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

July 22, 2011

Mr. Michael J. Annacone, Vice President
Brunswick Steam Electric Plant
Carolina Power & Light Company
Post Office Box 10429
Southport, North Carolina 28461

SUBJECT: BRUNSWICK STEAM ELECTRIC PLANT, UNIT 2 - RELIEF REQUESTS RR-47, RR-48, RR-49, AND RR-50 FOR THE THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN (TAC NOS. ME4343, ME4344, ME4345, AND ME4346)

Dear Mr. Annacone,

By letter dated July 23, 2010, as supplemented by letters dated January 28 and February 28, 2011, Carolina Power & Light Company (the licensee) submitted relief requests RR-47, RR-48, RR-49, and RR-50 to the Nuclear Regulatory Commission (NRC) for relief from the 100 percent coverage of weld volume or area examinations requirements of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section IX during the third 10-year inservice inspection (ISI) interval at Brunswick Steam Electric Plant (BSEP), Unit 2. The third 10-year ISI interval began on May 10, 1998. However, per paragraph IWA-2430(d) of ASME Code, Section XI, the third 10-year interval was extended for 1 year and ended on May 10, 2009.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), 50.55a(g)(6)(i), the licensee requested relief and to use alternative requirements (if necessary), for ISI items on the basis that code requirements are impractical.

Notwithstanding, the third 10-year ISI interval at the BSEP-2 ended on May 10, 2009, however, the licensee submitted its relief requests on July 23, 2010, which is over 2 months later than the 12 months after the end of the interval that is allowed under 10 CFR 55a(g)(5)(iv). The NRC Region II staff has been notified of this shortcoming.

The NRC staff has reviewed the licensee's submittal and concluded that it is impractical for the licensee to comply with the ASME Code examination 100 percent coverage requirements for the subject welds listed in RR-47, RR-48 (revised), RR-49, and RR-50. The NRC staff also concluded that the imposition of these ASME Code requirements would create a burden on the licensee. The NRC staff further has determined that based on the volumetric examination coverage achieved on the subject welds and 100 percent surface examination the of welds , it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Therefore, the NRC staff concluded that the examinations were performed to the extent practical and would provide reasonable assurance of structural integrity of the subject welds. The NRC staff also concludes that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest

given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The NRC staff has reviewed the subject requests and concludes that, as set forth in the enclosed safety evaluation, the Carolina Power & Light Company has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Accordingly, the NRC staff concludes the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a, with the exception of 10 CFR 50.55a(g)(5)(iv), and is in compliance with the ASME Code's requirements. Therefore, the NRC grants relief requests RR-47, RR-48, RR-49, and RR-50 at BSEP, Unit 2 for the third 10-year ISI interval, which ended on May 10, 2009.

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

If you have any questions regarding this matter, please contact Farideh Saba, Project Manager for Brunswick at (301) 415-1447.

Sincerely,

Tracy J. Orf for

Douglas A. Broaddus, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-324

Enclosure: Safety Evaluation

cc w/enclosure: Distribution via ListServ

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

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

RELIEF REQUESTS RR-47, RR-48, RR-49, AND RR-50

BRUNSWICK STEAM ELECTRIC PLANT, UNIT 2

DOCKET NO. 50-324

1.0 INTRODUCTION

By letter dated July 23, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102150345), as supplemented by letters dated January 28, and February 28, 2011 (ADAMS Accession Nos. ML110400192 and ML110670422, respectively), Carolina Power & Light Company (the licensee) requested reliefs from the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* ((ASME Code) requirements for the 100 percent coverage of weld volume or area examination associated with the third 10-year inservice inspection (ISI) interval at Brunswick Steam Electric Plant (BSEP), Unit 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), 50.55a(g)(6)(i), the licensee requested relief and to use alternative requirements (if necessary), for ISI items on the basis that code requirements are impractical.

2.0 REGULATORY REQUIREMENTS

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice 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 interval and subsequent 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), 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

Alternatives to the requirements may be authorized or relief granted by the Nuclear Regulatory Commission (Commission, NRC) pursuant to 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), or 10 CFR 50.55a(g)(6)(i). In proposing alternatives or requests for relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of quality and safety; (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility.

Inservice inspection of ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the NRC pursuant to the provisions of 10 CFR 50.55a(g)(6)(i).

Furthermore, 10 CFR 50.55a(g)(5)(iii) states that If the licensee has determined that conformance with certain code requirements is impractical for its facility, the licensee shall notify the NRC and submit, as specified in 10 CFR 50.4, information to support the determinations.

Pursuant to 10 CFR 50.55a(g)(6)(i), the Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The ASME Code of record for the third 10-year Interval ISI Program at the BSEP-2, which ended on May 10, 2009, was Section XI of the 1989 Edition, no Addenda.

3.0 TECHNICAL EVALUATION

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee submitted relief requests RR-47, RR-48, RR-49, and RR-50 in order to obtain relief from the applicable ISI requirements of the ASME Code, Section XI for the subject ASME Code Class 1 and 2 components at BSEP-2. The 1989 Edition of the ASME Code, Section XI, Articles IWB-2500, and IWC-2500 require that components be examined and tested as specified in Tables IWB-2500-1 and IWC-2500-1 of the ASME Code, Section XI. Tables IWB-2500-1 and IWC-2500-1 define the examination requirements for Class 1 and 2 components, respectively. These tables specify, among other things, the examination techniques (volumetric, surface, and/or visual) and the examination boundary. For each of the subject components, the examination boundary is provided in the figure specified for that particular ASME Code, Section XI, item number in Tables IWB-2500-1 and IWC-2500-1. For volumetric and surface exams, the required examination boundary includes essentially 100 percent of the volume or area specified in the applicable figure listed in Tables IWB-2500-1 and IWC-2500-1.

