September 19, 2019

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

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

C-10 RESEARCH AND EDUCATION FOUNDATION'S OPPOSITION TO NEXTERA'S SECOND MOTION *IN LIMINE*

I. INTRODUCTION

C-10 Research and Education Foundation ("C-10") hereby responds in opposition to NextEra's Motion *in Limine* to Strike or Exclude Portions of C-10's Testimony and Exhibits (Sept. 9, 2019) ("Second Motion").[1] NextEra seeks to strike or exclude from the record "all portions" of C-10's testimony and exhibits that NextEra contends are "irrelevant, immaterial, unduly cumulative, beyond the scope of [C-10's admitted contentions], or beyond the permissible scope of rebuttal testimony." Motion at 1 (footnote omitted). C-10 respectfully submits that the Motion is without merit and should be denied.

II. BACKGROUND

A. C-10's Admitted Contentions

The focus of this proceeding is a license amendment request ("LAR") by NextEra seeking approval of a program to assess and monitor alkali-silica reaction ("ASR"), a unique and time-progressing form of concrete degradation that was discovered at Seabrook in 2009. ASR

[1] NextEra's first motion in limine was filed on April 23, 2019. Motion *in Limine* to Exclude Testimony and Exhibits Regarding Structure Deformation Monitoring ("First Motion *in Limine*").

poses a safety risk because it may affect the ability of safety-related concrete structures, such as the containment enclosure building ("CEB"), to withstand design-basis seismic events.

On April 10, 2017, C-10 submitted a hearing request and ten contentions challenging the adequacy of NextEra's LAR to address ASR at Seabrook. C-10 Research and Education Foundation, Inc. Petition for Leave to Intervene: Nuclear Regulatory Commission Docket No. 50-443 ("Hearing Request"). In *NextEra Energy Seabrook, L.L.C.* (Seabrook Station, Unit 1), LBP-17-7, 86 N.R.C. 59 (2017), *aff'd,* CLI-18-4, 87 N.R.C. 59 (2018) ("LBP-17-7), the ASLB admitted five of C-10's contentions:

- As admitted, Contention A states that "crack width indexing and extensometer deployment are not sufficient tools for determining the presence and extent" of ASR at Seabrook. 86 N.R.C. at 93-102.
- As admitted, Contention B states that: "[t]he LAR misconstrues expansion occurring within a reinforced concrete structure due to [ASR] because any mitigation of lost structural capacity, due to reinforcement, is temporary and unpredictable." 86 N.R.C. at 107.
- As admitted, Contention C states that:

  > Thorough petrographic analysis, including core sample testing of Seabrook's *in-situ* concrete, must be integral to NextEra's assessment of the advance of ASR. Because of the extreme danger imposed by the radioactive substances contained within their walls, petrographic analysis of concrete from the Containment structures and the Spent Fuel Pool should be required by NRC. NextEra's choice not to continue core sample testing -- especially for safety-related structures -- is based on spurious assumptions, leaves inspectors and the surrounding communities with an unnecessarily incomplete picture of the actual state of concrete degradation, and could endanger the public health and safety.

  86 N.R.C. at 107-08, 111.
- As admitted, Contention D asserts:

  > The Large-Scale Test Program, undertaken for NextEra at the Ferguson Structural Engineering Laboratory (FSEL), has yielded data that are not "representative" of

> the progression of ASR at Seabrook Station, and therefore cannot be substituted for the required comprehensive petrographic analysis of in-situ concrete at the Seabrook reactor -- now many years overdue.

86 N.R.C. at 112, 121.

- As admitted, Contention H asserts that "[t]he proposed inspection intervals laid out in LAR 16-03 are too long to effectively measure the ongoing effects of ASR to structures at the Seabrook Nuclear Power Plant in a timely manner." 86 N.R.C. at 121, 125.

The ASLB "reformulated" C-10's five contentions as a single overarching contention which asserts:

> The large-scale test program, undertaken for NextEra at the FSEL, has yielded data that are not "representative" of the progression of ASR at Seabrook. As a result, the proposed monitoring, acceptance criteria, and inspection intervals are not adequate.

LBP-17-7, 86 N.R.C. at 90. As summarized by the ASLB, "the key issue is Contention D's challenge to the representativeness of the large-scale test program, and Contentions A, B, C, and H's alleged consequences from its alleged lack of representativeness." 86 N.R.C. at 127.

B. NextEra's First Motion *in Limine*

On April 23,2019, before the due date for C-10's testimony and exhibits, NextEra filed its First Motion *in Limine.* NextEra argued that the Structural Monitoring Program was outside the scope of C-10's admitted contentions. *Id.* at 6. C-10 opposed the motion on the ground that it was premature; and in any event, the scope of the contentions *did* encompass the Structural Monitoring Program because it depended on the results of the Ferguson Structural Engineering Laboratory ("FSEL") testing program at issue in the contentions, and because the Structural Monitoring Program and the FSEL testing program were "intertwined." C-10 Research and Education Foundation's Opposition to NextEra's Motion *in Limine* at 5-6 (May 3, 2019).

