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

March 27, 2017

Mr. Mano Nazar
President and Chief Nuclear Officer
Nuclear Division
NextEra Energy Seabrook, LLC
626 Lafayette Road
Mailstop: NT3/JW
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT NO. 1 – RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE (CAC NO. MF9127)

Dear Mr. Nazar:

By letter dated January 27, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17028A010), NextEra Energy Seabrook, LLC (the licensee) submitted Relief Request RA-17-001, 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 January 30, 2017 (ADAMS Accession No. ML17031A003), the NRC verbally authorized the use of Relief Request RA-17-001 to perform temporary repair of service water piping at Seabrook until either the end of the next refueling outage in Spring 2017 or the flaw progresses outside the encapsulated area such that the pipe wall thickness is below 0.105 inch, 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. 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'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 at Justin.Poole@nrc.gov.

Sincerely,

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 w/enclosure: Distribution via Listserv

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RA-17-001 REGARDING

TEMPORARY REPAIR OF SERVICE WATER PIPING

NEXTERA ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated January 27, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17028A010), 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-17-001 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-17-001 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 January 30, 2017 (ADAMS Accession No. ML17031A003), the NRC verbally authorized the use of Relief Request RA-17-001 to perform temporary repair of service water piping at Seabrook until either the end of the next refueling outage (OR18) in Spring 2017 or the flaw progresses outside the encapsulated area such that the pipe wall thickness is below 0.105 inch, 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's verbal authorization.

2.0 REGULATORY EVALUATION

The regulation at 10 CFR 50.55a(g)(4) states, in part, that ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in ASME Code, Section XI, to

the extent practical, within the limitations of design, geometry, and materials of construction of components. Seabrook is currently in the third 10-year inservice inspection interval and complies with ASME Code, Section XI, 2004 Edition, no addenda.

The regulation at 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the NRC if the licensee demonstrates that (1) the proposed alternatives would provide an acceptable level of quality and safety or (2) compliance with the specified requirements 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 October 14, 2016, with the plant in 100 percent power, the licensee observed through-wall leakage from a portion of the service water piping. The affected piping is moderate energy, ASME Code Class 3, service water pipe 1-SW-1818-001-153-24, as part of service water 1-SW-P-110-A discharge piping. The flaw is located at field weld FW1818-F0602, which connects a 24-inch lined elbow to straight pipe downstream of check valve 1-SW-V-53. The subject pipe is fabricated with SA-106, Grade B, carbon steel with a cement liner. The nominal wall thickness is 0.375 inches.

At the time, the licensee estimated the leak rate to be 40 to 50 drops per minute with the pump running. The size of the reduced-wall area (i.e., the flaw area) was conservatively estimated to be 0.60-inch axial x 1.20-inch circumferential based on ultrasonic testing (UT) data and the visual corrosion on the outside diameter of the pipe.

On December 19, 2016, the flaw area appeared to be further degraded, but still bounded by the original dimensions measured on October 14, 2016. However, a hole was visible and estimated to be less than 0.25 inches in diameter.

On January 10, 2017, the corroded area again appeared to be further degraded but still bounded by the original dimensions. The hole in the pipe wall was estimated to be 0.5 inches x 0.625 inches. The licensee took UT data at the original 0.60-inch x 1.2-inch perimeter, and the wall thickness at the established perimeter had not changed.

On January 23, 2017, after pump surveillance testing, the licensee visually estimated the flaw area to be 0.6 inches by 1.5 inches. UT data bounds the flaw to be no greater than 0.6 inches x 2.1 inches. The licensee measured minimum wall thickness at the UT perimeter to be 0.253 inches.

The licensee noted that Seabrook Technical Specification (TS) 3/4.7.4, "Service Water System Ultimate Heat Sink," requires that the service water system be operable with two cooling tower service water loops. Performing an ASME Code repair at the flaw location during power operation would require that the cooling tower "A" train of service water system be taken out of service. The licensee stated that while the TS provide 7 days for repair, doing so would result in the loss of one cooling tower train during the repair timeframe.