In the subject relief requests, the licensee stated that, for the listed components, the actual volumetric and/or surface examination coverage during the third 10-year interval ISI program at BSEP, Unit 2 was limited by component configuration, design, geometry, physical interferences, and/or accessibility issues. Based on these limitations, the licensee stated that they were unable to obtain "essentially 100 percent" (i.e., greater than 90 percent) examination coverage of the volume or area specified in the ASME Code, Section XI for the subject components, and compliance with the examination requirements for the subject components would be impractical. The licensee conducted alternative limited examinations on the subject components to the extent practical. The details concerning the NRC staff's evaluation of RR-47, RR-48, RR-49, and RR-50 based on the licensee's explanation regarding the impracticality of achieving the full examination coverage required by the ASME Code, Section XI and the alternative examinations for the subject components are provided below.

3.1 Relief Request RR-47

Component Identification

RR-47 addresses the following ASME Code Class 1, Examination Category B-D, Item No. B3.90 components:

Main Steam Nozzle-to-Reactor Pressure Vessel (RPV) - Welds 2B11-RPV-N3A, 2B11-RPV-N3B, 2B11-RPV-N3C, and 2B11-RPV-N3D

Head Spray Nozzle-to-RPV - Welds 2B11-RPV-N6A and 2B11-RPV-N6B

Head Instrument Penetration Nozzle-to-RPV - Weld 2B11-RPV-N7

Core Differential Pressure Instrumentation Nozzle-to-RPV - Weld 2B11-RPV-N10

Water Level Instrumentation Nozzle-to-RPV - Welds 2B11-RPV-N12A and 2B11-RPV-N12B

Applicable ASME Code, Section XI Requirements

The ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.90 requires a volumetric examination of the nozzle-to-RPV welds, with essentially 100 percent coverage of the volume specified in Figure IWB-2500-7.

Licensee's Basis for Relief and Proposed Alternative

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code Section XI examination coverage requirements for the Examination Category B-D, Item No. B3.90 nozzle-to-RPV welds listed in Table RR-47-1 of its July 23, 2010, submittal on the basis that the required examination coverage of "essentially 100 percent" is impractical due to physical obstructions and the limitations imposed by design and geometry. The licensee stated that ultrasonic scanning was performed on the subject nozzle-to-RPV welds to the fullest extent practical, resulting in total volumetric examination coverage of 51.7 percent for the subject main steam nozzle-to-RPV welds; 50.1 percent for the head spray and head instrument penetration nozzle-to-RPV welds; and 44.5 percent for the core differential pressure and water level instrumentation nozzle-to-RPV welds.

According to the licensee, the design of the subject nozzle-to-RPV welds precludes the performance of a volumetric examination with "essentially 100 percent" coverage of the ASME Code, Section XI-required volume. The nozzle-to-RPV welds are accessible from the vessel plate side of the weld and were therefore examined to the extent practical. The subject nozzle design at BSEP, Unit 2 does not allow for examination from the nozzle side of the weld. The outside bend radius of the nozzle forgings varies from 2.75 inches to 5 inches for the subject nozzles. The curvature of the surface prevents the ultrasonic transducer from maintaining contact and proper coupling on the nozzle side of the weld. Volumetric examination coverage was not achievable or practical from the nozzle side of the weld based on the latest qualified ultrasonic testing technology, nor by other considered volumetric examinations methods, such

as radiography. The licensee's submittal included Figure RR-47-4, which provides a plant nozzle configuration drawing and shows the nozzle curvature and weld configuration that results in the coverage limitation described above. This configuration is typical for all of the subject nozzle-to-RPV welds. The limited-scope volumetric examinations that were completed identified no indications, as specified in Table RR-47-1 of the licensee's July 23, 2010, submittal. The licensee concluded that if significant degradation existed in the subject welds, it would have been identified by the limited-scope volumetric examinations.

Additionally, as Class 1 Examination Category B-P components, visual (i.e., VT-2) examinations were performed on these reactor coolant pressure boundary (RCPB) components during system pressure tests each refueling outage. This was completed during the unit's 2009 refueling outage, and no evidence of leakage was identified for these components. Further, reactor coolant water chemistry at BSEP, Unit 2 is controlled in accordance with the 2008 revision to the BWR Water Chemistry Guidelines. A hydrogen water chemistry program is implemented to reduce the oxidizing environment in the reactor coolant. These measures provide added assurance against the initiation of cracking or corrosion from the inside surface of the reactor vessel.

The licensee has concluded that the provisions described above as an alternative to the subject ASME Code, Section XI requirements will continue to provide reasonable assurance of the structural integrity for the subject nozzle-to-RPV welds. The limited-scope volumetric examinations were completed to the extent practical and no reportable indications were present. Compliance with the volumetric examination coverage requirements of the ASME Code, Section XI would require modification, redesign, or replacement of the subject nozzle components.

The NRC Staff's Evaluation

The NRC staff reviewed the information provided by the licensee concerning the impracticality of achieving full volumetric coverage of the subject nozzle-to-RPV welds, as discussed above, and agreed with the licensee's determination that the geometry of the nozzle forgings did prevent the performance of meaningful ultrasonic scans from the nozzle side of the welds. The performance of ultrasonic examinations from the RPV shell side of the welds resulted in the maximum achievable volumetric examination coverage for the subject nozzle-to-RPV welds. The licensee's limited examinations achieved coverage of 51.7 percent, 50.1 percent, and 44.5 percent of the volume specified in the ASME Code, Section XI, Figure IWB-2500-7 for the subject nozzle-to-RPV welds. Specifically, the NRC staff evaluated the coverage calculations and the nozzle coverage figures that are provided in Enclosure 1 of the licensee's dated July 23, 2010. Based on this review, the NRC staff determined that achieving the volumetric examination coverage required by the ASME Code, Section XI is impractical for the subject nozzle-to-RPV welds because this would require redesign, modification, and/or replacement of the RPV nozzles in order to achieve greater than 90 percent examination coverage. Furthermore, the NRC staff acknowledged that no relevant indications were found as a result of the limited-scope examinations of the RPV shell-to-flange weld.

