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-LA-2
(Seabrook Station, Unit 1)	

AFFIDAVIT OF ANGELA BUFORD, BRYCE LEHMAN, JACOB PHILIP, AND GEORGE THOMAS IN RESPONSE TO C-10'S MOTION FOR PARTIAL RECONSIDERATION AND TO REOPEN THE RECORD

Q.1. Please state your name, occupation, and by whom you are employed.

A.1. This information is provided in A.1a–A.1c of Exhibit NRC001-R-00-BD01 for Angela Buford, Bryce Lehman, and George Thomas, respectively, and in A.1 of Exhibit NRC005-00-BD01 for Jacob Philip.

Q.2. Please describe the nature of your responsibilities on behalf of the U.S. Nuclear Regulatory Commission.

A.2. This information is provided in A.2a–A.2c of Exhibit NRC001-R-00-BD01 for Angela Buford, Bryce Lehman, and George Thomas, respectively, and in A.2 of Exhibit NRC005-00-BD01 for Jacob Philip.

Q.3. Please explain your qualifications to be an expert regarding the Staff review of the NextEra Energy Seabrook, LLC license amendment request (LAR) to revise the Seabrook Station, Unit 1 Updated Final Safety Analysis Report (UFSAR) (NRC007-00-BD01) to include an alkali-silica reaction (ASR) expansion monitoring program, based, in part, on a large-scale test program (LSTP), to demonstrate that Seabrook structures with ASR continue to meet the design

codes for original construction (INT010-00-BD01 (nonproprietary); NRC089-00-BD01 (proprietary)).[1]

A.3. This information is provided in A.3a–A.3c of Exhibit NRC001-R-00-BD01 for Angela Buford, Bryce Lehman, and George Thomas, respectively, and in A.3 of Exhibit NRC005-00-BD01 for Jacob Philip, as well as in LBP-20-09.

Q.4. Please explain the current status of the LAR.

A.4. On March 11, 2019, the Staff approved the LAR with two conditions (INT024-00-BD01 (nonproprietary); INT025-00-BD01 (proprietary)). Thereafter, the Atomic Safety and Licensing Board held a hearing on a reformulated contention on the LAR that it had admitted at the request of the C-10 Research and Education Foundation (C-10). On August 21, 2020, the Board issued an Initial Decision (LBP-20-09) on the reformulated contention, upholding the Staff's approval of the LAR subject to the addition of four conditions to the two conditions previously imposed by the Staff (i.e., the Board-imposed conditions (c), (d), (e), and (f), which followed the Staff-imposed conditions (a) and (b)).[2] These four conditions are:

> c. NextEra shall undertake the monitoring required by MPR-4273, Appendix B, Check 3, for control extensometers every six months, rather than in 2025 and every ten years thereafter.
>
> d. If stress analyses conducted pursuant to the [Structural Evaluation Methodology (SEM)] show that the stress in the [reinforcing bars (rebar)] from ASR-induced expansion and other loads will exceed the yield strength of the rebar, NextEra must develop a monitoring program sufficient to ensure that rebar failure or yielding does not occur, or is

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[1] NextEra supplemented the LAR on September 30, 2016 (NRC010-00-BD01), October 3, 2017 (NRC013-00-BD01), December 11, 2017 (NRC014-00-BD01), and June 7, 2018 (NRC015-00-BD01). Separately, on May 18, 2018, in updating its license renewal application for Seabrook, NextEra provided revised versions of MPR Associates (MPR) reports previously submitted as LAR supplements (NRC016-00-BD01).

[2] *NextEra Energy Seabrook, LLC* (Seabrook Station, Unit 1), LBP-20-9, 92 NRC __, __ (Aug. 21, 2020) (slip op. at 192–93).

detected if it has already occurred, in the areas at-risk of rebar failure or yielding.

e. If the ASR expansion rate in any area of a Seabrook seismic Category I structure significantly exceeds 0.2 mm/m (0.02%) through-thickness expansion per year, NextEra's Management will perform an engineering evaluation focused on the continued suitability of the six-month monitoring interval for Tier 3 areas. If the engineering evaluation concludes that more frequent monitoring is necessary, it shall be implemented under the [Structures Monitoring Program (SMP)].

f. Each core extracted from Seabrook Unit 1 will be subjected to a petrographic analysis to detect internal microcracking and delamination.[3]