The ASLB denied NextEra's motion *in limine* as premature, and stated that it would "defer ruling on the issues raised by the Motion until it has an adequate evidentiary record to review." Order (Ruling on NextEra's Motion *in Limine*) at 1 (June 7, 2019) ("6/7/19 Order").

C. Second Motion *in Limine*

On September 9, 2019, NextEra filed the Motion at issue here, expanding the scope of the previous motion *in limine* and specifically identifying the portions of C-10's testimony and exhibits NextEra seeks to strike or exclude. In addition to seeking to strike testimony related to the Structural Monitoring Program, NextEra now asks the ASLB to strike other testimony and exhibits on the grounds that they exceed the scope of the contention, are immaterial and irrelevant, are duplicative, and exceed the scope of rebuttal testimony. 6/7/19 Order at 1. The Motion seeks to exclude a significant portion of the direct testimony, rebuttal testimony, and supplemental rebuttal testimony submitted by C-10's expert witness, Dr. Victor E. Saouma.[2] NextEra also seeks to strike C-10's exhibits relating to C-10's Emergency Petition to the NRC Commissioners of February 13, 2019 (Emergency Petition by C-10 Research and Education Foundation for Exercise of Commission's Supervisory Authority to Reverse No Significant Hazards Determination and Immediately Suspend License Amendment and License Renewal Decisions (ADAMS Accession No. ML19044A768), including the expert report submitted by Dr. Saouma in support of the Emergency Petition (*Review of Selected Documents Pertaining to*

[2] *See* Exh. INT001-R, Pre-filed 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 (Proprietary) ("Saouma Direct Testimony"); Exh. INT028, Pre-filed 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 (Proprietary) ("Saouma Rebuttal Testimony"); Exh. INT030, Pre-Filed Supplemental 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 (Proprietary) ("Saouma Supplemental Rebuttal Testimony").

the Structural Evaluation of Seabrook Nuclear Power Plant (Feb. 12, 2019) (Exhibits INT007 (Proprietary) and INT031 (Non-Proprietary)). NextEra argues variously that the testimony and exhibits are outside the scope of C-10's contentions, irrelevant, immaterial, cumulative, and beyond the scope of rebuttal testimony. *Id.* at 1.

III. ARGUMENT

A. NextEra Errs in Seeking to Strike Testimony on the Ground That it was Ruled Out-of-Scope in LBP-17-7.

NextEra first argues that some of C-10's evidence must be stricken because it relates to issues and arguments that were rejected by the ASLB in LBP-17-7. Motion at 9-12. As the ASLB pointed out in its June 7 Order, however, the fact that an issue was rejected in the course of denying admission of a contention or portion thereof does not dispose of evidence related to that issue if the evidence is within the 'reasonably inferred bounds' of the admitted contention." *Id.* at 10 (quoting *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 309 (2010)). Here, NextEra errs by seeking to strike evidence that is within the bounds of C-10's admitted contention, even though it may also be related to inadmissible portions of C-10's contentions.

NextEra asserts, for example, that the Board should strike testimony by Dr. Saouma that "concrete should be tested for its (free) chloride concentration and make sure that it is below critical limits before steel depasivate (i.e. corrode)" (sic). Motion at 8 (quoting Saouma Direct Testimony, Section C.3.2 at 21). NextEra argues that the testimony should be stricken because the Board rejected Contention F, which contained a claim that "'elevated levels of salt . . . [have] likely created the conditions for corrosion of reinforcing steel." *Id.* (citing Hearing Request at 12). While Contention F did indeed identify elevated salt levels in concrete as contributors to corrosion in Seabrook rebar, was the focus of the contention "monitoring [of] *rebar* for

corrosion." 86 N.R.C. at 133 (emphasis added). And the reason the ASLB rejected the contention was that "the plant's rebar is already subject to a monitoring program that is not being altered in the LAR." 86 N.R.C. at 133. Thus, the contention focused on monitoring of rebar, not monitoring of concrete. Unlike Contention F, Dr. Saouma's testimony does not advocate monitoring of the rebar. Instead, he advocates testing of the concrete for (free) chloride concentrations. His testimony falls within the scope of Contention D, because it addresses the question of what measurements should be made in "the required comprehensive petrographic analysis of in-situ concrete at Seabrook." LPB-17-7, 86 N.R.C. at 112.

