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Murphy, Martin

From: Thomas, George
Sent: Thursday, September 29, 2011 8:59 AM
To: Murphy, Martin
Subject: TIA for Seabrook ASR Issue
Attachments: Final TIA ML1116105300db.pdf

Marty,

As requested, attached is the TIA.

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September 12, 2011

MEMORANDUM TO: Robert A. Nelson, Deputy Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: Darrell J. Roberts, Director **/RA/ David A. Ayres for:**
Division of Reactor Projects

SUBJECT: REQUEST FOR TECHNICAL ASSISTANCE
SEABROOK STATION ALKALI-SILICA REACTION

Region I requests technical assistance from the Office of Nuclear Reactor Regulation (NRR) to evaluate the potential consequence of alkali-silica reaction (ASR) degradation of a safety related concrete structure at Seabrook Station. More specifically, based on NRR review for adequacy of a NextEra prompt operability determination (POD) and its associated open issues, NRC staff should be able to identify what additional information is needed in order to fully evaluate the impact of the degradation on the current licensing and design basis in the final operability determination for structures important-to-safety at the plant. As the primary case for review, NextEra evaluated the Seabrook Control Building ("B" Electrical Tunnel and Penetration Room) in light of the recently discovered degradation mechanism. Other structures important-to-safety within the scope of the maintenance rule have also been affected by the ASR problem. Accordingly, additional Task Interface Agreements may be necessary such as for a review of the final operability determination results for other buildings also exhibiting the ASR problem.

Background

NextEra (the licensee) analyzed concrete core samples from the interior surface of exterior walls of the Control Building as part of their assessment to support renewal of their license. In August 2010, tests undertaken as a part of the core sample analysis reported a change in material properties. The analysis reported the presence of ASR-degradation in core samples taken from chronically wet walls below grade, with reductions reported in the concrete compressive strength and modulus of elasticity from that expected. NextEra evaluated these parametric reductions to determine the impact on the design basis of the Control Building. By their process, the licensee performed an immediate and prompt operability determination (POD) and concluded, preliminarily, that the Control Building (CB) was operable but with reduced strength reserves to design capacity.

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NextEra continued to evaluate the extent of this condition for five other safety related concrete buildings. The other five buildings for which concrete core samples were taken were: Equipment Vault (housing ECCS equipment including that for Residual Heat Removal (RHR)], Radiological Controls Area (RCA) Walkway, Emergency Feedwater Building (EFW), Emergency Diesel Generator (EDG) Building, and the Containment Enclosure Building (CEB). As of June 30, 2011 there are two open prompt operability determinations, one for the Control Building and one for the other five buildings collectively. The licensee found additional evidence of ASR in four of the five other buildings and they evaluated that information in a separate immediate and prompt operability determination using the same evaluation techniques as for the Control Building. This evaluation is also considered preliminary or open. Based on NRC internal discussions, it appears that the calculation methods and correlations that NextEra used in their prompt operability determination may not be fully appropriate in light of the ASR problem.

NextEra's planned actions are two-fold: 1) to follow their operability determination process; and, 2) to follow the guidance in NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule," to develop an aging management program to support the license renewal application. Possible outcomes to the PODs are: 1) restored conditions (which may not be possible); 2) resolved conditions (use "as is" by procedure change incorporated or Action Request (AR) disposition approved); or 3) current licensing basis (CLB) revised (e.g., 10 CFR 50.59 evaluation). The licensee has posted on the Certrec internal website their operability determination process for reference (EN-AA-203-1001_005, No. 1 on Certrec Document Tab List).

NextEra's proposal related to license renewal was described in a letter dated April 14, 2011, under the response to NRC request for additional information B.2.1.31-1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11108A131). This letter describes periodic reviews for operability as information is developed to support the aging management review. At the time, the proposal included another analysis (termed "final" by NextEra) of the impact of ASR on the current licensing and design basis, including the extent of the condition, to be completed by June 2011. Since that letter and as noted above, the control building POD was kept open; a new immediate and POD were completed for the other five building core sample results that were involved in an extent of conditions review. The subject NextEra letter also commits to an Engineering Evaluation to be completed in March 2012.

