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

June 26, 2012

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

SUBJECT: SEABROOK STATION, UNIT NO. 1 – REQUEST FOR RELIEF FROM AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE CASE N-729-1, REQUIREMENTS FOR EXAMINATION OF REACTOR VESSEL HEAD PENETRATION WELDS (TAC NO. ME7537)

Dear Mr. Walsh:

By letter dated October 27, 2011, NextEra Energy Seabrook, LLC (NextEra or licensee) submitted a relief request from certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(6)(ii)(D)(1) for the third 10-year inspection interval at Seabrook Station, Unit 1 (Seabrook) that commenced on August 19, 2010.

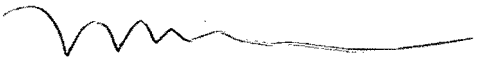
The submittal requests authorization of a proposed alternative from the inspection requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, ASME Code Case N-729-1, for the examination of reactor pressure vessel upper head penetrations for the control rod drive mechanism (CRDM). Specifically, pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee requested to use an alternative on the basis that complying with the specified requirements would result in hardship or unusual difficulty.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety, and that the alternative proposed will provide reasonable assurance of structural integrity of the CRDM nozzles. Therefore, the alternative proposed is authorized pursuant to 10 CFR 50.55a(a)(3)(ii), for the third 10-year inservice inspection interval for Seabrook.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved remain applicable, including a third-party review by the Authorized Nuclear Inservice Inspector. The NRC staff's safety evaluation is enclosed.

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

Sincerely,



Meena 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
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF

FROM AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE CASE N-729-1

NEXTERA ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated October 27, 2011 (Agencywide Documents Access and Management System Accession No. ML11307A370), NextEra Energy Seabrook, LLC (NextEra or licensee) submitted a relief request from certain requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(6)(ii)(D)(1) for the third 10-year inspection interval at Seabrook Station, Unit 1 (Seabrook) that commenced on August 19, 2010.

The submittal requests authorization of a proposed alternative from the inspection requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, ASME Code Case N-729-1, for the examination of reactor pressure vessel (RPV) upper head penetrations for the control rod drive mechanism (CRDM). Specifically, pursuant to 10 CFR 50.55a(a)(3)(ii), the licensee requested to use an alternative on the basis that complying with the specified requirements would result in hardship or unusual difficulty.

2.0 REGULATORY EVALUATION

In this relief request, the licensee proposes to use alternatives to the requirements of ASME Code Case N-729-1.

10 CFR 50.55a(g)(6)(ii)(D) requires augmented inservice inspection (ISI) of RPV head penetration nozzles of pressurized-water reactors (PWRs) in accordance with ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Pressure Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial Penetration Welds Section XI, Division 1," subject to the conditions specified in paragraphs (2) through (6) of 10 CFR 50.55a(g)(6)(ii)(D).

10 CFR 50.55a(a)(3), states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used when authorized by the U.S. Nuclear Regulatory Commission (NRC) if the

licensee demonstrates: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) 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 analysis, the NRC staff finds that regulatory authority to authorize an alternative to the ASME Code, as requested by the licensee, exists.

3.0 TECHNICAL EVALUATION

3.1 Applicable Code edition and addenda

The current Code of Record for the Seabrook third 10-year ISI interval is ASME Code Section XI, 2004 Edition, as augmented by ASME Code Case N-729-1, "Alternative Examination Requirements for PWR Reactor Vessel Upper Head with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1," as amended by 10 CFR 50.55a(g)(6)(ii)(D).

3.2 Affected Systems and Components

The licensee is requesting relief for five CRDM penetrations nozzles designated as Item No. B4.20, "UNS N06600 nozzles and UNS N06082 or UNS W86182 partial-penetration welds in head," in Table 1 of Code Case N-729-1. The nozzles are as follows: penetration nozzle nos. 74, 75, 76, 77, and 78.

3.3 Proposed Alternative

As an alternative to the volumetric and/or surface examination coverage requirements shown as dimension "a" in Figure 2 of ASME Code Case N-729-1, for the penetrations for which relief has been requested, the licensee proposes to perform attainable ultrasonic examination distances of each RPV head CRDM penetration nozzle, as shown in the table below. For all other penetrations, the required examination coverage dimension "a" reflected in Figure 2 of ASME Code Case N-729-1, will be met or exceeded.

Seabrook Inspection Coverage Obtained for CRDM Penetrations Having Limited Coverage

Penetration No.	Degrees	N-729-1 Required Exam Coverage (inches)	Inspection coverage Obtained (inches)
74	48.7	1.0	0.94
75	48.7	1.0	0.32
76	48.7	1.0	0.43
77	48.7	1.0	1.07
78	48.7	1.0	0.48

3.4 Licensee's Basis for Request

Due to the physical configuration of certain reactor vessel head penetration nozzles, full examination volume required by ASME Code Case N-729-1, Table 1 cannot be achieved for the above penetrations; therefore, use of Mandatory Appendix I is requested in accordance with

10 CFR 50.55a(g)(6)(ii)(D)(6). Appendix I provides the analysis procedure for evaluation of an alternative examination area or volume if impediments prevent examination of the complete zone.

