



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

January 23, 2019

The Honorable Kristine L. Svinicki  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

**SUBJECT: SUMMARY REPORT – 659<sup>th</sup> MEETING OF THE ADVISORY  
COMMITTEE ON REACTOR SAFEGUARDS, DECEMBER 6-7, 2018**

Dear Chairman:

During its 659<sup>th</sup> meeting, December 6-7, 2018, the Advisory Committee on Reactor Safeguards (ACRS) discussed several matters and completed the following reports and memorandum:

**REPORTS**

Reports to Kristine L. Svinicki, Chairman, NRC, from Michael L. Corradini, Chairman, ACRS:

- “Early Site Permit – Clinch River Nuclear Site,” dated January 9, 2019
- “Report on the Safety Aspects of the License Renewal Application for the Seabrook Station, Unit 1,” dated December 19, 2018
- “Seabrook Station Unit 1 License Renewal Application Review of Licensee Program Addressing Alkali-Silica Reaction,” dated December 14, 2018

**MEMORANDUM**

Memorandum to Margaret M. Doane, Executive Director for Operations, NRC, from Andrea D. Veil, Executive Director, ACRS:

- “Documentation of Receipt of Applicable Official NRC Notices to the Advisory Committee on Reactor Safeguards for December 2018,” dated December 10, 2018

## HIGHLIGHTS OF KEY ISSUES

### 1. Clinch River Early Site Permit

The Committee met with representatives of the NRC staff and Tennessee Valley Authority (TVA) to review the staff's final safety evaluation report for the Clinch River Nuclear Site early site permit application for two or more small modular reactors. Our reviews of the application and safety evaluation report were conducted to fulfill the requirements of 10 CFR 52.23, that the ACRS report on those portions of an early site permit application that concern safety.

TVA filed an early site permit application for its Clinch River site in May 2016 and the NRC accepted and docketed the application in December 2016. The TVA application was based on a plant parameter envelope approach as a surrogate for a specific plant design. Using inputs from four prospective vendors (NuScale, Holtec, BWX Technologies, and Westinghouse) of light-water reactor-derivative small modular reactor designs, TVA determined bounding values for construction and operation of two or more small modular reactors at the Clinch River site with a total nuclear generating capacity up to 2420 MWt and 800 MWe (up to 800 MWt for a single unit or module). This approach allows TVA flexibility, while also potentially reducing licensing risk.

The TVA early site permit application and the staff's review demonstrated suitability of the Clinch River site considering topics including surrounding population, external hazards, site physical characteristics, potential radionuclide releases, and emergency preparedness. This application is unique in its approach to emergency planning in that it proposes a risk-informed, dose-based, consequence-oriented methodology to determine the appropriate plume exposure pathway emergency planning zone. We note that this is in parallel to proposed rulemaking on emergency preparedness for small modular reactors and other new technologies, which we agreed with in our recent October 19, 2018 letter on this subject.

The TVA early site permit application benefits from the proposed use of advanced light-water reactor-derivative small modular reactor designs that are expected to exhibit both lower accident frequencies and consequences than the current fleet of large light-water reactors; the large body of knowledge associated with light-water reactor technology, particularly regarding source terms; and extensive light-water reactor operating and licensing experience. TVA's approach to emergency planning in providing dose savings is consistent with that used in developing NUREG-0396 and the staff's proposed current rulemaking on the matter.

### Committee Action

The Committee issued a report to the NRC Chairman on this matter, dated January 9, 2019, with the following conclusion and recommendations: 1) Small modular reactors with design characteristics within the plant parameter envelope used by TVA in developing its Clinch River Nuclear Site early site permit application can be constructed and operated without undue risk to the health and safety of the public, 2) The staff's safety evaluation report of the TVA early site permit application should be issued. The staff accepted TVA's plume

exposure pathway emergency planning zone sizing methodology; two *major features* emergency plans (one plan for a site boundary plume exposure pathway emergency planning zone and a second plan for an approximate 2-mile radius plume exposure pathway emergency planning zone); and associated exemption requests. The safety evaluation report also identified a number of items that are treated either as permit conditions or as action items that must be addressed at the operating license stage, and 3) The early site permit for the Clinch River Nuclear Site should be issued.

## 2. Seabrook License Renewal Application

The Committee met with representatives of the NRC staff and NextEra Energy Seabrook, LLC (NextEra) to review the staff's final safety evaluation report for the Seabrook, Unit 1 license renewal application. In its application, NextEra requests renewal of the operating license for a period of 20 years beyond the current expiration date of March 15, 2030.

In its final safety evaluation report, the staff documented its review of the license renewal application and other information submitted by the applicant and obtained through staff audits and inspections at the plant site. The staff reviewed the completeness of the identification of structures, systems, and components that are within the scope of license renewal. The staff also reviewed the integrated plant assessment process; the identification of plausible aging mechanisms associated with passive, long-lived components; the adequacy of the Aging Management Programs (AMPs); and the identification and assessment of Time-Limited Aging Analyses (TLAAs) requiring review. The staff conducted license renewal audits and performed a license renewal inspection at Seabrook. The audits verified the appropriateness of the scoping and screening methodology for AMPs, the appropriateness of the aging management review, and the acceptability of the TLAAs.

