

August 23, 2019

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In the Matter of)	
NextEra Energy Seabrook, LLC)	Docket No. 50-443
(Seabrook Station, Unit 1))	
)	

**C-10 RESEARCH AND EDUCATION FOUNDATION, INC.
REBUTTAL STATEMENT OF POSITION ON C-10'S CONTENTIONS REGARDING
NEXTERA'S PROGRAM FOR MANAGING ASR
AT SEABROOK STATION NUCLEAR POWER PLANT**

I. INTRODUCTION

Pursuant to 10 C.F.R § 2.1207(a)(2) and the Atomic Safety and Licensing Board's ("ASLB's") February 15, 2018 Revised Scheduling Order, C-10 Research and Education Foundation, Inc. ("C-10") hereby submits its Rebuttal Statement of Position on C-10's admitted contentions A, B, C, D, and H. These contentions challenge the adequacy of a license amendment request ("LAR") by NextEra Energy Seabrook, LLC ("NextEra") to address the pernicious effects of Alkali Silica Reaction ("ASR") on Seismic Category I reinforced concrete safety structures, including the containment. This Rebuttal Statement of Position is supported by the attached Rebuttal Testimony of C-10's expert witness, Dr. Victor E. Saouma, one of the world's foremost experts in ASR.¹ Revised Appendix A, a list of all of C-10's exhibits to date, is also attached.

¹ Rebuttal Testimony of Victor E. Saouma, Ph.D Regarding Scientific Evaluation of NextEra's Aging Management Program for Alkali-Silica Reaction at the Seabrook Nuclear Power Plant at 7 (Aug. 23, 2019) ("Saouma Rebuttal Testimony") (**Exh. INT028**) (Proprietary) ("Saouma Rebuttal Testimony"). A non-proprietary version of Dr. Saouma's testimony will be filed as soon as possible.

The testimony and position statements submitted by NextEra and the U.S. Nuclear Regulatory Commission (“NRC”) Staff fail to overcome Dr. Saouma’s thorough and well-supported criticisms of NextEra’s program for assessing and monitoring ASR in Seabrook safety structures, and therefore do not satisfy NextEra’s burden of proof.² While NextEra’s and the Staff’s witnesses submitted hundreds of pages of testimony and exhibits, they have not fundamentally altered Dr. Saouma’s expert opinion that the approach taken by NextEra to assess ASR at Seabrook and devise a long-term monitoring plan for ASR was far from adequate to satisfy the NRC’s reasonable assurance standard. Given the complexity of ASR and its potential to compromise the ability of critical safety structures like the Containment Enclosure Building (“CEB”) to withstand a design-basis earthquake, NextEra should have taken a more scientific approach and consulted experts in the field, including obtaining independent peer review of its work. As a result of NextEra’s failure to take an up-to-date sophisticated approach to the ASR problem, it failed to obtain meaningful data or conduct analyses that could adequately support the proposed monitoring, acceptance criteria, and inspection intervals in the LAR.

Therefore, the ASLB does not have a basis in this record for a reasonable assurance finding or the approval of the LAR. Under the circumstances, the ASLB should order the reversal of the LAR and to refer to the Commission the question of whether the license renewal decision should also be reversed for its dependence on the seriously deficient LAR.

² NextEra Seabrook LLC’s Statement of Position (July 24, 2019) (“NextEra SOP”) and NRC Staff Initial Written Statement of Position (July 24, 2019) (“Staff SOP”); Testimony of NextEra Witnesses Michael Collins, John Simons, Christopher Bagley, Oguzhan Bayrak, and Edward Carley (July 24, 2019) (Exhibit NER001) (“MPR Testimony”); Testimony of NextEra Witnesses Said Bolourchi, Glenn Bell, and Matthew Sherman (July 24, 2019) (Exhibit NER004) (“SGH Testimony”); NRC Staff Testimony of Angela Buford, Bryce Lehman, and George Thomas (July 24, 2019) (Exhibit NRC001) (“NRC Staff Testimony”); NRC Staff Testimony of Jacob Phillip (July 24, 2019) (Exhibit NRC005) (“Phillip Testimony”).

