UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 10, 2014

Mr. Kevin Walsh, Site Vice President
c/o Michael Ossing
Seabrook Station
NextEra Energy Seabrook, LLC
P.O. Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT 1 - REQUEST FOR RELIEF 3IR-6 FROM AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE, SECTION XI REQUIREMENTS REGARDING THE REACTOR VESSEL HEAD FLANGE SEAL LEAK DETECTION PIPING (TAC NO. MF3674)

Dear Mr. Walsh:

By letter dated March 24, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14086A017), as supplemented by letter dated April 2, 2014 (ADAMS Accession No. ML14098A040), NextEra Energy Seabrook, LLC (NextEra or the licensee) requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, for pressure testing the reactor vessel head flange seal leak detection piping at Seabrook Station, Unit 1 (Seabrook), for the duration of the third 10-year inservice inspection (ISI) interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested to use an alternative on the basis that complying with the system leakage test that is required by the ASME Code, Section XI, Table IWC-2500-1, Examination Category C-H would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the subject request and concludes, as documented in the enclosed safety evaluation, that NextEra has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(3)(ii). Therefore, the NRC staff authorizes use of the proposed alternative until the end of the third 10-year ISI interval at Seabrook, currently scheduled to end on April 18, 2020.

All other requirements of ASME Code, Section XI for which relief has not been specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact me at 301-415-3100 or via e-mail at John.Lamb@nrc.gov.

Sincerely,

Meena K. Khanna, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF 3IR-6 - FROM AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE, SECTION XI REQUIREMENTS REGARDING THE REACTOR VESSEL HEAD FLANGE SEAL LEAK DETECTION PIPING

NEXTERA ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated March 24, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14086A017), as supplemented by letter dated April 2, 2014 (ADAMS Accession No. ML14098A040), NextEra Energy Seabrook, LLC (NextEra or the licensee) submitted "Relief Request No. 3IR-6, Alternative Examination of Reactor Vessel Flange Leak-Off Lines" for U.S. Nuclear Regulatory Commission (NRC) review and authorization. The licensee requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Table IWC-2500-1, Examination Category C-H, at Seabrook Station, Unit 1 (Seabrook), for the duration of the third 10-year inservice inspection (ISI) interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee has proposed an alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Instead of pressurizing the subject line to the system leakage test pressure required by IWC-5221, the licensee proposes to pressurize the line using the static pressure head of the refueling water prior to performing a VT-2 visual examination.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection requirements," ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year ISI interval and subsequent 10-year ISI intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b), "Standards approved for

incorporation by reference," 12 months prior to the start of the 120-month inspection interval, subject to the limitations and modifications listed therein.

The regulations in 10 CFR 50.55a(a)(3) state, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide an acceptable level of quality and safety; or (ii) compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on analysis of the regulatory requirements, the NRC staff concludes that the NRC has the regulatory authority to authorize the licensee's proposed alternative on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(a)(3)(ii).

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request for Alternative

3.1.1 Components for which Relief is Being Requested

Reactor Pressure Vessel (RPV) Flange Leak-Off Piping Numbers:

- 1-RC-89-1-2501-1"
- 1-RC-89-2-2501-3/4"
- 1-RC-90-1-2501-1"
- 1-RC-90-2-2501-3/4"
- 1-RC-90-3-2501-3/8";

ASME Code Class 2, Examination Category C-H, Item Number C7.10

3.1.2 Applicable Code Edition

The Code of record for the Seabrook third 10-year ISI interval is the 2004 Edition of the ASME Code, Section XI with no Addenda. Seabrook's third 10-year ISI interval is scheduled to end on April 18, 2020.

3.1.3 ASME Code Requirements

As stated in the licensee's submittal dated March 24, 2014:

> System Leakage Tests of Class 2 pressure retaining components per Table IWC-2500-1, Examination Category C-H, Item No. C7.10 are to be conducted each inspection period. Paragraph IWC-5221 indicates that system leakage tests shall be conducted at the system pressure obtained while the system, or portion of the system, is in service performing its normal operation function or at a system pressure developed during a test conducted to verify system operability (e.g., to

demonstrate system safety function or satisfy technical specification surveillance requirements).