NextEra also argues that Dr. Saouma makes impermissible arguments that "NextEra should have used specific alternative methodologies capable of identifying the point of failure." Motion at 10. NextEra attempts to compare Dr. Saouma's testimony in Sections C.5 and B.3 with rejected Contention G, which criticized the LAR for not including a program to test FSEL samples of Seabrook concrete to the point of failure/limit state. Hearing Request at 13; *see also* LBP-17-7, 86 N.R.C. at 134. Specifically, NextEra seeks to exclude Dr. Saouma's testimony that "the LAR is deficient because it does not capture 'the maximum expansion' of ASR through 'the time the reaction stops.'" Motion at 10 (quoting Saouma Direct Testimony, Answer C.5 at 31) and that "the LAR's analysis methodology is deficient because it does not 'capture . . . the failure load' of ASR." Motion at 10-11 (quoting Saouma Direct Testimony, Answer B.5). NextEra argues that the "objectives" of capturing the maximum expansion and failure loads were "excluded" by the ASLB. Motion at 11 (citing LBP-17-7, 86 N.R.C. at 134).

NextEra's comparison of Dr. Saouma's testimony with Contention G confuses the concepts of testing for failure load with a concern about the impact of a pre-damaged test specimen with a horizontal crack on the reliability of the FSEL test results. Contention G

asserted that the LAR "should set out a methodology to test materials up to and beyond their point of failure in order to have a full understanding of the effects of ASR." 86 N.R.C. at 134. Characterizing the contention as "an attempt to require the use of a specific methodology for determining acceptance criteria," the ASLB rejected it because "NextEra has chosen to set the acceptance criteria for structures affected by ASR below the limits set by the test program." *Id.* at 134-35. As the ASLB further explained:

> [E]ven though the test program did not test out to the point of failure, the current ASR levels at Seabrook and the LAR acceptance criteria are bounded by the test program, such that the tipping point would not be reached before the acceptance criteria are exceeded.

86 N.R.C. at 135. Thus, the ASLB found that "a requirement to test to the tipping point is not material to the findings the Staff must make about the LAR under 10 C.F.R. § 2.309(f)(1)(iv)." *Id.*

Dr. Saouma recognizes that there are two major components to the FSEL testing. The first addresses the impact of ASR on the shear strength of a beam. The second one focuses on the development of a testing procedure to measure crack index and out of plane expansion. This second component has a bearing on the subsequent in-situ deformation measurement. Having said that, Dr. Saouma is not addressing the same subject as Contention G (shear strength) but rather the procedure for using crack index and out-of-plane deformation to determine the volumetric expansion (which will be subsequently used in the finite element analysis). As stated in Section 2.1 of his testimony:

> As a result of FSEL's failure to use identical concrete in its testing program, and its failure to conduct accelerated expansion tests, *it is impossible to predict with any confidence the maximum expansion at Seabrook*. Essentially, that figure is completely unknown. This is a significant problem that could have been easily avoided.

Id. at 10 (emphasis added). Furthermore, seeking maximum expansion is tantamount of determining the progression of the ASR with time (allowed within Contention D).

In addition, as he testifies in Section B.3, NextEra's safety assessment is deficient because it hinges on the results of the defective FSEL tests rather than incorporating consideration of the nonlinear nature of ASR. Thus, the ASLB has no grounds to strike Section B.3. Similarly, there are no grounds to strike Dr. Saouma's statement in Section C.5 that one of the "three critical questions confronting an engineer overseeing the safety of a structure affected by [ASR]" is "What would be the maximum expansion at the time the reaction stops." This statement does not advocate testing to maximum expansion limits, but rather seeks to determine the progression of ASR.

NextEra also asks the ASLB to strike Section 3.4.1.1 of Dr. Saouma's testimony, on the ground that "it argues that NextEra should have abandoned code-based analysis altogether, and instead performed a "probabilistic based analysis." Motion at 11 (quoting Saouma Direct Testimony at 29-30). Similarly, NextEra seeks exclusion of Sections C.6, C.7, and C.8, as well as INT007 and Sections A.10, A.11, A.14, and page 9 as "academic contemplation of alternative compliance methods." *Id.* To the extent that NextEra uses term "academic" to mean "theoretical" or "speculative" or having no practical or useful significance" (Merriam-Webster, https://www.merriam-webster.com/dictionary/academic), the characterization is fundamentally incorrect.[3] Throughout his testimony, including the challenged sections, Dr. Saouma identifies numerous specific aspects in which the FSEL tests were fundamentally inadequate to provide

[3] There certainly is no doubt that Dr. Saouma is an "academic" in the sense of "relating to, or associated with an academy or school especially of higher learning." Merriam-Webster, *supra*. He has devoted decades of his career to the study of ASR in a university setting, applying a variety of academically-developed techniques to the very complex problem of ASR, and consistently applying commonly accepted academic principles such as the scientific method and testing his conclusions against the independent expertise of his peers. He has also applied his expertise in a number of practical settings, on an international level. Projects in which he has participated in the assessment of ASR in critical infrastructures such as dams are listed in Section A.3 of his Direct Testimony. *Id.* at 1.

data representative of the Seabrook concrete. Dr. Saouma does not speculate on methods that might be better or preferable in some way; instead, he shows that NextEra chose methods that were simply incapable of yielding representative data, in comparison to others that were. As the Commission recognized in affirming CLI-17-7, it is permissible to demand alternative methods if the demand is in connection with a demonstration that the proposed methods are inadequate. *NextEra Energy Seabrook, L.L.C.* (Seabrook Station, Unit 1), CLI-18-4, 87 N.R.C. 59, 106 (2018) ("CLI-18-4").

