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

September 30, 2019

Mr. Don Moul
Vice President, Nuclear Division and
Chief Nuclear Officer
Florida Power & Light Company
NextEra Energy Seabrook, LLC
Mail Stop: NT3/JW
15430 Endeavor Drive
Jupiter, FL 33478

SUBJECT: SEABROOK STATION, UNIT NO. 1 – RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (EPID L-2019-LLR-0036)

Dear Mr. Moul:

By letter dated May 7, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19127A384), as supplemented by letter dated May 9, 2019 (ADAMS Accession No. ML19129A378), NextEra Energy Seabrook, LLC (the licensee) submitted Relief Request RA-19-001 to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements at Seabrook Station, Unit No. 1 (Seabrook).

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee requested to use 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. Specifically, the licensee requested to perform a temporary repair of a leaking service water pipe.

On May 9, 2019 (ADAMS Accession No. ML19130A075), the NRC staff verbally authorized the use of Relief Request RA-19-001 at Seabrook until either the end of the next refueling outage in spring 2020, or the flaw progresses outside the encapsulated area such that the pipe wall thickness is below 0.105 inches, whichever occurs first. The NRC staff determined that complying with the ASME Code requirement would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concluded that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and is in compliance with ASME Code requirements. The enclosed safety evaluation documents the technical basis for the NRC staff's verbal authorization.

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

If you have any questions, please contact the Project Manager, Justin Poole, at 301-415-2048 or by e-mail to Justin.Poole@nrc.gov.

Sincerely,

/RA/

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RA-19-001 REGARDING

TEMPORARY REPAIR OF SERVICE WATER PIPING

NEXTERA ENERGY SEABROOK, LLC, ET AL.

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated May 7, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19127A384), as supplemented by letter dated May 9, 2019 (ADAMS Accession No. ML19129A378), NextEra Energy Seabrook, LLC (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4412, at Seabrook Station, Unit No. 1 (Seabrook). The licensee submitted Relief Request RA-19-001 to the U.S. Nuclear Regulatory Commission (NRC) to perform a temporary repair of a leaking service water pipe.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee submitted Relief Request RA-19-001 for a temporary repair of leaking service water piping on the basis that complying with the specified ASME Code requirement to repair the degraded piping would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

On May 9, 2019 (ADAMS Accession No. ML19130A075), the NRC staff verbally authorized the use of Relief Request RA-19-001 to perform temporary repair of service water piping at Seabrook until either the end of the next refueling outage (OR20) in spring 2020 or the flaw progresses outside the encapsulated area such that the pipe wall thickness is below 0.105 inches, whichever occurs first. The NRC staff determined that complying with the ASME Code requirement would result in a hardship or unusual difficulty, without a compensating increase in the level of quality and safety. The NRC staff also determined that the proposed alternative is technically justified and provides reasonable assurance of the structural integrity of the affected piping. Accordingly, the NRC staff concluded that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and is in compliance with the ASME Code requirements. This safety evaluation documents the technical basis for the NRC staff's verbal authorization.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components will meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI. Seabrook is currently in the third 10-year inservice inspection (ISI) interval and its code of record is ASME Code, Section XI, 2004 Edition, with no Addenda.

Paragraph 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that: (1) The proposed alternative would provide an acceptable level of quality and safety; or (2) 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 the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of the alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 Licensee's Proposed Alternative

On May 1, 2019, with Seabrook in operation at 100 percent power, the licensee detected a through-wall leakage on the outside diameter of pipe line 1-SW-1801-004-153-24" at south circumferentially from top dead center, approximately 5 inches from the nearest weld (FW1801-F0603). This piping supplies cooling water to remove heat from systems and components during normal plant operations and emergency plant evolutions. The affected piping is 24-inch nominal pipe size (NPS) SA-106, Grade B, carbon steel piping with a nominal wall thickness of 0.375 inches. The flaw is located in the bypass piping of service water strainer 1-SW-S-10. The licensee estimated the initial leak rate to be approximately 3 drops per minute (dpm). After ultrasonic testing (UT) preparations, the leak rate increased to 10 dpm. The licensee conservatively estimated the size of the wall thinning area to be approximately 0.90 inches in the axial direction and 0.90 inches in the circumferential direction based on UT data. Additionally, the licensee identified a second degraded area located north circumferentially from top dead center of the pipe, near the first degraded area. The licensee conservatively estimated the second degraded area to be less than 0.50 inches in the axial and circumferential directions with a wall thickness of approximately 0.122 inches based on UT data. The second location is not through wall. The licensee stated that minimum calculated wall thickness is 0.105 inches. The licensee indicated that the remaining wall thickness currently provides sufficient structural integrity to maintain operability of the service water system.