Per IWC-5222(a), the pressure retaining boundary includes the portion of the system required to operate or support the safety function up to and including the first normally closed valve.

3.1.4 Licensee's Reason for Request

As stated in the licensee's submittal dated March 24, 2014:

> NextEra recently determined, through issuance of NRC Information Notice 2014-02, ["Failure to Properly Pressure Test Reactor Vessel Flange Leak-Off Lines," dated February 25, 2014] that NextEra is susceptible to the issue identified to the industry regarding compliance with ASME Section XI for examination of the reactor vessel flange leak-off piping. The issue of not examining RPV leak-off piping is a relatively new issue within the industry and with the proposed alternative, NextEra is seeking to come back into full compliance with the ASME Code.
>
> In accordance with the provisions of 10CFR50.55a(a)(3)(ii), Seabrook requests relief from the Section XI code requirement for system leakage tests of the RPV head flange O-ring leak-off lines on the basis that compliance with the Code specified pressure requirement to test the leak-off lines at system operating pressure [. . .] would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.
>
> The RPV head flange O-ring leak-off lines direct leakage, if any, from the RPV head flange to the Reactor Coolant Drain tank (RCDT) and provide alarms to alert the Control Room of leakage. These lines are separated from the reactor coolant system operating pressure by an inner and outer RPV flange O-ring. The inner O-ring, in conjunction with the reactor vessel and reactor vessel head flange surfaces, functions to isolate the inner and outer RPV head flange leak-off lines from reactor coolant (RCS) system pressure. The outer O-ring functions as a back-up in the event of the inner O-ring failing to perform its intended function. Because of this, the affected leak-off lines are not expected to experience RCS pressure during normal operation. During normal operation, the lines are typically pressurized to RCDT pressure (approximately 3 psig [pounds per square inch guage]). The lines are designed to 2485 psig at 650 °F. The 1 inch and ¾ inch lines are schedule 160, SA376, TP316 material. The 3/8 inch line is schedule 80S, SA376, TP316 material. Fittings are 6000 lb., SA182, F316 material.
>
> With the RPV head flange O-rings installed and performing their intended function, the leak-off lines are not expected to be pressurized above the RCDT pressure during the system pressure test following a refueling outage. Applying system pressure to the leak-off lines for the purpose of leakage testing is not practical with the RPV head installed after refueling, since it would require either

intentionally failing the O-rings or pressurizing the line with a hydrostatic test pump in the direction opposite to the intended design function of the O-rings resulting in the need for additional maintenance which would require depressurizing and removal of the reactor vessel head or could damage O-ring sealing material with debris. Performing a leakage test during shutdown prior to the removal of the head for refueling activities would delay the shutdown, requiring the plant to be maintained in Mode 3 at normal operating temperature and pressure at higher decay heat loads. This would be contrary to site efforts to reduce the time to reach cold shutdown in order to minimize shutdown risk.

With the RPV head removed, the configuration of the leak-off piping would require the lines to be plugged at the RPV flange to establish a boundary for leakage testing at system operating pressure. Threaded plugs would have to be installed prior to the pressure test and removed after the test was complete. Failure of either plug during the test would result in a personnel safety hazard, in addition to creating a foreign material exclusion (FME) issue. Installation and removal of the plugs for each pressure test would result in significant dose, which would be contrary to keeping dose as low as reasonably achievable (ALARA), and again would present FME issues.

Purposely failing the O-rings to perform the Code required pressure test would require purchase of a new set of O-rings and additional time and radiation exposure to remove the RPV head, install new O-rings, and reinstall the head.

3.1.5 Licensee's Proposed Alternative and Basis for Use

As stated in the licensee's submittals dated March 24, 2014, and April 2, 2014:

In accordance with the provisions of 10 CFR 50.55a(a)(3)(ii), Seabrook proposes to examine the Class 2 portions of the leak detection system consisting of the accessible portions of the RPV head flange O-ring leak-off lines. The leak off lines shall be examined using the VT-2 visual examination method and will be performed by certified VT-2 examiners. The test shall be conducted at ambient conditions after the refueling cavity has been filled to its minimum water level for refueling operations of 23 feet above the top of the RPV flange for at least four (4) hours. A static pressure of approximately 10 psig is expected to be experienced at the top of the RPV flange with a minimum of 23 feet of borated water above the flange.