On August 31, 2020, C-10 filed motions seeking changes to the Board-imposed conditions (c), (d), (e), and (f).[4] Specifically, as explained in the testimony of Dr. Victor E. Saouma (C-10's expert witness in the Seabrook Board proceeding) that accompanied C-10's motion, C-10 proposed to change condition (c) "to add language requiring the use of error bars, to be independently reviewed by the NRC Staff."[5] C-10 proposed to change condition (d) such that any monitoring program developed by NextEra to ensure that rebar failure or yielding does not occur, or is detected if it has already occurred, in the areas at-risk of rebar failure or yielding "should include the use of properly placed and attuned acoustic sensors to detect rebar fracture" and "readings should be taken no less than every six months after commencement of the

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[3] *Id*.

[4] C-10 Research and Education Foundation's Motion for Leave to File Motion for Partial Reconsideration of LBP-20-09 (Aug. 31, 2020) (ML20244A320); C-10 Research and Education Foundation's Motion for Partial Reconsideration and Motion to Re-Open the Record for Consideration of Supplemental Testimony Regarding License Conditions in LBP-20-09 (Aug. 31, 2020) (ML20244A321); Certificate of Counsel (Aug. 31, 2020) (ML20244A324); Certificate of Service (Aug. 31, 2020) (ML20244A319); Declaration by Victor E. Saouma, Ph.D in Support of C-10 Research and Education Foundation's Motion to Re-Open the Record (Aug. 28, 2020) (ML20244A323); Supplemental Testimony of Victor E. Saouma, Ph.D Regarding License Conditions in LBP-20-09 (Aug. 31, 2020) (ML20244A314) (Saouma Supplemental Testimony).

[5] Saouma Supplemental Testimony at 1–2.

program."[6] C-10 proposed to change condition (e) to "eliminate the word 'significantly' and instead provide that if the expansion rate in any area exceeds 0.[]2 mm/m (0.02%), NextEra should perform an engineering evaluation."[7] Finally, C-10 proposed to change condition (f) to specify that its petrographic analysis "should be capable of detecting microcracks as small as 10 μm."[8]

Q.5. What is the purpose of this affidavit?

A.5. The purpose of this affidavit is to provide our expert opinion on the Board-imposed conditions and the changes to those conditions proposed by C-10.

Q.6. What is your experience with evaluating and writing the terms of NRC licenses?

A.6. Between the four of us, we have decades of experience in evaluating the terms of NRC licenses to understand licensees' responsibilities and the Staff's enforcement authority under those terms. We also have decades of experience in writing the terms of NRC licenses such that they provide reasonable assurance of adequate protection of public health and safety and are clear and enforceable legal obligations. When writing the terms of NRC licenses with respect to license amendments, we are guided by Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-101.[9] LIC-101 states that license amendments should be processed in a manner consistent with the NRC's principles of good regulation,[10] which, in turn, state, in part, that regulations should be coherent, logical, and practical and should be readily understood and

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[6] *Id*. at 2.

[7] *Id*. at 2–4.

[8] *Id*. at 4–5.

[9] NRR Office Instruction LIC-101, "License Amendment Review Procedures" (July 31, 2020) (ML19248C539) (LIC-101).

[10] *Id*. at 2.

easily applied.[11] LIC-101 explains that license conditions are legally binding formal statements included in a license as necessary to establish, implement, or maintain applicable rules, regulations, or licensing bases.[12] It states that license conditions should be worded such that their meaning is clear and not open to different interpretations and should explicitly define the conditions for their satisfaction; license conditions should not address issues already addressed by an existing rule, requirement, order, or regulation, should not require NRC action to complete, and should not be open-ended.[13]

With respect to the Seabrook LAR in particular, Ms. Buford, Mr. Lehman, and Dr. Thomas helped write the Staff-imposed conditions (a) and (b). Ms. Buford, Mr. Lehman, Mr. Philip, and Dr. Thomas have an extensive understanding of the Seabrook LAR after years of work on it, including through multiple inspections, audits, requests for additional information, and public meetings.

Q.7. Based on your extensive experience with NRC licenses in general and the Seabrook LAR in specific, what is your reaction to Board-imposed condition (c) and the changes to that condition proposed by C-10?