In addition, Dr. Saouma adds weight to his criticisms of the adequacy of the FSEL test program by demonstrating that NextEra: a) was not making the best of a difficult situation, but rather failing to use tools that were both available and essential to obtain meaningful results; and b) relied on potentially flawed shear tests (due to the large structural crack). As the ASLB has previously noted:

> Evidence is material if it concerns a fact that is of consequence to the outcome of the proceeding. Evidence is relevant if it has 'any tendency' to make the existence of any material fact more or less likely. Thus, evidence need not be conclusive in order to be relevant. It is sufficient that it has some tendency, even a slight one, to make a fact or consequence more or less likely.

Calvert Cliffs 3 Nuclear Project, L.L.C. and UniStar Nuclear Operating Services, L.L.C. (Combined License Application for Calvert Cliffs Unit 3), Order (Granting in Part and Denying in Part NRC Staff's Motion in Limine) at 2 (Jan. 17, 2012) (Unpublished, ADAMS Accession No. ML12017A200) ("*Calvert Cliffs*").

B. Dr. Saouma's Testimony Does Not Impermissibly Expand the Scope of C-10's Contentions.

NextEra argues that C-10 has impermissibly changed the focus of its contentions through Dr. Saouma's testimony. Motion at 12-13. First, NextEra challenges Dr. Saouma's mention of license renewal in Section C.10, arguing that it is outside the scope of this proceeding. Motion at

12. But there is no dispute that the purpose of the LAR is to amend an Aging Management Program that will be used during the license renewal term recently approved by the Commission. In a memorandum to the Commissioners, the NRC's Director of the Office of Nuclear Reactor Regulations stated that:

> Four of the Seabrook license renewal aging management programs (i.e., the plant-specific Alkali-Silica Reaction (ASR) Monitoring Program, the plant-specific Building Deformation Monitoring Program, the Structures Monitoring Program, and the ASME Section XI, Subsection IWL aging management program) are based, in whole or in part, on the methodology submitted in the license amendment request.

Memorandum from Ho K. Nieh to NRC Commissioners re: Renewal of Full-Power Operating License for Seabrook Station, Unit No. 1 (Jan. 10, 2019) (Enclosure 2 to January 11, 2019 Board Notification, ADAMS Accession No. 19011A356). Dr. Saouma has expressed his opinion on this ultimate and consequential safety question, and therefore it is material.

In addition, NextEra challenges the inclusion of some arguments from the expert report and reply declaration submitted by Dr. Saouma in support of C-10's Emergency Petition to the Commissioners. Motion at 13. Contrary to NextEra's argument, Dr. Saouma's statements of his expert opinion were not "rejected" for purposes of this license amendment proceeding. Instead, the Commissioners found that this proceeding would be adequate to resolve any of C-10's concerns. *NextEra Energy Seabrook, L.L.C.* (Seabrook Station, Unit 1), CLI-19-07, __ N.R.C. __, slip op. at 18 (July 25, 2019). While the Commission stated that the Emergency Petition raises issues beyond the scope of the LAR proceeding, it did not specifically identify any out-of-scope issues. In any event, the purpose of including Dr. Saouma's expert report and reply declaration among C-10's exhibits is to show his familiarity with and expertise regarding the complex issue of ASR at Seabrook. For this reason, it is relevant and admissible.

NextEra also challenges the materiality of Dr. Saouma's criticisms of the lack of independent peer review for the work done by NextEra and its consultants on ASR at Seabrook. Motion at 14. But Dr. Saouma's testimony is relevant to the credibility of NextEra's and the NRC Staff's testimony regarding the adequacy of the testing and analyses performed by NextEra. Although NextEra claims to have done a thorough job of assessing ASR at Seabrook, and although the Staff claims to have reviewed NextEra's work and found it acceptable, Dr. Saouma challenged their expertise in light of the fact that none had performed any scientific study of ASR. And neither NextEra nor the NRC Staff had followed the standard scientific method of obtaining an independent peer review of their work. The failure to obtain an independent review of the assessment of a phenomenon as complex and consequential as ASR is a factor that is relevant to the adequacy of the FSEL testing program and the monitoring program that depends on it to support a finding that Seabrook can be operated safely for the next thirty years.