The licensee explained that the mechanical draft evaporative cooling tower is seismically designed and available as a backup to dissipate shutdown and accident heat loads, should normal seawater flow to the service water pump house be restricted due to seismically induced damage to the circulating water (seawater) intake and discharge tunnels. Also, the cooling tower is used for brief periods when seawater intake is influenced by ingress of materials from the Atlantic Ocean, such as seaweed.

In the event of high differential pressure across the screen wash system or strainers, the licensee needs to align the system to the cooling tower to reduce debris accumulation and erosion in the service water system, particularly in the winter months when the system is more vulnerable for seaweed intrusion due to the prevailing winds across the Atlantic Ocean. Removing the "A" train of the cooling tower from service would eliminate the defense-in-depth provided by the system design.

The licensee explained that an ASME Code repair of the flaw in the "A" train of cooling tower service water during power operation could exceed the TS allowed timeframe and necessitate a plant shutdown. Shutting the plant down towards the end of the current fuel cycle creates undue and unnecessary stress on plant systems, structures, and components. The applicable Code requirement is Section IWA-4412 of ASME Code, Section XI, 2004 Edition, with no addenda, which states, "Defect removal shall be accomplished in accordance with the requirements of IWA-4420." The licensee noted that the defect will not be removed during operation of the "A" train of service water system piping, because doing so would result in a significant leak rate through a larger area resulting from the removal of degraded pipe wall.

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 covering the flaw at the degraded pipe location. The encapsulation consists of a 6-inch nominal pipe size (NPS) weldolet, weld neck flange, and blind flange as depicted in Figure 1 of the relief request. The technical basis of the temporary repair is as follows.

Flaw Sizing and Characterization

The licensee characterized the defect as a single, isolated, nonplanar flaw. The licensee stated that based upon the UT examination, the flaw appears to be localized corrosion from seawater resulting from a loss of the pipe cement liner. The licensee noted that wall thinning was further accelerated when the normally stagnant piping system was put into operation for a pump surveillance run.

The licensee initially sized the flaw size (area) to be 0.600-inches axial by 1.20-inches circumferential to evaluate the structural integrity of the subject pipe. However, as the flaw size increases, the licensee subsequently postulated a flaw size of 0.75-inches axial by 3.0-inches circumferential to evaluate the structural integrity of the subject pipe.

In accordance with 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 subject pipe 3 inches upstream and 3 inches downstream of the flaw in weld FW1818-F0602. The licensee did not detect any other flaws.

Flaw Evaluation

The licensee stated that the typical corrosion rate used in Seabrook service water piping evaluations is 30 mils per year (mpy). Based on UT data from October 14, 2016, to January 23, 2017, the licensee estimated the actual corrosion rate along the length of the flaw to be 0.0149 inches per day. However, during the time period from January 10, 2017, to January 23, 2017, the flaw length increased from 1.2 inches to 2.1 inches, a change of 0.9 inches. The licensee explained that this change is not attributed to corrosion, but is likely due to mechanical abrasion when the temporary patch over the leak was removed to perform UT. The licensee predicted the bounding flaw length to be 3.1 inches (2.1 inches + 67 days (0.0149 inches per day) = 3.1 inches) by April 1, 2017. The licensee stated that the 6.6875-inch inside diameter of the weldolet will encapsulate the predicted final flaw size by extending the system pressure boundary and maintaining system integrity. The licensee further stated that it will observe the flaw daily with a flaw length limit of 2.8 inches, as established in the current operability determination. The licensee noted that it will perform periodic UT inspections of no more than 30-day intervals around the installed weldolet to identify wall loss propagating outside the encompassed area.

