[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket No. 50-443; NRC-2015-0184]

NextEra Energy Seabrook, LLC, Seabrook Station, Unit 1

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a July 24, 2014, request from NextEra Energy Seabrook, LLC (NextEra or the licensee), from specific requirements in NRC's regulations, as they pertain to the establishment of minimum temperature requirements, for all modes of operation, based on the material properties of the material of the reactor pressure vessel (RPV) closure flange region that is highly stressed by the bolt preload.

ADDRESSES: Please refer to Docket ID **NRC-2015-0184** when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to http://www.regulations.gov and search for Docket ID **NRC-2015-0184**. Address questions about NRC dockets to Carol Gallagher;

telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

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FOR FURTHER INFORMATION CONTACT: John G. Lamb, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-3100, e-mail: John.Lamb@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Background.

NextEra is the holder of Facility Operating License No. NPF-86, which authorizes operation of the Seabrook Station, Unit No. 1 (Seabrook).

The Seabrook facility consists of a pressurized-water reactor located in Rockingham County, New Hampshire.

II. Request/Action.

By letter dated July 24, 2014 (ADAMS Accession No. ML14216A404), as supplemented by letters dated March 9, April 24, and June 24, 2015 (ADAMS Accession Nos. ML15072A023, ML15125A140, and ML15181A262, respectively), the licensee requested an exemption from section 50.60 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Acceptance criteria for fracture prevention measures for lightwater nuclear power reactors for normal operation," pursuant to 10 CFR 50.12, "Specific exemptions."

Part 50, appendix G requires that pressure-temperature (P-T) limits be established for RPVs during normal operating and hydrostatic or leak rate testing conditions. Specifically, 10 CFR part 50, appendix G states that "[t]he minimum temperature requirements...pertain to the controlling material, which is either the material in the closure flange or the material in the beltline region with the highest reference temperature....the minimum temperature requirements and the controlling material depend on the operating condition (i.e., hydrostatic pressure and leak tests, or normal operation including anticipated normal operational occurrences), the vessel pressure, whether fuel is in the vessel, and whether the core is critical. The metal temperature of the controlling material, in the region of the controlling material which has the least favorable combination of stress and temperature, must exceed the appropriate minimum temperature requirement for the condition and pressure of the vessel specified in Table 1 [of 10 CFR part 50, appendix G]." Footnote 2 to Table 1 in 10 CFR part 50, appendix G specifies that RPV minimum temperature requirements related to RPV closure flange considerations shall be

based on “[t]he highest reference temperature of the material in the closure flange region that is highly stressed by bolt preload.”

By letter dated July 24, 2014, NextEra submitted a license amendment request (LAR) to implement a revision of the P-T operating limits for Seabrook. In requesting the revisions to the P-T operating limits, the licensee referenced a topical report with a methodology that did not meet some of the requirements of 10 CFR part 50, appendix G, thus requiring the exemption pursuant to 10 CFR 50.12. Specifically, the exemption would permit use of an alternate methodology contained in WCAP-17444-P, Revision 0 (ADAMS Accession No. ML14216A406), “Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Seabrook, Unit 1,” October 2011. The exemption would permit the methodology contained in WCAP-17444-P, in lieu of the specific requirements of 10 CFR part 50, appendix G, related to the establishment of minimum temperature criteria for all modes of reactor operation addressed by Table 1 of 10 CFR part 50, appendix G, that are based on the properties of the material of the RPV closure flange region, that is highly stressed by the bolt preload for pressures greater than 20 percent of the pre-service hydrostatic test pressure. A non-proprietary version of WCAP-17444-P is available in ADAMS under Accession No. ML14216A406. The requirements from which NextEra requested that Seabrook be exempted shall be referred to, for the purpose of this exemption, as those requirements related to the application of footnote (2) to Table 1 of 10 CFR part 50, appendix G, for pressures greater than 20 percent of the pre-service hydrostatic test pressure. The licensee did not request exemption from those requirements related to the application of footnote (2) to Table 1 of 10 CFR part 50, appendix G, for pressures less than or equal to 20 percent of the pre-service hydrostatic test pressure. These minimum temperature requirements (hereafter referred to as the minimum bolt-up temperature requirements) shall

remain in effect for the Technical Specification (TS) P-T limit curves for all modes of reactor operation.

