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

December 29, 2010

Christopher Burton, Vice President
Shearon Harris Nuclear Power Plant
Carolina Power & Light Company
Post Office Box 165, Mail Zone 1
New Hill, North Carolina 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 – RELIEF REQUEST FOR APPROVAL OF AN ALTERNATIVE INSERVICE INSPECTION METHOD FOR SIX PRESSURE RETAINING DISSIMILAR METAL WELDS IN THE REACTOR PRESSURE VESSEL NOZZLES (TAC NO. ME3894)

Dear Mr. Burton:

By letter dated May 27, 2010, as supplemented by an e-mail dated July 26, 2010, Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc., submitted Relief Request I3R-07 for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP).

The proposed relief request seeks approval to allow an alternative to the inservice inspection requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," for six pressure retaining dissimilar metal welds in the reactor pressure vessel nozzles. The proposed alternative pertains to the third 10-year inspection interval at HNP.

Specifically, pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee proposed to demonstrate that an alternative to the ASME Code, Section XI requirements would provide an acceptable level of quality and safety.

The Nuclear Regulatory Commission (NRC) staff has completed its review of Relief Request I3R-07 and the NRC staff's safety evaluation is enclosed. Although the licensee requested relief pursuant to 10 CFR 50.55a(a)(3)(i), the technical data was inconclusive on determining an acceptable level of quality and safety (i.e., equivalency with the existing requirement). However, the NRC staff has concluded that compliance with the N-695-required 0.125-inch root mean square error (RMSE) criteria, at this time, is impractical and that the proposed alternative to add the difference between 0.189-inch RMSE and the ASME Code-required value (0.189-inch minus 0.125-inch = 0.064-inch) provides reasonable assurance of the structural integrity of the dissimilar metal welds that will be examined during the third 10-year inservice inspection (ISI) interval which began May 2, 2007, and is scheduled to end on May 1, 2017.

Therefore, Relief Request I3R-07 is granted pursuant to 10 CFR 50.55a(g)(6)(i), for HNP, Unit 1, for the third ISI interval that began on May 2, 2007, and is scheduled to end on May 1, 2017. 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 giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The NRC staff's safety evaluation is enclosed. If you have any questions regarding this matter, please contact Brenda Mozafari at 301-415-2020.

Sincerely,

/Brenda Mozafari for

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

Docket No. 50-400

Enclosure: Safety Evaluation

cc w/enclosure: Distribution via Listserv

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

REQUEST FOR RELIEF NUMBER I3R-07 FOR THE

THIRD 10-YEAR INSERVICE INSPECTION INTERVAL

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

CAROLINA POWER & LIGHT COMPANY

DOCKET NUMBER 50-400

1.0 INTRODUCTION

By letter dated May 27, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML101550272), as supplemented by an e-mail dated July 26, 2010 (ADAMS Accession No. ML102150328), Carolina Power & Light Company (the licensee), now doing business as Progress Energy Carolinas, Inc., submitted a request for relief from certain examination requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) at the Shearon Harris Nuclear Power Plant, Unit 1 (HNP).

The licensee requested that the U.S. Nuclear Regulatory Commission (NRC) approve Relief Request I3R-07 for HNP, which relates to the inservice inspection (ISI) of six pressure retaining dissimilar metal (DSM) welds in the reactor pressure vessel nozzles during the third 10-year inservice inspection interval that began on May 2, 2007, and is scheduled to end on May 1, 2017. Specifically, pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee proposed to demonstrate that an alternative to the Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," requirements of the ASME Code would provide an acceptable level of quality and safety.

2.0 REGULATORY REQUIREMENTS

NRC regulations in 10 CFR 50.55a(g) specify that the ISI of nuclear power plant components shall be performed in accordance with the requirements of the ASME Code, Section XI, except where specific written relief has been granted by the NRC pursuant to 10 CFR 50.55a(g)(6)(i). As stated in 10 CFR 50.55a(g)(6)(i), the NRC 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, given the consideration of the burden upon the licensee.