Reactor Vessel Head CRDM Penetrations at Seabrook have two styles of ends, referred to as Type "X" and Type "Y." Penetrations 1 through 73 are Type "Y." These penetrations are essentially smooth wall cylinders with a radius at the outer diameter and inner diameter. Full inspection coverage was obtained for these penetrations. Penetrations 74 through 78 have a threaded outside diameter and an internal taper. The configuration of penetrations 74, 75, 76, and 78 is such that the distance from the lowest point at the toe of the J-groove weld to the top of the threaded region is less than the required coverage dimension "a" shown in Figure 2 of ASME Code Case N-729-1. The configuration of penetration 77 is such that, in past exams, the required coverage dimension "a" shown in Figure 2 of ASME Code Case N-729-1 was met, however, the margin is sufficiently small that, in the present exam, it is possible that the "a" dimension will not be met. Therefore, deviation from the required inspection coverage is sought for reactor vessel head penetrations 74 through 78. The licensee will meet the required examination coverage above the J groove weld.

The licensee supported the proposed alternative with a stress analysis and deterministic fracture mechanics analysis. The plant-specific stress analysis demonstrated that the hoop and axial stresses remain below 20 kips per square inch (ksi) over the entire region outside the alternative examination zone, as defined by the licensee's proposed alternative. The licensee also provided a plant-specific fracture mechanics analysis that demonstrated that a potential axial crack in the unexamined zone will not grow to the toe of the J-groove weld within 6 effective full-power years (EFPYs). The next required examination would be completed prior to the potential flaw propagation into the J-groove welds.

The licensee also noted that performance of dye penetrant testing may be possible in lieu of ultrasonic testing to cover the area of missed inspection coverage. However, compliance with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Nozzles are typically inspected using remotely operated volumetric examination equipment. The threaded outside diameter makes a dye penetrant examination on the lower section of the penetration not practical because of excessive bleed out from the threads. Radiation levels under the reactor vessel head were measured during the previous inspection in 2006 and ranged from 7,000 millirem (mrem)/hour to 10,000 mrem/hour at the bottom of the CRDM nozzles, resulting in an exposure of approximately 1,750 to 2,500 mrem per nozzle to perform surface examination.

3.5 NRC Staff's Evaluation

The NRC staff's review of this request was based on 10 CFR 50.55a(a)(3)(ii), which states that:

> 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.

The specific regulatory requirements for which relief is requested are defined in 10 CFR 50.55a(g)(6)(ii)(D)(3), which states in part:

> Instead of the specified 'examination method' requirements for volumetric and surface examinations in Note 6 of Table 1 of Code Case N-729-1, the licensee shall perform volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the nozzle tube, as identified by Figure 2 of ASME Code Case N-729-1.

Mandatory Appendix I is requested for use by the licensee in accordance with 10 CFR 50.55a(g)(6)(ii)(D)(6). Appendix I provides the analysis procedure for evaluation of an alternative examination area or volume if impediments prevent examination of the complete zone. Section I-1000 requires that analyses shall be performed using at least the stress analysis method or the deterministic fracture mechanics analysis method to demonstrate that the applicable criteria are satisfied. The licensee has provided, as required by Section I-1000, a stress analysis for the subject penetrations. In addition, the licensee has provided a deterministic fracture mechanics analysis, though this was not required by Appendix I.

The licensee has provided evidence that a physical and radiological hardship would be incurred, in order to be within compliance with the specified requirements. The NRC staff finds that a physical hardship exists due to the inability of ultrasonic or eddy current inspection to effectively scan the bottom end of each CRDM penetration, as each nozzle is threaded on the outside diameter and internally tapered. While dye penetrant inspection would be a possible option for the licensee, the inspection would require manual application in a high radiation area. Furthermore, additional setup work would require additional accumulation of dose for each nozzle. Therefore, the NRC staff finds that the radiological dose required to perform the additional inspection would be a significant radiological hardship for the limited additional inspection coverage.

The NRC staff then compared the regulatory requirements to the proposed alternative to ensure that given this hardship, compliance with the regulations did not provide a compensating increase in the level of quality and safety. The NRC staff reviewed the licensee's basis for the proposed alternative through a review of the licensee's stress and fracture mechanics analysis.

The NRC staff's review of the stress analysis was based on the degradation phenomenon of concern being primary water stress corrosion cracking (PWSCC). PWSCC typically initiates in the areas of the highest tensile stress in susceptible materials, such as alloy 600 materials, and propagates in response to time, environment (i.e., temperature) and stress intensity. Seabrook has a cold temperature head, which has slower PWSCC crack growth rates. In addition, based on the licensee's stress analysis, the licensee proposed and the NRC staff concurs that the areas of missed inspection coverage are in a low stress area, i.e., less than 20 ksi. These two factors combined demonstrate that the propagation of a through-wall PWSCC crack is unlikely in the interval between examinations.

The licensee's fracture mechanics analysis showed that a postulated through-wall axial flaw, located at the bottom edge of the uninspected region of the nozzle, would not grow to the toe of

the J-groove weld. In this case, the licensee is referring to the edge of the reactor coolant system pressure boundary, in less than 6 EFPYs. The NRC staff reviewed the analysis and finds the inspection area for each penetration nozzle to be adequate, because in all instances, the time required for the postulated crack to grow the necessary distance to reach the toe of the J-groove weld exceeds the time interval between inspections. Based on the above analysis, the NRC staff finds that the proposed inspection coverage and frequency provide reasonable assurance of structural integrity of each nozzle for which relief has been requested.

The NRC staff finds that while the licensee could perform surface examinations to increase the inspection coverage for the nozzle, these additional inspections would be of limited value and require extensive work in very high radiation fields. The NRC staff finds that performing these additional surface examinations would result in hardship through significant radiation exposure without a compensating increase in the level of quality or 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 components and that complying with the 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). Therefore, the NRC staff authorizes the use of the proposed alternative to define an alternate examination zone below the J-groove weld at Seabrook until the end of the third 10-year ISI interval (August 18, 2020).

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

Principal Contributor: Margaret Audrain

Date: June 26, 2012

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

Sincerely,

/ra/

Meena 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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