko, Lawrence; Lee, Samson; Lubinski, John; Lund, Louise; McGinty, Tim; Monninger, John; Muessle, Mary; Nieh, Ho; Skeen, David
Cc: Dorman, Dan; Uhle, Jennifer; Scales, Kerby; Wertz, Trent
Subject: Direct Report's Meeting Feedback

Outside of Scope

C54

Outside of Scope

DLR:

1. Is a Water Quality Permit required before Indian Point can get LR?
2. ASR at Seabrook: We should consider another IN once we receive feedback about the Univ of Texas testing.

Outside of Scope

Eric J. Leeds
Director, Office of Nuclear Reactor Regulation
U.S. Nuclear Regulaotry Commission
301-415-1270

Marshall, Michael

From:	Marshall, Michael
Sent:	Tuesday, March 05, 2013 9:28 AM
To:	Buford, Angela
Subject:	ACTION: NextEra Response to CAL No. 11 -
Attachments:	SBK-L-13027 CAL Response - Anchor Test Program 022813.pdf

Angie,

Please, send me a proposed response to Melanie's question (see email below).

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Galloway, Melanie
Sent: Tuesday, March 05, 2013 7:09 AM
To: Marshall, Michael
Subject: FW: NextEra Response to CAL No. 11 -

What is the summary message that this submittal boils down to—both in terms of what the applicant is saying and our response to it? thanks.

From: Conte, Richard
Sent: Monday, March 04, 2013 11:38 AM
To: Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; McMurtray, Anthony; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Cc: Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Trapp, James; Wilson, Peter; Dacus, Eugene; McNamara, Nancy; Screnci, Diane; Sheehan, Neil; Tifft, Doug; Dean, Bill; Lew, David; Holody, Daniel
Subject: NextEra Response to CAL No. 11 -

Here is the response to the CAL No. 11, submit technical details for the Anchor Test Program. They consider certain sections proprietary but they are promising a more complete package by March 15. We will need to consult if a FOIA comes in right now.

In the interim, the inspection team and working group will need to further digest. There is a working group meeting scheduled for March 13, 2013.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, March 04, 2013 10:26 AM
To: Conte, Richard

C55

Cc: Noble, Rick; Brown, Brian; Vassallo, Theodore
Subject: RE: You Guys Working Today?

see attached...proprietary version uploaded to CERTREC as well as proprietary version of Overview

From: Conte, Richard [mailto:Richard.Conte@nrc.gov]
Sent: Friday, March 01, 2013 4:41 PM
To: Willoughby, Paul
Cc: Noble, Rick; OKeefe, Michael
Subject: You Guys Working Today?

Is the response out yet on the CAL No.11 item due 2/28/13. Can I get a heads up pdf.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) NRC cell)

Marshall, Michael

From: Buford, Angela
Sent: Friday, March 08, 2013 4:02 PM
To: Marshall, Michael
Subject: RE: ACTION: NextEra Response to CAL No. 11 -

<<What is the summary message that this submittal boils down to—both in terms of what the applicant is saying and our response to it>>

1. This submittal was sent by NextEra as a response to item number 11 of the Confirmatory Action Letter, which was revised earlier in 2013 to allow the licensee to submit the technical details of its anchor testing program; the CAL previously stated that NextEra must complete the anchor testing by December 2012. This submittal contains the technical details (test methodology, number of samples, concrete mix, how the results will be reported, etc.) of the anchor testing. The testing program will not be completed (results-in-hand) until possibly 2014.

2. Recall that there are two test campaigns being conducted. One is "beam testing" for shear and lap splice, the other is "anchor testing" for testing of concrete anchors. NextEra provided a similar submittal of technical details for the beam testing.

3. The NRC will respond to this submittal in its Region I inspection report with a review and assessment of the test details and methodology and provide observations as necessary, similar to its review of the other CAL responses.

4. For license renewal staff, this submittal is For Information Only, as the licensee has stated that it will not be using the testing to inform its aging management program and this report has not been submitted as docketed LR correspondence or information.

From: Marshall, Michael
Sent: Tuesday, March 05, 2013 9:28 AM
To: Buford, Angela
Subject: ACTION: NextEra Response to CAL No. 11 -

Angie,

Please, send me a proposed response to Melanie's question (see email below).

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

> **From:** Galloway, Melanie
> **Sent:** Tuesday, March 05, 2013 7:09 AM
> **To:** Marshall, Michael
> **Subject:** FW: NextEra Response to CAL No. 11 -

C56

What is the summary message that this submittal boils down to—both in terms of what the applicant is saying and our response to it? thanks.

From: Conte, Richard
Sent: Monday, March 04, 2013 11:38 AM
To: Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; McMurtray, Anthony; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Cc: Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Trapp, James; Wilson, Peter; Dacus, Eugene; McNamara, Nancy; Screnci, Diane; Sheehan, Neil; Tifft, Doug; Dean, Bill; Lew, David; Holody, Daniel
Subject: NextEra Response to CAL No. 11 -

Here is the response to the CAL No. 11, submit technical details for the Anchor Test Program. They consider certain sections proprietary but they are promising a more complete package by March 15. We will need to consult if a FOIA comes in right now.

In the interim, the inspection team and working group will need to further digest. There is a working group meeting scheduled for March 13, 2013.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, March 04, 2013 10:26 AM
To: Conte, Richard
Cc: Noble, Rick; Brown, Brian; Vassallo, Theodore
Subject: RE: You Guys Working Today?

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Sent: Friday, March 01, 2013 4:41 PM
To: Willoughby, Paul
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Subject: You Guys Working Today?

Is the response out yet on the CAL No.11 item due 2/28/13. Can I get a heads up pdf.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Marshall, Michael

From: Marshall, Michael
Sent: Wednesday, March 13, 2013 1:06 PM
To: Galloway, Melanie
Subject: RE: NextEra Response to CAL No. 11 -

Hello Melanie,

The "Specification for Strength Testing of Attachments in ASR-Affected Concrete" report submitted by NextEra is in response to the confirmatory action letter issued by Region 1. Specifically, the report is in response to item number 11 of the confirmatory action letter, which was revised earlier in 2013 to allow the licensee to submit the technical details of its anchor testing program. Previously, confirmatory action letter item number 11 stated that NextEra would complete the anchor testing by December 2012. This submittal contains the technical details (test methodology, number of samples, concrete mix, how the results will be reported, etc.) of the anchor testing. The testing program will not be completed (results-in-hand) until possibly 2014. This is one of two different types of tests being conducted. The other type is "beam testing" for shear and lap splice.

Basically, this report describes, in part, how the applicant plans to confirm the adequacy of its interim operability report and verify the plant is still within its current licensing basis. The NRC will respond to this submittal during ongoing inspection activities (incl., review and assessment of the test details and methodology, provide observations) similar to our review of the other confirmatory action letter responses. DLR will continue to support the Region's review of completed confirmatory action letter items. As with the other completed confirmatory action letter items, the closeout of this item will be documented in an inspection report issued by Region 1.

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Galloway, Melanie
Sent: Tuesday, March 05, 2013 7:09 AM
To: Marshall, Michael
Subject: FW: NextEra Response to CAL No. 11 -

What is the summary message that this submittal boils down to—both in terms of what the applicant is saying and our response to it? thanks.

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To: Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; McMurtray, Anthony; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Ott, William; Philip, Jacob; Raymond, William; Schroeder, Daniel; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Cc: Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Trapp, James; Wilson, Peter; Dacus, Eugene; McNamara, Nancy; Screnci, Diane; Sheehan, Neil; Tifft, Doug; Dean, Bill; Lew,

C57

David; Holody, Daniel
Subject: NextEra Response to CAL No. 11 -

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In the interim, the inspection team and working group will need to further digest. There is a working group meeting scheduled for March 13, 2013.

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Sent: Monday, March 04, 2013 10:26 AM
To: Conte, Richard
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Sent: Friday, March 01, 2013 4:41 PM
To: Willoughby, Paul
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Subject: You Guys Working Today?

Is the response out yet on the CAL No.11 item due 2/28/13. Can I get a heads up pdf.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) [redacted] (NRC cell)

From: Conte, Richard
To: Dean, Bill; Case, Michael; Cheok, Michael; Clifford, James; Correia, Richard; Delligatti, Mark; Evans, Michele; Galloway, Melanie; Hiland, Patrick; Lubinski, John; Lund, Louise; Miller, Chris; Nieh, Ho; Roberts, Darrell; Thomas, Brian; Lew, David
Cc: Buford, Angela; Cartwright, William; Chaudhary, Suresh; Cline, Leonard; Cook, William; Cruz, Holly; Dentel, Glenn; Erickson, Alice; Floyd, Niklas; Fuhrmann, Mark; Graves, Herman; Hogan, Rosemary; Hughey, John; Khanna, Meena; Kobetz, Timothy; Lamb, John; Manoly, Kamal; Marshall, Michael; McMurtray, Anthony; Merzke, Daniel; Milano, Patrick; Morey, Dennis; Ott, William; Philip, Jacob; Raymond, William; Sheikh, Abdul; Sircar, Madhumita; Stuchell, Sheldon; Thomas, George; Trapp, James
Subject: Short Brief on Seabrook ASR CAL status/issues
Date: Monday, March 18, 2013 2:05:59 PM
Attachments: ASR Brief of Regional Management 3-19-2013 FINAL.docx

Some executives from research wanted to listen in. We are distributing the brief in advance for reading or it could be viewed as a written status brief on CAL issues.

The time of the brief is Tuesday March 19 from 830 am to 900 am. The bridge information is as follows:

Conference Bridge Number: 1-800-369-3308 – Passcode (b)(6)

The working group is considering a separate brief for the Executives who oversee the project.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

C58

BRIEF OF REGIONAL MANAGEMENT
SEABROOK ASR PROJECT
TUESDAY MARCH 19, 2013

TIME: 0830 TO 0930
LOCATION: Region I Sequoia Conference Room
Conference Bridge Number: 1-800-369-3308 – Passcode (b)(6) [redacted] ex6

Purpose:

1. To provide an overview of the remaining technical issues associated with the Seabrook alkali-silica reaction (ASR) Project;

2. While summarizing actions by the NRC and NextEra to date, provide a reasonable projection on the closure of the project and future actions for agency.

Success:

Be able to respond to questions with straight forward answers and record any important information needed for further actions.

Agenda (see Attachment 1):

1. Closed issues

2. Remaining Open Issues

3. Next Steps and Schedule

4. Critique

Attachment 1 – Status of CAL Items and Other Issues

- ☐ CAL No. 1, Prompt Operability Determination for "B" Electrical Tunnel
- ☐ CAL No. 3, Interim Structural Assessment
- ☐ CAL No. 5, Prompt Operability Determination for Other Effected Structures
- ☐ CAL No. 6, Short Term (Mortar Bar) Expansion Test
- ☐ CAL No. 7, Long Term (Prism) Expansion Test – *Deleted*
  - Admin action to provide write-up in the next inspection report (IR 009, section 5.2)
- ☐ CAL No. 10, Initial Six-Month Crack Measurements

☐ **CAL No. 2, Root Cause Evaluation, revision needed to address organizational performance in addition to construction testing shortcomings**

Status: Revised RCA Complete – looks acceptable. Plan to submit by 4/30/2013.

- NextEra to consider explaining changes of the new revision in the submittal cover letter.

☐ **CAL No. 4, Integrated Corrective Action Plan, outdated and needs to reflect current actions including completion of extent of condition**

Status: Draft Complete. Plan to submit by 4/30/2013.

- Provide the Phase III walk-down schedule, separately (IR 009, Section 7.2) – *Complete*
- Consider Primary Containment Next Steps (IR 009, section 3.2.1) – *In Progress*
  - Three Options: (1) Take core samples, (2) Structural analysis using finite element analysis, (3) Use previous research data on triaxial reinforcement
- Consider adding action to plan "subject R&D test results to 50.59 review"

☐ **CAL No. 8, Submit technical details for R&D effort in Texas for Beam Testing Program**

Status: Plan to submit by 4/30/2013

- Waiting for the overarching document. NextEra is soliciting feedback from EPRI.
- Will also submit test specifications, similar to anchor program (redacted/un-redacted)

☐ **CAL No. 9, In-situ structures monitoring program, based on revision to SMP**

Status: Revised SMP to be provided on Certrec by 4/30/2013

- Review CCI and its physical significance for SMP application (IR 009, section 6.2).
- Provide/review latest round of CCI measurement for 6 months ending Dec. 2012 in 1-2 weeks from March 1, 2013.
- Need for additional rebar inspection (IR 009, section 3.2.9) or it may be covered by a commitment to ACI 349.3R.
- NextEra is still considering committing to ACI 349.3R. There could be a long lead on the SMP revision due to the technical details that need to be addressed. NextEra plans to notify NRC when available, but it will not be on the docket.

- *Preliminary discussion with NextEra indicate procedure will contain monitoring aspects:*
  - Tier II structural evaluation actions at inspection frequency of 2.5 years (131 areas noted in IR009, section 6.2).
  - Deep pins for in-situ monitoring of z-direction expansion
  - Water chemistry and groundwater monitoring program
  - Comparison of CCI level to petrography between the core bores from plant and core bores from test specimen (IR009, sections 3.2.2 and 6.2).

  If these aspects are appropriately included in the SMP, program would be appropriate until testing program is completed.

□ **CAL No. 11, Submit technical details for R&D effort in Texas for Anchor Testing Program**

Status: Redacted version on time (2/28/2013)

- Un-redacted version due 3/15 – 10 CFR 2.390
- Anchor Bolt testing will not begin until April/May timeframe due to slow developing ASR from cold weather

Other Related Issues

□ **Provide the structural evaluation calcs for areas of CCI 1.0 – 1.5 mm/m not specifically addressed in PODs. (IR009, section 3.2.1)**

Status: Expect by 3/31/13

- The ASR Team reviewed the status of NextEra's structural evaluations during the week of February 25th, which were being performed using the same methodology used by MPR in the Interim Assessment.

□ **Quantification of rebar pre-stresses (IR 009, section 3.2.8)**

Status: TBD

- Based on a conference call of Feb. 28, 2013 with vendor and consultants, NextEra plans to provide a brief written summary of how structural expansions correlate to CCI.
- Additional conference call may be necessary in April.
- The effects of prestressing in non-transversely reinforced concrete will be studied through the testing program.

□ **Confined vs. un-confined core testing**

Status: TBD

- NextEra will write a CR to address the feasibility of testing based on consultant input.
- Office of Research (NIST) is also reviewing the feasibility of results

□ **Update to the UFSAR (*NEW ISSUE, See Attachment 2*)**

Status: Due by 5/1/2013

- Based on Commission requested evaluation of May 2012, NextEra must update the FSAR "to identify that the site has ASR." They will need to be deliberate on the wording of the change on how the 50.59 screening will be applied.

- NextEra is considering how to approach the 50.71 submittal

- **Licensing Amendment Request, now or later (*NEW ISSUE*)**

  Status: TBD

  - Evaluation methods used to assess the impact of ASR (e.g. testing program at University of Texas) warrants a LAR. The timing is at the discretion of NextEra
  - NextEra to consider explicitly stating CCI as a methodology for showing structural performance in the LAR rather than indirectly via the testing program.
  - NextEra to consider what will resolve the OD for CNMT. NextEra will tentatively include in a LAR, separate from the LAR on testing methodology (IR009 section 8 and sections 3.2.3 to 3.2.7).
  - Details involving the LAR to be included in the Integrated Correction Action Plan (see CAL No. 4)

- **On-site Inspections at Seabrook**
  - Scheduled inspections: (1) Onsite during week of March 27th, (2) Late April, early May 2013, likely in Austin, Texas.
  - Next scheduled status call – 4/10/2013
  - Continue dialog on open issues and review of documents

- **Public Meetings**
  - Annual Assessment Meeting – 3/27/2013
  - ASR Status Meeting – July/August 2013

- **Testing at University of Texas**
  - Anchor Testing Program – Finished by end of 2014
    - Scheduled to begin April/May 2013
    - Possible team inspection/visit
  - Beam Testing Program – Finished by end of 2015

- **CAL Closure**
  - Anticipate to have report written by June/July 2013
  - Close the CAL to NextEra's testing program and the resulting LAR submittal

- **Deviation Memo Closure**
  - Close deviation after final public meeting

- **Task Force Status**
  - Review task force status after an approval is finalized by the Working Group recommendation to Division Executives. *Likely recommendation will be to throttle back level of effort, but maintain the task force.*
  - Need to determine accounting resources and guidance related to regulatory oversight of R&D effort in Texas after CAL is closed.

Attachment 2 – Regulatory Process Overview and Approach

1. The licensee has performed an operability determination and is currently tracking this issue as a degraded or noncomforming condition in accordance with their corrective action program. The U.S. Nuclear Regulatory Commission (NRC) staff's review of alkali-silica reaction (ASR) issue to date has determined that there are no immediate safety concerns due, in part, to existing safety margins, the localized nature of the ASR, and ongoing crack monitoring. In Inspection Report, dated December 3, 2012, "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 [NRC] 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."

2. Seabrook submitted evaluation/analysis in accordance with the Confirmatory Action Letter (CAL) on May 25, 2012.
   - 2.1. Evaluation of impact of ASR on Seabrook constitutes an analysis performed at NRC request.
   - 2.2. 10 CFR 50.71(e) requires the Final Safety Analysis Report (FSAR) to be updated with "...all analyses of new safety issues performed by or on behalf of the applicant or licensee at Commission request."
   - 2.3. The FSAR update must, "...assure that the information included in the report contains the latest information developed. This submittal shall contain all the changes necessary to reflect information and analyses submitted to the Commission by the ... licensee ..."

3. Therefore, NextEra is required to incorporate this information into the FSAR in accordance with 10 CFR 50.71(e)(4).
   - 3.1. Based on the May 25, 2012 submittal, this FSAR update must be submitted no later than November 17, 2013. Licensee is working on update and plans to submit in May 2013.
   - 3.2. The change to the FSAR must be evaluated in accordance with 10 CFR 50.59 to determine if NRC approval is required prior to incorporation into the FSAR update.

4. The 10 CFR 50.59 evaluation of the FSAR update may trigger a request for amendment pursuant to 10 CFR 50.90. This evaluation is made by the licensee and is subject to NRC review and /or inspection.
   - 4.1. Amendment process provides a strong regulatory framework to document NRC staff review of the licensee evaluation/analysis of ASR.
   - 4.2. Amendment process provides a structured opportunity for public involvement.
   - 4.3. An amendment could be structured to provide license conditions that track future milestones toward permanent resolution of the issue.

5. Licensee final disposition of the degraded/nonconforming condition will likely require additional changes to the facility as described in the FSAR after the large scale testing is completed in mid-2014. Once again, the licensee needs to perform a 10 CFR 50.59 evaluation and determine if an amendment request is needed pursuant to 10 CFR 50.90.

Note: The only potentially affected structure and activity, as a result of the ASR at Seabrook, that falls within the scope of 50.55a is the inservice inspection (ISI) of the ASME Class CC containment structure, in accordance with Section XI, IWE/IWL. This applicability of 50.55a exists regardless of whether there is ASR or not. None of the other structures at Seabrook (whether ASR-affected or not-affected) fall within the scope of 10 CFR 50.55a, and therefore 50.55a does not apply to these structures or address ASR on these structures. Therefore, 50.55a is not applicable to this issue at Seabrook.