As stated in10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if (i) the proposed alternatives would provide an acceptable level of quality and safety or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The regulations also require that the ISI 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 into 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

3.0 TECHNICAL EVALUATION

3.1 Applicable ASME Code Edition and Addenda

The code of record for the third 10-year interval ISI program at HNP is the 2001 Edition through the 2003 addenda of the ASME Code, Section XI. In addition, as required by 10 CFR 50.55a(b)(2)(xv), licensees who use later editions and addenda than the 2001 Edition of the ASME Code shall use the 2001 Edition of Appendix VIII, "Performance Demonstration for Ultrasonic Examinations Systems." The third 10-year ISI interval for HNP began on May 2, 2007, and is scheduled to end on May 1, 2017.

3.2 Components for Which Relief is Requested

The affected components are the AMSE Code Class 1, Examination Category B-F, Item Number B5.10, Reactor Pressure Vessel (RPV) nominal pipe size (NPS) 4 or larger Nozzle-to-Safe End DSM pressure retaining butt welds.

Description	Weld No.	Nozzle/Piping Base Material	Weld
Loop A Piping to RPV Inlet Nozzle	RVNOZAI-N-01SE 1-RC-1-FW-4	SA508/SA351	82/182
Loop A Piping to RPV Outlet Nozzle	RVNOZAO-N-06SE 1-RC-1-FW-1	SA508/SA376	82/182
Loop B Piping to RPV Inlet Nozzle	RVNOZBI-N-03SE 1-RC-2-FW-4	SA508/SA351	82/182
Loop B Piping to RPV Outlet Nozzle	RVNOZBO-N-02SE 1-RC-2-FW-1	SA508/SA376	82/182
Loop C Piping to RPV Inlet Nozzle	RVNOZCI-N-05SE 1-RC-3-FW-4	SA508/SA351	82/182
Loop C Piping to RPV Outlet Nozzle	RVNOZCO-N-04SE 1-RC-3-FW-1	SA508/SA376	82/182

3.3 Applicable ASME Code Requirements

The ASME Code, Section XI, IWB-2500, "Examination and Pressure Test Requirements," specifies, in part, that "components shall be examined and tested as specified in Table IWB-2500-1. The method of examination for the components and parts of the pressure retaining boundaries shall comply with those tabulated in Table IWB-2500... ."

Table IWB-2500-1, "Examination Categories," Examination Category B-F, "Pressure Retaining Dissimilar Metal Welds in Vessel Nozzles," requires that all welds in Item No. B5.10, "Reactor

Vessel NPS 4 or Larger Nozzle-to-Safe End Butt Welds," meet the volumetric and surface examination requirements of Figure No. IWB-2500-8.

IWA-2232, "Ultrasonic Examination," requires that ultrasonic examinations be conducted in accordance with Appendix I, "Ultrasonic Examinations." Appendix I, I-2220, "Welds in Piping," requires that ultrasonic examination procedures, equipment, and personnel used to detect and size flaws in piping welds shall be qualified by performance demonstration in accordance with Appendix VIII with no other I-2000 applicable requirements.

HNP will be using NRC approved ASME Code Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," as an alternative to the qualification requirements for dissimilar metal piping welds specified in Appendix VIII, Supplement 10.

3.4 Licensee Proposed Alternative and Basis for Use

3.4.1 Variation to 0.125 RMSE

The licensee stated that relief is requested to allow the use of an alternative root mean square error (RMSE) value when depth sizing flaws that may be found during examination of the reactor vessel nozzle-to-piping welds from the inside surface. The ASME Code, Section XI, Appendix VIII, Supplement 10, and ASME Code Case N-695 specify that the examination procedures, equipment, and personnel are qualified for depth sizing when the RMSE of the flaw depth measurements, as compared to the true depth flaws, do not exceed 0.125-inch.

The licensee stated that this request for relief from the required RMSE in depth sizing is needed because, to date, examination vendors have not met the established RMSE of 0.125-inch for depth sizing. The licensee proposes to use a contracted examination vendor that has demonstrated the ability to meet the depth sizing qualification requirement with an RMSE of 0.189-inch instead of the 0.125-inch required by the ASME Code, Section XI, Appendix VIII, Supplement 10, and ASME Code Case N-695.

The licensee also stated that in the event an indication is detected that requires depth sizing, the difference between the required RMSE and the demonstrated RMSE will be added to the measured through-wall extent for comparison with applicable ASME Code, Section XI, IWB-3500 acceptance criteria. If the examination vendor demonstrates an improved depth sizing RMSE prior to the examination, the excess of that improved RMSE over the 0.125-inch RMSE requirement, if any, will be added to the measured value for comparison with applicable acceptance criteria. The licensee states that because this process provides a reasonable assurance of structural integrity, an acceptable level of quality and safety will be maintained.