NextEra claims that Dr. Saouma "attempts to shift the focus of the Contention to an entirely *new* set of bases" regarding the LSTP that were not raised in its original contentions. Motion at 15 (emphasis in original). According to NextEra, the issue of representativeness is limited to age, length of time ASR has propagated, exposure to fresh water at various levels, exposure to salt in the water at different levels and concentrations, heat effects, and radiation effects. *Id.* (citing CLI-18-4, 87 N.R.C. at 104). NextEra errs, however, in asserting that Dr. Saouma's testimony falls outside this scope of issues. Virtually every aspect of Dr. Saouma's testimony relates to the question of whether FSEL's testing program is representative of the progress of ASR at Seabrook over time. For example, he testified to: a) timing of crack index measurements at Seabrook; b) applicability time-scheduled monitoring; and c) analysis of a time-

progressing ASR reaction and how the parameters that can accelerate the reaction over time (such as temperature and humidity) are accounted for. As stated in his Direct Testimony, ASR progression is a complex phenomenon affected by a range of inter-related factors:

> *The kinetics of the reaction (that is the rate of expansion) is a function of time, temperature and concrete relative humidity.* ASR is almost never homogeneously spread over a large structure, because reactive concrete tends to occur in "pockets" where silica-rich aggregates may have been used. Heterogeneous distribution of ASR (as is the case of Seabrook) is more problematic than homogeneous distribution, because it will cause gradients of expansion (think of the Tower of Pisa with unequal settlement).
>
> *ASR progress depends very much on the geological nature of the aggregate and sand. In some cases, we have an early-expansion (such as rhyolitic aggregate), and in others a late-expansion (such as granite). Furthermore, sand will result in a rapid expansion, and aggregates will cause a slower, but larger, future expansion. Hence, it is nearly impossible to duplicate a reactive concrete unless one uses exactly the same concrete mix and ingredients.*

Id., Section B.1 at 5-6 (emphasis added). Factors such as the geological nature of the aggregates tested thus directly relate to the issue of whether the test adequately reflects ASR's progress over time. As Dr. Saouma states in his Direct Testimony, for example:

- It is well established (Poyet, et al. 2007) that fine aggregates (sand) will yield a faster reaction (by virtue of their high volume to surface ratio which facilitates diffusion) than coarse ones. However, the coarse aggregates will ultimately yield larger expansion than the one caused by the sand. Hence, expansion will be under-estimated in the long run.

- Expansion is highly dependent on types of aggregates. Some are so called early-expansion, others are late-expansion. Overlooking the geological nature of the aggregate and sand will fatally compromise the outcome of any investigation.

- ASR field expansion as high as 3% have been reported in the literature. (Katayama, T. 2017). However, we have no idea of the potential ultimate expansion at Seabrook, because accelerated expansion tests were not performed.

Id., Section C.2 at 11. His testimony shows that the temporal and spatial aspects of ASR are interrelated and cannot be pulled apart. The implications of this relationship for safety are stated in Section C.5, where Dr. Saouma states that one of the "three critical questions confronting an engineer overseeing the safety of a structure affected by [ASR]" is "What would be the

maximum expansion at the time the reaction stops." *Id.* at 31. All of Dr. Saouma's criticisms of FSEL's testing program, including the failure to test identical materials or properly scaled specimens, relate to the ability of the FSEL testing process to represent the progress of ASR over time.

Another example of the relationship between temporal and spatial features of NextEra's assessment and monitoring programs is provided in Dr. Saouma's testimony regarding the corroboration study, which:

> focuses on a correlation developed during the LSTP that is used by NextEra to estimate through-thickness expansion at Seabrook before an extensometer is installed. According to MPR, it is "an approach for obtaining in-plant data to evaluate how expansion at the plant aligns with observed expansion of the LSTP specimens." In A176, MPR states that the corroboration study will occur several years after installation of the extensometers "to allow time for through-thickness expansion to occur.

Saouma Rebuttal Testimony, Section D.9.1 (quoting MPR Testimony, A95). As Dr. Saouma explains, to a significant extent the corroborations study "depends on approximating quantitative values related to ASR" and adjusting them to account for concrete that was cast over 30 years ago. *Id.* at 41.

One of the most important time-related features of ASR for the FSEL test program, asserted by C-10 in its Hearing Request and acknowledged by both the ASLB and the Commission, is its "non-linear" progression over space and time. *See* CLI-18-4 at 107 (quoting LBP-17-7, 86 N.R.C. at 116) ("C-10 identified, *among other factors,* heat and radiation as variables that may contribute to the 'non-linear advancement of ASR over the course of 35-40 years' in the concrete structures at Seabrook.'") (emphasis added). *See also* LBP-17-7, 86 N.R.C. at 112, 130. The effects on the FSEL test results of NextEra's failure to account for the non-linear progression of ASR is a central concern of Dr. Saouma's testimony. *See, e.g.,* Saouma Direct Testimony, Sections B.3 (at 7); C.1 (at 7-8); C.3.4.1, ¶ 1 (at 24); C.3.4.1, ¶ 15 (at 28);

C.3.4.1, ¶ 18 (at 28); C.6 (at 31-32); C.8 (at 34); C.11, ¶ 17 (at 36); C.11, ¶ 19 (at 37). *See also* Saouma Rebuttal Testimony, Sections A.11 (at 6); A.12 (at 7); B.4 (at 10); C.1 (at 12); D.1 (at 13); D.1.1 (at 14); D.5.1 (at 21); D.7.1 (at 27); D.8.1 (at 34); D.8.2 (at 35); D.9.1 (at 39). Thus, Dr. Saouma's testimony is within the "reasonably inferred bounds" of the admitted contention. 6/7/19 Order at 7.