WCAP-17444-P documents a linear elastic fracture mechanics (LEFM) analysis of postulated flaws in the Seabrook RPV closure flange region under normal operating conditions associated with RPV bolt-up, the 100 degrees Fahrenheit (°F) per hour reactor coolant system (RCS) heat-up transient, and the 100 °F per hour cool-down transient. The LEFM analysis was performed by first calculating through-wall stress distributions for the flange region based on a finite element analysis (FEA) for bolt-up and the 100 °F per hour heat-up and cool-down transients. The RCS heat-up and cool-down transients were evaluated by calculating the flange stresses as RCS pressure and temperature vary with time. The pressure and temperature changes were modeled based on realistic 100 °F per hour heat-up and cool-down transients that would be considered permissible for normal operating conditions based on the TS P-T limit curves. Therefore, the stress at any given temperature is based on a lower pressure than the limiting pressure from the proposed TS P-T limit curve, which is based on the limiting RPV beltline material properties and minimum bolt-up temperature requirement. The pressures used are those that are actually achievable based on physical properties of the reactor coolant during the heat-up process and the plant operating configuration, rather than what is permitted by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Appendix G, P-T limits that are calculated based on the beltline material properties.

The NRC concluded in its safety evaluation (SE) (ADAMS Accession No. ML15205A333) that the licensee has demonstrated that the combination of high stresses along with low metal temperature in the RPV flange region cannot exist simultaneously, based on the NRC staff's evaluation of WCAP-17444-P and the licensee's RAI responses. The NRC staff determined that the licensee also demonstrated that the structural integrity of the Seabrook RPV

closure flange materials will not be challenged by facility operation in accordance with the proposed TS P-T limit curves that are based on the Seabrook RPV beltline region and the flange minimum bolt-up temperature, without the minimum temperature requirements related to Footnote (2) to Table 1 of 10 CFR part 50, appendix G for pressures greater than 20 percent of the pre-service hydrostatic test pressure.

Therefore, for pressures greater than 20 percent of the pre-service hydrostatic test pressure, the minimum temperature requirements related to Footnote (2) to Table 1 of 10 CFR part 50, appendix G are not necessary to meet the underlying intent of 10 CFR part 50, appendix G, to protect the Seabrook RPV closure flange from brittle fracture during normal operation under both core critical and core non-critical conditions and RPV hydrostatic and leak test conditions.

III. Discussion.

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when: (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. Under 10 CFR 50.12(a)(2)(ii), special circumstances include, among other things, when application of the specific regulation in the particular circumstance would not serve, or is not necessary to achieve, the underlying purpose of the rule. The NRC staff's detailed review and technical basis for the approval of the exemption, requested by NextEra, is provided in the NRC staff's SE (ADAMS Accession No. ML15205A333).

A. The Exemption is Authorized by Law.

This exemption would allow the use of WCAP-17444-P, Revision 0, "Reactor Vessel Closure Head/Vessel Flange Requirements Evaluation for Seabrook Unit 1," in lieu of the minimum temperature requirement that is based on the highest reference temperature of the material in the closure flange region that is highly stressed by the bolt preload, for pressures greater than 20 percent of the pre-service hydrostatic test pressure, as required by 10 CFR part 50, appendix G, Table 1. As stated previously, 10 CFR 50.12(a)(2) allows the NRC to grant exemptions from the requirements of 10 CFR part 50, appendix G, provided that special circumstances are present. As described below, the NRC staff has determined that special circumstances exist to grant the requested exemption. In addition, granting the exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or NRC's regulations. Therefore, the exemption is authorized by law.