OUTSIDE OF SCOPE

Thomas, George

From: Thomas, George
Sent: Monday, March 18, 2013 11:49 AM
To: McMurtray, Anthony
Subject: RE: Need another update: Convention on Nuclear Safety
Attachments: Concrete Structural Issues for 2013 CNS Report 3-18-13.doc; One page for RIC 2013 Shield Building Laminar Crack_DB_RIC2013 - with RIII comments acm rev.doc

Outside of Scope

C59

OUTSIDE OF SCOPE

Outside of Scope

OUTSIDE OF SCOPE

Outside of Scope

- Seabrook Alkali Silica reaction,

Outside of Scope

OUTSIDE OF SCOPE

Outside of Scope

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OUTSIDE OF SCOPE

Outside of Scope

Concrete Structural Issues

OUTSIDE OF SCOPE

Since 2009, there were several significant conditions adverse to quality that occurred or discovered in safety-related concrete structures of operating reactors in the US. These events or conditions included the following.

Outside of Scope

(c) Alkali-Silica Reaction (ASR) Concrete Degradation at Seabrook Station

Each of the above issues was or is being addressed by the respective licensee under its Corrective Action Program. A brief description of each of the above issues is provided below.

Outside of Scope

OUTSIDE OF SCOPE

OUTSIDE OF SCOPE

Outside of Scope

OUTSIDE OF SCOPE

Outside of Scope

Outside of Scope

OUTSIDE OF SCOPE

(c) Alkali-Silica Reaction Concrete Degradation at Seabrook Station

Alkali-Silica Reaction (ASR) is a slow chemical process that can occur over time in hardened concrete. For ASR to occur, it is necessary for the concrete to have reactive aggregate, high alkali content in the cement, and adequate moisture to form a gel. The gel expands by absorbing water resulting initially in a network of micro-cracks in concrete. Depending on the progression and severity, ASR can reduce/affect mechanical properties of concrete (i.e., compressive, tensile, shear, and bond strengths, elastic modulus, and the poisson ratio) used in design to different extents, and could also affect empirical code relationships between mechanical properties in the American Concrete Institute (ACI) design/construction codes. ASR can potentially affect structural performance over time.

In August 2010, during an assessment for license renewal by the Seabrook Station (Seabrook) in Seabrook, New Hampshire, NextEra Energy (the licensee) identified the presence of ASR-degradation of concrete in below-grade walls of several safety-related structures with groundwater intrusion. Seabrook is the first nuclear plant in the US nuclear power industry to identify ASR degradation. Initial testing of core samples by the licensee indicated a reduction in compressive strength and elastic modulus properties from the properties that existed at the time of construction. The licensee's root cause analysis determined that, along with other causal factors, ASR developed in the concrete used at Seabrook primarily because the concrete mix design unknowingly utilized an aggregate that was susceptible and slow-reacting. The potential reactivity of this aggregate was undetected by the testing specified by the applicable American Society for Testing and Materials (ASTM) construction standards (e.g. C227, C289), at the time of construction in the late 1970s. Since this time, the role of slow-reacting aggregate in ASR has been identified in the construction industry and improved standard tests (such as ASTM C1260, C1293, etc.) are now available to ensure slow reactive aggregates can be better identified prior to use in construction.

Seabrook has continued with detailed testing, walkdowns, crack monitoring and evaluations to comprehensively address and manage the issue in the short-term and the long-term. On May 16, 2012, the NRC staff issued a letter to NextEra Energy to confirm licensee commitments to comprehensively address this issue. These actions were focused on assuring operability of the affected structures pending a review of a formal root cause analysis and short-term and long-term monitoring actions while plant-specific ASR research and development occurred. The research and development includes large-scale testing, in the structural context, of specimens with different levels of ASR and conservatively enveloping Seabrook conditions. The results of the research and development will be used to address long-term effects on structural performance and management of the issue, and to provide the technical basis for the final operability determination and corrective actions (if required).

The discovery of ASR concrete degradation at Seabrook is a concern for the ongoing license renewal application review under Title 10 of the Code of Federal Regulations (10 CFR) Part 54 because the aging effects of ASR on the affected structures may be different in character and/or magnitude after the term of the current operating license. The NRC staff has questions about the adequacy of proposed actions to manage the aging effects during the period of extended operation. Specifically, NextEra Energy needs to enhance the information in their license renewal application on the technical basis for the adequacy of the proposed plant-specific, first-of-kind ASR aging management program.

The NRC staff's oversight reviews under 10 CFR Part 50 are focused on ensuring that the ASR issue at Seabrook is comprehensively addressed and managed such that there is reasonable assurance that the affected structures will continue to perform their intended safety functions through the expected service life. The staff has performed detailed inspections to verify and assess the adequacy of NextEra Energy's interim operability basis and actions and commitments to address the impact of ASR on reinforced concrete structures at Seabrook. The staff continues to review NextEra's proposed large-scale testing and other activities to address the uncertainties in evaluating the current level and progression of ASR on Seabrook reinforced concrete structures through follow-up inspections. These follow-up inspections will verify adequacy of actions related to the ASR-specific Structures Monitoring Program for long term management of the issue, and the proposed large-scale testing of beam specimens to reconcile the ASR issue with the design and licensing basis.

The NRC has also engaged with external stakeholders and the public while addressing the ASR issue at Seabrook through public meetings and written communications under the reactor oversight and license renewal processes. On November 18, 2011, the NRC issued Information Notice 2011-20 "Concrete Degradation by Alkali-Silica Reaction" to inform holders of US operating reactor licenses of the occurrence of ASR-induced concrete degradation of safety-related structures at Seabrook.

The NRC's oversight review of this issue to date (February 2013) has determined that there are no immediate safety concerns based on existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review has included an evaluation of NextEra's prompt operability determinations for various structures affected by ASR. The results of the NRC staff's review are documented in a December 2012 NRC inspection report for Seabrook.

OUTSIDE OF SCOPE

Outside of Scope

OUTSIDE OF SCOPE

Outside of Scope

February 2012

OUTSIDE OF SCOPE

Thomas, George

From: Thomas, George
Sent: Tuesday, March 19, 2013 4:17 PM
To: McMurtray, Anthony
Subject: FW: Input for the CNS
Attachments: Concrete Structural Issues for 2013 CNS Report 3-18-13 rev.doc

Outside of Scope

C60

Concrete Structural Issues

Since 2009, there have been several significant conditions adverse to quality that occurred or were discovered in safety-related concrete structures of operating reactors in the United States (U.S.). These ~~events or~~ conditions involve~~included~~ the following:

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Outside of Scope

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OUTSIDE OF SCOPE

OUTSIDE OF SCOPE

Outside of Scope

OUTSIDE OF SCOPE

Outside of Scope

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Alkali-Silica Reaction (ASR) is a slow chemical process that can occur over time in hardened concrete. For ASR to occur, it is necessary for the concrete to have reactive aggregate, high alkali content in the cement, and adequate moisture to form a gel. The gel expands by absorbing water resulting initially in a network of micro-cracks in concrete. Depending on the progression and severity, ASR can reduce/affect mechanical properties of concrete (i.e., compressive, tensile, shear, and bond strengths, elastic modulus, and the poisson ratio) used in design to different extents, and could also affect empirical code relationships between mechanical properties in the American Concrete Institute (ACI) design/construction codes. ASR can potentially affect structural performance over time.

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Seabrook has continued with detailed testing, walkdowns, crack monitoring and evaluations to comprehensively address and manage the issue in the short-term and the long-term. On May 16, 2012, the NRC staff issued a letter to NextEra Energy to confirm licensee commitments to comprehensively address this issue. These actions were focused on assuring operability of the affected structures pending a review of a formal root cause analysis and short-term and long-term monitoring actions while plant-specific ASR research and development occurred. The research and development includes large-scale testing, in the structural context, of specimens with different levels of ASR and conservatively enveloping Seabrook conditions. The results of the research and development will be used to address long-term effects on structural performance and management of the issue, and to provide the technical basis for the final operability determination and corrective actions (if required).

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The NRC staff's oversight reviews under 10 CFR Part 50 are focused on ensuring that the ASR issue at Seabrook is comprehensively addressed and managed such that there is reasonable assurance that the affected structures will continue to perform their intended safety functions through the expected service life. The staff has performed detailed inspections to verify and assess the adequacy of NextEra Energy's interim operability basis and actions and commitments to address the impact of ASR on reinforced concrete structures at Seabrook. The staff continues to review NextEra's proposed large-scale testing and other activities to address the uncertainties in evaluating the current level and progression of ASR on Seabrook reinforced concrete structures through follow-up inspections. These follow-up inspections will verify adequacy of actions related to the ASR-specific Structures Monitoring Program for long term management of the issue, and the proposed large-scale testing of beam specimens to reconcile the ASR issue with the design and licensing basis.

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The NRC's oversight review of this issue to date (February 2013) has determined that there are no immediate safety concerns based on existing safety margins, the localized and slow nature of the ASR, and ongoing crack monitoring. This review has included an evaluation of NextEra's prompt operability determinations for various structures affected by ASR. The results of the NRC staff's review are documented in a December 2012 NRC inspection report for Seabrook.

Marshall, Michael

From: Marshall, Michael
Sent: Tuesday, March 26, 2013 8:08 AM
To: Conte, Richard
Subject: RE: Unredacted CAL No. 11 Response with 2.390 Affidavit on the Technical Details of Anchor Test Program

Hello Rich,

I only did a quick skim of the report, and I only have one comment:

- The report should be returned to the licensee, because they were not consistent in redacting information. If the brand name of the anchors are considered proprietary, then they should be consistently redacted (see tables).

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

From: Conte, Richard
Sent: Monday, March 25, 2013 2:38 PM
To: Dentel, Glenn; Khanna, Meena; Kobetz, Timothy; Marshall, Michael; McMurtray, Anthony; Morey, Dennis
Cc: Floyd, Niklas; Cook, William; Lamb, John; Raymond, William; Trapp, James; Farrar, Karl
Subject: FW: Unredacted CAL No. 11 Response with 2.390 Affidavit on the Technical Details of Anchor Test Program

Do the BCs have any comments on the redaction?

We are leaning on accepting it as is. Please respond by COB Tuesday tomorrow with ya or na or you need more time to review and by when will you be done.

From: Conte, Richard
Sent: Monday, March 18, 2013 9:12 AM
To: Holody, Daniel; Dentel, Glenn; Trapp, James; McLaughlin, Marjorie; Crisden, Cherie; Farrar, Karl
Cc: McNamara, Nancy; Screnci, Diane; Sheehan, Neil; Tifft, Doug; Floyd, Niklas; Dacus, Eugene; Cook, William; Roberts, Darrell; Clifford, James; Miller, Chris; Dean, Bill; Lew, David
Subject: FW: Unredacted CAL No. 11 Response with 2.390 Affidavit on the Technical Details of Anchor Test Program

Here is the un-redacted version of the CAL No. 11 response with Enclosure 3 affidavit. We need to review IAW Reg. Inst. 0220.3/4 and 10 CFR 2.390.

I am unclear on specific next steps for now other than review and meet if there are issues. If all is ok then we sent out a receipt. Does legal or enforcement staff have an example from which to work.

C61

I will be sending it to the ASR working group for their comments if any – by week's end appears reasonable at this time. Perhaps we can do an interim review on this Thursday afternoon. I will be in the office in the PM since I will return from Alexandria in the morning.

It would be nice if we can get our response out before the AAM open house but if there are problem/issues that may be unrealistic.

From: Willoughby, Paul [mailto:Paul.Willoughby@nexteraenergy.com]
Sent: Monday, March 18, 2013 6:57 AM
To: Conte, Richard
Subject: RE: How you guys doing on the Unredacted Version of the Feb 28 response? - EOM

Rich

see attached

Paul

From: Conte, Richard [mailto:Richard.Conte@nrc.gov]
Sent: Friday, March 15, 2013 4:04 PM
To: Willoughby, Paul
Cc: OKeefe, Michael; Noble, Rick
Subject: How you guys doing on the Unredacted Version of the Feb 28 response? - EOM

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Buford, Angela

From: Buford, Angela
Sent: Monday, April 01, 2013 9:52 AM
To: (b)(6)
Subject: FW: Revised Crack Indexing Paper - Please Review Format Change
Attachments: In-situ Monitoring of ASR Paper Rev 3 2-11-13(2).docx

From: Buford, Angela
Sent: Monday, February 11, 2013 4:20 PM
To: Cook, William
Subject: Revised Crack Indexing Paper - Please Review Format Change

Bill,

I made mostly minor revisions to the crack monitoring paper, but pretty major changes in terms of format. Can you take a look and tell me if I captured your comment on format or if I missed the mark? I want to make sure we are still conveying the messages we intended in a digestible way.

Thanks,

Angie

C62

Buford, Angela

From: Buford, Angela
Sent: Tuesday, March 26, 2013 2:27 PM
To: Conte, Richard; Trapp, James; Dentel, Glenn; Marshall, Michael
Cc: Raymond, William; Floyd, Niklas
Subject: RE: For tomorrow night - Seabrook AAM - poster session

I can also talk about how the waste confidence ruling affects license renewal.

From: Conte, Richard
Sent: Tuesday, March 26, 2013 2:03 PM
To: Trapp, James; Dentel, Glenn; Buford, Angela; Marshall, Michael
Cc: Raymond, William; Floyd, Niklas
Subject: RE: For tomorrow night - Seabrook AAM - poster session

We are good then.

Nick has a compilation of correspondence from last year that I just reviewed. The themes are:

-is the NRC doing a thorough review
-why are they safe
-why aren't you having a public meeting or more frequent public meetings -what are the next steps for license renewal -how can we trust NextEra they are focused on production and since the place was built by drunks and sex addicts.

Recent questions were along the lines of what process are you in and why not use the concrete at Unit 2.

From: Trapp, James
Sent: Tuesday, March 26, 2013 1:58 PM
To: Conte, Richard; Dentel, Glenn; Buford, Angela; Marshall, Michael
Subject: RE: For tomorrow night - Seabrook AAM - poster session

I think I can fake it – if needed.

From: Conte, Richard
Sent: Tuesday, March 26, 2013 1:44 PM
To: Trapp, James; Dentel, Glenn; Buford, Angela; Marshall, Michael
Subject: For tomorrow night - Seabrook AAM - poster session

Do we have enough information on the Waste Confidence ruling and why it puts all the license renewal applications on hold.

There must be a standard Q&A already developed.

Upon thinking of this, I am not sure I can give history and development of the case since I was out of the license renewal loop since last year.

Rich Conte, Seabrook ASR Team Lead, Region I
(610) 337-5183 (Office)
(b)(6) (NRC cell)

Lamb, John

From: Lamb, John
Sent: Friday, April 26, 2013 10:32 AM
To: Marshall, Michael; Cook, William
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James; Erickson, Alice; Sheikh, Abdul
Subject: RE: Question From Debbie Grinnell - Seabrook ASR

Michael,

Who is the Seabrook License Renewal PM since Pat Milano retired?

Thanks.
John

-----Original Message-----
From: Marshall, Michael
Sent: Friday, April 26, 2013 10:28 AM
To: Lamb, John; Cook, William
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James; Erickson, Alice; Sheikh, Abdul
Subject: RE: Question From Debbie Grinnell - Seabrook ASR

John,

I am assuming she is referring to the RAIs that we have issued as part of the Seabrook license renewal review. We have the only ongoing licensing review that involves ASR that I am aware.

There is not much in the way of specifics in her question, but I can have may staff prepare a high level response with a timeline of RAIs that were issued concerning ASR. Are you looking for assistance in preparing a response or just want an answer on which RAIs that Ms. Grinnell is referring?

Best Regards,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch Division of License Renewal Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

-----Original Message-----
From: Lamb, John
Sent: Friday, April 26, 2013 10:23 AM
To: Cook, William; Marshall, Michael
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James
Subject: Question From Debbie Grinnell - Seabrook ASR
Importance: High

Bill & Michael,

C63

See question below from Debbie Grinnell on ASR. I am not clear what ASR RAIs she is referring to. RAIs from ASR Working Group or License Renewal? NRR DORL has not sent out any RAIs regarding to ASR.

Thanks.
John

-----Original Message-----
From: Deborah Grinnell [mailto:(b)(6) [redacted]]
Sent: Friday, April 26, 2013 8:41 AM
To: Lamb, John
Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's License Amendment Request to Revise Seabrook Unit 1 Technical Specification Associated with Containment Enclosure Emergency Air Cleanup System Surveillance Requirement

John,

Can you tell me when the licensing branch actually writes/constructs the (RAI) Requests for Additional Information. for Seabrook, as
pertains the ASR issue, who? They are good although resubmitted
often numerous times to mentor/convince the industry of the correct answer.

Thanks,

Debbie
On Apr 25, 2013, at 8:11 PM, Lamb, John wrote:

> Dear Ms. Grinnell,
>
> It takes approximately 12 hours at most to fix the door.
>
> Thanks.
> John
> ________________________________
> From: Deborah Grinnell [(b)(6) [redacted]]
> Sent: Thursday, April 25, 2013 6:44 PM
> To: Lamb, John
> Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's
> License Amendment Request to Revise Seabrook Unit 1 Technical
> Specification Associated with Containment Enclosure Emergency Air
> Cleanup System Surveillance Requirement
>
> Thank you. How long does it take to fix a door seal or latch when it
> is a priority? over 30 hours?
>
>
> Debbie
> On Apr 25, 2013, at 12:33 PM, Lamb, John wrote:
>
> Dear Ms. Grinnell:
>
> I understand that you have a question regarding the Seabrook CEEACS
> Amendment. I understand that your question is why does Seabrook need
> to open doors and if it is to get water out of the containment.
>
> Seabrook needs to open the doors if they need to perform maintenance
> on the doors, such as to fix a door seal or latch. Seabrook is not

> opening doors to get water out of containment.
>
> Thanks.
> John
>

Lamb, John

From: Lamb, John
Sent: Friday, April 26, 2013 10:41 AM
To: Deborah Grinnell
Cc: Khanna, Meena; Cook, William; Trapp, James; Marshall, Michael; Morey, Dennis; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Plasse, Richard
Subject: Response: Question Regarding Seabrook ASR RAIs

Importance: High

Dear Ms. Grinnell:

The Branch that has written the RAIs regarding Seabrook ASR that you are referring to is the Projects Branch 1 in the Division of License Renewal in Office of Nuclear Reactor Regulation. The project manager for the Seabrook License Renewal is Richard Plasse.

Thanks.
John

-----Original Message-----
From: Deborah Grinnell [mailto:(b)(6) [redacted]] ef6
Sent: Friday, April 26, 2013 8:41 AM
To: Lamb, John
Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's License Amendment Request to Revise Seabrook Unit 1 Technical Specification Associated with Containment Enclosure Emergency Air Cleanup System Surveillance Requirement

John,

Can you tell me when the licensing branch actually writes/constructs the (RAI) Requests for Additional Information. for Seabrook, as
pertains the ASR issue, who? They are good although resubmitted
often numerous times to mentor/convince the industry of the correct answer.