NextEra also charges that C-10's admitted contentions do not encompass the issues of whether the LSTP failed to model in-plane shear, the significance of the fact that LSTP specimens did not experience shear cracking, or the fact that an LSTP specimen already had a longitudinal crack. Motion at 17. Again, NextEra fails to recognize that FSEL's testing failures in this area are time-related. The crack in the test sample did not occur instantly, but progressed with time (between day of casting and day of testing; A later testing day could have resulted in even more disturbing crack) only after a period when it was aged under environmentally-controlled conditions (that are certainly very different than at Seabrook) for an established period of time. Clearly, the damage to the beam was time-dependent, in a time frame that was not anticipated by FSEL. Indeed, using a potentially flawed or contaminated beam (by the presence of a horizontal crack) will have great consequences on the entire process. In addition, Dr. Saouma's testimony on these issues is relevant to Contention B, which asserts that the LAR "misconstrues expansion occurring within a reinforced concrete structure due to [ASR] because any mitigation of lost structural capacity, due to reinforcement, is temporary and unpredictable." LBP-17-7, 86 N.R.C. at 103; CLI-18-4, 87 N.R.C. at 102.

C. Evidence on the Structural Evaluation Methodology, Finite Element Models, and Deformation Monitoring is Admissible.

NextEra also renews its attempt to exclude or strike any evidence relating to the Structural Evaluation Methodology ("SEM"), finite element models ("FEM"), and deformation

monitoring, alleging that they are not sufficiently related to the representativeness' of the LSTP so as to be considered within the bounds of the original Contention. Motion at 19. Contrary to NextEra's argument, however, Dr. Saouma has demonstrated that deficiencies in the FSEL test program are propagated into these elements of NextEra's program and are therefore relevant to the representativeness of the FSEL test program. As Dr. Saouma asserts in his Rebuttal Testimony, Section D.2.1:

> NextEra developed, deployed, and validated an approach that allows the determination *in-situ* (at Seabrook) of in-plane, and out of plane expansions. Those measurements will be taken *in-situ* from the SMP (field measurements) to the SEM (for the finite element analysis safety assessment). Such an innovative technique, never tested before, had to be first validated in the laboratory. This was done through the LSTP. *Hence, the LSTP had a direct impact on the SMP and SEM.*
>
> For the final safety assessment, the finite element analysis first determines the demand (based on the various loads), and then the capacity (ability of the structure to resist a particular load under certain conditions, ASR in particular). Capacity under those conditions not being addressed by codes, NextEra has performed large-scale tests (LSTP) to determine how ASR would affect the shear resistance (it was found to increase with ASR). As a result, the finite element models were accordingly adjusted. *Without this observation, the SEM would not have been possible.*

Id. at 16 (emphasis in original). Hence, without the LSTP, the SMP and SE would not have been achievable.

Furthermore, in Section 3.4, Dr. Saouma explains how "the structural assessment is an integral part of ASR expansion monitoring, and the finite element analysis is in turn an integral part of the structural assessment." *Id.*, Section 3.4. In addition, Dr. Saouma states:

> As a structural engineer, I find it very difficult to sharply distinguish between AAR monitoring and structural monitoring. One cannot and should not separate material from structural effects, as the two are intertwined. To ignore this fact and decouple them is a grave mistake.

Saouma Direct Testimony, Section C.3 at 18. *See also id.,* Figure 11. And he continues:

> In addition, both the ASR monitoring program and the Structural Deformation Monitoring Program are based in part on the faulty FSEL test results. As a result, both

> programs prescribe monitoring measures that are insufficient to address the actual conditions at Seabrook. And as shown in Figure 11, these defects are interdependent.

Id.

Section D.9.1 of Dr. Saouma's Rebuttal Testimony, regarding the corroboration study used to "obtain plant data" and "evaluate how expansion at the plant aligns with observed expansion of the LSTP specimens," also shows the relationship between the FSEL test results and the SEM. The corroboration component was first developed and "validated" in the FSEL and then deemed adequate to be made an integral part of the SEM. However, Dr. Saouma has have challenged the reliability of the method as a haphazard approach with large margins of errors, and very sensitive to the input parameters (normalized elastic modulus). *Id.* at 38-40. Dr. Dr. Saouma concludes that there would be a "very low confidence level associated with what NextEra perceives to be the total expansion." *Id.* at 39. And that "[t]his is critical because it is precisely this expansion that is inputted to the SEM to ultimately assess the safety of Seabrook." *Id.* In Figure 22, Dr. Saouma shows a significant level of uncertainty in the determination of the elastic modulus from the compressive strength as proposed by NextEra. (Note that Dr. Saouma subsequently corrected Figure 22 to show that the uncertainty is even greater, in his Supplemental Rebuttal Testimony, Exh. INT030). As Dr. Saouma concludes, "this entire procedure would not have been possible without the validation of the methodology through the LSTP. Hence, once again the tight coupling between LTSP, SMP, and SE is proven without any doubt." *Id.* at 41.