3.4.2 Inside Diameter Ultrasonic Examinations Supplemented by Eddy Current

The licensee states that the examination vendor for the HNP reactor vessel nozzle-to-pipe welds examinations has been qualified for detection of axial flaws in accordance with the ASME Code, Appendix VIII, Supplement 10, as demonstrated through the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) Program, for DSM nozzle-to-piping welds examined from the inside diameter (ID) surface provided the surface is machined or ground smooth with no exposed root reinforcement or counter-bore. However, the presence of

surface roughness could result in uncertainty in the ultrasonic qualifications demonstrated for detection of axial flaws. The licensee also notes that the examination vendor has qualified for detection of circumferential flaws in accordance with Appendix VIII, Supplement 10, as demonstrated through the EPRI PDI Program for DSM nozzle-to-piping welds examined from the ID surface.

The licensee proposes to use surface geometry profiling software (profilometry) in conjunction with a focused immersion ultrasonic transducer positioned to permit accurate profile data across the examination volume, in order to help the examiner confirm locations where the raw data indicates lack of transducer contact due to problematic surface geometry. Subsequently, eddy current examination will be used to supplement ultrasonic examination where there is sufficient surface roughness to call into question the applicability of the ultrasonic examination qualification to detect axial flaws. The ultrasonic examinations, as supplemented by eddy current examinations and profilometry, will be conducted to the maximum extent practical. The licensee anticipates that all six DSM nozzle-to-piping welds will be examined using this process.

To supplement the ultrasonic examinations for rough surface detection coverage, the following eddy current techniques will be utilized:

1) Up to two plus point probes applied circumferentially on the inside surface in scan increments of 0.080-inch circumferentially (for axial flaws) and 0.25-inch axially. Data will also be collected at 0.080-inch intervals on circumferential scans.

2) Automated systems for data collection and analysis.

The target flaw size for the eddy current procedure is 0.28-inch long, which is well within the ASME Code linear flaw acceptance standards of 0.45-inch for austenitic material, and 0.625-inch for ferritic material as defined in the ASME Code Tables for the outside surface.

The eddy current technique to be utilized at HNP was first used for the V. C. Summer Nuclear Station reactor vessel primary nozzle examinations of 2000. The procedure was refined by applying it to the V. C. Summer hot leg DSM weld section, which was removed from service. The removed section had a number of primary water stress corrosion cracking (PWSCC) flaws along with nonrelevant indications resulting from metallurgical interface and surface geometry. Using these actual flaws and geometric conditions in the removed section to refine the technique, the vendor developed reliable flaw-screening criteria that allowed for the successful use of the procedure in the V. C. Summer 2002 and 2003 examinations.

Subsequently, the technique was successfully blind tested for the Swedish Nondestructive Testing Qualification Center (SQC Kvalificeringscentrum AB) under the program, "Qualification of Equipment, Procedure and Personnel for Detection, Characterization and Sizing of Defects in Areas in Nozzle to Safe End Welds at Ringhals Unit 3 and 4," (Hakan Soderstrand, July 10, 2003). The important qualification parameters for eddy current in the SQC blind tests (Ref. SQC Qualification Report No. 019AN03) were as follows:

- Defect types: fatigue and stress corrosion cracks, surface initiated
- Tilt: +/-10 degrees; Skew: +/-10 degrees
- Detection target size: IDSCC 6mm (0.25-inch) long

- Flaw Location: within 10mm (13/32-inch)
- Length of the planar flaw within a 70 percent confidence interval: +/- 9mm (3/8-inch)
- False call rate: less than or equal to 20 percent for the personnel qualification tests

The use of ultrasonic profilometry and eddy current examination, in conjunction with procedures and personnel qualified through the SQC blind tests to supplement Appendix VIII qualified ultrasonic procedures and personnel, provides additional assurance that surface-breaking flaws (that may be present) will be detected in the presence of potential surface roughness. This process will ensure that there is reasonable assurance of the structural integrity of the subject welds, and thus will continue to provide an acceptable level of quality and safety.

3.4.3 Duration of Proposed Alternative

The proposed alternative is requested for the third 10-year ISI interval at HNP, which began on May 2, 2007, and is scheduled to end on May 1, 2017.