Thanks,

Debbie
On Apr 25, 2013, at 8:11 PM, Lamb, John wrote:

> Dear Ms. Grinnell,
>
> It takes approximately 12 hours at most to fix the door.
>
> Thanks.
> John
> ________________________________
> From: Deborah Grinnell (b)(6) [redacted] ef6
> Sent: Thursday, April 25, 2013 6:44 PM
> To: Lamb, John
> Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's
> License Amendment Request to Revise Seabrook Unit 1 Technical
> Specification Associated with Containment Enclosure Emergency Air

C64

> Cleanup System Surveillance Requirement
>
> Thank you. How long does it take to fix a door seal or latch when it
> is a priority?   over 30 hours?
>
>
> Debbie
> On Apr 25, 2013, at 12:33 PM, Lamb, John wrote:
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> Seabrook needs to open the doors if they need to perform maintenance
> on the doors, such as to fix a door seal or latch. Seabrook is not
> opening doors to get water out of containment.
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> Thanks.
> John
>

Lamb, John

From:	Deborah Grinnell (b)(6) [redacted] (b)(6)
Sent:	Friday, April 26, 2013 8:41 AM
To:	Lamb, John
Subject:	Re: Response: Issuance of Safety Evaluation RE: NextEra's License Amendment Request to Revise Seabrook Unit 1 Technical Specification Associated with Containment Enclosure Emergency Air Cleanup System Surveillance Requirement

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> opening doors to get water out of containment.
>

C65

> Thanks.
> John
>

Lamb, John

From:	Marshall, Michael
Sent:	Friday, April 26, 2013 10:36 AM
To:	Lamb, John
Cc:	Plasse, Richard; Morey, Dennis; Khanna, Meena
Subject:	RE: Question From Debbie Grinnell - Seabrook ASR

Rick Plasse

-----Original Message-----
From: Lamb, John
Sent: Friday, April 26, 2013 10:32 AM
To: Marshall, Michael; Cook, William
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James; Erickson, Alice; Sheikh, Abdul
Subject: RE: Question From Debbie Grinnell - Seabrook ASR

Michael,

Who is the Seabrook License Renewal PM since Pat Milano retired?

Thanks.
John

-----Original Message-----
From: Marshall, Michael
Sent: Friday, April 26, 2013 10:28 AM
To: Lamb, John; Cook, William
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James; Erickson, Alice; Sheikh, Abdul
Subject: RE: Question From Debbie Grinnell - Seabrook ASR

John,

I am assuming she is referring to the RAIs that we have issued as part of the Seabrook license renewal review. We have the only ongoing licensing review that involves ASR that I am aware.

There is not much in the way of specifics in her question, but I can have may staff prepare a high level response with a timeline of RAIs that were issued concerning ASR. Are you looking for assistance in preparing a response or just want an answer on which RAIs that Ms. Grinnell is referring?

Best Regards,

Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch Division of License Renewal Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

C66

-----Original Message-----
From: Lamb, John
Sent: Friday, April 26, 2013 10:23 AM
To: Cook, William; Marshall, Michael
Cc: Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James
Subject: Question From Debbie Grinnell - Seabrook ASR
Importance: High

Bill & Michael,

See question below from Debbie Grinnell on ASR. I am not clear what ASR RAIs she is referring to. RAIs from ASR Working Group or License Renewal? NRR DORL has not sent out any RAIs regarding to ASR.

Thanks.
John

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Sent: Friday, April 26, 2013 8:41 AM
To: Lamb, John
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> Thanks.
> John
>

Lamb, John

From: Trapp, James
Sent: Friday, April 26, 2013 10:28 AM
To: Lamb, John
Cc: Cook, William; Marshall, Michael; Khanna, Meena; Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew; Trapp, James
Subject: Re: Question From Debbie Grinnell - Seabrook ASR

I talked to her on Monday. She is talking about the LR RAIs. She likes Michael's work but is not happy with NextEra's response.

Sent via Divide iOS

On Friday, April 26, 2013, 10:22:37 AM, "Lamb, John" <John.Lamb@nrc.gov> wrote:

Bill & Michael,

See question below from Debbie Grinnell on ASR. I am not clear what ASR RAIs she is referring to. RAIs from ASR Working Group or License Renewal? NRR DORL has not sent out any RAIs regarding to ASR.

Thanks.
John

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> opening doors to get water out of containment.
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> Thanks.
> John
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Lamb, John

From: Deborah Grinnell (b)(6)
Sent: Friday, April 26, 2013 10:53 AM
To: Lamb, John
Subject: Re: Response: Question Regarding Seabrook ASR RAIs

Importance: High

I thought he was long gone. Is he back?

Debbie
On Apr 26, 2013, at 10:41 AM, Lamb, John wrote:

> Dear Ms. Grinnell:
>
> The Branch that has written the RAIs regarding Seabrook ASR that you
> are referring to is the Projects Branch 1 in the Division of License
> Renewal in Office of Nuclear Reactor Regulation. The project manager
> for the Seabrook License Renewal is Richard Plasse.
>
> Thanks.
> John
>
> -----Original Message-----
> From: Deborah Grinnell (b)(6)
> Sent: Friday, April 26, 2013 8:41 AM
> To: Lamb, John
> Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's
> License Amendment Request to Revise Seabrook Unit 1 Technical
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>> John

C67

>> ________________________________
>> From: Deborah Grinnell (b)(6) b6
>> Sent: Thursday, April 25, 2013 6:44 PM
>> To: Lamb, John
>> Subject: Re: Response: Issuance of Safety Evaluation RE: NextEra's
>> License Amendment Request to Revise Seabrook Unit 1 Technical
>> Specification Associated with Containment Enclosure Emergency Air
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>> on the doors, such as to fix a door seal or latch. Seabrook is not
>> opening doors to get water out of containment.
>>
>> Thanks.
>> John
>>
>

Buford, Angela

From: Trapp, James
Sent: Tuesday, June 11, 2013 6:47 AM
To: Raymond, William; Cook, William; Buford, Angela; Sheikh, Abdul; Floyd, Niklas
Cc: Dentel, Glenn; Cataldo, Paul; Jennerich, Matthew
Subject: FW: Call on Seabrook ASR
Attachments: Trapp letter.docx

FYI – I have agreed to have a chat with this member of the public on Seabrook ASR.

From: (b)(6)
Sent: Monday, June 10, 2013 9:43 PM
To: Trapp, James
Subject: Re: Call on Seabrook ASR

Attached is background to the upcoming conference call on ASR at Seabrook. If you can pick a time that works for you on this Th or Fri or Mon of next week, I can be available.

Regards

Paul Brown

-----Original Message-----
From: Trapp, James <James.Trapp@nrc.gov>
To: grtbrown (b)(6)
Sent: Mon, Jun 10, 2013 1:04 pm
Subject: RE: Call on Seabrook ASR

Great to hear from you. Sounds like we can share thoughts sometime soon.

Again – really appreciate your interest and support.

Thank you!

From: (b)(6)
Sent: Monday, June 10, 2013 1:03 PM
To: Trapp, James
Subject: Re: Call on Seabrook ASR

Yes I did get your e.mail and I am interested in chatting about Seabrook ASR. However, I have been travelling so it has not been the best time. I am presently at an ASTM meeting, and coincidently participating in a C-9 subcommittee meeting here on ASR, but will be home on Th-Fri.

If my time permits today or tomorrow, I will send you a brief outline of areas of interest as a basis for a phone discussion.

If you have any preferred times for a chat on Th or Fri of this week, please let me know and I will hold that time open.

Regards

Paul Brown
-----Original Message-----
From: Trapp, James <James.Trapp@nrc.gov>
To: grtbrown (b)(6)

> before we respond. You mentioned the need for NextEra to file for a
> license amendment. Did you state that it would occur in 2016 after the
> "Replica Project" study is completed and the data results released.
> Do you suspect it will be the last and then only open CAL item to
> be resolved?
>
> Does NextEra need to complete all CAL items before they file for a
> license amendment or just complete and submit data results from the "
> Replica Project"?
>
> They have been out of design basis since the ASR discovery. I am
> not clear about when they MUST submit a license amendment. What
> does the NRC process entail?
>
> What do you view as next steps with our expert?
>
> Thanks so much.
>
>
> Debbie
>
>

Marshall, Michael

From: Marshall, Michael
Sent: Tuesday, June 18, 2013 11:11 AM
To: Lubinski, John; Pelton, David
Subject: RESPONSE: Status of Seabrook Alkali-Silica Reaction Issue for Use at DE Counterparts Meeting

Part 50 – Oversight Status

NRC Activities:

- Next week on June 26th and 27th, Region 1 with support from DLR will be conducting the final inspection to verify the actions in the CAL have been completed. Region 1 is currently drafting the second ASR CAL inspection report. The first one was issued in December 2012. The CAL was issued in May 2012. The CAL had 11 discrete items.

- Next week on June 25th, Region 1 has scheduled a joint briefing with Eric Leeds and Bill Dean to discuss status of the Seabrook ASR issue and to obtain agreement with the path forward that includes:

    - Closing the Seabrook ASR CAL,
    - Keeping the Seabrook ASR Issue Working Group active with Region 1 as lead,
    - Conducting a public meeting near site in September 2013 to share with public status of NRC oversight of Seabrook ASR Issue,
    - Include ASR as a sample in future PI&R inspections until ASR issue is fully addressed, and
    - Leverage any DLR audits that may aid in oversight of licensee's resolution of ASR issue; DLR plans to conduct at least one audit during the beam test.

Licensee Activities:

- Surveillance and inspection of structures for ASR is ongoing. Monitoring of specific locations with ASR is ongoing.

- Licensee is conducting tests to assess the impact of ASR on anchorage and the "strength" of the structure are ongoing at the University of Texas at Austin to verify that current operability determination is correct and their approach for managing the effects of ASR is consistent with their current licensing basis. If the test does not support using methods in their current licensing basis, the licensee will likely submit an amendment to modify their current licensing basis with new methods based on the test results.

Opinion/Commentary:

- The actions the Region 1 has proposed are reasonable and commiserate with importance/urgency of this issue. The early judgment of our engineers is still applicable; ASR is not an immediate threat to the functions of the structures. The actions that the licensee has planned and the timetable to implement their plan are reasonable and commiserate with importance/urgency of this issue.

- The closure of the CAL will be a communication challenge, because the Seabrook ASR issue will not be fully resolved for at least a couple more years. The resolution hinges on anchorage and beam tests the licensee is sponsoring at the University of Texas at Austin that is currently scheduled for completion in CY2015.

Note:

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- Region 1 has lead on maintaining a public website concerning the Seabrook ASR issue. http://www.nrc.gov/info-finder/reactor/seabrook/concrete-degradation.html. The site contain links to many of the documents mentioned in this status update.

Outside of Scope

A

Outside of Scope

(A)

Buford, Angela

From: Buford, Angela
Sent: Wednesday, July 24, 2013 9:37 AM
To: Trapp, James; Cook, William; Raymond, William; Floyd, Niklas
Subject: RE: Seabrook ASR Conference Call

Jim/all – In what capacity do we plan on responding to these comments?

From: Trapp, James
Sent: Tuesday, July 23, 2013 6:48 AM
To: Cook, William; Raymond, William; Floyd, Niklas; Buford, Angela
Subject: FW: Seabrook ASR Conference Call

FYI

From: Deborah Grinnell (b)(6)
Sent: Monday, July 22, 2013 3:34 PM
To: Trapp, James; Paul Brown; Sean Meyer
Subject: Re: Seabrook ASR Conference Call

Hello James,

Thank you for arranging a conference call concerning your SAITT investigation of Seabrook's ASR with our expert, Paul Brown. We are certainly encouraged that you intend to maintain an open dialog with Paul Brown. Please find attached Paul's commentary on our conference call. We will all be very keen to know what your response to his comments will be and looking forward to the discussions that follow.

My Best,

Debbie
>
> I would like to maintain and open dialog with Dr. Brown as the
> onsite data and testing program results come in, if he is willing.
> I found his input to us was very useful.
>
> I am on vacation this week, but will be in the office all next week
> if you would like to talk.
>
> Thanks.
>
>
> -----Original Message-----
> From: Deborah Grinnell (b)(6)
> Sent: Tuesday, July 16, 2013 11:52 AM
> To: Trapp, James
> Subject: Seabrook ASR Conference Call
>
> Hello James,
>

C70

> We were all encouraged to have you and Bill provide our expert, Paul
> Brown, responses to his concerns and questions concerning Seabrook's
> extensive ASR degradation. We all appreciate that you read and
> utilized Paul's input in your SAITT Seabrook inspection. There is
> still so much information not shared with us. We have discussed the
> call and next steps. and will respond soon. We do have one question
> before we respond. You mentioned the need for NextEra to file for a
> license amendment. Did you state that it would occur in 2016 after the
> "Replica Project" study is completed and the data results released.
> Do you suspect it will be the last and then only open CAL item to
> be resolved?
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> does the NRC process entail?
>
> What do you view as next steps with our expert?
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> Thanks so much.
>
>
> Debbie
>
>

Marshall, Michael

From: Erickson, Alice
Sent: Friday, July 26, 2013 1:38 PM
To: Marshall, Michael
Subject: RE: REQUEST: Draft Seabrook ASR CAL Follow-up Report for your review
Attachments: IR 2012-010 draft 7-23-13 - AE comments.docx

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Urgent

Michael,

I've made comments through track changes in the attached file. Outside of Scope
Outside of Scope

outside Scope of FOIA

Alice

From: Marshall, Michael
Sent: Wednesday, July 24, 2013 5:32 PM
To: Erickson, Alice
Subject: REQUEST: Draft Seabrook ASR CAL Follow-up Report for your review

Hello Alice,

Please, review the attached inspection report and provide me with any comments you may have by next Tuesday. I will review the report in parallel. If you have time before you class next week, let's plan to compare notes on Tuesday or Thursday morning.

Thanks,
Michael L. Marshall, Jr.
Chief
Aging Management of Structures, Electrical, and Systems Branch
Division of License Renewal
Office of Nuclear Reactor Regulation

301-415-2871
Email: michael.marshall@nrc.gov

> **From:** Cook, William
> **Sent:** Tuesday, July 23, 2013 5:28 PM
> **To:** Trapp, James; Dentel, Glenn; Marshall, Michael; McMurtray, Anthony
> **Cc:** Raymond, William; Cook, William; Buford, Angela; Floyd, Niklas
> **Subject:** Draft Seabrook ASR CAL Follow-up Report for your review
>
> Attached is the draft report for your early review and feedback. We would appreciate your review and comments at your earliest convenience.
>
> Thanks,
> Bill Cook

C71

ENCLOSURE

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

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

SUBJECT: SEABROOK STATION, UNIT NO. 1 - CONFIRMATORY ACTION LETTER FOLLOW-UP INSPECTION - NRC INSPECTION REPORT 05000443/2012010

Dear Mr. Walsh:

On June 27, 2013, 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 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.

The NRC determined that the eleven actions committed to in CAL have been satisfactorily completed. The team independently verified that NextEra had appropriately assessed and determined that all ASR affected structures remain operable. The team also confirmed that your root cause evaluation was thorough and identified appropriate corrective actions.

Many important corrective actions necessary to resolve this issue are currently in progress. These actions include your planned two year test program of ASR affected large scale concrete specimens at the University of Texas, Ferguson Structural Engineering Laboratory (FSEL). Therefore, while our review of the CAL items was completed during this inspection, the NRC will continue to provide oversight of both NextEra's testing program at the FSEL and onsite ASR related activities. Our final decision regarding closure of the CAL will be provided to NextEra in a future correspondence.

Comment [A1]: Is DLR planning to do this, or the Region?

Comment [A2]: Why is the final decision going to be in a future correspondence? In several paragraphs, we state that the CAL items were reviewed and closed.

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,

Raymond K. Lorson, Director
Division of Reactor Safety

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

Enclosures:
1. Inspection Report No. 05000443/2012010
   w/ Attachment: Supplemental Information
2. Confirmatory Action Letter 1-2012-002

cc w/encl: Distribution via ListServ

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,

Raymond K. Lorson, Director
Division of Reactor Safety

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

Enclosures:
1. Inspection Report No. 05000443/2012010
   w/ Attachment: Supplemental Information
2. Confirmatory Action Letter 1-2012-002

cc w/encl: Distribution via ListServ

Distribution w/encl:
W. Dean, RA
D. Lew, DRA
D. Roberts, DRP
A. Burritt, DRP
R. Lorson, DRS
J. Rogge, DRS
G. Dentel, DRP
R. Barkley, DRP
P. Cataldo, DRP, SRI
M. Jennerich, DRP, RI
A. Cass, DRP, Resident AA
RidsNrrPMSeabrook Resource
C. Santos, RI, OEDO
RidsNrrDorlLpl1-2 Resource
ROPreports Resource

DOCUMENT NAME: G:\DRS\Seabrook Concrete\Oper-funct - TIAs\CAL FU 92702 Report 1\IR 2012-009 12-03-12.docx
ADAMS Accession No.: ML

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OFFICE mml	RI/DRS	RI/DRP	RI/DRS	RI/DRS
NAME	WCook	GDental	JTrapp/	RLorson/
DATE	/ /13	/ /13	/ /13	

OFFICIAL RECORD COPY

U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket No.:	50-443
License No.:	NPF-86
Report No.:	05000443/2012010
Licensee:	NextEra Energy Seabrook, LLC
Facility:	Seabrook Station, Unit No. 1
Location.	Seabrook, New Hampshire 03874
Dates:	November 3, 2012 to April 30, 2013
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 (DLR), Office of Nuclear Reactor Regulation (NRR) G. Thomas, Structural Engineer, Division of Engineering, NRR A. Sheikh, Senior Structural Engineer, DLR, NRR N. Floyd, Reactor Inspector, DRS
Approved by:	James Trapp, Chief, Engineering Branch 1 Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000443/2012010; 11/03/2012 - 06/27/2013; Seabrook Station, Unit No. 1; Confirmatory Action Letter (CAL) Follow-up Inspection Report.

This report covered several weeks of onsite inspection at Seabrook Station, two weeks of inspection at the Ferguson Structural Engineering Laboratory (FSEL) University of Texas – Austin, and periodic in-office reviews, over the past eight months, 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.

Comment [A3]: Recommend using the same wording from the cover letter (highlighted) for consistency.

Cornerstone: Mitigating Systems

During this second CAL follow-up inspection, the team examined the remaining six commitments documented in CAL No. 1-2012-002, dated May 16, 2012. The CAL items reviewed and closed during this inspection were 2, 4, 7, 8, 9 and 11. In addition, a number of observations documented in the first CAL follow-up inspection (NRC Inspection Report 05000443/2012009, Section 9.0) were reviewed and closed in this report. Closure of CAL Item 7 was administrative, in that, NextEra had withdrawn this commitment by letter dated December 13, 2012 (ML12362A323). NextEra's revision to this commitment was approved by the NRC as documented in the CAL revision letter, dated January 14, 2013 (ML13014A555). Our assessment of CAL Item 7 and the remaining CAL items reviewed and closed are documented in the enclosed inspection report.