A.7. We believe that condition (c), as written by the Board, is clear and enforceable. However, to further improve its clarity and to make it consistent with Staff-imposed conditions (a) and (b), we recommend that the Board include in the condition the appropriate revision number in the reference to MPR-4273. Specifically, we recommend changing "MPR-4273" to "MPR-4273, Revision 1." We also recommend deleting the clause "rather than in 2025 and every ten years thereafter" because it is not necessary. Moreover, the reference to 2025 may

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[11] NUREG-1350, Volume 31, "2019-2020 Information Digest," at 3 (Aug. 2019) (ML19242D326).

[12] LIC-101 at App. B, p. 22.

[13] *Id*.

appear to imply that this condition is related to Staff-imposed condition (b), which is not the case.

We do not agree with C-10's proposal to require the use of "error bars" with respect to condition (c)[14] because the use of error bars does not apply in this situation. The Board imposed condition (c) to address its concern that, "because LSTP data was not sufficiently representative of Seabrook concrete [with respect to aggregate chemical composition and structure], through-thickness cracking approaching the expansion limit may occur even though the extensometer [installation] threshold [(i.e., a combined cracking index (CCI) of 1.0 mm/m (0.1%) based on the LSTP] has not been reached."[15] Therefore, condition (c) requires that the control extensometers that are installed in select locations less than the CCI 1.0 mm/m (0.1%) threshold be measured every six months to ensure the prompt detection of any observation that would challenge this threshold.[16] The Board determined that this monitoring would satisfy the reasonable assurance standard despite the differences in aggregate chemical composition and structure between the LSTP and Seabrook.[17] Therefore, the purpose of condition (c) is to frequently make sure that the CCI 1.0 mm/m (0.1%) threshold for extensometer installation based on the LSTP remains valid; adding error bars to this monitoring process would not further this purpose. Moreover, the Board determined that C-10 had not provided any evidence that aggregate chemical composition and structure would affect the correlation between reduced elastic modulus and past expansion[18] and, therefore, to the extent that C-10 seeks to apply

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[14] Saouma Supplemental Testimony at 1–2.

[15] LBP-20-9, 92 NRC at __ (slip op. at 89, 94).

[16] *Id*. at __ (slip op. at 97).

[17] *Id*.

[18] *Id* at __ (slip op. at 88).

error bars to condition (c) with respect to this correlation, its argument is unsupported. Finally, as demonstrated by the LSTP and as approved by the Staff and upheld by the Board, the extensometers in use at Seabrook provide accurate and reliable measurements for monitoring through-thickness expansion[19] and, therefore, C-10 has not explained why error bars would have to accompany their use.

We also do not agree with C-10's proposal to require that any imposition of error bars be "independently reviewed by the NRC Staff."[20] This requirement is inconsistent with the NRC's role as a regulator. The NRC performs independent reviews of applications for new licenses or for changes to existing licenses; it does not perform independent reviews of the ongoing actions of licensees pursuant to their licenses, which, instead, are at all times subject to NRC oversight. This distinction is made clear by the Staff's guidance, which states that license conditions "should not … require NRC action to complete…."[21] Therefore, C-10's proposed language regarding an independent Staff review is not appropriate.[22]

For these reasons, the Board should not change condition (c) as proposed by C-10.

Q.8. Based on your extensive experience with NRC licenses in general and the Seabrook LAR in specific, what is your reaction to Board-imposed condition (d) and the changes to that condition proposed by C-10?

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[19] *See, e.g.,* LBP-20-9, 92 NRC at __ (slip op. at 65).

[20] Saouma Supplemental Testimony at 1–2.

[21] LIC-101 at App. B, p. 22.

[22] As discussed in the Staff's answer accompanying this affidavit, the addition of this language is also impermissible as a matter of law. NRC Staff's Answer to C-10's Motion for Partial Reconsideration and to Reopen the Record at 2 (Sep. 10, 2020).

A.8. We believe that condition (d), as written by the Board, is clear and enforceable. However, we recommend spelling out the abbreviation "SEM" in condition (d) as "Structural Evaluation Methodology" for the sake of clarity.