II. EVALUATING COMPLIANCE WITH REASONABLE ASSURANCE STANDARD

NextEra correctly observes that in applying the reasonable assurance standard, “the Commission takes a case-by-case approach, exercising sound technical judgment and verifying the applicant’s compliance with Commission regulations based on all relevant facts and circumstances.” NextEra SOP at 5 (citing *Amergen Energy Company, LLC*, (Oyster Creek Nuclear Generating Station), CLI-09-7, 69 NRC 235, 262, n.143 (2009); *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-14, 71 NRC 449, 465-66 (2010)). Here, where the NRC has no regulatory standard for ASR, and industry codes even lack standard for ASR, the ASLB must evaluate all of the evidence presented, relying on the testimony of qualified experts to determine whether the reasonable assurance standard has been met. The record demonstrates that Dr. Saouma is the *only* expert witness to testify in this proceeding who has extensive scientific and engineering experience in the study of ASR. Not only did NextEra’s and the NRC Staff’s witnesses lack sufficient expertise, but they could point to no independent peer review by qualified scientists, other than a very limited peer review of a single issue. *See* Saouma Rebuttal Testimony, B.6 at 11. Thus, Dr. Saouma’s testimony should be given great weight in comparison to the testimony by expert witnesses for NextEra and the Staff, who are all engineers lacking any particular experience with the measurement or evaluation of ASR. *Carolina Power & Light Co.* (Shearon Harris Nuclear Power Plant), LBP-01-09, 53 NRC 239, 251 (2001) (licensing boards should give expert testimony “due weight” proportionate to their expertise).

Dr. Saouma has presented two thorough and well-documented pieces of testimony that present a serious indictment of NextEra’s program for addressing ASR at Seabrook for its lack of

sophistication or effectiveness in diagnosing ASR at Seabrook or establishing an effective monitoring program. As he summarized on rebuttal:

[T]he work done by NextEra is insufficient to characterize the current condition of ASR at Seabrook or to support a monitoring plan that can identify and assess ASR progression during the 30 years of future operation for which Seabrook has been licensed. As I have repeatedly testified, the simplistic methods used by NextEra to gather data and assess the condition of ASR at Seabrook are fundamentally inadequate to address such a complex problem with such significant safety implications. NextEra effectively put on blinders to a wide range of available techniques and sources of outside expertise, choosing instead to take a code-based engineering approach that could only scratch at the problem. As a result, the basic safety of the population living within 10 miles of Seabrook cannot be reasonably assured.

Saouma Rebuttal Testimony, B.1 at 8.

Dr. Saouma has also suggested “a set of more modern and effective alternative methods for gathering and analyzing data about ASR (*i.e.*, accelerated expansion tests, periodic damage rating index (DRI) measurements, detailed petrographic studies, and modern computational methods).” *Id.* In offering these alternatives, Dr. Saouma has not made a bid for perfection; and indeed, perfection is not required by the “reasonable assurance” standard. *See* NextEra SOP at 5, NRC Staff SOP at 31. Instead, as Dr. Saouma explained, “This approach is not just a different way to do the job, or even just a better way. It is demonstrably effective (for example, Hydro-Quebec), in contrast to the demonstrably ineffective measures used by NextEra.” Saouma Rebuttal Testimony, B.1 at 8. Given these extremely serious and fundamental inadequacies, the LAR must be rejected and NextEra must be sent back to the drawing board to conceive a new program for assessing and monitoring ASR.