According to the licensee, the sizing of the 6-inch weldolet was based upon the identified wall thickness of the piping and its installation position with respect to the predicted final flaw size of 0.6 inches x 3.1 inches on April 1, 2017. The licensee stated that it will weld the weldolet to pipe wall thickness verified to be of a thickness of 0.328-inch or better. To proactively address the corrosion potential within the bounded area after encapsulation is installed, the licensee applied a factor of 4 to obtain a corrosion rate of 120 mils per year. Although the installation duration is less than 1 year (next refueling outage is Spring 2017), 120 mils is used. The licensee predicted that the resulting pipe wall under the weldolet and weldment will, therefore, be reduced from 0.328 inches to 0.208 inches (0.328 – 0.120). The licensee calculated a required minimum pipe wall of 0.105 inches based upon system design pressure of 150 pounds per square inch (psi) in accordance with ASME Code, Section III. Using the operating pressure of 75 psi, the licensee calculated a Code-required minimum wall of 0.053 inches. The pipe wall thickness with future metal loss, calculated to be 0.208 inches, exceeds the ASME Code minimum of 0.105 inch. Therefore, the licensee demonstrated that structural integrity of the repair will be maintained. In addition, the licensee stated that the inside diameter of the weldolet of 6.6875 inches is greater than the 3.1-inch circumferential length of the predicted final flaw size. This also demonstrates that the encapsulation has sufficient metal such that further corrosion will not affect the integrity of the repair.

The licensee evaluated the bounding flaw of 0.75 inches by 3.0 inches in accordance with ASME Code Case N-513-3 and concluded that structural integrity of the subject pipe is maintained.

Design

The design pressure and temperature of the service water piping system is 150 psi and 200 degrees Fahrenheit (°F). Normal operating pressure is 75 psi, and normal operating temperature is 65 °F maximum and 35 °F minimum. The weldolet, 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 weldolet is constructed from ASME SA-105 material and meets ASME Code, Section III, ND requirement for branch connections.

The licensee designed the encapsulation to meet the ASME Code, Section III, ND requirements for fabrication. The acceptance criteria are in accordance with the requirements of the original construction code, ASME Code, Section III, ND. The nondestructive examination (NDE) methods performed will meet the requirements of ASME Code, Section XI, IWA-4500.

The licensee calculated the weight of the encapsulation to be 80.2 pounds. The defect area is well-supported by a vertical and lateral pipe support approximately 2.5 feet downstream and 8.25 feet upstream of the defect area. The licensee reviewed the pipe support design documentation and concluded that the existing pipe supports can accommodate the additional encapsulation weight of 80.2 pounds.

Installation

The pre-installation inspection requirements for the weldolet consist 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 stated that it will remove water from the weld area by suction or wiping prior to welding the weldolet to the pipe, as necessary.

The licensee will perform welding using a qualified procedure that meets the requirements of ASME Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators," for an open root, full penetration weld. The licensee stated that impact to the cement lining in the pipe attributed to the heat from welding the weldolet will be minimal, based on past experience at Seabrook. In addition, any damaged lining would exist for only 2 months until the next refueling outage (OR18) when the weldolet will be removed, plus any corrosion in this area would be observed by the UTs being performed.

The post-installation NDE requirements consist of a VT-2 visual examination for leakage in accordance with ASME Code, Section XI, IWA-5000.

Extent of Condition

In accordance with Code Case N-513-3, the licensee performed augmented inspections to determine the extent of condition. The licensee did not find any flaws in the augmented inspections.

Post-Repair Monitoring

The licensee stated that it will perform periodic UT inspections of no more than 30-day intervals around the installed weldolet to identify wall loss propagating outside the encompassed area. In addition, the licensee will perform daily walkdowns of the area in which the repair is located.

The licensee stated that the proposed temporary repair will remain in place until the next refueling outage (OR18) and that the relief request will expire at the end of the refueling outage scheduled for Spring 2017. The licensee further stated that should the ongoing non-destructive examination identify that the flaw progresses outside the encapsulated area to the point that the Code minimum thickness of 0.105-inch is challenged, the relief request would expire.