The Class 2 portions from the reactor vessel flange to the Class 2 boundaries are required to be examined. Segments of the O-ring leak-off lines that are inaccessible [1-RC-89, Inner O-ring line (approximately 16 ft.) and 1-RC-90, Outer O-ring line (approximately 17 ft.)] for direct VT-2 visual examination, will include inspection of the surrounding areas below the lines for evidence of leakage as permitted by ASME Section XI Code, 2004 Edition, no Addenda IWA-5241(b). The remaining sections of the leak-off lines to be inspected per the proposed alternative will be examined as required by IWC-5000. The accessible

portions of the lines include 1-RC-89, (approximately 51 ft.) and 1-RC-90, (approximately 49 ft.) as shown on isometric drawings in Enclosures 1 and 2.

In addition to the proposed alternatives, NextEra also commits to additional visual examination as a result of service history. NextEra experienced a through-wall leak in leak-off line 1-RC-89-1-2501-1" in the normally inaccessible area under the reactor cavity seal ring. This leak was detected in refueling outage OR15 (October 2012) during performance of Alloy 600 bare metal visual examinations. The affected pipe section was replaced. The inner and outer leak-off lines that are inaccessible for examination during the pressure test will receive a direct VT-2 examination by certified VT-2 examiners once every 10-Year ISI Interval [with a cavity seal ring hatch removed].

NRC Requests for Additional Information submitted to several other Licensees have been reviewed and included in this submittal. One request pertained to provisions for leak testing should leakage occur past the inner O-ring and the valve subsequently closed, whereby the line would experience operating pressure of 2235 psig. During power operation, the accessible portion of line to the isolation valve represents less than two (2) feet. Also during power operation, the portion of piping not under the cavity seal ring (within the bioshield area) is not accessible to personnel during power operation due to radiation levels. Therefore, NextEra does not plan to institute additional measures for such an unusual and infrequent condition.

The flange seal leak-off lines are essentially a leakage collection/detection system and would only function as a Class 2 pressure boundary in the event of failure of the O-rings that separate the lines from reactor coolant system operating pressure. Any significant leakage due to this condition would be expected to clearly exhibit boric acid accumulation that would be discernible during the proposed alternate VT-2 visual examination that will be performed. The static head developed with the leak detection line filled with water will allow for the detection of any gross indications in the line.

3.2 NRC Staff Evaluation

The subject leak-off line is associated with the RPV closure head flange leakage detection system. The RPV closure head flange is designed with two concentric O-rings that act as flange seals to enable the vessel to be pressurized during normal operation, with the inner O-ring acting as the primary pressure seal for the RPV. The outer O-ring and the leak-off line are designed to support identification of leakage, should the primary inner O-ring seal leak. Inner O-ring leakage during the operating cycle would be identified by an increase in the leak-off line pressure, actuating an alarm in the control room. This alarm would be monitored by procedurally-controlled operator actions, allowing identification of any further required compensatory actions. The subject leak-off line is not pressurized by primary system water during normal reactor operation, and can only be tested at the ASME Code-required pressure using an external pressure source.

The NRC staff recognizes three possible methods of externally pressurizing the subject line to perform the ASME Code-compliant system leakage test: (1) installing a threaded plug in the flange face during the outage to act as a pressure boundary, and removing it after the examination; (2) pressurizing the leak-off line upon entering the refueling outage prior to removing the RPV head; and (3) pressurizing the leak-off line at the end of the outage after installing new O-rings.

The licensee stated in the submittal dated March 24, 2014, that an ASME Code-compliant examination could be performed by a design modification. This would involve installing mechanical threads into the pressure tap on the vessel flange. A threaded plug would need to be installed in the flange face to act as a pressure boundary for each test, then removed after the test. The licensee also stated that handling a small diameter plug would present a foreign material exclusion issue. The NRC staff concludes that the installation of a mechanical plug and the associated foreign material exclusion issues would present a hardship.

By letter dated March 24, 2014, concerning pressurizing the leak-off line with an external source at the beginning of an outage, the licensee stated, in part, that

> Performing a leakage test during shutdown prior to the removal of the head for refueling activities would delay shutdown, requiring the plant to be maintained in mode 3 at normal operating temperature and pressure at higher decay heat loads. This would be contrary to site efforts to reduce the time to reach cold shutdown in order to minimize shutdown risk.