NextEra's own documents also show that NextEra has relied on the FSEL large-scale test results for ASR expansion monitoring methodologies, and structural deformation monitoring. They also show that the finite element analysis – which NextEra claims "do *not* use values from the LSTP" (Motion at 21) – relies explicitly on FSEL test results to establish thresholds for

structure deformation monitoring. FSEL test results are relied on to assume that monitoring is not necessary until these thresholds are exceeded.

The UFSAR attached to the LAR, for example, demonstrates that monitoring of the crack indices established by the FSEL tests sets a threshold for structural monitoring and analysis:

> A Combined Cracking Index (CCI) is established at thresholds at which structural evaluation is necessary (see table below). The Cracking Index (CI) is the summation of the crack widths on the horizontal or vertical sides of 20-inch by 30-inch grid on the ASR-affected concrete surface. The horizontal and vertical Cracking Indices are averaged to obtain a Combined Cracking Index (CCI) for each area of interest. A CCI of less than the 1.0 mm/m can be deemed acceptable with deficiencies (Tier 2). Deficiencies determined to be acceptable with further review are trended for evidence of further degradation. The change from qualitative monitoring to quantitative monitoring occurs when the Cracking Index (CI) of the pattern cracking equals or is greater than 0.5 mm/m in the vertical and horizontal directions. Concrete crack widths less than 0.05 mm cannot be accurately measured and reliably repeated with standard, visual inspection equipment. A CCI of 1.0 mm/m or greater requires structural evaluation (Tier 3). All locations meeting Tier 3 criteria will be monitored via CCI on a Yi year (6-month) inspection frequency and added to the through-thickness expansion monitoring via extensometers. All locations meeting the Tier 2 structures monitoring criteria will be monitored on a 2.5 year (30-month) frequency. CCI correlates well with strain in the in-plane directions and the ability to visually detect cracking in exposed surfaces making it an effective initial detection parameter.

UFSAR at 148 (64 of 73). “Tiers” 1, 2, and 3 are the thresholds for structure deformation analysis and monitoring described in Section 3.5.2 of the LAR, which are also established through finite element analysis. *See also* Section 3.3.2 (describing tiers in more detail and application of finite element analysis).

In addition, a report by Simpson Gumpertz & Heger, Inc. (“SGH”): "Evaluation and Design Confirmation of As-Deformed CEB, 150252CA-02," Rev. 0 (Seabrook FP#100985) (July 2016) (ML16279A049) (“SGH Report”), shows that the results of the FSEL test program are incorporated into the finite element analysis (and therefore the Structure Deformation

Monitoring Program) as assumptions.[4] In Assumption JA03, SGH relied on the FSEL test results to assume that "[u]nreduced design material stiffness properties can adequately represent ASR-impacted reinforced concrete sections of the CEB structure." *Id.* at 22 (23 of 527). The "Justification" for this assumption is described as follows:

> Justification: A physical test program by MPR Associates *and the Ferguson Structural Engineering Laboratory (FSEL)* concludes that structural evaluations of ASR-affected structures at Seabrook Station with through-thickness expansion within certain limits should use the material properties specified in the original design specifications [17]. These limits bound the current conditions. Additionally, a parametric study (described in Appendix J) demonstrates that larger demands are computed from the as-deformed condition if an unreduced elastic modulus is used. Therefore, an unreduced elastic modulus based on the design concrete compression strength (f c) is used in the Standard and Standard-Plus Analysis Cases in this calculation.

Id. (emphasis added).

Similarly, in Assumption JA11, SGH assumed that "ASR expansion impacts the total demand on reinforced concrete elements, but does not reduce the resistance (capacity) of reinforced concrete elements so long as the strain does not exceed the limits defined in [the FSEL test results]. *Id.* at 25. The "Justification" for this assumption is described as follows:

> Justification: A physical testing program performed by MPR Associates *and the University of Texas at Austin Ferguson Structural Engineering Laboratory (FSEL) [16]* has shown that ASR does not reduce the design properties and capacities for the levels of ASR currently identified in the CEB.

Id. (emphasis added).[5]

---

[4] The SGH Report, prepared for the purpose of making "a structural evaluation and design confirmation of the as-deformed Unit 1 Containment Enclosure Building (CEB)," is attached as Enclosure 2 to NextEra's supplemental LAR of September 30, 2016 (ML16279A048).