B. The Exemption Presents No Undue Risk to Public Health and Safety.

The revised P-T limit curves developed for Seabrook reference the methodology described in WCAP-17444-P, as the technical basis for eliminating the minimum temperature requirement for the flange for pressures greater than 20 percent of the pre-service hydrostatic test pressure. The WCAP-17444-P methodology uses a higher material fracture toughness, K_{Ic} (fracture toughness based on the lower bound of static initiation critical values measured as a function of temperature) instead of K_{Ia} (fracture toughness based upon the lower bound of crack arrest critical values measured as a function of temperature), which results in less restrictive operating conditions for the flange than those required by Table 1 of 10 CFR part 50,

appendix G, for pressures greater than 20 percent of the pre-service hydrostatic test pressure. The regulations in 10 CFR part 50, appendix G, address the metal temperature of the closure head flange and vessel flange regions. The regulation states, in part, that the metal temperature of the closure flange regions must exceed the material un-irradiated nil-ductility reference temperature (RT_{NDT}) by at least 120 °F for normal operation when the pressure exceeds 20 percent of the pre-service hydrostatic test pressure.

Implementing the P-T limit curves that use the K_{Ic} material fracture toughness without eliminating the flange requirement of 10 CFR part 50, appendix G, would place a restricted operating window in the temperature range associated with the flange/closure head (i.e., flange RT_{NDT} + 120 °F). In accordance with WCAP-17444-P, the K_{Ic} toughness has been shown to provide significant margin between the applied stress intensity factor and the fracture toughness of the flange/closure head. Applying the WCAP-17444-P methodology for eliminating the flange minimum temperature requirement in the P-T limits, for pressures greater than 20 percent of the pre-service hydrostatic test pressure, will enhance overall plant safety by expanding the P-T operating window, especially in the region of low temperature operations.

The two primary safety benefits that would be realized are a reduction in the potential challenges to the cold overpressure mitigation system, and a reduction in the risk of damaging the reactor coolant pump seals. This will produce a significant improvement in plant safety by reducing the probability of an inadvertent reduction in reactor coolant inventory and in easing the burden on the operators. WCAP-17444-P concludes that the integrity of the closure head/flange is not a concern for safe unit operation and testing. Therefore, the proposed exemption does not present an undue risk to the public health and safety.

C. The Exemption is Consistent with the Common Defense and Security.

The licensee requested an exemption to use WCAP-17444-P in lieu of the minimum temperature requirement that is based on the highest reference temperature of the material in the closure flange region that is highly stressed by the bolt preload, for pressures greater than 20 percent of the pre-service hydrostatic test pressure, as required by 10 CFR part 50, appendix G, Table 1. This exemption request is not related to, and does not impact, any security issues at Seabrook. Therefore, the NRC staff determined that this exemption does not impact, and is consistent with, the common defense and security.

D. Special Circumstances.

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.60 and 10 CFR part 50, appendix G, is to protect the integrity of the reactor coolant pressure boundary. The regulations in 10 CFR part 50, appendix G, establish the requirements for the P-T limits for pressure retaining components of the reactor coolant pressure boundary and requirements for the minimum metal temperature of the RPV closure head flange and reactor vessel flange regions. The P-T limits are determined using the methodology of the ASME Code, Section XI, Appendix G, with additional, more restrictive, flange temperature requirements specified in 10 CFR part 50, appendix G.

The NRC staff examined the licensee's rationale to support the exemption request. Based on its consideration of the information provided in WCAP-17444-P and the information

provided in the licensee's letters dated April 24 and June 24, 2015, an acceptable technical basis has been established to exempt Seabrook from the requirements related to Footnote 2 to Table 1 of 10 CFR part 50, appendix G, for RCS pressures greater than 20 percent of the pre-service hydrostatic test pressure. The technical basis provided by the licensee has established that an adequate margin of safety against brittle failure would continue to be maintained for the Seabrook RPV without the application of those requirements related to Footnote 2 to Table 1 of 10 CFR part 50, appendix G, for normal operation under both core critical and core non-critical conditions and RPV hydrostatic and leak test conditions, for RCS pressures greater than 20 percent of the pre-service hydrostatic test pressure.

Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

E. Environmental Considerations.

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9), because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20, and issuance of this exemption involves (i) no significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need to be prepared in connection with the NRC staff's consideration of this exemption request. The basis for the

NRC staff's determination is discussed as follows, with an evaluation against each of the requirements in 10 CFR 51.22(c)(9)(i) - (iii).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated whether the exemption involves no significant hazards consideration using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed exemption does not impact the physical function of plant structures, systems, or components (SSCs) or the manner in which SSCs perform their design function. Operation in accordance with the proposed WCAP-17444 will ensure that all analyzed accidents will continue to be mitigated by the SSCs as previously analyzed. The proposed exemption does not alter or prevent the ability of operable SSCs to perform their intended function to mitigate the consequences of an initiating event within assumed acceptance limits. The proposed exemption neither adversely affects accident initiators or precursors, nor alter design assumptions.