Section XI of the ASME Code specifies Code-acceptable repair methods for flaws that exceed Code acceptance limits for piping that is in service. Specifically, IWA-4412 states that defect removal shall be accomplished in accordance with the requirements of IWA-4420. The licensee stated that a Code repair is required to restore structural integrity of flawed ASME Code piping, independent of the operational mode of the plant when the flaw is detected. Repairs not in compliance with Section XI of the ASME Code are classified as non-Code repairs. Seabrook Technical Specification (TS) 3/4.7.4, "Service Water System/Ultimate Heat Sink," requires that the service water system be operable with two ocean service water loops and two cooling tower

service water loops. The licensee explained that performing an ASME Code repair at the flaw location during power operation would require that the “A” train of service water be taken out of service. The TS allows 24 hours for repair.

According to the licensee, Code repair of the flaw in the “A” train service water piping during power operation is complex and could not be completed within 24 hours. The licensee considered that shutting down the plant to perform a Code repair versus using the proposed temporary non-Code repair is considered to be a hardship without a compensating increase in the level of quality and safety. In addition, the licensee stated that the identified defect will not be removed during operation of the “A” train of the service water system because doing so would result in a significant leak rate through a larger area resulting from the removal of degraded pipe wall. Therefore, relief is being requested to perform a temporary non-Code repair.

In lieu of an ASME Code repair and removal of the defect, the licensee proposes a temporary, non-ASME Code repair of installing an encapsulation of the identified pipe wall flaw by the addition of an 8 x 4-inch nominal diameter reducer, weld neck flange, and blind flange as depicted in Figure 1 of the application. The technical basis of the temporary repair is as follows.

Flaw Sizing and Characterization

The licensee performed an UT examination at an identified through-wall leak on line 1-SW-1801-004-153-24”. The leaking location occurred at south circumferentially from top dead center, approximately 5 inches from the nearest weld (FW1801-F0603). The licensee reported that the initial leak rate was approximately 3 dpm. After UT preparations of the leaking area, it increased to 10 dpm. The licensee stated that the leak was the result of a single isolated flaw that appears to be related to corrosion. In the May 9, 2019, supplement, the licensee stated that in accordance with the augmented examination provisions of ASME Code Case N-513-3, “Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping Section XI, Division 1,” the licensee inspected the full circumference of the pipe starting at the toe of the tee-to-pipe weld and extending 8 inch downstream towards SW-V-69 (1-SW-S-10 bypass valve). The licensee identified one additional degraded location, north circumferentially from top dead center with a wall thickness of approximately 0.122 inches. The licensee collected the encoded UT data at this location and used the data to evaluate the through-wall leakage area. This encoded area encompassed the entire flawed area. The licensee indicated that this initially resulted in a conservative bounded flaw area of 6.73-inch circumferentially by 1.75-inch axially. The licensee characterized this flaw as a non-planar with localized wall loss due to a loss of the pipe Belzona lining. The licensee evaluated a flaw size of 7-inch by 2-inch to demonstrate structural integrity of the affected pipe segment.

Degradation Mechanism

Based upon the non-destructive examination (NDE), the licensee stated that the localized flaw appears to be caused by seawater corrosion, which resulted from a loss of the pipe liner.

Flaw Evaluation

The licensee performed a flaw evaluation with the through-wall flaw size assumed to be the bounding area of 2-inch by 7-inch in accordance with Code Case N-513-3. The evaluation concluded that structural integrity of the affected pipe is maintained. In accordance with Code Case N-513-3, the licensee performed augmented inspections to determine the extent of condition.