[5] *See also id.* at 19 (emphasis added):

> Acceptance criteria for evaluation and design of reinforced concrete components are defined by ACI 318-71 [11]. *No reductions in capacity are made to account for material degradation due to ASR (Justified Assumption JA11, Section 5.1). Physical testing performed by others [FSEL, Ref. 16] has indicated that ASR expansion does not reduce*

Thus, the FSEL test results provide input to and assumptions for the finite element analysis relied on by NextEra for its methodology for ASR assessment and monitoring, including structural deformation. Accordingly, NextEra is incorrect in arguing that the Structure Deformation Monitoring Program and finite element analysis have no relevance to C-10's contentions. The ASLB therefore should deny the Motion as unsupported.

NextEra also argues that Dr. Saouma's testimony with respect to Rev. 0 of the CEB Evaluation should be stricken, because Rev. 0 has been replaced by Rev. 1. Motion at 24-25. While Dr. Saouma may have overlooked the revision to the CEB in his initial evaluation of thousands of pages of NextEra documents, he did respond to NextEra's testimony regarding the CEB, using the most up-to-date revision. Therefore, his testimony should not be stricken.

Further, NextEra argues that the Board should exclude a significant portion of Dr. Saouma's rebuttal testimony on four discrete points, arguing that the testimony is not responsive to NextEra's testimony, and rather seeks only to buttress Dr. Saouma's direct testimony. These arguments are without merit.

First, the ASLB should not strike Dr. Saouma's rebuttal testimony in Sections A.2 and A.3 with respect to his qualifications to fully respond to NextEra's and the NRC Staff's testimony." As discussed above, NextEra characterizes Dr. Saouma's concerns as "academic" in a pejorative sense of the word. The purpose of his rebuttal testimony on this subject is to show that he has extensive and comprehensive real-world experience with respect to ASR. The breadth and depth of his experience is paralleled by very few (if any).

---

structural capacities if the total out-of-plane expansion is less than the limits defined in Ref. 16.

Second, the ASLB should not strike Dr. Saouma's "cancer" analogy in Section A.9. His answer is an appropriate summation of his evaluation of the testimony of NextEra and the NRC Staff. Moreover, ASR is commonly referred to as 'concrete cancer." *See* https://en.wikipedia.org/wiki/Alkali%E2%80%93silica_reaction (last visited Sept. 19, 2019).

Third, the ASLB should not strike Dr. Saouma's testimony regarding relative humidity in Section D.6.1. In that section, Dr. Saouma provides a general discussion of relative humidity in setting the context for his response to MPR's testimony that monitoring internal relative humidity is not necessary, in Section 6.2.

Fourth, the ASLB should not strike Dr. Saouma's Rebuttal Testimony regarding structural cracking in Sections D.7.1 and D.7.2. The structural cracking addressed in Section D.7.1 was first addressed in Section C.2.3.2 of Dr. Saouma's Direct Testimony at page 20. Thus, Dr. Saouma did not address it for the first time on rebuttal. His additional discussion in Section D.7.1 responded to NextEra's testimony that delamination "will not occur in the CEB." *Id.* at 28. In Section D.7.2 of his rebuttal testimony, Dr. Saouma elaborates on the discussion in Section 7.1, stating that the information provided in Section 7.1 regarding delamination "highlighted the power of an ASR-induced unconstrained expansion in cracking concrete." *Id.* at 30. Thus, like Section 7.1, Section D.7.2 responds to testimony by NextEra.

Finally, NextEra seeks to exclude portions of Dr. Saouma's rebuttal testimony that Dr. Saouma could allegedly have presented in his direct testimony. But NextEra does not identify a single assertion by Dr. Saouma that it considers to be prejudicial to NextEra because it was unable to respond to his arguments. Nor has NextEra sought an opportunity to submit surrebuttal testimony. Therefore, its arguments should be rejected.

IV. CONCLUSION

For the foregoing reasons, the ASLB should find that Dr. Saouma's testimony is relevant and material and within the scope of C-10's contention, and therefore it should admit the testimony. The Board should also conclude that Dr. Saouma's testimony is not duplicative, and not prejudicial to NextEra in any way. Accordingly, the Board should deny NextEra's Motion *in Limine.*

Respectfully submitted,
__/signed electronically by/___

Diane Curran
Harmon, Curran, Spielberg, & Eisenberg, L.L.P.
1725 DeSales Street N.W., Suite 500
Washington, D.C. 20036
240-393-9285
dcurran@harmoncurran.com

September 19, 2019

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

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

CERTIFICATE OF SERVICE

I certify that on September 19, 2019, I posted C-10 RESEARCH AND EDUCATION FOUNDATION'S OPPOSITION TO NEXTERA'S SECOND MOTION *IN LIMINE* on the NRC's electronic hearing docket.

__/signed electronically by/___

Diane Curran