We do not agree with C-10's proposal that any monitoring program resulting from this condition must "include the use of properly placed and attuned acoustic sensors to detect rebar fracture" and that "readings should be taken no less than every six months after commencement of the program."[23] Acoustic sensors are not necessary because, as explained in the Staff's safety evaluation of the LAR (INT024-00-BD01 (nonproprietary), at 51–52; INT025-00-BD01 (proprietary), at 51–52), NextEra already conducts additional examination and analysis if code acceptance criteria are not met or if cracking index (CI) or CCI values exceed 2.0 mm/m (0.2%). This value is conservative with respect to the yielding of rebar, which is expected to occur at a strain of approximately 2.1 mm/m (0.21%), based on the specified rebar minimum yield strength (60 ksi) divided by the elastic modulus of rebar (29000 ksi). The required additional examination and analysis will ensure that rebar yielding has not occurred and, under its corrective action program, NextEra will consider whether any retrofit or repair is required if CI or CCI values reach the 2.0 mm/m (0.2%) threshold. Therefore, the addition of acoustic sensors and reading them every six months would not be necessary for reasonable assurance that rebar fracture is not impacting the safety function of Seabrook structures. As stated in the Staff's guidance, license conditions "should not … address issues already addressed by an existing rule, requirement, order, or regulation…."[24] For these reasons, the Board should not change condition (d) as proposed by C-10.

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[23] Saouma Supplemental Testimony at 2.

[24] LIC-101 at App. B, p. 22.

Q.9. Based on your extensive experience with NRC licenses in general and the Seabrook LAR in specific, what is your reaction to Board-imposed condition (e) and the changes to that condition proposed by C-10?

A.9. We agree with C-10 to the extent that C-10 argues that the word "significantly" should be deleted from condition (e). The word "significantly" is not quantitatively defined and, thus, its inclusion in this condition would make it unclear under exactly what conditions NextEra would be required to perform an engineering evaluation. This would be contrary to the Staff's guidance that states that license conditions "should … be worded such that the meaning is clear and not open to different interpretations…."[25] Therefore, for the sake of clarity and to avoid differing interpretations in the future, we agree that the word "significantly" should be deleted from condition (e). Additionally, we recommend that the Board change the value in this condition from "0.2 mm/m (0.02%)" to "0.24 mm/m (0.024%)," consistent with the increased ASR expansion rate posited in the Board's decision.[26]

We do not agree with Dr. Saouma's other arguments with respect to condition (e). For instance, we do not agree with Dr. Saouma's conflation of the issues of rebar stress and ASR expansion rate.[27] The ASR expansion rate of 0.02% discussed in condition (e) is based on the highest in-situ through-thickness expansion rate measured to date using extensometers. The extensometers are installed in the through-wall direction, which in a typical Seabrook wall has no rebar and provides the least restraint to expansion and, therefore, is expected to have the highest expansion rate. Discussing rebar yielding based on this through-thickness expansion

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[25] LIC-101 at App. B, p. 22.

[26] *See* LBP-20-9, 92 NRC at __ (slip op. at 135).

[27] Saouma Supplemental Testimony at 4.

rate, though, is not relevant because there is no rebar in the through-thickness direction in a typical Seabrook wall.

We also do not agree with Dr. Saouma's statement that an ASR expansion rate of 0.02% is "extremely close to unsafe levels, if not unsafe already."[28] To support this statement, Dr. Saouma cites to Figure 21 of Exhibit NER075-00-BD01; however, this figure shows expansion measurements on core samples taken from a dam structure (a massive, unreinforced concrete structure) that are not at all applicable to or representative of Seabrook reinforced concrete structures. Additionally, Dr. Saouma's implication that the Board relied on this figure as a basis for condition (e) is incorrect.

For these reasons, with respect to condition (e), the Board should delete the word "significantly" and change the ASR expansion rate value to "0.24 mm/m (0.024%)." We also recommend spelling out the abbreviation "SMP" in condition (e) as "Structures Monitoring Program" for the sake of clarity. The Board should not make any other changes to its decision based on C-10's arguments concerning condition (e).

Q.10. Based on your extensive history with NRC licenses in general and the Seabrook LAR in specific, what is your reaction to Board-imposed condition (f) and the changes to that condition proposed by C-10?

A.10. We believe that condition (f), as written by the Board, is clear and enforceable. We do not agree with C-10's proposal that the petrographic analysis required by condition (f) should be capable of detecting microcracks as small as 10 μm,[29] because this would not produce safety-significant information.

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[28] Saouma Supplemental Testimony at 4.

[29] *Id*. at 4–5.