The NRC staff noted that Table RR-47-1 includes a remark in the line entries for each of the subject nozzle-to-RPV welds stating that the "[e]xamination [was] performed prior to implementation of Appendix VIII [of the ASME Code, Section XI], Supplements 4 and 6." In

request for additional information (RAI) RR-47-1.a, the NRC staff requested that the licensee clarify whether this statement applied specifically to the limited-scope ultrasonic examinations of the nozzle-to-RPV welds discussed in RR-47. In RAI RR-47-1.b, the NRC staff requested that the licensee provide additional information concerning whether the limited scope nozzle-to-RPV weld examinations were performed using ultrasonic examination personnel, procedures, and equipment that were qualified in accordance with the ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," taking into consideration the requirements in 10 CFR 50.55a(g)(6)(ii)(C)(*1*)-(*2*) "Implementation of Appendix VIII to Section XI."

The licensee in its response to RAI RR-47-1.a, by letter dated January 28, 2011, stated that the requirements of Supplements 4 and 6 of the ASME Code, Section XI, Appendix VIII are applicable only to ultrasonic examinations of RPV axial and circumferential shell welds and, accordingly, the remarks contained in Table RR-47-1 were revised to eliminate the reference to Appendix VIII, Supplements 4 and 6 and to state when the component weld inspections were performed. As part of its RAI response, the licensee provided a revised Table RR-47-1, wherein the line entries now state that the limited examinations of the subject welds were performed in May 1999 and February 2001, prior to the implementation of the ASME Code, Section XI, Appendix VIII performance demonstration requirements applicable to the nozzle-to-RPV welds.

In its response to RAI RR-47-1.b, the licensee stated that the limited scope nozzle-to-RPV weld examinations listed in Table RR-47-1 of the licensee's July 23, 2010, submittal were performed in accordance with the 1989 Edition of the ASME Code, Section XI, Paragraph IWA-2232. These examinations were performed prior to the November 22, 2002, implementation date specified in 10 CFR 50.55a(g)(6)(ii)(C)(1) concerning the use of the Appendix VIII, Supplement 7 qualification requirements for nozzle-to-RPV welds. The licensee stated that subsequent ultrasonic examinations of the nozzle-to-RPV welds will be performed using systems appropriately qualified in accordance with Appendix VIII, Supplement 7 requirements.

The NRC staff found that the licensee's response to RAI RR-47-1.a was acceptable because the subject nozzle-to-RPV weld examinations were performed in May 1999 and February 2001, prior to the schedule requirements specified in of 10 CFR 50.55a(g)(6)(ii)(C)(1) for implementation of ASME Code, Section XI, Appendix VIII performance demonstration criteria applicable to ultrasonic examinations of the nozzle-to-RPV welds (Supplement 7 of Appendix VIII). The NRC staff also determined that the licensee appropriately revised Table RR-47-1 to remove references to Supplements 4 and 6 of Appendix VIII and to state that the subject examinations were performed prior to the implementation of the applicable ASME Code, Section XI, Appendix VIII requirements. The NRC staff found that the licensee's response to RAI RR-47-1.b was acceptable because 10 CFR 50.55a(g)(6)(ii)(C)(1) did not require implementation of the ASME Code, Section XI, Appendix VIII performance demonstration criteria for nozzle-to-RPV weld examinations until November 22, 2002. Accordingly, the subject nozzle-to-RPV weld ultrasonic examinations were performed in May 1999 and February 2001, using systems, personnel, and procedures that were qualified in accordance with the requirements of Paragraph IWA-2232 from the 1989 Edition of the ASME Code, Section XI.

In RAI RR-47-2, the NRC staff requested that the licensee state whether the third 10-year ISI interval volumetric examinations of the inner radius sections of the RPV nozzles addressed in

RR-47 achieved essentially 100 percent coverage, as required by the ASME Code, Section XI, Examination Category B-D, Item No. B3.100. The NRC staff also requested in RAI RR-47-2 that the licensee state whether any relevant indications were discovered as a result of these nozzle inner radius examinations. In its response to RAI RR-47-2, the licensee stated that the volumetric examinations of the RPV nozzle inner radius sections were not limited in coverage, and essentially 100 percent volumetric coverage was achieved. The licensee stated that no relevant flaws were detected in any Examination Category B-D, Item No. B3.100 for RPV nozzle inner radius sections. The licensee's response confirmed that these nozzle regions received full scope volumetric examinations and no relevant indications were discovered.

Based on the above evaluation, the NRC staff determined that the ASME Code, Section XI requirement to perform volumetric examinations of the subject nozzle-to-RPV welds with essentially 100 percent coverage is impractical. The licensee's limited volumetric examinations provide reasonable assurance of continued structural integrity for the subject nozzle-to-RPV welds at BSEP, Unit 2.

