



UNITED STATES
NUCLEAR REGULATORY COMMISSION

REGION I
475 Allendale Road
King of Prussia, PA 19406

MEMORANDUM TO: John Jolicoeur, Deputy Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

FROM: Darrell J. Roberts, Director
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 consequence of alkali-silica reaction (ASR) degradation of safety related concrete structures at Seabrook Station, and to evaluate the impact of the degradation on the current licensing and design basis.

Background

NextEra 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 alkali-silica-reaction (ASR) in core samples taken from chronically wet walls below grade, with apparent reductions reported in the concrete compressive strength and modulus of elasticity. NextEra evaluated these parametric reductions to determine the impact on the design basis of the Control Building. The licensee performed an operability determination and concluded the Control Building was within the limits of the design basis although with reduced margins. NextEra continues to evaluate the extent of this condition.

NextEra's planned actions 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. Their proposal is described in their letter of April 14, 2011, in response to an NRC request for additional information B.2.1.31-1(ML11008A131). The proposal includes another (termed "final" by NextEra) analysis of the impact of ASR on the current licensing and design basis, including the extent of the condition, to be completed during June 2011. CONTACT: Michael Modes, DRS (610)337-5198



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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 (ml111330689). More details related to the newly discovered ASR issue is also documented in NRC Inspection Report No. 05000443/2011007 (ml111360432) as a part of the license renewal inspection report. The cover letter for this later 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 staffs of Region I and NRR (Division of Engineering and License Renewal) have been working closely together to ensure the agency reviews this matter in unison.

Region I needs the assistance of NRR in reviewing various NextEra documents/evaluations to be issued from now until March 2012 (tentative) as noted in the licensee's position section below.

Licensee Position

NextEra has conducted a number of evaluations of ASR affected structures. Their actions are centered around taking core samples of the concrete and conducting various tests for compressive strength and modulus of elasticity on those unconfined samples. The primary actions to date or planned are:

1. Prompt Operability Determination for the Control Building (AR 581434 available by "certrec" website) based on compressive strength and modulus of elasticity testing. Petrographic examination was also conducted confirming the presence of ASR in the core samples.
2. Design Change No. EC-272057, Concrete Modulus of Elasticity for the Control Building Electrical Tunnel and the Containment Enclosure Building (available by certrex website), referring to AR Nos. 581434 and AR 1644074 which accepts the reduction in the modulus of elasticity in light of concrete core testing using a 10 CFR 50.59 screening process.
3. Additional core sampling on five other buildings with less severe evidence of ASR – Operability Determination will be available on or about June 30, 2011.
4. Engineering Evaluation scheduled for March 2012 which completes the aging management review and it is anticipated that it will not only address the proposed aging management program for license renewal but also provide recommended changes in the current Structures Monitoring Program for all Maintenance Rule in-scope building affected by ASR.

Within the limitations of their testing, NextEra's testing to date has not resulted in seismic category I structures being outside their design basis (control building and containment enclosure building).

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Region I Preliminary Inspector Views/Observations

Based on staff interactions to date related to this issue a number of questions have arisen:

1. Because the original design basis assumes no ASR is present during the design life of the structure, it is not clear how ASR affects the original design assumptions or calculational methods, such as the relationship between compressive strength and modulus of elasticity to shear capacity and shear force used in the seismic analysis. For example the assumed relationship between compressive strength and tensile strength may not be valid with ASR present. We agree with headquarter staff who have raised a questions in this area. What remains unknown is how much of an effect does the ASR have on this validity (some research may be needed).
2. A preliminary analysis by NextEra focuses on the effect of ASR on the foundation's response to design loads. It is not clear this approach, in the final analysis, would be adequate. Should we insist the final analysis include the response of the whole building with ASR present in the foundation?
3. What is the extent, duration, and timing of actions that NextEra should take to address the problem of immediate operability, and maintenance of the design basis response? In other words, how long do we wait and under what criteria do we have for research to be developed in order to address key questions related to operability and compliance with the current licensing and design basis.
4. It should be noted that no tensile strength testing is being performed on the concrete core samples and it is an issue raised by headquarters staff. With respect to the question of tensile strength reduction in concrete, the inspector's view is that it is not relevant in a constrained structure after the ASR pressure load is transferred to the rebar. Using the ASTM standard proposed by NRR, the tensile values reported can vary from the real values by up to $\pm 40\%$ and, as one researcher said, "... test can hardly be assumed to be a material property."¹ Prior to transfer, the pressure contribution appears to be minimal (on the order of less than 5% of the rebar yield based on preliminary research of literature).
5. A core sample with ASR does not represent the forces contained in the structure because for this test, in particular, rebound is not considered and frictional influences in the test itself are not accommodated. As a matter of fact the frictional losses are 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.
6. Preliminarily the design change had a 50.59 review which screened out. In light of the newly discovered issue, one would think that, as a minimum, an evaluation would have been conducted in order to determine if there is an unreviewed safety question.

¹ "Review of the splitting-test standards from a fracture mechanics point of view", C. Rocco, G. V. Guinea, J. Planas, and M. Ellicesb
 Facultad de Ingeniería, Universidad Nacional de la Plata, La Plata, Argentina, Departamento de Ciencia de Materiales,
 Universidad Politécnica de Madrid, Madrid, Spain, 5 September 2000

Requested Actions

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Copy of relevant section of the ASTM 496

10. Precision and Bias

10.1 Precision—An inter-laboratory study of this test method has not been performed. Available research data,¹ however, suggests that the within-batch coefficient of variation is 5% (see Note 4) for 6 3/12-in. [150 3/300-mm] cylindrical specimens with an average splitting tensile strength of 405 psi [2.8 MPa]. Results of two properly conducted tests on the same material, therefore, should not differ by more than 14% (see Note 4) of their average for splitting tensile strengths of about 400 psi [2.8 MPa].

Also I do not understand relationship between rebar yield strength and concrete shear/tensile strength as stated here

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In light of the questions above, Region I needs the assistance of NRR/DE in conjunction with the Division of License Renewal and as applicable the Office of Research in order to evaluate the below listed areas for the above noted NextEra operability determination and design changes or other evaluations that may support these reviews such as detailed calculations or computer code work. For each of the area, our regulatory basis should be clearly identified:

1. Adequacy of concrete core sampling (locations, numbers, frequency of sampling in the future, etc).
2. Completeness of the laboratory testing of core sampling including appropriate parameters obtained along with laboratory test conditions for now and in the future.
3. Need for and completeness of any insitu testing of building conditions, including appropriate parameters obtained along with test conditions for now and in the future. As an example, where and how much rebar should be exposed in order to assess the effect on rebar from the ASR issue.
4. Assess the effect of the alkali-silica reaction degradation on the current and future ability of safety structures to respond to design basis loads including seismic response.
5. Adequacy of an analysis of the foundations alone vs. the response of the whole structure when the foundation is degraded.
6. From the analysis done above, review the adequacy of the structures monitoring program for necessary changes in light of the ASR issue.

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In the longer term on or about March 2012, Region I needs the same assistance as noted above when NextEra completes and Engineering Evaluation which should complete the aging management review for license renewal but more importantly, recommendations are anticipated with respect to changes to the existing structures monitoring program to meet the maintenance rule up to the license expiration date. We request NRR review for adequacy of the additional monitoring and mitigation strategies proposed by NextEra in light of the newly discovered ASR issue.

Coordination

This request was discussed between Richard Conte (RI/DRS/EB1) and Meena Khanna (NRR/DE/EMCB) during a various conference calls on the subject of ASR at Seabrook. The TIA was accepted with an agreed upon response date within 90 days after receipt of the NextEra Engineering Evaluation completed during March 2012.

J. Jolicoeur

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References

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

Docket No. 50-443

ML111610530

SUNSI Review _____ Complete

DOCUMENT NAME: G:\DRS\Engineering Branch 1\-- MModes\TIA Seabrook ASR Draft 2.docx

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