Flaw Growth Rate

The licensee explained that the cause of the degradation is from localized corrosion. The licensee stated that the typical corrosion rate used in Seabrook service water piping evaluations is 30 mils per year (mpy). The licensee indicated that it will perform periodic UT inspections of no more than 30-day intervals around the installed reducer to identify wall loss propagating outside the encompassed area. The sizing of the reducer (8 x 4-inch nominal) as part of encapsulation design was based upon the identified wall thickness of the piping and its installation position with respect to the postulated flaw size of (1.75-inch x 6.73-inch). The licensee will weld the reducer to the pipe wall that has a thickness of 0.328 inches or greater. To proactively address the corrosion potential within the bounded area, once encapsulated, the licensee applied a factor of 4 to the typical corrosion rate which resulted in a corrosion rate of 120 mils per year. The licensee stated that although the installation duration is less than a year (from the discovery of the leak in May 2019 to the next refueling outage in spring 2020), it used the corrosion rate of 120 mils/year in the flaw growth calculation. The licensee stated that the resulting pipe wall under the reducer and weldment will therefore be reduced to 0.328 - 0.120 = 0.208 inches. According to the licensee, the ASME Code, Section III, requirement for the minimum pipe wall is 0.105 inches based upon a system design pressure of 150 pounds per square inch (psi). The licensee stated that if the nominal operating pressure of 75 psi is used in the calculation, a Code-required minimum wall thickness is reduced to 0.053 inches. The licensee projected that the near future pipe wall thickness considering future metal loss would be 0.208 inches, which exceeds the ASME Code minimum of 0.105 inches and structural integrity of the repair will be maintained. The licensee stated that the 7.981-inch inside diameter of the reducer in relationship with the major axis dimension of the bounded flaw (6.73-inch) provides sufficient metal such that further corrosion will not affect structural integrity of the repair.

The licensee stated that it does not expect any leakage from the blind flange of the branch connection. The licensee further stated that the maximum acceptable boundary leakage is 137.25 gallons per minute (gpm) based on 7-day cooling tower operation. According to the licensee, there are no other major leak sources in the system that would result in a cumulative impact to tower basin inventory.

Repair Components

The licensee indicated that the design pressure and temperature of the service water piping system is 150 psi and 200 degrees Fahrenheit (°F), respectively. Normal operating pressure is 75 psi and normal operating temperature is 65 °F maximum and 35 °F minimum. The repair components (reducer, weld neck flange, and blind flange design) conforms to these temperature and pressure requirements. The existing 24-inch diameter piping is constructed from SA-106 Grade B material. The reducer is constructed from ASME SA-234 material and meets the ASME Code, Section III, ND requirement for branch connections. The licensee will use its in-house general welding procedure which is qualified through and satisfies the requirements of

ASME Code, Section IX, “Qualification Standards for Welding, Brazing, and Fusing Procedures; Welders, Brazers, and Welding, Brazing, and Fusing Operators,” for an open-root, full-penetration weld. The licensee stated that it will install the temporary encapsulation on nominal pipe wall which exists around the bounding flaw area of approximately 2 by 7 inches. Prior to welding, the licensee will remove water from the weld area via suction or wiping, as necessary. The licensee will minimize the impact to the lining material in the pipe from the welding based on past experience at Seabrook. The licensee explained that the proposed branch connection will satisfy the ASME Code, Section III, ND requirements for fabrication. According to the licensee, the pre-installation NDE requirements for the reducer consists of the verification of ASME material, the verification of proper weld joint fit-up and a final visual and penetrant testing examination of the final weld. The licensee indicated that the post-installation NDE requirements consist of a VT-2 visual examination for leakage in accordance with the ASME Code, Section XI, IWA-5000. The licensee stated that the acceptance criteria for the NDE results are in accordance with the requirements of the original construction code, the ASME Code, Section III, ND. The licensee further stated that the NDE examination methods performed will meet the ASME Code, Section XI, IWA-4500 requirements.

Piping System Impact

The licensee stated that the 70-pound (lb.) weight of the repair components is the combination of 12 lbs. for the reducer, 31 lbs. for the weld neck flange with hardware, 17 lbs. for the blind flange, and 10 lbs. for water content.

The licensee further stated that because the reducer location is adjacent to a butt weld, the stress intensification factor attributed to the reducer addition of 2.00 is bounding compared to the straight pipe intensification of 1.00. The licensee concluded that resulting pipe stress levels remain within the ASME Code allowable.

The pipe supports adjacent to the defective area are: M/S 1801-10-1801-RG-08, a lateral support (X-X) approximately 1.0 foot downstream of the defect; 1801-SG-09, a vertical support (Y-Y) approximately 6.5 feet upstream of the defect; and 1801-SG-04, a vertical (Y-Y) and lateral support (Z-Z) approximately 22.5 feet upstream of the defect. The licensee stated that based on a review of the pipe support design, the existing pipe supports can accommodate the additional weight of 70 lbs.