The review and closure of each CAL item signifies the NRC's satisfactory assessment of NextEra's commitments and planned corrective actions to address the non-conforming alkali-silica reaction in Seabrook reinforced concrete structures. However, the completion of the CAL follow-up inspections is not the completion of NRC review and oversight of NextEra's actions to address the ASR issue. As discussed in the team's review of CAL Item 4 and the revised ASR Project Corrective Action Plan (CAP), NextEra has implemented a number of ongoing activities, in addition to the FSEL testing program to address ASR-affected structures. The details of the NRC's plans to oversee these activities will be addressed separately.

Comment [A4]: Recommend deleting, or adding the word "condition."

Comment [A5]: ??? We don't have detailed plans to do this, do we?

NextEra's root cause evaluation (CAL Item 2) appropriately identified the significant causal and contributing factors resulting in ASR impacting reinforced concrete structures at Seabrook Station. NextEra's ASR Project CAP (CAL Item 4) sufficiently captures the numerous corrective actions taken and planned to address the ASR non-conforming condition, and remains a "living document" to track the resolution of ASR at Seabrook Station.

Mortar Bar Testing (CAL Item 6, reference NRC Inspection Report 05000443/2012009) was successfully completed and the results indicated sufficient reactive silica and alkali in the Seabrook structures to fuel the progression of ASR for the foreseeable future. Consequently, NextEra withdrew their commitment for Prism Testing (CAL Item 7) and the NRC staff administratively closed this commitment. The team reviewed NextEra's large specimen testing program technical specifications (CAL Item 8) and anchor testing program description (CAL Item 11) and concluded that these programs were sufficiently developed and described to support an appropriate understanding of the testing plans and objectives.

NextEra implemented a number of enhancements to the Structures Monitoring Program (CAL Item 9) to adequately monitor the progression of ASR, pending the completion and evaluation of results from the large specimen testing program. The team concluded these monitoring actions were consistent with currently available industry practices.

Lastly, the team reviewed and closed a number of observations discussed in the first CAL Follow-up Inspection, including: pending structural evaluations (13); containment POD observations; core sample material property testing; quantification of pre-stressing effects of ASR expansion; additional rebar examinations; crack indexing use in the SMP; and Phase 3 walkdown plans and schedule.

REPORT DETAILS

1.0 Background

Alkali-Silica Reaction (ASR) is a chemical reaction occurring in hardened concrete that can change the physical properties of concrete and 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 numerous Seabrook Category I structures was evaluated in the Corrective Action Program via prompt operability determinations (PODs). The PODs were revised as new information became available and improved 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 a traditional method described in American Concrete Institute (ACI) 228.1R, "In-Place Methods to Estimate Concrete Strength," 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, "Building Code Requirements for Reinforced Concrete," to evaluate the structural capacity (operability) of the ASR-affected structures. However, the mathematical relationships in ACI-318 are based on empirical data from testing of non-degraded concrete, and these relationships may not be valid for 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. Based on this conclusion, NextEra suspended 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.

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 small scale 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 some testing (anchors) commenced in 2013 and large beam testing scheduled to be completed by 2015. Based upon the slow progression of the ASR expansion, the current operability evaluations, coupled with the Structures Monitoring Program six-month combined crack indexing, provide reasonable assurance of continued structural operability until the testing program is completed.

2.0 Confirmatory Action Letter 1-2012-002

Confirmatory Action Letter 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. As documented in NRC Inspection Report No. 05000443/2012009, dated December 3, 2012 (ML12338A283) CAL Items 1, 3, 5, 6, and 10 were closed.

Based on the results of this inspection, the remaining six CAL Items 2, 4, 7, 8, 9, and 11 are closed.

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

Inspection Scope

As documented in Inspection Report No. 05000443/2012009, 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) in a letter to the NRC dated May 24, 2012 (ML12151A396). Based upon the team's initial review, the inspectors concluded that the second root cause identified was not sufficiently characterized in NextEra's May 24, 2012, submittal. Specifically, NextEra did not clearly describe the personnel and organizational factors that contributed to inadequacies in the Structures Monitoring Program (SMP) and the failure of the Seabrook staff to have identified ASR degradation of reinforced concrete structures sooner. The team discussed this observation with the responsible Seabrook staff and NextEra determined that a revision to the RCE was warranted and revised the RCE to more appropriately develop and characterize this second root cause and the associated corrective actions.

NextEra submitted a revised RCE summary for NRC review in a letter dated May 1, 2013, (ML13151A328, Enclosure 1). The team reviewed the revised RCE summary for clarity and appropriateness of associated corrective actions, consistent with guidance outlined in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and NextEra's Corrective Action Program (CAP).

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 2 is closed.

As documented in Enclosure 1 to the May 1, 2013 letter, NextEra summarized the two root causes, as follows: RC1 – the ASR developed because the concrete mix design unknowingly *utilized a coarse aggregate that would, in the long term, contribute to ASR. Although the testing* was conducted in accordance with American Society for Testing and Materials (ASTM) standards, those testing standards were subsequently identified as limited in their ability to predict slow reactive aggregate that produced ASR in the long term; and RC2 – based on the long standing organizational belief that ASR was not a credible failure mode due to the concrete mix design, dispositions for Condition Reports involving groundwater intrusion or concrete degradation, along with the structures health monitoring program did not consider the possibility of ASR development. In addition, NextEra identified a contributing cause involving the failure of the organization to prioritize groundwater elimination or mitigation resulting in more concrete area exposed to moisture.

The team verified that NextEra had appropriately identified the root cause(s). The ASTM concrete aggregate testing standards in effect at the time of plant construction were properly implemented, but later determined to be ineffective in identifying slow reacting, ASR susceptible aggregates. Those standards were subsequently revised by the industry and adopted by NextEra to prevent recurrence. NextEra's RCE concluded that the Structures Monitoring Program (SMP) did not remain current with concrete industry operating experience and associated failure modes, such as ASR. Contributing to the shortcomings in the SMP to have identified this concrete degradation mechanism earlier was the "organizational mindset" that the groundwater in-leakage was an operational nuisance and nothing more. Consequently, station and engineering staffs were insensitive to the potential detrimental effects of the ground water infiltration and did not assess the long term impact on station structures. The team concluded that NextEra's implementation of a broad periodic review process to ensure all systems and component monitoring programs remain current and effective was determined an appropriate corrective action for this causal factor.

4.0 Integrated Corrective Action Plan (CAL Item 4)

Inspection Scope

CAL No. 1-2012-002 documented NextEra's commitment to submit by June 8, 2012, a corrective action plan for the continued assessment of ASR in concrete structures at Seabrook Station including development of remedial actions to mitigate the effects of ASR, where warranted. By letter dated June 8, 2012 (ML12171A227), NextEra submitted their integrated corrective action plan (CAP) for NRC review. The CAP outlined the major elements of diagnosis, evaluation, prognosis and mitigation of ASR-affected structures as understood at the time. Since June 8, 2012, NextEra has made considerable progress in refining the elements of this plan, implementing the initial phases, and more clearly defining and focusing future actions. NextEra provided an updated ASR Project CAP in a letter dated May 1, 2013 (ML13151A328, Enclosure 2) to document these plan changes.

During this inspection period, the team conducted numerous discussions, meetings, and conference calls with NextEra, as well as onsite inspections at both Seabrook Station and UT-Austin to review NextEra's actions to address the ASR-affected reinforced concrete structures. From these interactions, the CAP has developed greater clarity of the necessary steps (corrective actions) to address this non-conforming condition impacting safety-related reinforced concrete structures. As previously documented in Inspection Report 05000443/2012009 and detailed in other sections of this report, the team assessed the adequacy of completed and ongoing ASR-related activities identified in the integrated CAP, consistent with guidance outlined in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and NextEra's Quality Assurance Program.

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 4 is closed. NextEra's ASR project staff stated that they plan to maintain the ASR Project CAP as a "living document" and will update it periodically to capture completion of activities and add new actions, as appropriate.

5.0 Prism Testing Commitment Withdrawn (CAL Item 7)

Inspection Scope

CAL Item 7 committed NextEra to "Complete long term aggregate expansion testing (ASTM C 1293, Concrete Prism Test) by June 30, 2013." The purpose of this CAL item was to determine, in conjunction with the Mortar Bar Testing (CAL Item 6), if the coarse aggregate contributing to ASR in Seabrook reinforced concrete still contained sufficient reactive silica for the alkali-silica reaction to continue long-term under the existing environmental conditions. Alternatively, these tests could demonstrate that the progression of ASR at Seabrook maybe self-limiting due to the depletion of reactive silica in the concrete. The Prism Test (as defined by ASTM C1293) involves monitoring the expansion (by measurement of specimen elongation due to ASR) of the test specimen (a molded concrete brick approximately 3 by 5 by 12 inches in length) over a one year period. Expansion in excess of 0.04% is considered potentially deleterious and a positive test for slow reactive aggregate. The Prism Test is similar to the Mortar Bar Test (reference ASTM C1260), but has a duration of 14 days and an expansion limit of 0.1%.

Based upon the results of the completed Mortar Bar Expansion Testing (reference NRC Inspection Report No. 05000443/2012009, Section 5.0), NextEra concluded that the available quantities of silica in the concrete would not be depleted in the near term and that additional confirmatory testing via the Prism Test method was not warranted. NextEra ran the Mortar Bar Test several weeks beyond the 14-day test (terminated after 103 days) and observed that the alkali-silica reaction was still progressing at the conclusion of the test, indicating the presence of sufficiently reactive aggregate to maintain ASR for a longer period of time. The team noted that the Mortar Bar Test involved the reuse of aggregates from Seabrook test cores (concrete that had already experienced appreciable ASR) and similar aggregate from concrete not affected by ASR. The side-by-side comparison of the test specimens showed no appreciable difference in ASR progression or observed expansion rates. Accordingly, NextEra concluded the Prism Test would add no significant knowledge to the condition assessment of Seabrook concrete. NextEra concluded that all Seabrook reinforced structures are or may be affected by ASR, unless specifically ruled-out by further analysis, such as petrographic examination. By letter dated December 13, 2012, NextEra requested that CAL Item 7 be deleted. As documented in NRC letter dated January 14, 2013 (ML13014A555), the NRC accepted NextEra's technical basis for deleting CAL Item 7.

Findings and Observations

No findings were identified. CAL Item 7 is administratively closed.

6.0 Review of Technical Details of Large Specimen Testing Program (CAL Item 8)

Inspection Scope

CAL Item 8 committed NextEra to "Submit the technical details of the testing planned at the contracted research and development facility by June 30, 2012." By letter dated June 21, 2012, (ML12179A281) NextEra submitted the Shear and Lap Splice Testing overview prepared by the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas at Austin, dated March 15, 2012. The purpose of the test program, as described in the FSEL document, is to provide sufficient data and insights to establish the current and future implications of ASR on Seabrook reinforced concrete structures. Based upon limited available literature or test data relative to the impact of ASR on walls without transverse reinforcements (the majority of Seabrook ASR-affected structures) destructive testing of ASR-affected test specimens will be conducted to evaluate the impact of ASR on out-of-plane shear strength and lap splice development. The test specimens being prepared at FSEL will be of representative scale and design, such that the test results may be correlated to Seabrook structures.

The team reviewed the June 21, 2012 submittal and conducted a conference call on December 18, 2012, with the NextEra and UT-Austin FSEL staff to discuss the merits of the proposed test program. Based upon the complexity of the information discussed and follow-up inspection activities, NextEra prepared a test program overview document and a detailed test specification to supplement the June 21, 2012, CAL response letter. By letter dated May 1, 2013 (ML13151A328 redacted and ML13151A291 un-redacted) NextEra provided the NRC with the "Seabrook Station - Specification for Shear and Reinforcement Anchorage Testing of ASR-Affected Reinforced Concrete," (Enclosures 3 & 4) and "Approach for Shear and Reinforcement Testing of Concrete Affected by Alkali Silica Reaction," (Enclosure 5 & 6). Each of these documents has a proprietary and non-proprietary version.

The team reviewed the revised testing specification and the associated overview document to verify that the overall test program approach and application of test results would reasonably address the Seabrook ASR-affected concrete non-conforming condition. The team discussed the test program with the FSEL, MPR and responsible NextEra engineering staffs.

Findings and Observations

No findings were identified. Based upon team review of the submitted testing program documents and related inspection activities, the team concluded that NextEra has provided a satisfactory explanation of the proposed large-scale specimen testing program, and CAL Item 8 is closed.

The team concluded that NextEra's approach has technical merit. However, as documented in NextEra's ASR Project CAP (ML 13151A328, Enclosure 2) the acceptance of the testing results to resolve ASR concerns associated with design basis structural calculations will follow the regulatory process for approval and will include evaluations pursuant to 10 CFR 50.59 and 10 CFR 50.90. As stated above, the submitted test plans satisfy NextEra's commitment to explain the scope and depth of the large-scale specimen testing program.

7.0 Review of Structures Monitoring Program (CAL Item 9)

Inspection Scope

CAL Item 9 committed NextEra to implement an update to the Maintenance Rule (10CFR50.65) Structures Monitoring Program (SMP) to include monitoring requirements for selected locations in areas that exhibit ASR by July 15, 2012. NextEra issued Revision 2 to Structural Engineering Standard 36180, "Structural Monitoring Program," effective July 12, 2012. The primary changes incorporated in Revision 2 to the SMP were: 1) performing periodic (every six months) crack indexing measurements at 26 locations to collect quantitative information on the progression of ASR expansion/degradation; 2) establishing crack width (1.0 mm or greater) and Combined Crack Index (1.0 mm/m or greater) thresholds for conducting structural evaluations (reference Foreign Print 100716, Seabrook Station: Impact of ASR on Concrete Structures and Attachments); and 3) the addition of Federal Highway Administration (FHWA) document FHWA-HIF-09-004, "Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures," dated January 2010, as a reference.

The team reviewed the adequacy of these changes to the SMP to monitor ASR in Seabrook reinforced concrete structures. While not endorsed by the NRC or committed to by NextEra in Seabrook's licensing basis, the team used the American Concrete Institute (ACI) Committee Report 349.3R-96, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," as a reference to assess the adequacy of the revisions made to the SMP for monitoring the progression of ASR.

Based in part on NRC observations, NextEra issued Revision 3 to the SMP on April 30, 2013. The principle changes in Revision 3 of the SMP are: 1) the addition of periodic (every 30 months) combined crack indexing (CCI) measurements at 72 discrete locations identified as Tier II (Acceptable with Deficiency) areas (CCI values between 0.5 mm/m and 1.0 mm/m, or crack widths greater than 0.2 mm, but less than 1.0 mm) to collect quantitative information on the progression of ASR expansion/degradation (this monitoring was being performed, but not documented in the SMP); and, 2) inclusion of the periodic ground water sampling program for monitoring of chemical attributes detrimental to concrete structures. During follow-up discussion with the NextEra staff, the team noted that NextEra is considering additional SMP revisions, dependent upon the results of the large specimen test program and further engineering evaluation. One of the revisions involves the installation of deep pins for monitoring of expansion in the out-of-plane direction (reference NextEra's May 1, 2013, Response to Confirmatory Action Letter (ML13151A328) Enclosure 2, ASR Project Corrective Action Plan).

Findings and Observations

The team identified no findings in this area. CAL Item 9 is closed.

The team noted that changes made to the SMP to address ASR were generally consistent with the evaluation and monitoring methods outlined in ACI 349.3R-96 The team confirmed that NextEra had incorporated a three-tiered visual inspection criteria, as outlined in Sections 5.1 through 5.3 of ACI 349.3R-96. NextEra has also augmented this visual inspection criteria with periodic (six-month and 30-month interval) CCI measurements and associated structural evaluation thresholds based upon direct measurement (CCI) results. The CCI monitoring, performed at 98 selected locations (including containment) was implemented by NextEra based upon this method being a readily measurable indicator of ASR related progression and based, in part, upon endorsement by FHWA and outlined in FHWA-HIF-09-004.

The crack growth monitoring provides a visual indication of the progression of ASR within a reinforced concrete structure. The relative width and number of visible cracks may be correlated to the overall progression of ASR and may be used to evaluate ASR impact on structural performance. However, ASR cracking and crack propagation is closely associated with the specific reinforcement design and structural loading. Accordingly, the adequacy of CCI measurement as a long term structures monitoring methodology for Seabrook structures is being further evaluated by NextEra as part of the UT-Austin FSEL testing program. The results of the UT-Austin testing program is intended to be used to validate this methodology for application at Seabrook.

Evaluation of infiltration water chemistry and groundwater monitoring: ACI 349.3R-96 discusses environmental monitoring and related effects of aggressive water chemistry, including the potential for leaching. Accordingly, NextEra has integrated the periodic monitoring of ground water chemistry into the SMP (reference Revision 3, dated 4/30/2013, Attachment 4). NextEra plans to investigate the expansion of the water chemistry monitoring program (reference AR No. 1758920-40) to include periodic analysis of infiltrated water (water that has migrated through below grade reinforced concrete walls). The establishment of an initial baseline analysis and continued periodic monitoring could provide some relative trend data for further evaluation and follow-up actions, as appropriate.

The team concluded that the implemented and planned SMP enhancements provide NextEra with an improved program to assess the extent and degree of ASR progression and to more thoroughly monitor the environmental factors contributing to ASR. NextEra's initial SMP revision (Revision 2) was adequate; however, the SMP Revision 3 enhancements include multiple activities that are better aligned with ACI 349.3R guidance.

Comment [A6]: I don't think it's necessary to find a prior version of the SMP adequate.

8.0 Review of Anchor Testing Program (CAL Item 11)

Inspection Scope

The micro-cracking caused by ASR may adversely impact the structural capacity of anchors that support safety-related piping, cable trays and other components. NextEra's initial operability determinations were supported by anchor performance testing conducted on available ASR degraded specimens previously fabricated at or obtained by FSEL, UT-Austin (reference FP 100718). As documented in Inspection Report 05000443/2012009, the initial testing demonstrated satisfactory performance of the anchors in ASR-affected concrete during the earlier stages of ASR progression. NextEra's evaluation also stated that the eventual reduction in capacity due to ASR was sufficiently offset by established anchor manufacturer's design margins (FP 100716). However, based upon the limitations of the testing performed (on ASR-affected test specimens of different composition and compressive strength than Seabrook reinforced concrete structures) NextEra planned to conduct additional testing. The planned testing involves anchors installed (both during specimen fabrication and post-fabrication) in ASR-affected test specimens that more closely replicate the reinforced concrete structures and anchor configurations at Seabrook.

By licensee letter dated December 13, 2012, (ML12362A323) NextEra requested a revision to CAL Item 11 to address a schedule challenge to the targeted anchor testing program completion date. NextEra also proposed redefining CAL Item 11 to be consistent with the wording of CAL Item 8, regarding large-scale specimen testing. Specifically, NextEra revised their commitment to read, "Submit technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013." The original commitment read, "Complete anchor test program by December 31, 2012. Results will be available for NRC review approximately 30 days after testing is complete." Based upon unexpected specimen fabrication delays and the slow progression of accelerated ASR aging, NextEra identified that it would not be possible to complete the anchor testing per the original commitment date. The NRC accepted NextEra's revised commitment, as documented in NRC letter dated January 14, 2013 (ML13014A555).