The NRC staff concludes that the actions required to perform a leak test during either of these operating plateaus would present a hardship.

The final method of pressurizing the leak-off line to the required pressure involves pressurizing the line at the end of the refueling outage with the head installed. This would cause the inner O-ring to be put in a condition opposite to the design function, likely causing O-ring damage. As a result, the head would be required to be removed and the O-ring replaced prior to plant operation. The NRC staff concludes the heavy lift evolution associated with removing the head and replacing the O-rings would present a hardship or unusual difficulty.

In addition, the NRC staff recognizes the three possible methods of externally pressurizing the subject line may also have associated ALARA radiation hardship considerations.

The licensee proposes to pressurize the subject leak-off line each inspection period using the static pressure present when the reactor cavity is filled, then performing a visual, VT-2 examination of the accessible areas of the piping while it is subjected to the static pressure head of approximately 10 psig. The licensee stated that the subject line is insulated and a minimum 4-hour hold time (after test pressure has been reached) will be observed before performing the visual, VT-2 examination. This is to allow for any leakage to become visible through the insulation, in accordance with the hold time requirements of ASME Code, paragraph IWA-5213(a)(3), for insulated components. In the submittal dated April 2, 2014, the licensee stated that the leak-off lines will be flushed prior to the VT-2 to provide assurance that the lines are clear of air.

The licensee stated that the leak-off lines are designed to 2485 psig at 650 °F and the 1 inch and 3/4 inch lines are schedule 160 seamless, stainless steel (ASME SA376, TP316 material) and the 3/8 inch line is schedule 80 seamless, stainless steel (ASME SA376, TP316 material). There has been one through-wall leak in leak-off line 1-RC-89-1-2501-1" that was identified during the October 2012 refueling outage. The licensee also stated that the aforementioned flushing of the leak-off lines will provide the benefit of preventing the buildup of contaminants in the stagnant piping.

The NRC staff notes that the system leakage test requirements of the ASME Code, IWC-5220 are focused on demonstrating leak tightness in addition to structural integrity. The NRC staff's concern is whether the proposed low-test pressure would be sufficient to demonstrate the leak tightness of the leak-off line. If the leak-off line has a large through-wall crack, leakage would be evident under either a high- or low-pressure test condition. However, if the leak-off line has a very small and tight through-wall crack, the leakage may not be immediately evident under the proposed low-pressure test condition. The licensee stated in the submittal dated April 2, 2014, that the leak-off line is pressurized for a significant length of time during each refueling outage; during the current outage (OR16), the refueling cavity is expected to be kept full approximately one week. Additionally, the licensee stated that they had operational experience during refueling outage OR15, which showed that the pressure developed in the leak-off lines with the refueling cavity full was sufficient to identify a very small and tight through-wall crack in leak-off line 1RC-89-1-2501-1". The NRC staff concludes that if any significant leakage were to occur in the leak-off line during the time of pressurization during each refueling outage, boric acid accumulation would be discernible during a subsequent visual examination. The NRC staff, therefore, concludes that the proposed low-test pressure, although not as effective as high-test pressure, will provide reasonable assurance of the leak tightness of the subject leak-off line.

The NRC staff concludes, based on the evaluation of the service conditions and the materials of construction, that the proposed visual, VT-2 examination of the subject leak-off line after the reactor cavity is filled, provides reasonable assurance of structural integrity and leak tightness. The NRC staff also concludes that requiring compliance with the IWC-5220 system leakage test requirements would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that the proposed alternative, "Reactor Pressure Vessel Head Flange Seal Leak Detection Piping - Relief Request No. 3IR-6 provides reasonable assurance of structural integrity and leak tightness, and that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii) and therefore authorizes use of the proposed alternative 3IR-6 until the end of the third 10-year ISI interval at Seabrook, currently scheduled to end on April 18, 2020.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized in the subject proposed alternative remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: K.Hoffman

Date: April 10, 2014

If you have any questions, please contact me at 301-415-3100 or via e-mail at John.Lamb@nrc.gov.

Sincerely,

/RA/

Meena K. Khanna, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure:
Safety Evaluation

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