The Board found that NextEra did not have an adequate screening procedure to detect internal cracking and delamination in Seabrook's concrete.[30] However, the Board determined that the petrographic analysis of cores extracted from Seabrook's concrete could gauge the degree of internal microcracking that could lead to delamination and then, therefore, imposed this analysis as condition (f).[31] A petrographic analysis that is capable of detecting microcracks as small as 10 µm, which is 1/100th mm, is unnecessary to meet the Board's stated purpose for condition (f) of detecting internal microcracking that could lead to delamination.

Although Dr. Saouma cites to Exhibit NER075-00-BD01,[32] this document does not support the proposition that microcracks as small as 10 μm need to be detected to identify microcracking that could lead to delamination. On the contrary, this document states that ASR damage in core samples "can often easily be recognized with the naked eye…."[33] Moreover, when discussing observations under the light microscope, this document uses resolutions of 50 μm and 200 μm, both of which are significantly greater than the 10 μm resolution requested by Dr Saouma, but yet can identify cracks with clarity.[34] With respect to greater magnifications, this document states that these magnifications allow for a more detailed analysis of ASR-generated products in cracks and not that such magnifications are necessary for crack detection itself.[35] Petrography is conducted by qualified petrographers using a standard stereomicroscope or petrographic microscope as specified in an industry standard for

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[30] LBP-20-9, 92 NRC at __ (slip op. at 184).

[31] *Id*. at __ (slip op. at 185).

[32] Saouma Supplemental Testimony at 5.

[33] NER075-00-BD01 at 12.

[34] *Id*. at 13–14.

[35] *Id*. at 14.

petrographic examination of hardened concrete, such as ASTM C856. This is sufficient to detect potential delamination cracking, without a specific requirement to detect microcracks as small as 10 μm.

In sum, delamination cracks are significantly wider than 10 μm and microcracks as small as 10 μm have no significance to structural capacity or response. Therefore, standard petrography is sufficient to accomplish the purpose of condition (f) to detect internal microcracking that could lead to delamination. Moreover, the potential existence of delamination may be confirmed by the visual examination of the borehole from which a core was removed using a micro-camera. As the Board stated, this is already being done as part of the Seabrook Structures Monitoring Program, which subjects boreholes to visual examination to confirm the absence of mid-plane cracks.[36] As stated in the Staff's guidance, license conditions "should … address issues of high safety or regulatory significance" and "should not … address issues already addressed by an existing rule, requirement, order, or regulation…."[37] For these reasons, the Board should not change condition (f) as proposed by C-10.

Q.11. After reviewing all of the information available since the issuance of the safety evaluation for the LAR (INT024-00-BD01 (nonproprietary); INT025-00-BD01 (proprietary)), including LBP-20-09, is it your expert opinion that the Seabrook ASR expansion monitoring program, with the imposition of license conditions (a) through (f), including the changes to these conditions proposed in your foregoing testimony, is acceptable and provides reasonable assurance that Seabrook structures will continue to meet the NRC's requirements?

A.11. Yes.

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[36] LBP-20-9, 92 NRC at __ (slip op. at 182–83).

[37] LIC-101 at App. B, p. 22.

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NEXTERA ENERGY SEABROOK, LLC	Docket No. 50-443-LA-2
(Seabrook Station, Unit 1)	

AFFIDAVIT OF ANGELA BUFORD

I, Angela Buford, do hereby declare under penalty of perjury that my foregoing statements are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

Angela Buford
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Executed this 10th day of September 2020

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-LA-2
(Seabrook Station, Unit 1)	

AFFIDAVIT OF BRYCE LEHMAN

I, Bryce Lehman, do hereby declare under penalty of perjury that my foregoing statements are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

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Executed this 10th day of September 2020

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NUCLEAR REGULATORY COMMISSION

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In the Matter of	
NEXTERA ENERGY SEABROOK, LLC	Docket No. 50-443-LA-2
(Seabrook Station, Unit 1)	

AFFIDAVIT OF JACOB PHILIP

I, Jacob Philip, do hereby declare under penalty of perjury that my foregoing statements are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

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Executed this 10th day of September 2020

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NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	
NEXTERA ENERGY SEABROOK, LLC	Docket No. 50-443-LA-2
(Seabrook Station, Unit 1)	

AFFIDAVIT OF GEORGE THOMAS

I, George Thomas, do hereby declare under penalty of perjury that my foregoing statements are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR 2.304(d)

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Executed this 10th day of September 2020