The team reviewed the details and adequacy of NextEra's anchor testing program as outlined in the proprietary "Anchor Testing Program Overview," dated February 26, 2013. The anchor testing program overview and associated testing specifications were docketed for NRC review via NextEra letter dated February 28, 2013 (ML13088A218 redacted and ML13088A229 un-redacted, dated March 15, 2013). The technical overview document and accompanying specifications outline the major elements of the proposed anchor testing program, including the key attributes of the fabrication of the test specimens, monitoring of the specimens as accelerated ASR aging progresses, and the details of the testing of individual anchor bolt configurations.

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 11 is closed.

During the team's visits to the UT-Austin FSEL, the team observed the conditions and controls implemented for the aging of the test blocks and testing of concrete sample cylinders for compressive strength and modulus of elasticity. The team witnessed appropriate implementation of the testing procedures by FSEL staff and proper oversight of these activities by the MPR quality assurance staff.

At the conclusion of this inspection, the desired level of ASR progression in the test blocks had not been achieved to conduct the first round of ASR-affected anchor testing. The team reviewed the results of the control specimen anchor testing completed in November 2012. The purpose of the control specimen testing was to establish a baseline to determine the potential reduction in anchor bolt capacity due to ASR. Review of the test data (reference MPR Memorandum DRN 0326-0058-163, dated June 18, 2013) identified that all anchor bolts test results were in agreement with calculated capacities and an appropriate baseline had been established for comparison during future testing.

9.0 Review of Previously Identified Issues of Interest

9.1 Structural Evaluations for 13 Locations

As documented in Inspection Report 05000443/2012009, NextEra identified 26 locations (including containment) as having patterned cracking with a CCI of greater than 1.0 mm/m. In accordance with the SMP, Revision 2, structures with a CCI of >1.0 mm/m require a structural evaluation. NextEra's Interim Assessment documented an engineering judgment that biased the performance of detailed structural evaluations to the 11 locations with a CCI > 1.5 mm/m. 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 a minor performance deficiency which NextEra entered into the Corrective Action Program (AR 1804477 and AR 1819080). During this inspection, the team reviewed Calculation C-S-10168, Revision 1, and FP 100716, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 2, which incorporated the additional evaluations for the 13 locations.

Comment [A7]: Recommend referencing Revision 3 instead of Revision 2.

The evaluation methodology included reviewing the original calculations that govern the design of the structures to determine the design parameters associated with the general area of ASR degradation. The structural member's load demand and capacity were then noted and the margin calculated for comparison against the potential reductions in load capacities caused by ASR. The assumed reductions in capacity were determined based on lower bound values established in industry literature. A summary of the evaluation results was provided in Table 3 of FP100716, Revision 2. For areas where design margins were insufficient to offset assumed reductions, further review was performed to recapture margin. Specifically, for two areas (Electric Tunnel and Discharge Structure), the design calculation used conservative load factors which were lowered to establish more representative demand loads, as described in Calculation C-S-1-10168, Revision 1. NextEra demonstrated additional margin to assure structural integrity despite the assumed reduction in capacity due to ASR. However, in the calculation for Electric

Tunnel area MF101 (C-S-1-10168, pg 30), NextEra reduced the hydrostatic load factor (1.4) to achieve a more realistic load demand. NextEra plans to credit the 1.4 load factor in the load demand calculation to establish full qualification per the Final Safety Evaluation Report (FSAR) licensing basis in the final operability determination, following completion of the testing program at UT-Austin.

The team concluded that NextEra's initial approach to perform a bounding analysis for areas with CCI >1.5 mm/m was not conservative, because the design margins vary in each structural member of each reinforced concrete structure. This conclusion highlights the need, once the impact of the ASR degradation on structural capacities is determined from the UT-Austin FSEL test program, for NextEra to closely review the design calculations for each ASR impacted area to assure margins remain acceptable without having to remove or reduce the load factors assumed in the current licensing basis.

9.2 Review of Core Sample Material Property Testing

As documented in Inspection Report 05000443/2012009, Section 3.2.9, the NRC planned to reexamine the need of additional core sampling of Seabrook structures for the purpose of monitoring and assessing the condition of ASR-affected reinforced concrete. For the long term, NextEra has elected to evaluate structural performance (operability) of the Seabrook ASR-affected reinforced concrete structures by developing a testing program involving large specimens that are fabricated to closely replicate the Seabrook concrete and reinforcement design. NextEra has pursued this method, instead of conducting detailed material properties testing of core samples, based upon available laboratory testing and data that indicates that measurable material properties of removed cores do not, under all circumstances, accurately represent the "in situ" mechanical properties of the concrete. The reason for the difference is that prior to removal of the core sample, that concrete specimen was subjected to the specific structural compressive stresses (dead loads, live loads, and hydrostatic loads) and reinforcement bar restraints of its location within the structural member. When removed from the structural member, that concrete specimen is wholly unrestrained. In addition, as identified in the associated core sampling standard (ASTM C42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete") core sample test results may be "....affected by many factors such as the strength level of the concrete, the in-place temperature and moisture histories, the degree of consolidation, batch-to-batch variability, the strength-gain characteristics of the concrete, the condition of the coring apparatus, and the care used in removing cores."

Team review of this issue has identified two general approaches to gaining an informed understanding of the impact of ASR on reinforced concrete structures. One approach is that being taken by NextEra to assess the overall structural performance of an ASR-affected structural member, much like (but not the same) as the performance of a load test prescribed by ACI 318, "Building Code Requirements for Structural Concrete," Chapter 20, "Strength Evaluation of Existing Structures." Whereas, the alternative approach involves analytical evaluations using as an input the measureable steel and concrete material property values derived from samples from the affected structure, also recognized by ACI 318, Chapter 20. NextEra is challenged to appropriately correlate the test program results to the Seabrook structures. Accordingly, NextEra plans to take additional core samples from both the test

Comment [A8]: Is it necessary to compare the Seabrook approach to the recommendations described in Chapter 20 of ACI 318?

specimens and the Seabrook structures to better correlate the large specimen test results using petrography and mechanical testing.

9.3 Containment Prompt Operability Determination (POD) and Pre-stressing Effects of ASR

As discussed in Inspection Report 05000443/2012009, the team noted that the confinement provided by the steel reinforcement bar (rebar) cage restrains ASR expansion resulting in ASR-induced or "chemical" pre-stressing of affected structural members. The team observed that NextEra had provided a qualitative explanation of this condition in the Interim Assessment (FP 100716), and in the containment structural evaluation and prompt operability determination (POD) (AR 1804477). The team concluded that a quantitative evaluation of this condition may be warranted to address this aspect of the non-conforming ASR condition.

During this inspection, the team discussed the impact of ASR-induced pre-stressing on reinforced concrete structures with NextEra's ASR Project Team and reviewed NextEra's assessment in AR/POD 1804477. The effect of "chemical" pre-stressing is to both increase the compressive stresses in the concrete (within the rebar cage) and to increase the tensile stresses in the rebar, as long as the rebar cage restraint is sustained. Similar to fabricated pre-stressed concrete structural members, the ultimate load carrying capacity of the reinforced member is not significantly changed by the ASR-induced pre-stress. Due to pre-stressing the load sharing between the concrete and steel reinforcement bars is altered, resulting in a stiffer structure that replicates a member fabricated with higher compressive strength concrete and steel reinforcements that functions closer to established yield limits. The team concluded that the ASR-induced pre-stressing may result in some beneficial effects in terms of structural stiffness, but agreed with NextEra's engineering evaluation that this additional structural stiffness, cannot be credited for structural design purposes. Further, ASR conditions may result in the steel reinforcement strain limits being exceeded that could challenge the structural performance of the rebar.

The team noted that NextEra had not quantified the ASR induced stresses in the concrete reinforcement. The team also noted that although the crack index had been measured at three containment locations, absent quantitative analyses, NextEra has not shown that the containment reinforcement was below yield. Further, the team noted that the current design code for containment (ASME Section III, 1971) does not allow containment reinforcement strains to be above yield "......in order to keep the containment basically elastic under service load conditions and below the range of general yield under factored primary loads, the allowable stresses and strains in this subsection shall not be exceeded."

The team noted, based on measured CCI data, that it may be possible for strains in containment reinforcement to be above yield. However, this condition is not certain absent a definitive correlation between the containment CCI values and stress/strain in the rebar. This matter was discussed with NextEra representatives who stated actions would be taken (reference AR/POD 1804477) to determine the effects of ASR relative to the containment design code requirements.

The team concluded that was no significant safety concern with reinforcement strain at this time because: (1) the containment is heavily reinforced and ASR is highly localized affecting a small percentage of containment area; (2) the concrete stain (crack index) measured at the surface might not reflect the condition of the reinforcement; (3) the expansion noted at the containment location with highest crack index (mechanical penetration room, 270 degree azimuth) may be surface shrinkage and not ASR, based upon the absence of confirmatory petrography; and, (4) the integrated leak rate test in 2010 showed the containment returing to preesisting conditions. See Section 9.6 of this report, "Planned Regulatory Actions," which describes NextEra's plans to address the containment non-conforming condition within the corrective action program.

Comment [A9]: I think this statement may give the wrong impression, i.e., if they were to perform a petrographic examination and confirm ASR, would there be a significant safety concern?

9.4 Assessment of the Need for Further Rebar Examinations

As documented in Inspection Report 05000443/2012009, Section 3.2.9, the NRC reviewed the potential for ASR having an adverse impact on rebar. NextEra and their engineering consultants had concluded that rebar is unaffected by ASR-degraded concrete unless the cover concrete is severely damaged and the rebar is exposed. They concluded that in spite of the alkali-silica reaction, ample alkali would remain in the concrete to preserve the condition of the rebar and preclude a corrosive environment.

The team determined that NextEra's position was acceptable. Based upon the examination of Seabrook rebar, although limited, and review of available industry operating experience associated with reinforced concrete degradation mechanism, the team concluded that at the current level of ASR there is no evidence to suggest that the reinforcing steel bars at Seabrook are corroding. In accordance with the Seabrook SMP and their referenced American Concrete Institute 349.3R-96, "Evaluation of Existing Nuclear Safety Related Concrete Structures," periodic visual inspections (signs of leaching, staining, spalling and popouts) coupled with soil and groundwater testing for aggressive chemistry conditions (chlorides, sulfates and pH) provide appropriate monitoring and industry recommended detection methodology. Inspections conducted have not identified any iron oxide staining attributed to rebar corrosion on any ASR-affected concrete structures at Seabrook. Consequently, the team has concluded that no additional rebar examinations (removing the cover concrete to expose rebar for visual inspection) are currently warranted.

Comment [A10]: What does this mean? Recommend clarification

9.5 Use of Combined Crack Indexing for Structures Monitoring Program

As previously documented in Inspection Report 05000443/2012009, Section 6.0, the team planned to examine NextEra's basis for using Combined Crack Indexing (CCI) as the primary SMP method to monitor the progression of ASR in Seabrook structures. The team noted that the basis for NextEra's selection of CCI for monitoring, as endorsed by the FHWA, is that CCI provides a direct visual and measurable method for the detection and monitoring of ASR progression. Although the objective of NextEra's UT-Austin testing program is to establish and correlate the degree of ASR progression to overall structural performance, the interim use of the CCI method and the 6-month interval measurements taken, to date, provide reasonable assurance that the level of degradation due to ASR remains essentially the same and that the progression rate is low. As such, the bounding engineering calculations and associated prompt operability determinations remain valid.

Best available information concerning the impact of ASR on a structural member indicates that the formation of ASR gel within the concrete matrix, and subsequent absorption of more water by that gel, results in gel expansion that generates stresses within the concrete matrix. These expansion stresses are both absorbed and transferred between the concrete and reinforcing steel bars, until eventually revealed by the patterned cracking (stress relief) on unrestrained *and/or exposed surfaces of the affected structure. For structures that are not triaxially* reinforced (as many of the walls at Seabrook Station, having only inner and outer surface horizontal and vertical reinforcements, but no through-wall struts or ties) the potential exist for some undetected out-of-plane crack formation and a potential undetected structural performance impact. As documented in Section 6, the large-scale testing program is intending to provide additional insights to the overall performance of these structural wall designs.

In support of the use of CCI, which is a two-dimensional concrete surface measurement, NextEra is developing plans to install deep pins in ASR-affected walls at Seabrook to better monitor ASR progression. The large scale test specimens fabricated at the UT-Austin facility include three-dimensional through-wall pin placements which will provide a more comprehensive measurement of the ASR expansion and associated impact on structural performance. NextEra hopes to install similar deep pins at the site in order to better correlate the UT-Austin testing results and the two-dimensional CCI data to actual structural performance.

As stated above, within the confines of the reinforcement cage, the ASR expansion is restrained and some of the expansion stresses are transferred to longitudinal strain in the reinforcing bars. As long as, neither the tensile strength of the concrete nor the steel rebar yield strength is compromised (exceed elastic limits), no visible cracking (stress relief) is expected. The amount of restraint imposed by the rebar cage is dependent upon the type, size and design of the rebar used. More heavily reinforced structures resist ASR expansion and may depict a different level of surface cracking compared to a lightly or non-reinforced structure with a similar degree of ASR progression.

9.6 Planned Regulatory Actions

As discussed in Section 6.0 above, and in NextEra's ASR Project CAP, the crediting the FSEL test results for demonstrating current and longer term operability of ASR-affected reinforced concrete structures will be evaluated pursuant to 10CFR50.59 and 10CFR50.90 (license amendment request). The team concluded that this approach appears reasonable and consistent with existing regulatory processes.

The team notes that Combined Crack Indexing (CCI) may become the principle method used by NextEra for monitoring the progression of ASR in affected structures. However, this method is not recognized by NRC regulatory and design standards, and is not within the current Seabrook licensing basis. Pending the results of the FSEL testing program, NextEra may propose the use of this methodology for assessing current and future operability of ASR-affected structures.

Comment [A11]: I'm not sure why the method for monitoring would have to be part of the CLB?

9.7 ASR Impact on Containment

As part of NextEra's extent of condition review, evidence of ASR was identified on the exterior surface of containment structure. NextEra initiated a prompt operability determination (No.

1804477) and concluded containment was fully operable and capable of meeting all its design basis functions, with some reduced margin. At the conclusion of this inspection, NextEra had not yet developed a plan for resolving this non-conforming condition. As this issue has been documented in the Seabrook CAP with an open operability determination, resolution of the issue will be monitored via the ROP baseline inspection activities.

10.0 Review of Six-Month Combined Crack Indexing Data

Inspection Scope

The team reviewed the periodic concrete expansion measurements for ASR-impacted Seabrook structures. Specifically, the team examined the supporting documentation for the ASR Crack Index Report dated March 18, 2013 (FP 100811) and the ASR Expansion Measurements Report dated March 18, 2013 (FP100812). The team also conducted interviews and discussions with the responsible NextEra engineering staff. The team used 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and Criterion XI, "Test Control," as the regulatory guidance to assess the adequacy of NextEra's actions to address ASR-affected reinforced concrete structures.

Findings and Observations

No findings were identified. Overall, the combined crack index (CCI) data show some evidence of continued ASR degradation, but the expansion data (pin to pin measurements) showed no significant changes. There was no change in the CCI data for the containment, but the Electric Tunnel and the Primary Auxiliary Building/Residual Heat Removal (PAB/RHR) vault both show a positive trend in CCI value in the six months since June 2012. While this may be the result of seasonal affects, ASR degradation appears to be ongoing in some Seabrook structures as indicated by some minor incremental crack growth. Collectively, the CCI measurements indicate essentially no structural changes; and therefore no challenges to the conclusions in the current ASR-affected structures' prompt operability determinations. The team noted NextEra's plans to continue the 6-month CCI measurements to establish a stable trend in observable ASR expansion for each uniquely ASR-affected structure. Continued periodic measurements should eliminate the potential influence of seasonal ambient temperature changes from the trend results.

CCI Measurements

In the ASR Crack Index Report (FP100811), NextEra measured CCI values for 26 locations in the monitoring program and compared the results to the data taken in June 2012. The CCI data shows an apparent increase in most (18 of 26) of the monitored locations. NextEra identified that the CCIs measured in December 2012 appears larger than the CCI data measured in June 2012. NextEra concluded the apparent increase in CCI values was due to seasonal temperature variations because the concrete (in December) was significantly colder, which may cause the concrete to contract between the cracks, increasing the apparent crack widths.

The team noted that 3 of 7 monitored locations on the exterior of plant buildings (above grade and more susceptible to seasonal temperature and moisture variations), showed a decrease in

CCI from June to December. Further, 15 of 18 areas showing an increase in crack index were areas monitored on interior buildings surfaces and/or below grade; and therefore less susceptible to seasonal temperature variations. In particular, the Electric Tunnel (areas 3b, 4, and 5) and the PAB/RHR Vault (areas 17, 18, 22, and 23) all show a CCI value increase of between 0.20 to 0.26 mm/m compared to June 2012. These interior, below-grade areas have been chronically wet from ground water infiltration. The team noted there was no change in the CCI values for the Containment Building (Location 14 - Mechanical Penetration MF102-01).

As reported by NextEra, uneven cracking (total crack width in one direction is much larger than in the other direction) and measured larger cracks were identified in the horizontal direction compared to the vertical. The team observed that, over the long term, averaging the horizontal and vertical CCI values may be an adequate representation of overall changes due to ASR of the specific structural member. However, the practice of averaging the horizontal and vertical CCI values is different than outlined by available industry guidance (FHWA-HIF-09-004) that recognizes the influence of reinforcements on crack growth. Thus, reporting an averaged CCI vice directional CCI values separately, could mask the expansion in a preferred direction and hamper the identification of a trend, in the short term. NextEra acknowledged this team observation and initiated a Condition Report (CR 1758920-39) to evaluate this issue.

The team also noted that NextEra revised the method of calculating CCI in the recent 6-month measurement report (December 2012). The CCI measurement reporting method was changed to account for the use of rectangular grids to determine crack index, and thereby normalize index to the total number of lines in the both directions. In so doing, NextEra recalculated the CCI values for the December 2011 and June 2012 data to eliminate potential biasing errors. The team concluded that NextEra's more consistent use of a calculation method would aid the identification of apparent trends.

Structure Expansion Measurements

In the Expansion Measurement Report (FP100812), NextEra performed measurements between pins embedded in the surface of plant buildings at the 26 established CCI monitoring locations. The 26 monitored locations were selected from the 131 locations identified in the ASR Walkdown Report (reference FP100705) which exhibited the highest visible ASR-associated distress. NextEra noted a null result for expansion measurements between pins in most of the 26 monitored locations. Specifically, data recorded in most (436) measurement lines showed no significant changes compared to the baseline data. However, for 5 of the 436 measurement lines, NextEra noted length changes that were unexpected. Further, NextEra noted that the gage points at CCI monitoring locations 1, 9, and 14 had moved out of range of the measurement instrument. NextEra plans to evaluate these locations further.