On June 29, 2011, the NRR Division of License Renewal issued another "Request for Additional Information" (ADAMS Accession No. ML11178A338) related to key aspects of NextEra's comprehensive plan for assessing the ASR problem for the Structures Monitoring Program including that for the Fuel Handling Building and Containment ("Followup RAI B2.1.31-1, B2.1.31-4, and B2.1.28-3). The response to this letter dated August 11, 2011, (ADAMS Accession No. ML112227A0230) does not reflect a comprehensive plan for determining operability/functionality of affected buildings along with plans for the development of aging management review and program.

With respect to Part 50 requirements, Region I reviewed the NextEra current Structures Monitoring Program and found a violation of the maintenance rule for the control building. The finding is described in detail in NRC Inspection Report 05000443/2011002 (ADAMS Accession No. ML111330689). More details related to the newly discovered ASR issue were also documented in NRC Inspection Report 05000443/2011007 (ADAMS Accession No. ML111360432) as part of a license renewal inspection. The cover letter for the latter report

notes that the aging management review for the ASR issue is not complete and that there is a need for a continuing review in the Part 50 and 54 areas. The staff of Region I and NRR (Division of Engineering and Division of License Renewal) have been discussing actions since January 2011 to ensure that the Part 50 and 54 reviews are coordinated.

The documents listed below were made available for review on the licensee's "Certrec" internal website (Certrec Document Library Tab List). These documents reflect current NextEra view of operability for the Control Building and the associate tunnel and penetration room. The "Certrec" system was set up in order to facilitate NRC staff access to NextEra's internal documents. Please inform Region I and NextEra if the document is to be printed, for review purposes, prior to doing so.

1. C-S-1-10159 CALC_000, Rev. 0, 'B' Electrical Tunnel Transverse Shear Evaluation Supplement to Calculation CD-20
2. C-S-1-10150 CALC_000, Rev. 0, Effects of Reduce Modulus of Elasticity – 'B' Electrical Tunnel Exterior Walls
3. CD-20-CALC, UE Control and Diesel Generator Building Design of Material and Walls below grade for Electrical Tunnel and the Control Building (Original Design Calculation)
4. Action Request (AR) 581434 Prompt Operability Determination Reduced Concrete Properties Below Grade in 'B' Electrical Tunnel Exterior Walls.

On April 27, 2011, NRR Division of Engineering provided support by performing an initial review of NextEra's basis for acceptability of the reduction in modulus of elasticity in light of concrete core testing which supported 10 CFR 50.59 screening process without prior NRC staff review and approval. This evaluation and its related design change document accepts the reduced parameters of compressive strength and modulus of elasticity for the Control Building and the Containment Enclosure Building as a potential disposition for the operability determination (Certrec Document Library Tab List, Enclosure Bldg and Control Bldg MSP – Design Change Package Description No. EC-272057, Rev. 000, Concrete Modulus of Elasticity Evaluation). The staff questions the adequacy of this screening action.

The licensee is also planning an apparent cause review for the maintenance rule violation noted above. Corrective actions include a comprehensive walkdown of all structures important-to-safety with suspected ASR condition in accordance with a revised structures monitoring program procedure that meets the latest ACI standard in the area (ACI 349.3R-02). This has been completed for the control building, containment enclosure building, and the containment. Completion of these assessments for the other buildings is tentatively December 2011. Further, the licensee plans to conduct a root cause evaluation of the ASR issue which should be completed in time for incorporation into the planned March 2012 Engineering Evaluation as noted above.

Licensee Position

To date, within the limitations of their testing and analysis, NextEra determined that none of the seismic category I structures tested have been found to be outside their design basis and were, therefore, operable with extent of conditions questions needing be addressed. The Seabrook design and licensing basis to which the licensee made these determinations was documented in UFSAR Section 3.8. NextEra is willing to address the additional questions from the NRC staff; but, it is uncertain if those questions will be addressed in the final operability determination tentatively scheduled for September 30, 2011. It also remains uncertain what NextEra's

comprehensive plan is based on review of their August 11, 2011, response to NRC letter of June 29, 2011.