NextEra will implement 44 AMPs for license renewal, comprised of 29 existing programs and 15 new programs. Of the new programs, seven are consistent with the GALL Report, one is consistent with enhancement, two are consistent with allowed exceptions, one is consistent with enhancements and allowed exceptions, and four are plant specific. Of the 29 existing programs, eight are consistent with the GALL Report, 12 are consistent with enhancements, two are consistent with allowed exceptions, five are consistent with enhancements and allowed exceptions, and two (Nickel Alloy Nozzles and Penetrations, Boral Monitoring) are plant-specific. The license renewal application includes five programs with allowed exceptions to the GALL Report. The programs with exceptions and enhancements are acceptable.

Two of the new plant specific AMPs focus on concrete degradation caused by alkali-silica reaction. The Building Deformation Monitoring Program and the Alkali-Silica (ASR) Monitoring Program address NextEra's approach to assess, monitor, and manage alkali-silica reaction.

We agree with the staff conclusion that there are no issues related to the matters described in 10 CFR 54.29(a)(1) and (a)(2) that preclude renewal of the operating license for Seabrook.

This report fulfills the requirement of 10 CFR 54.25, that the ACRS review and report on all license renewal applications.

### Committee Action

The Committee issued a report to the NRC Chairman on this matter, dated December 19, 2018, with the following conclusion and recommendation: 1) The programs established and committed to by NextEra to manage age-related degradation provide reasonable assurance that Seabrook can be operated in accordance with its current licensing basis for the period of extended operation without undue risk to the health and safety of the public, and 2) NextEra's application for renewal of the operating license for Seabrook should be approved.

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The Committee's review of the Seabrook license renewal included a separate meeting with representatives of the NRC staff and NextEra to specifically consider NextEra's actions to address the concrete degradation mechanism, alkali-silica reaction, observed in plant structures. Degradation typical of ASR was first detected at the plant in 2009, and confirmed by concrete borings withdrawn from Seabrook structures in 2010. Since that time, NextEra has undertaken substantial and thorough actions to identify, understand, and address this condition.

Alkali-silica reaction occurs in concrete, in the presence of moisture, when reactive silica in the concrete aggregate reacts with alkali ions in the pore solution. The reaction produces an alkali-silica gel that expands in volume as it absorbs moisture, resulting in cracking of the concrete and potentially reducing the capacity of concrete structures. The alkali-silica reaction discovered at Seabrook is a slowly developing phenomenon that was initially manifested as micro-cracking and staining of concrete structures. Based on data and testing performed on the Seabrook concrete, it is reasonable to assume that the alkali-silica reaction phenomenon has been occurring since early operation of the plant (although virtually undetectable in its early stages) and will continue to occur through the balance of plant life.

Because alkali-silica reaction affects concrete properties and imposes structural loadings that were not originally addressed in Seabrook's operating license basis assessments, NextEra submitted License Amendment Request 16-03 to revise the Seabrook Updated Final Safety Analysis Report to include methods for analyzing Seismic Category I concrete structures affected by alkali-silica reaction. The license amendment request is based on testing and analyses that established appropriate concrete properties and analytical methods to demonstrate the acceptability of structures considering the effects of alkali-silica reaction. The license amendment request methodology has been used to analyze all Seismic Category I structures at Seabrook in their current, alkali-silica reaction-degraded condition, as well as to develop plant specific AMPs in the license renewal application to demonstrate that the structures affected by alkali-silica reaction will be acceptable for the proposed period of extended operation.

NextEra has undertaken comprehensive actions to characterize, evaluate, and apply test results into Seabrook-specific analysis and monitoring programs to understand current building structural capacity and to monitor and evaluate future building performance. The staff has conducted assessments of the testing program, the data from the testing, and the efficacy of licensee employment of these programs as bases for judging the acceptability of the affected structures for present and extended life through the period of extended operation. We concur with the staff conclusion that, while some of the structures are degraded, they are fully capable of performing their credited function through the requested period of extended operation under the committed enhanced monitoring and evaluations.

#### Committee Action

The Committee issued a report to the NRC Chairman on this matter, dated December 14, 2018, with the following conclusions: 1) NextEra License Amendment Request 16-03 establishes a robust analytical methodology, supported by a comprehensive large scale test program, for the treatment and monitoring of alkali-silica reaction-affected Seismic Category I structures at Seabrook, 2) The NextEra license renewal application includes two new Aging Management Programs to monitor alkali-silica reaction and building deformation. These incorporate the test program results and license amendment request methodology and assure that the effects of alkali-silica reaction will be effectively tracked and evaluated through the end of the license renewal application period of extended operation, and 3) The staff safety evaluations of the license amendment request and alkali-silica reaction-related Aging Management Programs in the license renewal application provide thorough assessments and findings. We agree with the staff's conclusion that NextEra's programs are acceptable.

#### SCHEDULED TOPICS FOR THE 660<sup>th</sup> ACRS MEETING

The following topics are scheduled for the 660<sup>th</sup> ACRS meeting, to be held February 6-9, 2019:

- Technology Inclusive, Risk-Informed, Performance-Based Approach for Approving Non-Light-Water Reactors
- Non-Production & Utilization Facilities Rulemaking
- Interim Letter: Chapters 2 and 17 of the NRC Staff's Safety Evaluation Reports With Open Items Related to the Certification of the NuScale Small Modular Reactor
- Review of AURORA-B for LOCA Scenarios
- Assessment of the Quality of Selected NRC Research Projects

Sincerely,

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Michael Corradini  
Chairman

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