3.2 Relief Request RR-48

Component Identification

RR-48 addresses the following ASME Code Case N-578-1 Examination R1.16 (ASME Code Class 1, Examination Category B-J, Item Nos. B9.11 and B9.31) components:

Item No. B9.11, Elbow-Valve - 2B32RECIRC-28-B-8

Item No. B9.31, Branch Connection (weld-o-let) - 2B32RECIRC-28-B-9BC, 2B32RECIRC-28-A-9BC-1, 2E1110-9-10-SWA, 2G31AY1-1-FWR10A, 2B32FF-12-FWRRA10A, and 2B32FF-12-FWRRB13A

Item No. B9.11, Valve-Pipe - 2B32RECIRC-28-A-9

Applicable ASME Code, Section XI Requirements

The examination requirement for the subject welds are governed by a risk-informed ISI (RI-ISI) program that was approved by the NRC in a safety evaluation dated November 23, 2001 (ADAMS Accession No. ML013320632). The RI-ISI program was developed in accordance with the Electric Power Research Institute Topical Report 112657, Revision B-A, "Revised Risk-Informed Inservice Inspection evaluation Procedure," and using ASME Code Case N-578 (N-578), "Risk-Informed Requirements for Class 1, 2, and 3 Piping, Method B." N-578 is listed in Regulatory Guide (RG) 1.193, Revision 2, "ASME Code Cases Not Approved for Use." The NRC has accepted licensees' referencing of N-578, Table 1 examination criteria when submitting requests for relief. Table IWB-2500-1 requires 100 percent of the examination volume described in ASME Code, Section XI, Figures IWB-2500-9, -10, and -11, as applicable.

Licensee's Basis for Relief and Proposed Alternative

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief for the components listed in Table RR-48-1 of its July 23, 2010, submittal on the basis that the required examination

coverage of "essentially 100 percent" is impractical due to physical obstructions and the limitations imposed by design, geometry, and materials of construction. No alternative examination was proposed by the licensee.

The licensee in its response to the NRC staff's RAIs for RR-48 by the letter dated February 28, 2011, revised its relief request.

The licensee in its request dated February 28, 2011, stated that BSEP, Unit 2 was at the end of the first period of the third 10-year inspection interval when the RI-ISI program was approved (i.e., ADAMS Accession No. ML013320632) and implemented. The licensee further explained that prior to the transition to a risk-informed inspection program, weld examinations required performance of surface examinations in accordance with Section XI of the ASME Code. Until the transition point (i.e., the end of the first period of the third inspection interval), 8 percent of the examinations required by the ASME Code, Section XI had been completed for Examination Category B-F and B-J piping welds. Beginning in the second period of the third interval, the components selected by the RI-ISI program replaced those formerly selected in accordance with the ASME Code, Section XI criteria. Since 8 percent of the examinations had been completed during the first period of the third interval, 92 percent of the RI-ISI examinations were performed during the second and third periods. Under the RI-ISI program, 61 ASME Class 1 piping welds are required to be examined over a complete 10-year interval. Due to the mid-interval implementation of RI-ISI, 56 welds were required to be examined to complete the remainder of the interval. Of those 56 welds examined, BSEP is seeking relief on 8 welds. Additionally, as Class 1 examination Category R-A components, a VT-2 visual examination is performed on the subject components of the reactor coolant pressure boundary during system pressure tests each refueling outage. This was completed during the 2009 refueling outage (i.e., the B219R1 outage) and no evidence of leakage was identified for these components.

The licensee stated that the sound beam modes and insonification angles used complied with the requirements of ASME Code, Section XI, Appendix VIII. The licensee clarified that because the examinations were completed from one side (i.e., 50 percent maximum coverage), examination coverage plots were not generated. The ultrasonic examinations of welds in the R-A Category, that are limited, were for austenitic components. These components were examined using an ultrasonic examination procedure based on the requirements of "PDI Generic Procedure for the Ultrasonic Examination of Austenitic Pipe Welds UT-PDI-2." This procedure states, "Where dual side access is not possible, the examination shall be performed from a single side of the weld." As such, where components were limited to single side access due to configuration (i.e., in Table RR-48-1), the licensee has only taken credit for 50 percent of examination.

Further the licensee stated that it has performed qualified examinations that achieved the maximum, practical amount of coverage obtainable within the limitations imposed by the design of the components. All other ASME Code Class 1 piping examinations in the RI-ISI program have been completed in accordance with ASME Code volumetric requirements.

The NRC Staff's Evaluation

The ASME Code requires essentially 100 percent volumetric examinations of selected ASME Code, Section XI, Examination Category B-J pressure retaining welds in piping. The NRC staff

noted that BSEP Unit 2 was designed and fabricated before the examination requirements of ASME Code Section XI, were formalized and published. Therefore, BSEP Unit 2 was not specifically designed to meet the requirements of ASME Code Section XI. Complete volumetric examinations of the subject welds were restricted by geometrical configurations and materials. Out of a population of 56 welds that were scheduled for RI-ISI examinations, the licensee could not perform full volumetric examinations from both sides of the eight listed welds due to geometrical configurations and materials. To gain access for examination, the welds would require design modifications or replacement. Imposition of this requirement would place a burden on the licensee; therefore, the ASME Code-required 100 percent volumetric examinations are considered impractical.

The NRC staff noted that the ASME Code examination categories include requirements for both surface and volumetric examinations. However, the licensee has not requested relief for the surface examination, since it had completed all the required surface examination.

As shown on the sketch and technical descriptions included in the licensee's submittal, examinations of the subject circumferential welds have been performed to the extent practical with the licensee obtaining volumetric coverage ranging from approximately 42.25 to 50 percent from the accessible side of the welds. Volumetric scan limitations were caused by the weld pipe-to-weld-o-let, pipe-to-valve, and valve-to-elbow configurations.