III. SUMMARY OF KEY POINTS IN REBUTTAL TESTIMONY

The key points of Dr. Saouma’s Rebuttal Testimony are summarized in his response to Question E.1 as follows:

1. NextEra's testimony reflects a narrow code-based engineering approach rather than a combination of scientific and engineering approaches as is required for a problem with the complexity of ASR in the concrete enclosure of a nuclear reactor. The contrast can be seen by comparing the Seabrook ASR project to Hydro-Quebec's investigation of ASR at the Gentilly-2 nuclear plant, a much more sophisticated and effective investigation.
2. Through their testimony, NextEra's and the NRC Staff's witnesses have demonstrated a lack of sufficient expertise in the field of ASR assessment and analysis. This lack of expertise was compounded by a failure to obtain independent peer review of NextEra's work.
3. NextEra's proposed code-based-engineering approach may comply with the 1971 ACI code. However, the corresponding margin of error has not been quantified and is likely to be unacceptable. This makes it too risky to be adopted.
4. ACI 318-71, is not an adequate tool because it stipulates linear elastic analysis rather than inelastic (i.e., nonlinear) analysis. Use of nonlinear analysis is common and widely performed in the 21st century for complex structures such as Seabrook (as in the *post-mortem* investigation of Crystal-River). It should have been employed at Seabrook.
5. The finite element simulation used by NextEra is very rudimentary, completely inappropriate modeling of the ASR and the possible in-plane degradation. NextEra has failed to recognize some of the key characteristics of ASR, namely the driving force of relative humidity, the relationship between the characteristics of aggregates to both the nature of cracks and the timing of their development, the kinetics of the ASR reaction, the degradation of concrete mechanical properties in the SEM, and the lack of uniformity in the location and progression of ASR. NextEra also fails to acknowledge that the

progression of ASR over time follows a sigmoid curve and is not linear. NextEra's failure to account for all these factors plays a significant role in undermining the reliability of its assessment of ASR.

6. Dr. Saouma does not give much credence to the shear tests for the purpose of assessing the impact of ASR and the ultimate strength of the beam. Those results could have been easily anticipated and confirmed by proper finite element studies (*i.e.*, they were un-necessary). On the other hand, a by-product was the development of the inspection methodology.
7. The environmental conditions under which the CI and through crack extension were measured in the laboratory do not correspond to the conditions at the Seabrook Plant. As a result, the extent of internal expansion will most certainly be misleading. Furthermore, NextEra failed to recognize the impact of the reinforcement close to the surface of the wall that would inhibit crack opening.
8. Due to the confinement, the expansion will be radial, hence the cracking will be internal and propagate vertically (along the lines of compression). Furthermore, it will seldom daylight to be captured by CI. Hence, the walls of the CEB could very well delaminate internally, and this delamination will either not be captured by the instrumentation, or not captured in a timely way.
9. The ten-year effort to understand ASR at Seabrook and establish a program to adequately monitor ASR's progression over the next 30 years (including the remainder of Seabrook's current license term and a 20-year renewal term) has fallen far short of providing a reasonable assurance that NRC seismic design requirements are satisfied and that the public will be protected in the event of an earthquake. Yet, some progress has been made, especially in the program to install extensometers for more accurate monitoring.

10. In Dr. Saouma's expert opinion, NextEra should return to the drawing board, applying greater expertise, collecting more meaningful data, and using more appropriate and commensurate scientific and engineering approaches. Some of the work that has been done will still be useful and should be expanded on, such as the use of extensometers. But overall, the investigation should take a new approach that is more scientific, rigorous and sophisticated and subject it to a panel of independent expert reviewers in various related disciplines.

IV. CONCLUSION

As set forth in Dr. Saouma's Opening Testimony and Rebuttal Testimony, NextEra has failed to satisfy its burden of providing that its LAR contains an adequate assessment of the condition of ASR at the Seabrook nuclear power plant, or that it can be monitored in an effective way. As a result, affected members of the public lack a reasonable assurance that their safety will be protected during the next 30 years of operation. In particular, NextEra has failed to demonstrate that the CEB will not crack or otherwise fail during a design-basis earthquake at the plant. For these reasons, C-10 requests the ASLB to:

- a) reverse the NRC Staff's decision issuing a license amendment to NextEra; and
- b) notify the Commission that the reversal of the LAR should have the effect of nullifying the license renewal decision.

Respectfully submitted,

/signed electronically by/

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