The team noted that the crack index data shows apparent increase when expansion data in 2-dimensions shows no change. It appears that the CI data better reflects expansion (strain) in the structure compared to the expansion measurements in only 2-dimensions, which may not be a complete indicator of changes in the structure. The team noted that NextEra plans to add deep pins to ASR impacted walls in the monitored locations that will allow expansion measurements in the third direction.

11.0 Review of Adequacy of Revisions to the Phase 3 Walkdown Plans and Schedule

Inspection Scope

During the previous inspection, the team reviewed the overall thoroughness of NextEra's completed and planned ASR walkdown activities conducted in accordance with FP 100642, "ASR Walkdown Scope," Revision 1, and documented in FP 100705, "Seabrook Station: Summary of Alkali Silica Reaction Walkdown Results," Revision 0. At the time of the inspection, not all of the potentially affected structures had been examined and NextEra had drafted a tentative schedule for the completion of the Phase 3 (areas not readily accessible) walkdowns. During this inspection, the team assessed NextEra's final Phase 3 schedule for completeness and to ensure a timely examination of the extent of condition of ASR-affected structures.

Findings and Observations

No findings were identified.

NextEra's ASR extent of condition structures 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 at the earliest opportunity (e.g. routine maintenance or outage activities). Team examination of the Phase 3 walkdown areas identified a minor documentation issue (in addition to the previously documented containment IWL inspection oversight) that the spent fuel pool (SFP) reinforced concrete walls were not included in the planned Phase 3 walkdown. The SFP walls pose a particular challenge to NextEra due to the limited accessibility of the concrete surfaces. At the conclusion of this inspection, NextEra was working to complete their evaluation of various methods to assess the SFP concrete walls. A target date of June 30, 2013 was established to develop the necessary steps to accomplish this task (reference ASR Project Corrective Action Plan, revised April 2013). NextEra had already initiated plans to remove a core sample from the SFP telltale sump, per an earlier commitment made under the license renewal process (reference ____________).

The team assessed the Phase 3 walkdown schedule and concluded the target dates for completion were reasonable. With respect to completing a comprehensive examination of the containment structure, the team concluded that performing this inspection concurrent with the scheduled 2015 refueling outage IWL examination was appropriate and commensurate with the safety significance of the issue. The balance of the Phase 3 extent of condition walkdowns are scheduled for completion in mid-to-late 2013 and during the April 2014 refueling outage. In summary, the team concluded that NextEra's completed and planned extent of condition reviews for identification of ASR-affected reinforced concrete structures was appropriate.

12.0 Aircraft Impact Review

Inspection Scope

The team reviewed NextEra's evaluation of the aircraft impact study performed in response to the identification of ASR. The aircraft impact study for Seabrook containment is described in UFSAR Section 3.8.1.3 and Appendix 2P. As noted in the Updated Final Safety Analysis Report (UFSAR), the postulated aircraft impact load is not combined with any other containment transient design loading. Further, the study assumes the impact area to be on the dome just above the spring line.

Findings and Observations

No findings were identified.

The effects of an aircraft impact were found not to be controlling for overall containment design considerations. Also, the analysis assumes that the enclosure building fails when struck by the aircraft and deforms until the aircraft contacts the containment structure. The containment enclosure building design and analysis is described in UFSAR Section 3.8.4. NextEra's evaluation states that ASR has only been identified in below grade elevations of the containment and containment enclosure buildings, where sufficient moisture has contributed to ASR progression. To date, no above grade (or vicinity of the anticipated aircraft impact area) evidence of ASR has been identified on containment. As discussed in Section 11, a detailed ASR inspection in conjunction with the IWL examination will be conducted in 2015. Accordingly, NextEra has concluded that the Seabrook aircraft impact study remains valid and unaffected, based upon engineering evaluations of other ASR-affected reinforced concrete structures completed, to date.

13.0 UT-Austin Ferguson Structural Engineering Laboratory Visits

Scope of Review

On two separate occasions, members of the team visited the UT-Austin testing facility to observe ongoing activities and inspect general facility quality assurance and control measures as implement per NextEra's regulatory obligations. The team noted that NextEra has contractual agreements with MPR Associates and the UT-Austin Ferguson Structural Engineering Laboratory to oversee and conduct, respectively, the ASR large scale testing program. The team toured the facility, including: main fabrication and testing areas with overhead crane lifting capabilities; outside exposed and protected (green house) specimen curing areas, with continuous or cyclic wetting and drying capability; aggregate and sand storage yard; and office and laboratory spaces for storage and use of calibration and test equipment, as well as, environmentally controlled storage units for a variety of mortar bar, prism, and concrete cylinder test specimens. The team examined the large block anchor bolt test specimens, including the control specimen block which had been tested. The team also witnessed fabrication of the second large shear and lap-splice test beam, and some testing of cylinders for compressive strength and Modulus of Elasticity determination.

Findings and Observations

No findings were identified. The team verified appropriate oversight and quality control practices being implemented. Direct oversight by both UT-Austin supervisory staff and MPR engineers was evident and effective.

14.0 Meetings, Including Exit

On June 27, 2013, 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
None

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."

Documents Reviewed at FSEL

1. Purchase Order No. 0326 – 0058 -25, dated December 1, 2011 and change order Nos. 1, dated March 21, 2012; No. 2, dated March 27, 2012; No. 3, dated July 23, 2012; and No. 4, August 2, 2012 between MPR Associates Inc. and Ferguson Structural Engineering Laboratory as applied to Anchor Testing Program

2. Contract No. 02293285, dated June 6, 2011, and Amendment Nos. 1, dated October 25, 2011; No. 2, dated December 17, 2011; No. 003, dated January 3, 2012; No. 004, dated February 27, 2012; Amendment 6, dated July 26, 2012, between NextEra and MPR Associates Inc.

3. MPR Letter to Ferguson Structural Engineering Laboratory, dated December 1, 2011, Notice of Intent to Contract for Testing of Anchors in ASR-affected Concreter – authorizing FSEL to develop project-specific quality system manual, implementing procedures for testing and perform initial characterization of the ASR degradation on girders.

4. MPR Letter to Ferguson Structural Engineering Laboratory, dated December 1, 2011, Research on Performance of Anchors in ASR-affected Concrete

5. MPR Letter to Ferguson Structural Engineering Laboratory, dated March 27, 2012, Research on Performance of Anchors in ASR-affected Concrete

6. MPR Letter to Ferguson Structural Engineering Laboratory, dated July 23, 2012, Research on Performance of Anchors in ASR-affected Concrete

7. MPR Letter to Ferguson Structural Engineering Laboratory, dated August 2, 2012, Research on Performance of Anchors in ASR-affected Concrete

8. MPR Letter to Ferguson Structural Engineering Laboratory, dated October 26, 2012, Research on Performance of Anchors in ASR-affected Concrete

9. Purchase Order No. 0326 – 0063 -01, dated June 4, 2012, between MPR Associates Inc. and Ferguson Structural Engineering Laboratory as applied to Beam Testing Program

10. Contract No. 02207204, dated April 27, 2012, NextEra and MPR Associates Inc., related to ASR Concrete Beam Testing Program (for Shear and Lap-splice anchorage)

11. Project Plan 0326 – 0062 -01, Revision 0, dated May 1, 2012, by MPR Associates Inc. as applied to Beam Testing Program

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

Marshall, Michael

From: Erickson, Alice
Sent: Thursday, August 01, 2013 7:34 AM
To: Marshall, Michael
Subject: SBK Inspection Report Follow-up
Attachments: IR 2012-010 draft 7-23-13 - AE comments.docx

outside scope of FOIA

Good Morning Michael,

I've added a comment to Section 11 to address the Region's reference to a LR commitment Outside of Scope
Outside of Scope

Alice Erickson
Structural Engineer
Office of Nuclear Reactor Regulation
Division of License Renewal
Aging Management of Structures, Electrical, and Systems Branch

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C72

ENCLOSURE

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

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

SUBJECT: SEABROOK STATION, UNIT NO. 1 - CONFIRMATORY ACTION LETTER FOLLOW-UP INSPECTION - NRC INSPECTION REPORT 05000443/2012010

Dear Mr. Walsh:

On June 27, 2013, 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 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.

The NRC determined that the eleven actions committed to in CAL have been satisfactorily completed. The team independently verified that NextEra had appropriately assessed and determined that all ASR affected structures remain operable. The team also confirmed that your root cause evaluation was thorough and identified appropriate corrective actions.

Many important corrective actions necessary to resolve this issue are currently in progress. These actions include your planned two year test program of ASR affected large scale concrete specimens at the University of Texas, Ferguson Structural Engineering Laboratory (FSEL). Therefore, while our review of the CAL items was completed during this inspection, the NRC will continue to provide oversight of both NextEra's testing program at the FSEL and onsite ASR related activities. Our final decision regarding closure of the CAL will be provided to NextEra in a future correspondence.

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,

Raymond K. Lorson, Director
Division of Reactor Safety

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

Enclosures:
1. Inspection Report No. 05000443/2012010
   w/ Attachment: Supplemental Information
2. Confirmatory Action Letter 1-2012-002

cc w/encl: Distribution via ListServ

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,

Raymond K. Lorson, Director
Division of Reactor Safety

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

Enclosures:
1. Inspection Report No. 05000443/2012010
   w/ Attachment: Supplemental Information
2. Confirmatory Action Letter 1-2012-002

cc w/encl: Distribution via ListServ

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U.S. NUCLEAR REGULATORY COMMISSION

REGION I

Docket No.:	50-443
License No.:	NPF-86
Report No.:	05000443/2012010
Licensee:	NextEra Energy Seabrook, LLC
Facility:	Seabrook Station, Unit No. 1
Location:	Seabrook, New Hampshire 03874
Dates:	November 3, 2012 to April 30, 2013
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 (DLR), Office of Nuclear Reactor Regulation (NRR) G. Thomas, Structural Engineer, Division of Engineering, NRR A. Sheikh, Senior Structural Engineer, DLR, NRR N. Floyd, Reactor Inspector, DRS
Approved by:	James Trapp, Chief, Engineering Branch 1 Division of Reactor Safety

SUMMARY OF FINDINGS

IR 05000443/2012010; 11/03/2012 - 06/27/2013; Seabrook Station, Unit No. 1; Confirmatory Action Letter (CAL) Follow-up Inspection Report.

This report covered several weeks of onsite inspection at Seabrook Station, two weeks of inspection at the Ferguson Structural Engineering Laboratory (FSEL) University of Texas – Austin, and periodic in-office reviews, over the past eight months, 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.

Comment [A1]: Recommend using the same wording from the cover letter (highlighted) for consistency.

Cornerstone: Mitigating Systems

During this second CAL follow-up inspection, the team examined the remaining six commitments documented in CAL No. 1-2012-002, dated May 16, 2012. The CAL items reviewed and closed during this inspection were 2, 4, 7, 8, 9 and 11. In addition, a number of observations documented in the first CAL follow-up inspection (NRC Inspection Report 05000443/2012009, Section 9.0) were reviewed and closed in this report. Closure of CAL Item 7 was administrative, in that, NextEra had withdrawn this commitment by letter dated December 13, 2012 (ML12362A323). NextEra's revision to this commitment was approved by the NRC as documented in the CAL revision letter, dated January 14, 2013 (ML13014A555). Our assessment of CAL Item 7 and the remaining CAL items reviewed and closed are documented in the enclosed inspection report.

The review and closure of each CAL item signifies the NRC's satisfactory assessment of NextEra's commitments and planned corrective actions to address the non-conforming alkali-silica reaction in Seabrook reinforced concrete structures. However, the completion of the CAL follow-up inspections is not the completion of NRC review and oversight of NextEra's actions to address the ASR issue. As discussed in the team's review of CAL Item 4 and the revised ASR Project Corrective Action Plan (CAP), NextEra has implemented a number of ongoing activities, in addition to the FSEL testing program to address ASR-affected structures. The details of the NRC's plans to oversee these activities will be addressed separately.

Comment [A2]: Recommend deleting, or adding the word "condition," e.g., ... non-conforming condition ~~alkali-silica reaction~~ .....

NextEra's root cause evaluation (CAL Item 2) appropriately identified the significant causal and contributing factors resulting in ASR impacting reinforced concrete structures at Seabrook Station. NextEra's ASR Project CAP (CAL Item 4) sufficiently captures the numerous corrective actions taken and planned to address the ASR non-conforming condition, and remains a "living document" to track the resolution of ASR at Seabrook Station.

Mortar Bar Testing (CAL Item 6, reference NRC Inspection Report 05000443/2012009) was successfully completed and the results indicated sufficient reactive silica and alkali in the Seabrook structures to fuel the progression of ASR for the foreseeable future. Consequently, NextEra withdrew their commitment for Prism Testing (CAL Item 7) and the NRC staff administratively closed this commitment. The team reviewed NextEra's large specimen testing program technical specifications (CAL Item 8) and anchor testing program description (CAL Item 11) and concluded that these programs were sufficiently developed and described to support an appropriate understanding of the testing plans and objectives.

NextEra implemented a number of enhancements to the Structures Monitoring Program (CAL Item 9) to adequately monitor the progression of ASR, pending the completion and evaluation of results from the large specimen testing program. The team concluded these monitoring actions were consistent with currently available industry practices.

Lastly, the team reviewed and closed a number of observations discussed in the first CAL Follow-up Inspection, including: pending structural evaluations (13); containment POD observations; core sample material property testing; quantification of pre-stressing effects of ASR expansion; additional rebar examinations; crack indexing use in the SMP; and Phase 3 walkdown plans and schedule.

REPORT DETAILS

1.0 Background

Alkali-Silica Reaction (ASR) is a chemical reaction occurring in hardened concrete that can change the physical properties of concrete and 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 numerous Seabrook Category I structures was evaluated in the Corrective Action Program via prompt operability determinations (PODs). The PODs were revised as new information became available and improved 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 a traditional method described in American Concrete Institute (ACI) 228.1R, "In-Place Methods to Estimate Concrete Strength," 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, "Building Code Requirements for Reinforced Concrete," to evaluate the structural capacity (operability) of the ASR-affected structures. However, the mathematical relationships in ACI-318 are based on empirical data from testing of non-degraded concrete, and these relationships may not be valid for 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. Based on this conclusion, NextEra suspended 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.

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 small scale 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 some testing (anchors) commenced in 2013 and large beam testing scheduled to be completed by 2015. Based upon the slow progression of the ASR expansion, the current operability evaluations, coupled with the Structures Monitoring Program six-month combined crack indexing, provide reasonable assurance of continued structural operability until the testing program is completed.

2.0 Confirmatory Action Letter 1-2012-002

Confirmatory Action Letter 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. As documented in NRC Inspection Report No. 05000443/2012009, dated December 3, 2012 (ML12338A283) CAL Items 1, 3, 5, 6, and 10 were closed.

Based on the results of this inspection, the remaining six CAL Items 2, 4, 7, 8, 9, and 11 are closed.

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

Inspection Scope

As documented in Inspection Report No. 05000443/2012009, 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) in a letter to the NRC dated May 24, 2012 (ML12151A396). Based upon the team's initial review, the inspectors concluded that the second root cause identified was not sufficiently characterized in NextEra's May 24, 2012, submittal. Specifically, NextEra did not clearly describe the personnel and organizational factors that contributed to inadequacies in the Structures Monitoring Program (SMP) and the failure of the Seabrook staff to have identified ASR degradation of reinforced concrete structures sooner. The team discussed this observation with the responsible Seabrook staff and NextEra determined that a revision to the RCE was warranted and revised the RCE to more appropriately develop and characterize this second root cause and the associated corrective actions.

NextEra submitted a revised RCE summary for NRC review in a letter dated May 1, 2013, (ML13151A328, Enclosure 1). The team reviewed the revised RCE summary for clarity and appropriateness of associated corrective actions, consistent with guidance outlined in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and NextEra's Corrective Action Program (CAP).

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 2 is closed.

As documented in Enclosure 1 to the May 1, 2013 letter, NextEra summarized the two root causes, as follows: RC1 – the ASR developed because the concrete mix design unknowingly utilized a coarse aggregate that would, in the long term, contribute to ASR. Although the testing was conducted in accordance with American Society for Testing and Materials (ASTM) standards, those testing standards were subsequently identified as limited in their ability to predict slow reactive aggregate that produced ASR in the long term; and RC2 – based on the long standing organizational belief that ASR was not a credible failure mode due to the concrete mix design, dispositions for Condition Reports involving groundwater intrusion or concrete degradation, along with the structures health monitoring program did not consider the possibility of ASR development. In addition, NextEra identified a contributing cause involving the failure of the organization to prioritize groundwater elimination or mitigation resulting in more concrete area exposed to moisture.

The team verified that NextEra had appropriately identified the root cause(s). The ASTM concrete aggregate testing standards in effect at the time of plant construction were properly implemented, but later determined to be ineffective in identifying slow reacting, ASR susceptible aggregates. Those standards were subsequently revised by the industry and adopted by NextEra to prevent recurrence. NextEra's RCE concluded that the Structures Monitoring Program (SMP) did not remain current with concrete industry operating experience and associated failure modes, such as ASR. Contributing to the shortcomings in the SMP to have identified this concrete degradation mechanism earlier was the "organizational mindset" that the groundwater in-leakage was an operational nuisance and nothing more. Consequently, station and engineering staffs were insensitive to the potential detrimental effects of the ground water infiltration and did not assess the long term impact on station structures. The team concluded that NextEra's implementation of a broad periodic review process to ensure all systems and component monitoring programs remain current and effective was determined an appropriate corrective action for this causal factor.

4.0 Integrated Corrective Action Plan (CAL Item 4)

Inspection Scope

CAL No. 1-2012-002 documented NextEra's commitment to submit by June 8, 2012, a corrective action plan for the continued assessment of ASR in concrete structures at Seabrook Station including development of remedial actions to mitigate the effects of ASR, where warranted. By letter dated June 8, 2012 (ML12171A227), NextEra submitted their integrated corrective action plan (CAP) for NRC review. The CAP outlined the major elements of diagnosis, evaluation, prognosis and mitigation of ASR-affected structures as understood at the time. Since June 8, 2012, NextEra has made considerable progress in refining the elements of this plan, implementing the initial phases, and more clearly defining and focusing future actions. NextEra provided an updated ASR Project CAP in a letter dated May 1, 2013 (ML13151A328, Enclosure 2) to document these plan changes.

During this inspection period, the team conducted numerous discussions, meetings, and conference calls with NextEra, as well as onsite inspections at both Seabrook Station and UT-Austin to review NextEra's actions to address the ASR-affected reinforced concrete structures. From these interactions, the CAP has developed greater clarity of the necessary steps (corrective actions) to address this non-conforming condition impacting safety-related reinforced concrete structures. As previously documented in Inspection Report 05000443/2012009 and detailed in other sections of this report, the team assessed the adequacy of completed and ongoing ASR-related activities identified in the integrated CAP, consistent with guidance outlined in 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and NextEra's Quality Assurance Program.

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 4 is closed. NextEra's ASR project staff stated that they plan to maintain the ASR Project CAP as a "living document" and will update it periodically to capture completion of activities and add new actions, as appropriate.