The manual ultrasonic examinations conducted by the licensee included 35-, 45-, 60-, and 70-degree shear wave and 60-degree refracted longitudinal wave (L-wave) examinations, as applicable, from the accessible pipe side of the welds. The combined shear and L-wave examinations account for the aggregate coverage reported. Although the licensee did not claim credit for coverage on the inaccessible side of these welds, the L-wave technique is believed capable of detecting planar inside diameter surface-breaking flaws on the far-side of wrought stainless steel welds. Studies[1,2] reported in the technical literature recommend the use of both shear and L-waves to obtain the best detection results, with minimum false calls, in austenitic welds. For the subject piping welds, volumetric examinations were conducted using techniques qualified in accordance with performance demonstration requirements listed in ASME Code, Section XI, Appendix VIII.

The licensee has shown that it is impractical to meet the ASME Code-required volumetric examination coverage, as applicable, for the subject welds due to the design geometry of the welds. Based on the coverage obtained, and considering the full examination of other pressure retaining piping welds, it is reasonable to conclude that, if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds.

The NRC staff has reviewed the licensee's revised request for relief RR-48 and concludes that the ASME Code examination coverage requirements are impractical for the subject welds.

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1 FV Ammirato, X Edelmann, and SM Walker. 1987. "Examination of Dissimilar Metal Welds in BWR Nozzle-to-Safe End Joints," 8th International Conference on NDE in the Nuclear Industry, ASM International.

2 P. Lemaitre, TD Koble, and SR Doctor. 1995. "PISC III Capability Study on Wrought-to-Wrought Austenitic Steel Welds: Evaluation at the Level of Procedures and Techniques," *Effectiveness of Nondestructive Examination Systems and Performance Demonstration*, PVP-Volume 317, NDE-Volume 14, ASME.

Furthermore, imposition of these ASME Code requirements would create a burden on the licensee. Based on the volumetric coverage obtained on the subject welds, the NRC staff determined that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. The NRC staff concluded that examinations performed to the extent practical provided reasonable assurance of structural integrity of the subject welds.

3.3 Relief Request RR-49

Component Identification

RR-49 addresses the following ASME Code Class 1, Examination Category B-A, Item Nos. B1.22 and B1.30 components at BSEP, Unit 2:

Item No. B1.22, RPV Bottom Head Meridional Welds 2B11-RPV-J31 and 2B11-RPV-J42

Item No. B1.30, RPV Shell-to-Flange Weld 2B11-RPV-F1/1B11-RPV-F2

Applicable ASME Code, Section XI Requirements

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.22 requires a volumetric examination of the RPV head meridional welds, with essentially 100 percent coverage of the volume specified in Figure IWB-2500-3, along the accessible length of the welds.

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-A, Item No. B1.30 requires a volumetric examination of the RPV shell-to-flange weld, with essentially 100 percent coverage of the volume specified in Figure IWB-2500-4, along the total length of the weld.

Licensee's Basis for Relief and Proposed Alternative

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code, Section XI examination coverage requirements for the Examination Category B-A, Item No. B1.22 RPV head meridional welds (Welds 2B11-RPV-J31 and 2B11-RPV-J42) and Item No. B1.30 RPV shell-to-flange weld (Weld 2B11-RPV-F1/1B11-RPV-F2), at BSEP Unit 2, as listed in RR-49. Relief was requested on the basis that the required volumetric examination coverage of "essentially 100 percent" is impractical due to physical obstructions and the limitations imposed by design and geometry.

In its request dated July 23, 2010, as supplemented by the letter dated January 28, 2011, the licensee stated that the limited-scope volumetric examinations were completed to the extent practical and no reportable indications were present. As discussed below, licensee concluded that the limited-scope volumetric examinations to the subject ASME Code, Section XI requirements in RR-49 will provide reasonable assurance of the structural integrity for the subject nozzle-to-RPV and RPV head meridional welds and that compliance with the volumetric examination coverage requirements of the ASME Code, Section XI would require modification, redesign, or replacement of the subject components.

RPV Bottom Head Meridional Welds 2B11-RPV-J31 and 2B11-RPV-J42

RPV Bottom Head Meridional Welds 2B11-RPV-J31 and 2B11-RPV-J42 extend from one side of the hemispherical RPV bottom head to the other. These welds are approximately 213 inches in length, and the RPV sits on an integrally welded support skirt that obstructs approximately 194 inches (support skirt diameter) of each of the bottom head welds located within the support skirt. The licensee provided Figure RR-49-1 in its July 23, 2010, submittal to illustrate these obstructions. The licensee stated that any control rod drive (CRD) maintenance activity is performed through access provided from under the RPV at the CRD flanges. The area inside the reactor support skirt man-way provides access to the upper portions of the CRD housings, within the support skirt. This inside area contains 137 CRD housings, 43 in-core penetrations, and one bottom head drain line. The housings are 6 inches in diameter and the distance between each of the housings is only 6 inches. The elevation between the reactor vessel and insulation within the man-ways ranges from approximately 4 feet at the outer diameter to approximately 12 inches at the center of the reactor. This configuration does not allow physical access for performing ultrasonic examinations of the subject RPV bottom head meridional welds.

During the third 10-year ISI interval, the licensee performed ultrasonic examinations from both sides of the accessible portion of the welds. The licensee stated that the examinations achieved 8.9 percent of the ASME Code, Section XI-required coverage on each of the welds, which is outside the RPV support skirt, and that is 100 percent of the accessible length of these welds. The licensee added that this is the maximum achievable coverage because access to the inside of the RPV support skirt is not possible for performing these weld examinations. The licensee also stated that no recordable indications were observed during these examinations. Examination personnel and examination procedures were qualified in accordance with the ASME Code, Appendix VIII as administered by the EPRI PDI.