Post-Repair Monitoring

The licensee will perform periodic UT inspections of no more than 30-day intervals around the installed reducer (3-inch radial band around the circumference of the weld, where accessible) to identify wall loss propagating outside the encompassed area. The licensee will also continue to perform daily walk downs of the repaired area.

Duration of Proposed Alternative

The licensee proposed that the temporary non-Code repair to the Seabrook service water system will remain in place until the next refueling outage (OR20) scheduled for spring 2020. The licensee stated that the relief request will expire at the end of the next refueling outage. The licensee indicated that should the ongoing NDE inspections identify that the flaw progresses outside the encapsulated area to the point that the ASME Code minimum thickness of 0.105 inches is challenged, the relief request would expire.

3.2 NRC Staff Evaluation

The NRC staff used the provisions of Code Case N-513-3 as a guide to review the licensee's relief request. Code Case N-513-3 is applicable to the straight segment of a Class 2 or 3, moderate energy pipe. The subject pipe at Seabrook satisfies this provision. The NRC staff recognizes that the relief request is not based on Code Case N-513-3, but it has used certain provisions of the code case to perform flaw evaluations. The NRC staff notes that the licensee is not required to use Code Case N-513-3 to disposition the pinhole leak or to design the branch connection to repair the pinhole leak. However, the NRC staff finds that Code Case N-513-3 contains relevant provisions (e.g., flaw evaluations, pre-installation preparation, augmented examinations, and inservice monitoring) that are applicable to the proposed temporary non-Code repair at Seabrook.

Pre-Installation Evaluation

Section 2(a) of Code Case N-513-3 requires flaw characterization. The NRC staff finds that the licensee has characterized the flaw adequately and has ultrasonically examined area where the pinhole leak exists. The licensee has also prepared the outside surface of the pinhole to enhance the wall thickness measurements. The NRC staff determines that the licensee has performed an extent of condition inspection and found a wall thinning area near the pinhole. The NRC staff finds the licensee has adequately performed the pre-installation evaluation.

Design

The NRC staff notes that although the proposed repair (i.e., the branch connection) is designed outside of the ASME Code requirements, the design must be demonstrated to support all the applied loading for continued service until the next refueling outage. The licensee explained that the proposed branch connection will satisfy the ASME Code, Section III, ND requirements for fabrication. The reducer is constructed from ASME SA-234 material and meets the branch connection requirements of the ASME Code, Section III, ND. The NRC staff notes that the licensee also evaluated the pipe supports near the repaired area to demonstrate that the pipe supports are adequate for the additional 70 lbs. of the branch connection design. The NRC staff finds that the pipe stresses near the repaired location will still be within the allowable stresses. Based on its evaluation, the NRC staff finds that the temporary non-Code branch connection is sufficient to content the leakage and provide structural integrity of the affected pipe.

Analysis

The NRC staff has determined that the licensee has evaluated growth of the pinhole and demonstrated that the final pinhole size at the refueling outage in spring 2020 will not exceed the covered area of the encapsulation. The NRC staff notes that in accordance with Section 3 of Code Case N-513-3, the licensee analyzed the pinhole as a circumferential crack and an axial crack based on the method in the ASME Code, Section XI, Appendix C, C-7000. The method of Article C-7000 is based on linear elastic fracture mechanics which is applicable to the subject piping because the pipe is made of carbon steel. The licensee postulated a circumferential flaw of 7 inches and an axial flaw of 2 inches. The licensee calculated that the applied stress intensity factors for the circumferential and axial flaws are less than the allowable stress intensity factors. The NRC staff notes that this result demonstrated that the analyzed flaws will not cause pipe rupture. The NRC staff finds that structural integrity of the subject pipe will be maintained until the next refueling outage in spring 2020 for the circumferential flaw of 7 inches or the axial flaw of 2 inches.