3.2 NRC Staff Evaluation

The NRC staff evaluated the proposed alternative based on the applicable provisions of ASME Code Case N-513-3, and the 2004 Edition of ASME Code, Section XI, as follows:

Flaw Sizing and Characterization

The NRC staff finds that the licensee has used UT to measure the wall thickness of the affected area of the pipe and has periodically measured the flaw with UT since the initial discovery of the leak. Based on the information provided, the NRC staff acknowledges that the degradation is a non-planar through-wall flaw, not a crack, and that the degradation mechanism of the defect is localized corrosion caused by seawater. The NRC staff finds that the licensee has satisfied the flaw sizing and characterization requirements of paragraphs 2(a) and 2(b) of Code Case N-513-3.

Flaw Evaluation

The licensee demonstrated the structural integrity of the repaired pipe from the date of flaw discovery to the Spring 2017 refueling outage when the licensee will perform an ASME Code repair on the subject piping. The licensee's flaw evaluation is based on (a) the predicted final flaw size with respect to the weldolet size, (b) the thickness of the pipe wall underneath the encapsulation with respect to the minimum ASME Code-required pipe wall thickness, and (c) the stability of the predicted final flaw size using the methodology in accordance with ASME Code Case N-513-3 and ASME Code, Section XI, Appendix C.

The NRC staff finds acceptable the licensee's use of a corrosion rate of 0.0149 inches per day to predict the final flaw size, based on actual corrosion data from October 14, 2016, to January 23, 2017. The licensee also considered that circumferential flaw length increased from 1.2 inches to 2.1 inches during the time period from January 10, 2017, to January 23, 2017. The NRC staff notes that the circumferential length is longer than the axial length of the flaw and is limiting. Therefore, the circumferential length of the flaw is used to compare to that allowable. Based on the flaw size detected on January 23, 2017, the licensee predicted the final circumferential flaw length to be 3.1 inch by the Spring 2017 refueling outage. The NRC staff notes that the 6.6875-inch inside diameter of the weldolet is larger than the predicted circumferential flaw length of 3.1 inch; therefore, the encapsulation covers sufficient metal such that the structural integrity of the pipe will be maintained.

The NRC staff finds that the licensee's plan to install the weldolet to pipe wall thickness of 0.328 inch or better to be acceptable. However, degradation may continue to occur inside the pipe after encapsulation is installed. To estimate the corrosion rate, the licensee applied a factor of 4 to the normal corrosion rate of 30 mpy to obtain a corrosion rate of 120 mpy. The licensee conservatively assumed that the pipe wall thickness under the weldolet and attachment weld will be reduced by the corrosion rate of 0.120 inches from the date of the repair to the Spring 2017 refueling outage. The licensee predicted that the pipe wall under the weldolet and weldment will be reduced to 0.208 inches (0.328 – 0.120). Based on independent calculation performed in accordance with ASME Code, Section III, the NRC staff has verified that the licensee-calculated minimum pipe wall of 0.105 inch, based upon system design pressure of 150 psi, is acceptable. The NRC staff noted that if the operating pressure of 75 psi were to be used rather than the design pressure, based on Equation 4 of ASME Code Case, N-513-3, the required minimum wall would have been 0.053 inch. The NRC staff finds it acceptable that the licensee conservatively used 0.105 inch as the allowable for the minimum wall thickness. Since the estimated pipe wall thickness of 0.208 inch exceeds the minimum allowable wall thickness of 0.105 inch, NRC staff finds that, in terms of metal loss, the licensee has demonstrated that the structural integrity of the repaired pipe will be maintained.

The NRC staff notes that the licensee used the linear elastic fracture mechanics method in accordance with ASME Code, Section XI, Appendix C, Article C-7000, to demonstrate that the postulated final flaw size of 0.75 inches axial and 3.0 inches circumferential will be stable and the structural integrity of the subject pipe will be maintained. The NRC staff finds that the licensee has applied proper loading and load combination in the flaw evaluation of the subject pipe.