In addition, the licensee stated in its July 23, 2010 request that during each refueling outage, a VT-2 visual examination was also performed in conjunction with system pressure testing required by the ASME Code, Section XI, Examination Category B-P for all Class 1 components. Reactor coolant system leak rate limitations and atmospheric particulate radioactivity monitoring also ensure that any leakage would be detected prior to component failure.

RPV Shell-to-Flange Welds 2B11-RPV-F1/1B11-RPV-F2

The RPV shell-to-flange weld (Weld 2B11-RPV-F1/F2) is a circumferential weld that attaches the RPV flange to the upper shell. The shell-to-flange configuration is a structural discontinuity comprised of the RPV shell segment welded to the flange segment. The flange segment is thicker than the shell segment and this creates a transition on the outside diameter (OD) surface. This OD transition limits the physical scanning area of the transducer. Loss of contact between the part and the ultrasonic transducer occurs when trying to scan over the transition. The licensee provided drawings illustrating the RPV shell-to-flange weld configuration and the limitation in ultrasonic examination coverage in RR-49. According to the licensee, no ultrasound enters the weld once loss of contact occurs, when scanning from the outside surface of the weld, as illustrated in Figure RR-49-2 of the licensee's July 23, 2010, submittal. As shown in Figure RR-49-2, the limited examination achieved 64 percent ASME Code, Section XI-required coverage for the RPV shell-to-flange weld.

The licensee stated that the third 10-year ISI interval limited-scope ultrasonic examinations of the RPV shell-to-flange weld were performed from the outside surface of the RPV in calendar year 2000 using the industry-accepted technology that was available. At that time of the examination, the technology for performing ultrasonic examinations from the inside surface of the RPV was still emerging and was not yet considered proven technology for commercial application. According to the licensee, the third 10-year ISI interval ultrasonic examinations of the RPV shell-to-flange weld were performed to the fullest extent practical. These examinations achieved the maximum amount of coverage obtainable within the limitations imposed by the design of the RPV shell-to-flange weld. These weld examinations were completed prior to the implementation of inspection techniques qualified under Appendix VIII of the ASME Code, Section XI as administered by the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI). The licensee stated that future examinations of the RPV shell-to-flange weld will be performed from the inside surface of the RPV using ASME Section XI, Appendix VIII-qualified techniques, which will provide an improved examination with a greater amount of weld examination coverage. The licensee stated that no recordable indications were observed as a result of the limited-scope examination of the RPV shell-to-flange weld.

The licensee also stated that during each refueling outage a VT-2 visual examination for detecting leakage is performed in conjunction with system pressure testing, as required by the ASME Code, Section XI, Examination Category B-P for all Class 1 components. No indications of leakage were found as a result of the VT-2 visual examinations. Reactor coolant system leak rate limitations and atmospheric particulate radioactivity monitoring also ensure that any leakage would be detected prior to failure. The licensee stated that the design configuration of the RPV shell-to-flange weld makes compliance with the ASME Code-required examination coverage requirements impractical. RPV modifications would be required to meet the ASME Code, Section XI examination coverage requirements, which would impose a considerable burden on the licensee.

The NRC Staff's Evaluation

RPV Bottom Head Meridional Welds 2B11-RPV-J31 and 2B11-RPV-J42

Item B1.22 of Examination Category B-A in Table IWB-2500-1 of the ASME Code Section XI, Article IWB-2500 requires volumetric examination of the accessible length of 100 percent of the weld length. The NRC staff reviewed the information in the licensee's submittals and based on this review the NRC staff determined that the portions of the RPV head meridional welds inside the RPV support skirt are inaccessible for volumetric examination and therefore do not require examination under the ASME Code, Section XI, Article IWB-2500. The NRC staff also determined that that the licensee's volumetric examinations of all portions of the RPV head meridional welds outside the RPV support skirt covered 100 percent of the accessible length of these welds. Therefore, the NRC staff concluded that the licensee has met the ASME Code, Section XI, Article IWB-2500, Examination Category B-A, Item No. B1.22 requirements for the third 10-year interval ISI program at BSEP, Unit 2.

Based on the above evaluation, the NRC staff determined that it is impractical to perform a volumetric examination of essentially 100 percent length of the bottom head meridional welds

for BSEP, Unit 2 RPV. The licensee's 100 percent volumetric examination of the accessible portions of these welds, in conjunction with a visual examination and system pressure testing, provides reasonable assurance of continued structural integrity for the RPV bottom head meridional welds at BSEP, Unit 2.

RPV Shell-to-Flange Weld 2B11-RPV-F1/1B11-RPV F2

The NRC staff reviewed the information provided by the licensee concerning the impracticality of achieving full volumetric coverage of the RPV shell-to-flange weld, as discussed above, and determined that the geometry of the outer surface of this welded joint did prevent the performance of meaningful ultrasonic scans from the RPV outer surface with greater than 90 percent volumetric coverage. The licensee's ultrasonic examinations from the outer surface of the RPV resulted in the maximum achievable volumetric examination coverage for the RPV shell-to-flange weld. The NRC staff also determined that achieving the volumetric examination coverage required by the ASME Code, Section XI is impractical for the RPV shell-to-flange weld because this would require redesign and modification of the RPV shell-to-flange weld in order achieve greater than 90 percent examination coverage. Furthermore the NRC staff acknowledged that no relevant indications were found as a result of the limited-scope examinations of the RPV shell-to-flange weld.