Therefore, this exemption does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed exemption does not involve a physical alteration of the plant (i.e., no new or different type of equipment will be installed), does not create new failure modes for existing

equipment, or create any new limiting single failures. The exemption will continue to ensure that appropriate fracture toughness margins are maintained to protect against reactor vessel failure, during both normal and low temperature operation. The proposed exemption is consistent with the applicable NRC approved methodologies (i.e., WCAP-17444-P, Revision 0). Plant operation will not be altered, and all safety functions will continue to perform as previously assumed in accident analyses.

Therefore, this exemption does not create the possibility of a new or different kind of accident from an accident previously evaluated.

3. Does the proposed exemption involve a significant reduction in a margin of safety?

Response: No.

Margin of safety is associated with confidence in the ability of the fission product barriers (i.e., fuel cladding, reactor coolant system pressure boundary, and containment structure) to limit the level of radiation dose to the public. The proposed exemption will not adversely affect the operation of plant equipment or the function of any equipment assumed in the accident analysis. The proposed exemption was developed using NRC-approved methodologies and will continue to ensure an acceptable margin of safety is maintained. The safety analysis acceptance criteria are not affected by this exemption. The proposed exemption will not result in plant operation in a configuration outside the design basis. The proposed exemption does not adversely affect systems that respond to safely shut down the plant and to maintain the plant in a safe shutdown condition.

Therefore, this exemption does not involve a significant reduction in a margin of safety.

Based on the above evaluation of the standards set forth in 10 CFR 50.92(c), the NRC staff concludes that the proposed exemption involves no significant hazards consideration. Accordingly, the requirements of 10 CFR 51.22(c)(9)(i) are met.

Requirements in 10 CFR 51.22(c)(9)(ii)

The proposed exemption would allow the use of WCAP-17444-P, Revision 0, in lieu of the highest reference temperature of the material in the closure flange region that is highly stressed by the bolt preload required by 10 CFR part 50, appendix G, Table 1. WCAP-17444 demonstrates that the flange region can tolerate assumed flaws of 0.1 T (thickness) during the heat-up, cool-down, and bolt-up conditions. Additionally, it can be concluded that flaws are unlikely to initiate in the flange region, since there is no known degradation mechanism for the flange region and the fatigue usage in the flange region is less than 0.1 T. Furthermore, based on WCAP-17444, the alternative flange temperature requirement of 46 °F is less than the minimum bolt-up temperature of 60 °F for Seabrook. Therefore, the proposed exemption will not significantly change the types of effluents that may be released offsite, or significantly increase the amount of effluents that may be released offsite. Therefore, the requirements of 10 CFR 51.22(c)(9)(ii) are met.

Requirements in 10 CFR 51.22(c)(9)(iii)

The proposed exemption would allow the use of WCAP-17444-P, Revision 0, in lieu of the methodology required by 10 CFR part 50, appendix G, Footnote (2), to Table 1. Therefore, the proposed exemption will not significantly increase individual occupational radiation exposure or significantly increase cumulative occupational radiation exposure. Therefore, the requirements of 10 CFR 51.22(c)(9)(iii) are met.

Conclusion

Based on the above, the NRC staff concludes that the proposed exemption meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's issuance of this exemption.

IV. Conclusions.

Accordingly, the Commission has determined that pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants the licensee an exemption from 10 CFR 50.60 to permit the use of WCAP-17444-P in lieu of the highest reference temperature of the material in the closure flange region that is highly stressed by the bolt preload required by 10 CFR 50, Appendix G, Table 1 for Seabrook. This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 28th day of July 2015.

For the Nuclear Regulatory Commission.

George Wilson, Acting Director,
Division of Operating Reactor Licensing,
Office of Nuclear Reactor Regulation.

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