The NRC staff notes that in addition to the above assessment, the licensee stated that it will observe the flaw daily with a limit of 2.8 inches for the flaw size as established in the current operability determination and that it will measure wall thickness by UT every 30 days. As a defense-in-depth measure, the licensee stated that the relief request would expire if the ongoing UT identifies that the flaw progresses outside the encapsulated area to the point that the ASME Code minimum thickness of 0.105 inch is challenged.

Based on the above evaluation, the NRC finds that the licensee has satisfactorily demonstrated the structural integrity of the repaired pipe until the Spring 2017 refueling outage.

Design

The NRC staff finds that the weldolet, weld neck flange, and blind flange design conforms to the design temperature and pressure requirements. The NRC staff further finds that the material of the encapsulation is compatible with the pipe material and meets the ASME Code, Section III, ND requirement for branch connections.

The NRC staff finds that the encapsulation is designed to meet the ASME Code, Section III, ND requirements for fabrication. The acceptance criteria are in accordance with the requirements of the original construction code, ASME Code, Section III, ND. The NDE examination methods performed will meet the requirements of ASME Code, Section XI, IWA-4500.

As discussed above, the weight of the encapsulation is 80.2 pounds. The defect area is well-supported by a vertical and lateral pipe support approximately 2.5 feet downstream and 8.25 feet upstream of the defect area. The NRC staff finds that because of the proximity of the existing pipe supports, the additional encapsulation weight of 80.2 pounds does not affect the pipe stress significantly.

Installation

The NRC staff finds that the licensee will ensure that the surface of the pipe is dry and, therefore, suitable for welding. The licensee will also ensure that weld joint fit-up is acceptable. Therefore, the NRC staff finds that the licensee's pre-installation evaluation is acceptable.

The NRC staff finds that following the welding requirements of ASME Code, Section IX, as proposed by the licensee, is acceptable. The NRC staff finds that the licensee proposed VT-2 visual examination and penetrant testing examination of the final weld is acceptable for the temporary repair of the ASME Class 3 component.

Extent of Condition

The NRC staff finds that the licensee has satisfied the extent of condition inspection requirement in accordance with Section 5 of Code Case N-513-3 because it has performed an augmented examination and has not detected any flaw other than the subject defect.

Post-Repair Monitoring

The NRC staff finds that the licensee proposed daily walkdown to monitor the encapsulation of the flaw area and periodic UT inspections of no more than 30-day intervals are acceptable, because this inspection requirement is consistent with Code Case N-513-3 and is adequate to observe potential leakage.

Hardship Justification

The NRC staff recognizes that an ASME Code repair of the subject pipe will lead to the unavailability of the "A" train service water system. This will cause the "A" train cooling tower to be unavailable. This will eliminate the defense-in-depth in the system design of two trains. In addition, the ASME Code repair may exceed the required limiting condition of operation required by the plant TSs, which would result in a plant shutdown. A plant shutdown near the scheduled refueling outage would place the systems and components in an undue and unnecessary stress condition. The NRC staff has determined that performing an ASME Code repair as compared to the proposed temporary repair would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

In summary, the NRC staff finds that the licensee has demonstrated the structural integrity of the repaired pipe by analysis, by the margin between the encapsulation diameter and the predicted final flaw size, and by periodic monitoring of the repaired pipe location. Therefore, the NRC staff finds that Relief Request RA-17-001 will provide reasonable assurance that the structural integrity of the subject service water piping and its intended safety function will be maintained until the end of the next refueling outage (OR18) in Spring 2017.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the proposed alternative provides reasonable assurance of structural integrity of the subject service water piping. The NRC staff has 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 concludes 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. Therefore, the NRC staff authorizes the proposed alternative in Relief Request RA-17-001, in accordance with 10 CFR 50.55a(z)(2), for Seabrook until either the end of the next refueling outage (OR18) in Spring 2017, or 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: March 27, 2017

SUBJECT: SEABROOK STATION, UNIT NO. 1 – RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE (CAC NO. MF9127) DATED MARCH 27, 2017

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