In light of the newly discovered ASR issue, it appears that NextEra technical personnel are developing new insights for what key aspects must be addressed in the final operability determination for any building with evidence of ASR. NextEra is considering NRC staff questions to date and has hired consultants in this area. These consultants also will be developing a new model for the Containment Enclosure Building load analysis.

Requested Actions

In order for Region I to independently determine operability of the control building or any other important-to-safety structure affected by the ASR problem; and, as a primary case, we need a review for adequacy of the control building prompt operability determination and any related open issues as identified by NextEra. This information would be applied to the final operability determination for the control building and any other affected important-to-safety structures. The important-to-safety structures affected by the ASR problem are within the scope of the maintenance rule and are also consistent within the scope of license renewal. More specifically we need to independently develop a comprehensive set of issues to be applied to any final operability determination as a part of our oversight of the licensee's process and any new insights gained from NextEra's technical research.

Accordingly, Region I requests that NRR evaluate the adequacy of NextEra's control building prompt operability determination and its related open issues with particular focus, but not limited to, the below listed key technical questions. The licensee has provided a set of documents as noted on the "Certrec" website referenced above, but the NRR review should not be limited to those documents. Region I will facilitate ensuring that additional documents, as needed, are available on the website or, as necessary, by an onsite inspection. NRR's determination should enable the staff to confirm that there is reasonable assurance of continued operability given the concrete degradation identified due to ASR for the control building once the final operability determination is made by NextEra for this or any other important structure affected by the ASR problem.

During the course of this review, Region I requests that NRR specifically identify any concerns with the assumptions, methodologies, or calculations, etc., along with the regulatory or other basis of each concern; and, notify Region I immediately if NRR finds that any of the reviewed documents for the control building do not provide reasonable assurance of continued operability of that building. As a minimum, the response to this TIA should include an independently developed comprehensive set of issues to be addressed in the final operability determination for the Control Building in order for us to further assess the licensee's process and their new insights gained for all important-to-safety structures with evidence of ASR.

1. Working with Region I staff in an inspection forum, NRR staff should identify a comprehensive list of issues that need to be addressed in the final operability determination for the Control Building, given the current view of operability by NextEra as reflected in the prompt operability determination.

   Discussion: NRC staff identified questions as listed in the NRC RAI [(ADAMS Accession No. ML11178A338) dated June 29, 2011. The questions related to key aspects of NextEra's comprehensive plan for assessing the ASR problem for the Structures Monitoring

Program, including that for the Fuel Handling Building and Containment (Followup RAI B2.1.31-1, B2.1.31-4, and B2.1.28-3)]. If the issues are initially considered comprehensive, please give consideration to the below additional views produced by the regional technical staff. If those issues are not considered comprehensive, then identity those additional issues to be included with consideration to those listed below along with regulatory or other basis for the concern. An example would be the need for Poisson ratio calculations on core samples because there are assumed numbers in the UFSAR or the need for stiffness damage tests because of applicable ACI standard requires it in the current licensing basis.

2. Because the original design basis assumes no ASR is present during the design life of the structure, what, if any, are the specific original design assumptions affected by the presence of ASR that are not clearly evident in the UFSAR design basis?

   Discussion: For example several calculation methods such as the relationship between compressive strength and modulus of elasticity to shear capacity and shear force are used in the seismic analysis. These assumed relationships may not be valid with ASR present in the structure.

3. What is the appropriate ACI standard to be used for degraded concrete core sampling assessing in-situ ASR degradation for the control building (locations, numbers, frequency of sampling in the future, etc)?

   Discussion: While this is an issue raised based on staff questioning, we need to know the regulatory or other basis for the use of either of two applicable standards or other more appropriate standard. One standard is ACI 228 used by NextEra for correlation to penetration resistance probe data and the other is ACI 214 (version 1965 is referenced in the UFSAR section 3.8.2.4). It should be further noted that a later revision of ACI 214 (ACI-214.R-03) provides for additional sampling in order to achieve a 95% confidence level. The ACI 228 appears to be met by NextEra but it requires less sampling. These standards were developed for general design and construction of concrete structures for non-nuclear applications. Technical research may be needed in order to determine their relevance for nuclear application in which the structures are heavily reinforced with rebar.