RR-49 states that the limited ultrasonic examination of the RPV shell-to-flange weld was performed in calendar year 2000 using the industry accepted technology that was available. RR-49 also states that "[t]hese weld examinations were completed prior to the implementation of inspection techniques qualified under Appendix VIII of the ASME Code, Section XI, administered by the EPRI PDI." The NRC staff requested in RAI RR-49-1 that the licensee state the ASME Code, Section XI requirements to which ultrasonic examination personnel, procedures, and equipment were qualified when performing the limited scope examination of the RPV shell-to-flange weld. The NRC staff also requested in RAI RR-49-1 that the licensee provide justification for the use of these qualification standards based on the requirements of 10 CFR 50.55a(b)(2)(xiv)-(xvi), and 10 CFR 50.55a(g)(6)(ii)(C)(1)-(2).

In its January 28, 2010, response to RAI RR-49-1, the licensee stated that the BSEP, Unit 2 RPV shell-to-flange weld examination was performed in calendar year 2001, rather than calendar year 2000, as stated in the July 23, 2010, submittal. The licensee stated that none of the ASME Code, Section XI, Appendix VIII supplements identified in 10 CFR 50.55a(g)(6)(ii)(C)(1) applied to the subject RPV shell-to-flange weld examination. The licensee further stated that neither 10 CFR 50.55a(g)(6)(ii)(C)(1) nor 10 CFR 50.55a(g)(6)(ii)(C)(2) were applicable to the limited examination of the RPV shell-to-flange weld when the weld was examined in 2001. According to the licensee, the RPV shell-to-flange weld was examined in accordance with the requirements of Paragraph IWA-2232 from the 1989 Edition of the ASME Code, Section XI.

The NRC staff found the applicant's response to RAI RR-49-1 acceptable because the 1995 Edition and 1996 Addenda of ASME Code, Section XI, Appendix VIII do not include supplements specifically applicable to examinations of RPV shell-to-flange welds. The NRC staff also found that the requirements of Paragraph IWA-2232 from the 1989 Edition of the ASME Code, Section XI were acceptable for licensee implementation for the performance of the

limited scope volumetric examination of the RPV shell-to-flange weld at BSEP, Unit 2, when the examination was performed in 2001.

The NRC staff noted that the limited scope ultrasonic examination of the subject weld was performed from the outer surface of the RPV. In RR-49, the licensee acknowledged that techniques for volumetric examination through the performance of ultrasonic scans from the RPV inner surface have been developed. However, the licensee stated that these techniques were not available for implementation at BSEP, Unit 2 in 2001 when the limited examination was performed. In its request dated July 23, 2010, the licensee stated that going forward these welds will be examined using ASME Code, Section XI, Appendix VIII techniques, which will provide improved examination with a greater amount of weld examination coverage. The NRC staff found that this licensee's statement, sufficient for ensuring greater volumetric examination coverage of the RPV shell-to-flange weld at BSEP, Unit 2 during the fourth 10-year ISI interval.

Based on the above evaluation, the NRC staff determined that the ASME Code, Section XI requirement to perform a volumetric examination of the RPV shell-to-flange weld with essentially 100 percent coverage is impractical for BSEP, Unit 2. The licensee's 100 percent volumetric examination of the accessible portions of these welds, in conjunction with a visual examination and system pressure testing, provides reasonable assurance of continued structural integrity for the RPV shell-to-flange weld at BSEP, Unit 2.

3.4 Relief Request RR-50

Component Identification

RR-50 addresses the following ASME Code Class 2, Examination Category C-B, Item No. C2.21 component at BSEP, Unit 2:

Residual Heat Removal Heat Exchanger (RHRHX) Nozzle-to-Shell Weld 2E11HX-2A-SWN4

Applicable ASME Code, Section XI Requirements

ASME Code, Section XI, Table IWC-2500-1, Examination Category C-B, Item No. C2.21 requires a surface examination and a volumetric examination of the subject weld with essentially 100 percent (i.e., greater than 90 percent) coverage of the examination surface and volume specified in Figure IWC-2500-4(a).

Licensee's Basis for Relief and Proposed Alternative

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from volumetric examination coverage requirements for Item C2.21 in Examination Category C-B of the ASME Code, Section XI for the subject RHRHX nozzle-to-shell weld (Weld 2E11HX-2A-SWN4) at BSEP, Unit 2. Relief was requested on the basis that the required volumetric examination coverage of "essentially 100 percent" is impractical due to the limitations imposed by design and geometry.

ASME Code, Section XI requires volumetric examination of the RHRHX nozzle-to-shell weld from two sides of the weld in order to be 100 percent complete. The licensee in its submittal

stated that due to the configuration of the RHRHX nozzle, the ultrasonic examination is limited to scanning on the shell side of the weld. Weld 2E11HX-2A-SWN4 is a Class 2 RHRHX nozzle-to-shell weld with no access for ultrasonic examination coverage from nozzle side of the weld. An ultrasonic examination was performed to the maximum extent practical in accordance with the requirements of the ASME Code, Section XI, 1989 Edition. The limited scope examination achieved 47.9 percent of the ASME Code, Section XI-required coverage. The licensee stated that qualified examinations were performed that achieved the maximum practical amount of coverage obtainable within the limitations imposed by the design of the components. The subject RHRHX nozzle design at BSEP, Unit 2 does not allow for examination on the nozzle side of the weld. The curvature of the nozzle forging surface prevents the ultrasonic transducer from maintaining contact and proper coupling as required by the procedure. Figure RR-50-2 in the licensee's July 23, 2010, submittal provided a typical scan limitation coverage plot.

In addition to the limited scope volumetric examination, a magnetic particle surface examination of the subject weld was performed from the outside surface, achieving 100 percent ASME Code, Section XI-required surface coverage. As an ASME Class 2 component, a VT-2 visual examination is also performed on the RHRHX pressure boundary during system pressure tests each refueling outage and no evidence of leakage has been identified.