5.0 Prism Testing Commitment Withdrawn (CAL Item 7)

Inspection Scope

CAL Item 7 committed NextEra to "Complete long term aggregate expansion testing (ASTM C 1293, Concrete Prism Test) by June 30, 2013." The purpose of this CAL item was to determine, in conjunction with the Mortar Bar Testing (CAL Item 6), if the coarse aggregate contributing to ASR in Seabrook reinforced concrete still contained sufficient reactive silica for the alkali-silica reaction to continue long-term under the existing environmental conditions. Alternatively, these tests could demonstrate that the progression of ASR at Seabrook maybe self-limiting due to the depletion of reactive silica in the concrete. The Prism Test (as defined by ASTM C1293) involves monitoring the expansion (by measurement of specimen elongation due to ASR) of the test specimen (a molded concrete brick approximately 3 by 5 by 12 inches in length) over a one year period. Expansion in excess of 0.04% is considered potentially deleterious and a positive test for slow reactive aggregate. The Prism Test is similar to the Mortar Bar Test (reference ASTM C1260), but has a duration of 14 days and an expansion limit of 0.1%.

Based upon the results of the completed Mortar Bar Expansion Testing (reference NRC Inspection Report No. 05000443/2012009, Section 5.0), NextEra concluded that the available quantities of silica in the concrete would not be depleted in the near term and that additional confirmatory testing via the Prism Test method was not warranted. NextEra ran the Mortar Bar Test several weeks beyond the 14-day test (terminated after 103 days) and observed that the alkali-silica reaction was still progressing at the conclusion of the test, indicating the presence of sufficiently reactive aggregate to maintain ASR for a longer period of time. The team noted that the Mortar Bar Test involved the reuse of aggregates from Seabrook test cores (concrete that had already experienced appreciable ASR) and similar aggregate from concrete not affected by ASR. The side-by-side comparison of the test specimens showed no appreciable difference in ASR progression or observed expansion rates. Accordingly, NextEra concluded the Prism Test would add no significant knowledge to the condition assessment of Seabrook concrete. NextEra concluded that all Seabrook reinforced structures are or may be affected by ASR, unless specifically ruled-out by further analysis, such as petrographic examination. By letter dated December 13, 2012, NextEra requested that CAL Item 7 be deleted. As documented in NRC letter dated January 14, 2013 (ML13014A555), the NRC accepted NextEra's technical basis for deleting CAL Item 7.

Findings and Observations

No findings were identified. CAL Item 7 is administratively closed.

6.0 Review of Technical Details of Large Specimen Testing Program (CAL Item 8)

Inspection Scope

CAL Item 8 committed NextEra to "Submit the technical details of the testing planned at the contracted research and development facility by June 30, 2012." By letter dated June 21, 2012, (ML12179A281) NextEra submitted the Shear and Lap Splice Testing overview prepared by the Ferguson Structural Engineering Laboratory (FSEL) at the University of Texas at Austin, dated March 15, 2012. The purpose of the test program, as described in the FSEL document, is to provide sufficient data and insights to establish the current and future implications of ASR on Seabrook reinforced concrete structures. Based upon limited available literature or test data relative to the impact of ASR on walls without transverse reinforcements (the majority of Seabrook ASR-affected structures) destructive testing of ASR-affected test specimens will be conducted to evaluate the impact of ASR on out-of-plane shear strength and lap splice development. The test specimens being prepared at FSEL will be of representative scale and design, such that the test results may be correlated to Seabrook structures.

The team reviewed the June 21, 2012 submittal and conducted a conference call on December 18, 2012, with the NextEra and UT-Austin FSEL staff to discuss the merits of the proposed test program. Based upon the complexity of the information discussed and follow-up inspection activities, NextEra prepared a test program overview document and a detailed test specification to supplement the June 21, 2012, CAL response letter. By letter dated May 1, 2013 (ML13151A328 redacted and ML13151A291 un-redacted) NextEra provided the NRC with the "Seabrook Station - Specification for Shear and Reinforcement Anchorage Testing of ASR-Affected Reinforced Concrete," (Enclosures 3 & 4) and "Approach for Shear and Reinforcement Testing of Concrete Affected by Alkali Silica Reaction," (Enclosure 5 & 6). Each of these documents has a proprietary and non-proprietary version.

The team reviewed the revised testing specification and the associated overview document to verify that the overall test program approach and application of test results would reasonably address the Seabrook ASR-affected concrete non-conforming condition. The team discussed the test program with the FSEL, MPR and responsible NextEra engineering staffs.

Findings and Observations

No findings were identified. Based upon team review of the submitted testing program documents and related inspection activities, the team concluded that NextEra has provided a satisfactory explanation of the proposed large-scale specimen testing program, and CAL Item 8 is closed.

The team concluded that NextEra's approach has technical merit. However, as documented in NextEra's ASR Project CAP (ML 13151A328, Enclosure 2) the acceptance of the testing results to resolve ASR concerns associated with design basis structural calculations will follow the regulatory process for approval and will include evaluations pursuant to 10 CFR 50.59 and 10 CFR 50.90. As stated above, the submitted test plans satisfy NextEra's commitment to explain the scope and depth of the large-scale specimen testing program.

7.0 Review of Structures Monitoring Program (CAL Item 9)

Inspection Scope

CAL Item 9 committed NextEra to implement an update to the Maintenance Rule (10CFR50.65) Structures Monitoring Program (SMP) to include monitoring requirements for selected locations in areas that exhibit ASR by July 15, 2012. NextEra issued Revision 2 to Structural Engineering Standard 36180, "Structural Monitoring Program," effective July 12, 2012. The primary changes incorporated in Revision 2 to the SMP were: 1) performing periodic (every six months) crack indexing measurements at 26 locations to collect quantitative information on the progression of ASR expansion/degradation; 2) establishing crack width (1.0 mm or greater) and Combined Crack Index (1.0 mm/m or greater) thresholds for conducting structural evaluations (reference Foreign Print 100716, Seabrook Station: Impact of ASR on Concrete Structures and Attachments); and 3) the addition of Federal Highway Administration (FHWA) document FHWA-HIF-09-004, "Report on the Diagnosis, Prognosis, and Mitigation of Alkali-Silica Reaction in Transportation Structures," dated January 2010, as a reference.

The team reviewed the adequacy of these changes to the SMP to monitor ASR in Seabrook reinforced concrete structures. While not endorsed by the NRC or committed to by NextEra in Seabrook's licensing basis, the team used the American Concrete Institute (ACI) Committee Report 349.3R-96, "Evaluation of Existing Nuclear Safety-Related Concrete Structures," as a reference to assess the adequacy of the revisions made to the SMP for monitoring the progression of ASR.

Based in part on NRC observations, NextEra issued Revision 3 to the SMP on April 30, 2013. The principle changes in Revision 3 of the SMP are: 1) the addition of periodic (every 30 months) combined crack indexing (CCI) measurements at 72 discrete locations identified as Tier II (Acceptable with Deficiency) areas (CCI values between 0.5 mm/m and 1.0 mm/m, or crack widths greater than 0.2 mm, but less than 1.0 mm) to collect quantitative information on the progression of ASR expansion/degradation (this monitoring was being performed, but not documented in the SMP); and, 2) inclusion of the periodic ground water sampling program for monitoring of chemical attributes detrimental to concrete structures. During follow-up discussion with the NextEra staff, the team noted that NextEra is considering additional SMP revisions, dependent upon the results of the large specimen test program and further engineering evaluation. One of the revisions involves the installation of deep pins for monitoring of expansion in the out-of-plane direction (reference NextEra's May 1, 2013, Response to Confirmatory Action Letter (ML13151A328) Enclosure 2, ASR Project Corrective Action Plan).

Findings and Observations

The team identified no findings in this area. CAL Item 9 is closed.

The team noted that changes made to the SMP to address ASR were generally consistent with the evaluation and monitoring methods outlined in ACI 349.3R-96. The team confirmed that NextEra had incorporated a three-tiered visual inspection criteria, as outlined in Sections 5.1 through 5.3 of ACI 349.3R-96. NextEra has also augmented this visual inspection criteria with periodic (six-month and 30-month interval) CCI measurements and associated structural evaluation thresholds based upon direct measurement (CCI) results. The CCI monitoring, performed at 98 selected locations (including containment) was implemented by NextEra based upon this method being a readily measurable indicator of ASR related progression and based, in part, upon endorsement by FHWA and outlined in FHWA-HIF-09-004.

The crack growth monitoring provides a visual indication of the progression of ASR within a reinforced concrete structure. The relative width and number of visible cracks may be correlated to the overall progression of ASR and may be used to evaluate ASR impact on structural performance. However, ASR cracking and crack propagation is closely associated with the specific reinforcement design and structural loading. Accordingly, the adequacy of CCI measurement as a long term structures monitoring methodology for Seabrook structures is being further evaluated by NextEra as part of the UT-Austin FSEL testing program. The results of the UT-Austin testing program is intended to be used to validate this methodology for application at Seabrook.

Evaluation of infiltration water chemistry and groundwater monitoring: ACI 349.3R-96 discusses environmental monitoring and related effects of aggressive water chemistry, including the potential for leaching. Accordingly, NextEra has integrated the periodic monitoring of ground water chemistry into the SMP (reference Revision 3, dated 4/30/2013, Attachment 4). NextEra plans to investigate the expansion of the water chemistry monitoring program (reference AR No. 1758920-40) to include periodic analysis of infiltrated water (water that has migrated through below grade reinforced concrete walls). The establishment of an initial baseline analysis and continued periodic monitoring could provide some relative trend data for further evaluation and follow-up actions, as appropriate.

The team concluded that the implemented and planned SMP enhancements provide NextEra with an improved program to assess the extent and degree of ASR progression and to more thoroughly monitor the environmental factors contributing to ASR. NextEra's initial SMP revision (Revision 2) was adequate; however, the SMP Revision 3 enhancements include multiple activities that are better aligned with ACI 349.3R guidance.

8.0 Review of Anchor Testing Program (CAL Item 11)

Inspection Scope

The micro-cracking caused by ASR may adversely impact the structural capacity of anchors that support safety-related piping, cable trays and other components. NextEra's initial operability determinations were supported by anchor performance testing conducted on available ASR degraded specimens previously fabricated at or obtained by FSEL, UT-Austin (reference FP 100718). As documented in Inspection Report 05000443/2012009, the initial testing demonstrated satisfactory performance of the anchors in ASR-affected concrete during the earlier stages of ASR progression. NextEra's evaluation also stated that the eventual reduction in capacity due to ASR was sufficiently offset by established anchor manufacturer's design margins (FP 100716). However, based upon the limitations of the testing performed (on ASR-affected test specimens of different composition and compressive strength than Seabrook reinforced concrete structures) NextEra planned to conduct additional testing. The planned testing involves anchors installed (both during specimen fabrication and post-fabrication) in ASR-affected test specimens that more closely replicate the reinforced concrete structures and anchor configurations at Seabrook.

By licensee letter dated December 13, 2012, (ML12362A323) NextEra requested a revision to CAL Item 11 to address a schedule challenge to the targeted anchor testing program completion date. NextEra also proposed redefining CAL Item 11 to be consistent with the wording of CAL Item 8, regarding large-scale specimen testing. Specifically, NextEra revised their commitment to read, "Submit technical details of the anchor test program planned at the contracted research and development facility by February 28, 2013." The original commitment read, "Complete anchor test program by December 31, 2012. Results will be available for NRC review approximately 30 days after testing is complete." Based upon unexpected specimen fabrication delays and the slow progression of accelerated ASR aging, NextEra identified that it would not be possible to complete the anchor testing per the original commitment date. The NRC accepted NextEra's revised commitment, as documented in NRC letter dated January 14, 2013 (ML13014A555).

The team reviewed the details and adequacy of NextEra's anchor testing program as outlined in the proprietary "Anchor Testing Program Overview," dated February 26, 2013. The anchor testing program overview and associated testing specifications were docketed for NRC review via NextEra letter dated February 28, 2013 (ML13088A218 redacted and ML13088A229 un-redacted, dated March 15, 2013). The technical overview document and accompanying specifications outline the major elements of the proposed anchor testing program, including the key attributes of the fabrication of the test specimens, monitoring of the specimens as accelerated ASR aging progresses, and the details of the testing of individual anchor bolt configurations.

Findings and Observations

The team identified no findings. Based upon the team's review, CAL Item 11 is closed.

During the team's visits to the UT-Austin FSEL, the team observed the conditions and controls implemented for the aging of the test blocks and testing of concrete sample cylinders for compressive strength and modulus of elasticity. The team witnessed appropriate implementation of the testing procedures by FSEL staff and proper oversight of these activities by the MPR quality assurance staff.

At the conclusion of this inspection, the desired level of ASR progression in the test blocks had not been achieved to conduct the first round of ASR-affected anchor testing. The team reviewed the results of the control specimen anchor testing completed in November 2012. The purpose of the control specimen testing was to establish a baseline to determine the potential reduction in anchor bolt capacity due to ASR. Review of the test data (reference MPR Memorandum DRN 0326-0058-163, dated June 18, 2013) identified that all anchor bolts test results were in agreement with calculated capacities and an appropriate baseline had been established for comparison during future testing.

9.0 Review of Previously Identified Issues of Interest

9.1 Structural Evaluations for 13 Locations

As documented in Inspection Report 05000443/2012009, NextEra identified 26 locations (including containment) as having patterned cracking with a CCI of greater than 1.0 mm/m. In accordance with the SMP, Revision 2, structures with a CCI of >1.0 mm/m require a structural evaluation. NextEra's Interim Assessment documented an engineering judgment that biased the performance of detailed structural evaluations to the 11 locations with a CCI > 1.5 mm/m. 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 a minor performance deficiency which NextEra entered into the Corrective Action Program (AR 1804477 and AR 1819080). During this inspection, the team reviewed Calculation C-S-10168, Revision 1, and FP 100716, "Seabrook Station: Impact of Alkali-Silica Reaction on Concrete Structures and Attachments," Revision 2, which incorporated the additional evaluations for the 13 locations.

The evaluation methodology included reviewing the original calculations that govern the design of the structures to determine the design parameters associated with the general area of ASR degradation. The structural member's load demand and capacity were then noted and the margin calculated for comparison against the potential reductions in load capacities caused by ASR. The assumed reductions in capacity were determined based on lower bound values established in industry literature. A summary of the evaluation results was provided in Table 3 of FP100716, Revision 2. For areas where design margins were insufficient to offset assumed reductions, further review was performed to recapture margin Specifically, for two areas (Electric Tunnel and Discharge Structure), the design calculation used conservative load factors which were lowered to establish more representative demand loads, as described in Calculation C-S-1-10168, Revision 1. NextEra demonstrated additional margin to assure structural integrity despite the assumed reduction in capacity due to ASR. However, in the calculation for Electric

Tunnel area MF101 (C-S-1-10168, pg 30), NextEra reduced the hydrostatic load factor (1.4) to achieve a more realistic load demand. NextEra plans to credit the 1.4 load factor in the load demand calculation to establish full qualification per the Final Safety Evaluation Report (FSAR) licensing basis in the final operability determination, following completion of the testing program at UT-Austin.

The team concluded that NextEra's initial approach to perform a bounding analysis for areas with CCI >1.5 mm/m was not conservative, because the design margins vary in each structural member of each reinforced concrete structure. This conclusion highlights the need, once the impact of the ASR degradation on structural capacities is determined from the UT-Austin FSEL test program, for NextEra to closely review the design calculations for each ASR impacted area to assure margins remain acceptable without having to remove or reduce the load factors assumed in the current licensing basis.

9.2 Review of Core Sample Material Property Testing

As documented in Inspection Report 05000443/2012009, Section 3 2 9, the NRC planned to reexamine the need of additional core sampling of Seabrook structures for the purpose of monitoring and assessing the condition of ASR-affected reinforced concrete. For the long term, NextEra has elected to evaluate structural performance (operability) of the Seabrook ASR-affected reinforced concrete structures by developing a testing program involving large specimens that are fabricated to closely replicate the Seabrook concrete and reinforcement design. NextEra has pursued this method, instead of conducting detailed material properties testing of core samples, based upon available laboratory testing and data that indicates that measurable material properties of removed cores do not, under all circumstances, accurately represent the "in situ" mechanical properties of the concrete. The reason for the difference is that prior to removal of the core sample, that concrete specimen was subjected to the specific structural compressive stresses (dead loads, live loads, and hydrostatic loads) and reinforcement bar restraints of its location within the structural member. When removed from the structural member, that concrete specimen is wholly unrestrained. In addition, as identified in the associated core sampling standard (ASTM C42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete") core sample test results may be "....affected by many factors such as the strength level of the concrete, the in-place temperature and moisture histories, the degree of consolidation, batch-to-batch variability, the strength-gain characteristics of the concrete, the condition of the coring apparatus, and the care used in removing cores."

Team review of this issue has identified two general approaches to gaining an informed understanding of the impact of ASR on reinforced concrete structures. One approach is that being taken by NextEra to assess the overall structural performance of an ASR-affected structural member, much like (but not the same) as the performance of a load test prescribed by ACI 318, "Building Code Requirements for Structural Concrete," Chapter 20, "Strength Evaluation of Existing Structures." Whereas, the alternative approach involves analytical evaluations using as an input the measureable steel and concrete material property values derived from samples from the affected structure, also recognized by ACI 318, Chapter 20. NextEra is challenged to appropriately correlate the test program results to the Seabrook structures. Accordingly, NextEra plans to take additional core samples from both the test specimens and the Seabrook structures to better correlate the large specimen test results using petrography and mechanical testing.

9.3 Containment Prompt Operability Determination (POD) and Pre-stressing Effects of ASR

As discussed in Inspection Report 05000443/2012009, the team noted that the confinement provided by the steel reinforcement bar (rebar) cage restrains ASR expansion resulting in ASR-induced or "chemical" pre-stressing of affected structural members. The team observed that NextEra had provided a qualitative explanation of this condition in the Interim Assessment (FP 100716), and in the containment structural evaluation and prompt operability determination (POD) (AR 1804477). The team concluded that a quantitative evaluation of this condition may be warranted to address this aspect of the non-conforming ASR condition.

During this inspection, the team discussed the impact of ASR-induced pre-stressing on reinforced concrete structures with NextEra's ASR Project Team and reviewed NextEra's assessment in AR/POD 1804477. The effect of "chemical" pre-stressing is to both increase the compressive stresses in the concrete (within the rebar cage) and to increase the tensile stresses in the rebar, as long as the rebar cage restraint is sustained. Similar to fabricated pre-stressed concrete structural members, the ultimate load carrying capacity of the reinforced member is not significantly changed by the ASR-induced pre-stress. Due to pre-stressing the load sharing between the concrete and steel reinforcement bars is altered, resulting in a stiffer structure that replicates a member fabricated with higher compressive strength concrete and steel reinforcements that functions closer to established yield limits. The team concluded that the ASR-induced pre-stressing may result in some beneficial effects in terms of structural stiffness, but agreed with NextEra's engineering evaluation that this additional structural stiffness, cannot be credited for structural design purposes. Further, ASR conditions may result in the steel reinforcement strain limits being exceeded that could challenge the structural performance of the rebar.