4. Did NextEra perform adequate laboratory tests for core sampling, including appropriate parameters obtained along with laboratory test conditions?

   Discussion: Also, during the course of this review, please identify the need for any *in situ* testing of control building conditions including appropriate parameters to be obtained such as temperature and humidity along with test conditions for now and in the future. Also, provide guidance on where and how much rebar should be exposed in order to assess the effect on rebar from the ASR issue.

   No tensile strength testing is being performed on the concrete core samples and this question was raised in the RAI in terms of how shear capacity is being determined. However, the Region I staff believe that the specific parameter of tensile strength of concrete may not be sufficiently accurate and therefore relevant in a constrained structure. As the pressure load from the ASR gell increases, that load may be transferred to the rebar. Available research in this area appears to be conflicting. The UFSAR for containment assume concrete in reinforced systems provide no tensile strength.

A core sample with ASR does not represent the forces contained in the structure because for this test, in particular, elastic rebound is not considered. For split tensile tests on core samples, the frictional influences in the test itself are not accommodated. The frictional losses are further exacerbated by the standard laboratory practice of placing plywood on opposing faces of the tensile specimen to stop it from rolling off the test stand, thus restraining axial expansion of the sample.

5. Is the current NextEra structural monitoring program sufficient to discover or predict additional ASR damage to structures prior to the damage negatively impacting the design basis of the structure?

   Discussion: To date three building assessments have been completed: control building, the containment, and the containment enclosure building. These assessments were initiated as a consequence of discoveries made preparing for a renewed license application. These discoveries should be reflected in enhancements to the programs required as part of the Maintenance Rule. The Region requests NRR assistance in evaluating the current acceptability of NextEra's programs to maintain the integrity of the safety related structures.

Coordination

This request was discussed between Michael Modes/Suresh Chaudhary of Region I staff and Meena Khanna (NRR/DE) and her staff and Ed Miller (NRR, PM) along with Holly Cruz (NRR) during a final conference call on August 18, 2011. The conference was a culmination of several months of discussion between counterpart branch chiefs from Region I (DRP/DRS) and NRR (DE/DLR/DORL). The TIA was accepted with an agreed upon response date within 90 days from the last day of the technical reviewer's onsite review of the building initial assessments and no later than 90 days from September 30, 2011. Region I will ensure the upcoming inspection is scheduled to end before September 30th. An additional TIA may be needed for the final operability for the control building and other buildings as they are completed. A final response would be dependent on the successful completion of the September 2011, inspection, otherwise, response dates will need to be renegotiated.

References

http://ims.certrec.com

(No. 2 on Certrec Document Library Tab List) C-S-1-10159 CALC_000, Rev. 0, 'B' Electrical Tunnel Transverse Shear Evaluation Supplement to Calculation CD-20

(No. 4 on Certrec Document Library Tab List) C-S-1-10150 CALC_000, Rev. 0, Effects of Reduce Modulus of Elasticity – 'B' Electrical Tunnel Exterior Walls

(No. 5 on Certrec Document Library Tab List) CD-20-CALC, UE Control and Diesel Generator Building Design of Material and Walls below grade for Electrical Tunnel and the Control Building (Original Design Calculation)

(No. 6 on Certrec Document Library Tab List) Action Request (AR) 581434 Prompt Operability Determination Reduced Concrete Properties Below Grade in 'B' Electrical Tunnel Exterior Walls.

http://portal.nrc.gov/edo/ri/EB1/Shared%20Documents/Forms/AllItems.aspx

Docket No. 50-443

(No. 6 on Certrec Document Library Tab List) Action Request (AR) 581434 Prompt Operability Determination Reduced Concrete Properties Below Grade in 'B' Electrical Tunnel Exterior Walls.

http://portal.nrc.gov/edo/ri/EB1/Shared%20Documents/Forms/AllItems.aspx

Docket No. 50-443

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SUBJECT: REQUEST FOR TECHNICAL ASSISTANCE
SEABROOK STATION ALKALI-SILICA REACTION

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