The licensee stated that the design and configuration of the subject RHRHX nozzle imposes an ultrasonic scanning restriction, which makes compliance with the ASME Code, Section XI examination coverage requirements impractical. The licensee stated that extensive modifications would be required to meet the ASME Code, Section XI volumetric coverage requirements, which would impose a considerable burden. The licensee concluded that the volume of coverage obtained from the limited scope ultrasonic examination, as well as the full scope magnetic particle surface examination and the associated pressure testing provide reasonable assurance of the continued structural integrity for the subject weld.

The NRC Staff's Evaluation

The NRC staff reviewed and evaluated the information provided by the licensee, in letters dated July 23, 201 and January 28, 2011, concerning the impracticality of achieving full volumetric coverage of the subject RHRHX nozzle-to-shell weld. The licensee's limited volumetric examination achieved coverage of 47.9 percent of the required examination volume specified in the ASME Code, Section XI, Figure IWB-2500-4(a) for the subject RHRHX nozzle-to-shell weld. Based on its evaluation, the NRC staff determined that the geometry of the nozzle forging did prevent the performance of meaningful ultrasonic scans from the nozzle side of the weld. Therefore, the ultrasonic examination of the shell side of the weld resulted in the maximum achievable volumetric examination coverage for the subject nozzle-to-shell weld. Furthermore, the NRC staff acknowledged that the licensee's surface examination of the subject welded joint using the magnetic particle technique achieved 100 percent coverage. The NRC staff determined that achieving essentially 100 percent volumetric examination coverage, as required by the ASME Code, Section X, is impractical for the subject nozzle-to-shell weld, since this would require redesign, modification, and/or replacement of the subject RHRHX nozzle in order achieve greater than 90 percent examination coverage.

The NRC staff noted that RR-50, Table RR-50-1 included a statement under the "Examination Results" column indicating that there were "[n]o service induced indications." Based on this statement, the NRC staff requested that the licensee clarify whether any recordable indications were found as a result of the limited scope volumetric examination or the full-scope (100 percent) surface examination of the subject weld. The NRC staff also requested that the licensee clarify whether any recordable was determined to be unacceptable for continued service (without repair or analytical evaluation) under the ASME Code, Section XI, IWC-3500 acceptance standards. For any such unacceptable flaws, the NRC staff requested that the licensee discuss the disposition of any such flaws, including repairs made under ASME Code, Section XI, IWC-4000 and/or analytical evaluations performed under ASME Code, Section XI, IWC-3600. If any flaws in the subject weld were evaluated under ASME Code, Section XI, IWC-3600, the NRC staff requested that the licensee provide references for any flaw evaluation reports documenting analytical evaluations for acceptance of such flaws.

The licensee responded, in its letter dated January 28, 2011, that fabrication indications have been detected in the subject RHRHX nozzle-to-shell weld. The indications were determined to be slag inclusions. In its response, the licensee stated that the subject indications have been evaluated and found acceptable based on the ASME Code, Section XI, IWC-3500 acceptance standards. The licensee further stated that no growth or changes in flaw characteristics have been detected since the initial discovery of these flaws during preservice examinations. Based on licensee's response, the NRC staff determined that these fabrication flaws do not pose a concern with respect to the integrity of the subject weld because (1) the flaw dimensions are bounded by the acceptance criteria specified in the ASME Code, Section XI, IWC-3500; and (2) the flaw characteristics have not changed since initial discovery during preservice examinations.

Based on the above evaluation, the NRC staff determined that the ASME Code, Section XI requirement to perform a volumetric examination of the RHRHX nozzle-to-shell weld with essentially 100 percent coverage is impractical for BSEP, Unit 2. The licensee's limited scope volumetric examination and a magnetic particle examination achieving 100 percent ASME Code required coverage, in conjunction with a visual examination (VT-2) during system pressure testing, provide reasonable assurance of continued structural integrity for the RHRHX nozzle-to-shell weld at BSEP, Unit 2.

4.0 CONCLUSION

As set forth above, the NRC staff has reviewed the licensee's submittal and concluded that it is impractical for the licensee to comply with the ASME Code examination 100 percent coverage requirements for the subject welds listed in RR-47, revised RR-48, RR-49, and RR-50. The NRC staff also concluded that imposition of these ASME Code requirements would create a burden on the licensee. The NRC staff further has determined that based on the volumetric achieved on the subject welds and the surface examination performed, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Therefore, the NRC staff concluded that the examinations were performed to the extent practical and would provide reasonable assurance of structural integrity of the subject welds. The NRC staff also concludes that "granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property, or the common defense and security, and is otherwise in the public interest given

due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Accordingly, the NRC staff concludes the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a, with the exception of 10 CFR 50.55a(g)(iv), and is in compliance with the ASME Code's requirements. Therefore, the NRC grants reliefs for RR-47, RR-48, RR-49, and RR-50 at BSEP, Unit 2 for the third 10-year ISI interval.

All other ASME Code, Section XI requirements for which relief was not specifically requested and granted in the subject requests for relief are remained applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: Christopher Sydnor
Don Naujock

Date: July 22, 2011

given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The NRC staff has reviewed the subject requests and concludes that, as set forth in the enclosed safety evaluation, the Carolina Power & Light Company has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Accordingly, the NRC staff concludes the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a, with the exception of 10 CFR 50.55a(g)(5)(iv), and is in compliance with the ASME Code's requirements. Therefore, the NRC grants relief requests RR-47, RR-48, RR-49, and RR-50 at BSEP, Unit 2 for the third 10-year ISI interval, which ended on May 10, 2009.

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

If you have any questions regarding this matter, please contact Farideh Saba, Project Manager for Brunswick at (301) 415-1447.

Sincerely,

/RA by TOrf for/

Douglas A. Broaddus, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-324

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