The team noted that NextEra had not quantified the ASR induced stresses in the concrete reinforcement. The team also noted that although the crack index had been measured at three containment locations, absent quantitative analyses, NextEra has not shown that the containment reinforcement was below yield. Further, the team noted that the current design code for containment (ASME Section III, 1971) does not allow containment reinforcement strains to be above yield "......in order to keep the containment basically elastic under service load conditions and below the range of general yield under factored primary loads, the allowable stresses and strains in this subsection shall not be exceeded."

The team noted, based on measured CCI data, that it may be possible for strains in containment reinforcement to be above yield. However, this condition is not certain absent a definitive correlation between the containment CCI values and stress/strain in the rebar. This matter was discussed with NextEra representatives who stated actions would be taken (reference AR/POD 1804477) to determine the effects of ASR relative to the containment design code requirements.

The team concluded that was no significant safety concern with reinforcement strain at this time because: (1) the containment is heavily reinforced and ASR is highly localized affecting a small percentage of containment area; (2) the concrete stain (crack index) measured at the surface might not reflect the condition of the reinforcement; (3) the expansion noted at the containment location with highest crack index (mechanical penetration room, 270 degree azimuth) may be surface shrinkage and not ASR, based upon the absence of confirmatory petrography; and, (4) the integrated leak rate test in 2010 showed the containment returing to preesisting conditions. See Section 9.6 of this report, "Planned Regulatory Actions," which describes NextEra's plans to address the containment non-conforming condition within the corrective action program.

Comment [A3]: This statement may give the wrong impression, i.e., if they were to perform a petrographic examination and confirm ASR, would there be a significant safety concern? Consider deleting the third item from this list.

9.4 Assessment of the Need for Further Rebar Examinations

As documented in Inspection Report 05000443/2012009, Section 3.2.9, the NRC reviewed the potential for ASR having an adverse impact on rebar. NextEra and their engineering consultants had concluded that rebar is unaffected by ASR-degraded concrete unless the cover concrete is severely damaged and the rebar is exposed. They concluded that in spite of the alkali-silica reaction, ample alkali would remain in the concrete to preserve the condition of the rebar and preclude a corrosive environment.

The team determined that NextEra's position was acceptable. Based upon the examination of Seabrook rebar, although limited, and review of available industry operating experience associated with reinforced concrete degradation mechanism, the team concluded that at the current level of ASR there is no evidence to suggest that the reinforcing steel bars at Seabrook are corroding. In accordance with the Seabrook SMP and their referenced American Concrete Institute 349.3R-96, "Evaluation of Existing Nuclear Safety Related Concrete Structures," periodic visual inspections (signs of leaching, staining, spalling and popouts) coupled with soil and groundwater testing for aggressive chemistry conditions (chlorides, sulfates and pH) provide appropriate monitoring and industry recommended detection methodology. Inspections conducted have not identified any iron oxide staining attributed to rebar corrosion on any ASR-affected concrete structures at Seabrook. Consequently, the team has concluded that no additional rebar examinations (removing the cover concrete to expose rebar for visual inspection) are currently warranted.

Comment [A4]: Reinforced concrete is not a degradation mechanism. "Reinforced concrete" or "Reinforced concrete degradation mechanism" should be replaced with a degradation mechanism such as corrosion.

9.5 Use of Combined Crack Indexing for Structures Monitoring Program

As previously documented in Inspection Report 05000443/2012009, Section 6.0, the team planned to examine NextEra's basis for using Combined Crack Indexing (CCI) as the primary SMP method to monitor the progression of ASR in Seabrook structures. The team noted that the basis for NextEra's selection of CCI for monitoring, as endorsed by the FHWA, is that CCI provides a direct visual and measurable method for the detection and monitoring of ASR progression. Although the objective of NextEra's UT-Austin testing program is to establish and correlate the degree of ASR progression to overall structural performance, the interim use of the CCI method and the 6-month interval measurements taken, to date, provide reasonable assurance that the level of degradation due to ASR remains essentially the same and that the progression rate is low. As such, the bounding engineering calculations and associated prompt operability determinations remain valid.

Best available information concerning the impact of ASR on a structural member indicates that the formation of ASR gel within the concrete matrix, and subsequent absorption of more water by that gel, results in gel expansion that generates stresses within the concrete matrix. These expansion stresses are both absorbed and transferred between the concrete and reinforcing steel bars, until eventually revealed by the patterned cracking (stress relief) on unrestrained and/or exposed surfaces of the affected structure. For structures that are not triaxially reinforced (as many of the walls at Seabrook Station, having only inner and outer surface horizontal and vertical reinforcements, but no through-wall struts or ties) the potential exist for some undetected out-of-plane crack formation and a potential undetected structural performance impact. As documented in Section 6, the large-scale testing program is intending to provide additional insights to the overall performance of these structural wall designs.

In support of the use of CCI, which is a two-dimensional concrete surface measurement, NextEra is developing plans to install deep pins in ASR-affected walls at Seabrook to better monitor ASR progression. The large scale test specimens fabricated at the UT-Austin facility include three-dimensional through-wall pin placements which will provide a more comprehensive measurement of the ASR expansion and associated impact on structural performance. NextEra hopes to install similar deep pins at the site in order to better correlate the UT-Austin testing results and the two-dimensional CCI data to actual structural performance.

As stated above, within the confines of the reinforcement cage, the ASR expansion is restrained and some of the expansion stresses are transferred to longitudinal strain in the reinforcing bars. As long as, neither the tensile strength of the concrete nor the steel rebar yield strength is compromised (exceed elastic limits), no visible cracking (stress relief) is expected. The amount of restraint imposed by the rebar cage is dependent upon the type, size and design of the rebar used. More heavily reinforced structures resist ASR expansion and may depict a different level of surface cracking compared to a lightly or non-reinforced structure with a similar degree of ASR progression.

9.6 Planned Regulatory Actions

As discussed in Section 6.0 above, and in NextEra's ASR Project CAP, the crediting the FSEL test results for demonstrating current and longer term operability of ASR-affected reinforced concrete structures will be evaluated pursuant to 10CFR50.59 and 10CFR50.90 (license amendment request). The team concluded that this approach appears reasonable and consistent with existing regulatory processes.

The team notes that Combined Crack Indexing (CCI) may become the principle method used by NextEra for monitoring the progression of ASR in affected structures. However, this method is not recognized by NRC regulatory and design standards, and is not within the current Seabrook licensing basis. Pending the results of the FSEL testing program, NextEra may propose the use of this methodology for assessing current and future operability of ASR-affected structures.

Comment [A5]: Consider deleting is not recognized by NRC regulatory and design standards."

9.7 ASR Impact on Containment

As part of NextEra's extent of condition review, evidence of ASR was identified on the exterior surface of containment structure. NextEra initiated a prompt operability determination (No.

1804477) and concluded containment was fully operable and capable of meeting all its design basis functions, with some reduced margin. At the conclusion of this inspection, NextEra had not yet developed a plan for resolving this non-conforming condition. As this issue has been documented in the Seabrook CAP with an open operability determination, resolution of the issue will be monitored via the ROP baseline inspection activities.

10.0 Review of Six-Month Combined Crack Indexing Data

Inspection Scope

The team reviewed the periodic concrete expansion measurements for ASR-impacted Seabrook structures. Specifically, the team examined the supporting documentation for the ASR Crack Index Report dated March 18, 2013 (FP 100811) and the ASR Expansion Measurements Report dated March 18, 2013 (FP100812). The team also conducted interviews and discussions with the responsible NextEra engineering staff. The team used 10 CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," and Criterion XI, "Test Control," as the regulatory guidance to assess the adequacy of NextEra's actions to address ASR-affected reinforced concrete structures.

Findings and Observations

No findings were identified. Overall, the combined crack index (CCI) data show some evidence of continued ASR degradation, but the expansion data (pin to pin measurements) showed no significant changes. There was no change in the CCI data for the containment, but the Electric Tunnel and the Primary Auxiliary Building/Residual Heat Removal (PAB/RHR) vault both show a positive trend in CCI value in the six months since June 2012. While this may be the result of seasonal affects, ASR degradation appears to be ongoing in some Seabrook structures as indicated by some minor incremental crack growth. Collectively, the CCI measurements indicate essentially no structural changes; and therefore no challenges to the conclusions in the current ASR-affected structures' prompt operability determinations. The team noted NextEra's plans to continue the 6-month CCI measurements to establish a stable trend in observable ASR expansion for each uniquely ASR-affected structure. Continued periodic measurements should eliminate the potential influence of seasonal ambient temperature changes from the trend results

CCI Measurements

In the ASR Crack Index Report (FP100811), NextEra measured CCI values for 26 locations in the monitoring program and compared the results to the data taken in June 2012. The CCI data shows an apparent increase in most (18 of 26) of the monitored locations. NextEra identified that the CCIs measured in December 2012 appears larger than the CCI data measured in June 2012. NextEra concluded the apparent increase in CCI values was due to seasonal temperature variations because the concrete (in December) was significantly colder, which may cause the concrete to contract between the cracks, increasing the apparent crack widths.

The team noted that 3 of 7 monitored locations on the exterior of plant buildings (above grade and more susceptible to seasonal temperature and moisture variations), showed a decrease in

CCI from June to December. Further, 15 of 18 areas showing an increase in crack index were areas monitored on interior buildings surfaces and/or below grade; and therefore less susceptible to seasonal temperature variations. In particular, the Electric Tunnel (areas 3b, 4, and 5) and the PAB/RHR Vault (areas 17, 18, 22, and 23) all show a CCI value increase of between 0.20 to 0.26 mm/m compared to June 2012. These interior, below-grade areas have been chronically wet from ground water infiltration. The team noted there was no change in the CCI values for the Containment Building (Location 14 - Mechanical Penetration MF102-01).

As reported by NextEra, uneven cracking (total crack width in one direction is much larger than in the other direction) and measured larger cracks were identified in the horizontal direction compared to the vertical. The team observed that, over the long term, averaging the horizontal and vertical CCI values may be an adequate representation of overall changes due to ASR of the specific structural member. However, the practice of averaging the horizontal and vertical CCI values is different than outlined by available industry guidance (FHWA-HIF-09-004) that recognizes the influence of reinforcements on crack growth. Thus, reporting an averaged CCI vice directional CCI values separately, could mask the expansion in a preferred direction and hamper the identification of a trend, in the short term. NextEra acknowledged this team observation and initiated a Condition Report (CR 1758920-39) to evaluate this issue.

The team also noted that NextEra revised the method of calculating CCI in the recent 6-month measurement report (December 2012). The CCI measurement reporting method was changed to account for the use of rectangular grids to determine crack index, and thereby normalize index to the total number of lines in the both directions. In so doing, NextEra recalculated the CCI values for the December 2011 and June 2012 data to eliminate potential biasing errors. The team concluded that NextEra's more consistent use of a calculation method would aid the identification of apparent trends.

Structure Expansion Measurements

In the Expansion Measurement Report (FP100812), NextEra performed measurements between pins embedded in the surface of plant buildings at the 26 established CCI monitoring locations. The 26 monitored locations were selected from the 131 locations identified in the ASR Walkdown Report (reference FP100705) which exhibited the highest visible ASR-associated distress. NextEra noted a null result for expansion measurements between pins in most of the 26 monitored locations. Specifically, data recorded in most (436) measurement lines showed no significant changes compared to the baseline data. However, for 5 of the 436 measurement lines, NextEra noted length changes that were unexpected. Further, NextEra noted that the gage points at CCI monitoring locations 1, 9, and 14 had moved out of range of the measurement instrument. NextEra plans to evaluate these locations further.

The team noted that the crack index data shows apparent increase when expansion data in 2-dimensions shows no change. It appears that the CI data better reflects expansion (strain) in the structure compared to the expansion measurements in only 2-dimensions, which may not be a complete indicator of changes in the structure. The team noted that NextEra plans to add deep pins to ASR impacted walls in the monitored locations that will allow expansion measurements in the third direction.

11.0 Review of Adequacy of Revisions to the Phase 3 Walkdown Plans and Schedule

Inspection Scope

During the previous inspection, the team reviewed the overall thoroughness of NextEra's completed and planned ASR walkdown activities conducted in accordance with FP 100642, "ASR Walkdown Scope," Revision 1, and documented in FP 100705, "Seabrook Station: Summary of Alkali Silica Reaction Walkdown Results," Revision 0. At the time of the inspection, not all of the potentially affected structures had been examined and NextEra had drafted a tentative schedule for the completion of the Phase 3 (areas not readily accessible) walkdowns. During this inspection, the team assessed NextEra's final Phase 3 schedule for completeness and to ensure a timely examination of the extent of condition of ASR-affected structures.

Findings and Observations

No findings were identified.

NextEra's ASR extent of condition structures 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 at the earliest opportunity (e.g. routine maintenance or outage activities). Team examination of the Phase 3 walkdown areas identified a minor documentation issue (in addition to the previously documented containment IWL inspection oversight) that the spent fuel pool (SFP) reinforced concrete walls were not included in the planned Phase 3 walkdown. The SFP walls pose a particular challenge to NextEra due to the limited accessibility of the concrete surfaces. At the conclusion of this inspection, NextEra was working to complete their evaluation of various methods to assess the SFP concrete walls. A target date of June 30, 2013 was established to develop the necessary steps to accomplish this task (reference ASR Project Corrective Action Plan, revised April 2013). NextEra had already initiated plans to remove a core sample from the SFP telltale sump, per an earlier commitment made under the license renewal process (reference ____________).

Comment [A6]: Recommend mak·ng the wording consistent with that in the commitment. The application portion was revised to state "Perform a confirmatory core bore and expose rebar in an area under the catch basin n spent fuel pool leakage sump."

I haven't verified if this is the same as saying the SFP telltale sump, but I still recommend using consistent language.

Comment [A7]: The commitment (Commitment No. 67) came in as part of their August 11, 2011 response. ML11227A023

FYI. The commitment states "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 team assessed the Phase 3 walkdown schedule and concluded the target dates for completion were reasonable. With respect to completing a comprehensive examination of the containment structure, the team concluded that performing this inspection concurrent with the scheduled 2015 refueling outage IWL examination was appropriate and commensurate with the safety significance of the issue. The balance of the Phase 3 extent of condition walkdowns are scheduled for completion in mid-to-late 2013 and during the April 2014 refueling outage. In summary, the team concluded that NextEra's completed and planned extent of condition reviews for identification of ASR-affected reinforced concrete structures was appropriate.

12.0 Aircraft Impact Review

Inspection Scope

The team reviewed NextEra's evaluation of the aircraft impact study performed in response to the identification of ASR. The aircraft impact study for Seabrook containment is described in UFSAR Section 3.8.1.3 and Appendix 2P. As noted in the Updated Final Safety Analysis Report (UFSAR), the postulated aircraft impact load is not combined with any other containment transient design loading. Further, the study assumes the impact area to be on the dome just above the spring line.

Findings and Observations

No findings were identified.

The effects of an aircraft impact were found not to be controlling for overall containment design considerations. Also, the analysis assumes that the enclosure building fails when struck by the aircraft and deforms until the aircraft contacts the containment structure. The containment enclosure building design and analysis is described in UFSAR Section 3.8.4. NextEra's evaluation states that ASR has only been identified in below grade elevations of the containment and containment enclosure buildings, where sufficient moisture has contributed to ASR progression. To date, no above grade (or vicinity of the anticipated aircraft impact area) evidence of ASR has been identified on containment. As discussed in Section 11, a detailed ASR inspection in conjunction with the IWL examination will be conducted in 2015. Accordingly, NextEra has concluded that the Seabrook aircraft impact study remains valid and unaffected, based upon engineering evaluations of other ASR-affected reinforced concrete structures completed, to date.

13.0 UT-Austin Ferguson Structural Engineering Laboratory Visits

Scope of Review

On two separate occasions, members of the team visited the UT-Austin testing facility to observe ongoing activities and inspect general facility quality assurance and control measures as implement per NextEra's regulatory obligations. The team noted that NextEra has contractual agreements with MPR Associates and the UT-Austin Ferguson Structural Engineering Laboratory to oversee and conduct, respectively, the ASR large scale testing program. The team toured the facility, including: main fabrication and testing areas with overhead crane lifting capabilities; outside exposed and protected (green house) specimen curing areas, with continuous or cyclic wetting and drying capability; aggregate and sand storage yard; and office and laboratory spaces for storage and use of calibration and test equipment, as well as, environmentally controlled storage units for a variety of mortar bar, prism, and concrete cylinder test specimens. The team examined the large block anchor bolt test specimens, including the control specimen block which had been tested. The team also witnessed fabrication of the second large shear and lap-splice test beam, and some testing of cylinders for compressive strength and Modulus of Elasticity determination.

Findings and Observations

No findings were identified. The team verified appropriate oversight and quality control practices being implemented. Direct oversight by both UT-Austin supervisory staff and MPR engineers was evident and effective.

14.0 Meetings, Including Exit

On June 27, 2013, 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
None

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."

Documents Reviewed at FSEL

1. Purchase Order No. 0326 – 0058 -25, dated December 1, 2011 and change order Nos. 1, dated March 21, 2012; No. 2, dated March 27, 2012; No. 3, dated July 23, 2012; and No. 4, August 2, 2012 between MPR Associates Inc. and Ferguson Structural Engineering Laboratory as applied to Anchor Testing Program

2. Contract No. 02293285, dated June 6, 2011, and Amendment Nos. 1, dated October 25, 2011; No. 2, dated December 17, 2011; No. 003, dated January 3, 2012; No. 004, dated February 27, 2012; Amendment 6, dated July 26, 2012, between NextEra and MPR Associates Inc.

3. MPR Letter to Ferguson Structural Engineering Laboratory, dated December 1, 2011, Notice of Intent to Contract for Testing of Anchors in ASR-affected Concreter – authorizing FSEL to develop project-specific quality system manual, implementing procedures for testing and perform initial characterization of the ASR degradation on girders.

4. MPR Letter to Ferguson Structural Engineering Laboratory, dated December 1, 2011, Research on Performance of Anchors in ASR-affected Concrete

5. MPR Letter to Ferguson Structural Engineering Laboratory, dated March 27, 2012, *Research on Performance of Anchors in ASR-affected Concrete*

6. MPR Letter to Ferguson Structural Engineering Laboratory, dated July 23, 2012, Research on Performance of Anchors in ASR-affected Concrete

7. MPR Letter to Ferguson Structural Engineering Laboratory, dated August 2, 2012, Research on Performance of Anchors in ASR-affected Concrete

8. MPR Letter to Ferguson Structural Engineering Laboratory, dated October 26, 2012, Research on Performance of Anchors in ASR-affected Concrete

9. Purchase Order No. 0326 – 0063 -01, dated June 4, 2012, between MPR Associates Inc. and Ferguson Structural Engineering Laboratory as applied to Beam Testing Program

10. Contract No. 02207204, dated April 27, 2012, NextEra and MPR Associates Inc., related to ASR Concrete Beam Testing Program (for Shear and Lap-splice anchorage)

11. Project Plan 0326 – 0062 -01, Revision 0, dated May 1, 2012, by MPR Associates Inc. as applied to Beam Testing Program

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