Section 2(e) of Code Case N-513-3 discusses a flaw growth calculation. The NRC staff notes that Seabrook assumed, in general, 30 mils per year as the corrosion rate for the subject piping. As a conservative measure, the licensee multiplied 30 mils per year by a factor of 4 to include uncertainties in the corrosion rate. The NRC staff finds that the licensee used 120 mils per year as the corrosion rate is adequate because the subject piping contains sea water which is more corrosive than lake or river water. The NRC staff notes that considering the current flaw size and a corrosion rate of 120 mils per year, the detected two flaws will not likely grow outside the encapsulation boundary within the duration to the next refueling outage in spring 2020. In addition, the licensee stated that if periodic inspections identify the flaw progresses outside the encapsulated area to the point that the ASME Code minimum thickness of 0.105 inches is challenged, the relief request would expire.

The licensee analyzed the impact of the encapsulation on the affected pipe in an earthquake. As stated above, the encapsulation is about 70 lbs. and is welded to the affected pipe. In a seismic event, the encapsulation may cause bending on the pipe wall. The licensee demonstrated that the stresses at the pipe run generated by the seismic event are still within ASME Code allowable stress. The NRC staff finds that the mass of the encapsulation will not affect structural integrity of the pipe run.

The NRC staff finds that the licensee has adequately performed analyses to demonstrate structural integrity of the subject pipe until the refueling outage in spring 2020.

Installation

The licensee will weld the proposed branch connection on the affected pipe in accordance with the ASME Code, Section IX. The NRC staff finds that prior to welding, the licensee will remove water from the weld area via suction or wiping, as necessary. The licensee will minimize the impact to the lining material in the pipe from the welding. The licensee stated that the branch connection will meet the requirements of the ASME Code, Section III, Article ND for fabrication. The NRC determines that the licensee's welding procedure is qualified to the ASME Code, Section IX, and, the fabrication will follow the ASME Code, Section III; therefore, the installation of the branch connection is acceptable.

Acceptance Examination

The licensee stated that it will perform a final visual and penetrant testing examination of the final weld. The NRC finds that the acceptance criteria for the acceptance examination are in accordance with the requirements of the original construction code, the ASME Code, Section III, Article ND. The NRC staff determines that the licensee's NDE examination methods will meet the requirements of the ASME Code, Section XI, IWA-4500. The NRC staff finds that the post-installation acceptance examination is based on the ASME Code, Sections III and XI and, therefore, is acceptable.

Post-Installation Monitoring

The licensee stated that it will perform periodic UT inspections of no more than 30-day intervals around the installed reducer (3-inch radial band around the circumference of the weld, where accessible) and daily walk downs of the repaired area. The NRC staff finds that the proposed monitoring schedule is consistent with Sections 2(e) and 2(f) of Code Case N-513-3. In addition, the licensee stated that should the ongoing NDE inspection identify that the flaw

progresses outside the encapsulated area to the point that the ASME Code minimum thickness of 0.105 inches is challenged, the relief request would expire. The NRC staff finds that the proposed monitoring is consistent with Code Case N-513-3 and the licensee has implemented a limit on the flaw growth beyond which the relief request would expire. The licensee further stated that the post-installation NDE requirements consist of a VT-2 for leakage in accordance with the ASME Code, Section XI, IWA-5000. Therefore, the NRC staff finds that post-installation monitoring is acceptable.

Hardship Justification

The NRC staff finds that performing an ASME Code repair at the flaw location during power operation would require that the "A" train of service water be taken out of service. The TS limits the train to be inoperable for 24 hours for repair. As the licensee stated, repair of the flaw in the "A" train service water piping during power operation is complex and could not be completed within 24 hours. Therefore, the NRC staff finds that requiring the licensee to perform an ASME Code repair constitutes hardship and unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity of the subject service water piping. The NRC staff finds that complying with the requirements of the ASME Code, Section XI, Section IWA-4000 to repair the subject pipe 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 the regulatory requirements set forth in 10 CFR 50.55a(z)(2) and is in compliance with ASME Code requirements. Therefore, the NRC authorizes the proposed alternative in Relief Request RA-19-001 in accordance with 10 CFR 50.55a(z)(2) for Seabrook until the end of the next refueling outage (OR20) in spring 2020, or until the flaw progresses outside the encapsulated area such that the pipe wall thickness is below 0.105 inches, whichever occurs first.

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

Principal Contributor: J. Tsao

Date: September 30, 2019

SUBJECT: SEABROOK STATION, UNIT NO. 1 – RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (EPID L-2019-LLR-0036) DATED SEPTEMBER 30, 2019

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