4.0 STAFF EVALUATION

4.1 Variation to 0.125 RMSE

The ASME Code, Section XI, Appendix VIII, Supplement 10 and ASME Code Case N-695 state that examination procedures, equipment, and personnel are qualified for depth-sizing when the root mean square error of the flaw depth measurements, as compared to true depths, do not exceed 0.125-inch. (Note: ASME Code Case N-695 is identified as an Acceptable Section XI Code Case in Revision 15 of NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1.")

The nuclear industry is in the process of qualifying personnel to Supplement 10 as implemented by the PDI program. However, for demonstrations performed from the inside surface of a pipe weld, personnel have been unsuccessful at achieving the ASME Code-required 0.125-inch RMSE flaw depth sizing criterion. The difficulties in meeting the RMSE requirement are associated with surface roughness and pipe misalignment that are common to field welds, and are replicated in mockups used in the PDI program. The PDI mockups contain the bounding DSM weld surface conditions found in nuclear power plants. There is the possibility that demonstrations performed on mockups with less severe surface conditions could meet the RMSE requirement; however, such mockups are not available in the PDI program. Therefore, the staff concludes that achieving the required 0.125-inch RMSE for depth sizing is impractical at this time.

The vendor contracted by the licensee has proposed to use an RMSE of 0.189-inch instead of the 0.125-inch required for Supplement 10 and ASME Code Case N-695. In the event an indication is detected that requires depth sizing, the difference between the required RMSE and the demonstrated RMSE (e.g., 0.189-inch – 0.125-inch = 0.064-inch) will be added to the measured through-wall extent. This total will then be assessed against the applicable acceptance criteria specified in ASME Code, Section XI, for flaw evaluation. Additionally, the licensee proposes that, if the examination vendor demonstrates an improved depth sizing

RMSE prior to the examination, the excess of that improved RMSE over the 0.125-inch RMSE requirement, if any, will be added to the measured value for flaw evaluation with applicable acceptance criteria as specified in Section XI of the ASME Code.

In its request for additional information (RAI), the NRC staff noted that although the licensee's Code of Record (2001 Edition through the 2003 Addenda) specifies that the acceptance standard for Examination Category B-F, Item B5.10 is IWB-3514, later versions of the ASME Code (2007 Edition with 2009 Addenda) no longer permit the use of IWB-3514 for pressurized-water reactors with nickel alloy welds that are susceptible to PWSCC for planar, surface-connected flaws that are in contact with the reactor coolant environment during normal operation.

Additionally, the NRC staff noted that the Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guideline (MRP-139), Section 7, Evaluation Methodologies, specifies that "any flaw attributed to PWSCC, regardless of depth, will be evaluated [using IWB-3600] even if it meets the IWB-3500 requirements." As such, the staff asked the licensee to justify the continued specification of IWB-3514 acceptance criteria when the flaw is determined to be surface-connected. In its response to the NRC's RAI, the licensee stated that "nickel alloy welds that are susceptible to [PWSCC] for planar, surface-connected flaws that are in contact with the reactor coolant environment during normal operation will be addressed in accordance with MRP-139. The staff finds that application of the flaw evaluation methodologies specified in IWB-3600 is acceptable.

The NRC staff finds that adding the difference between the ASME Code-required RMSE and the demonstrated RMSE to the measured through-wall extent, in addition to the use of the acceptance standards specified in Section IWB-3600 of the ASME Code, provides an acceptable level of quality and safety and reasonable assurance of structural integrity of the subject welds.

4.2 Inside Diameter Ultrasonic Examinations Supplemented by Eddy Current

The licensee proposed the use of surface geometry profiling software (profilometry) in conjunction with a focused immersion ultrasonic transducer positioned to permit accurate profile data across the examination volume to help the examiner confirm locations where the raw ultrasonic data indicates lack of transducer contact due to problematic surface geometry. The staff finds the use of profilometry to confirm the presence of rough surfaces acceptable as it provides additional information as to the condition of the surface of the examination volume. In addition to profilometry, the licensee proposed the use of eddy current examination to supplement the ultrasonic examination for the nozzle-to-safe end and safe end-to-pipe welds having sufficient surface roughness to call into question the applicability of the ultrasonic examination qualification to detect axial flaws. Profilometry will confirm the presence of rough surfaces and the eddy current examination will assure the detection of surface breaking flaws.

HNP states that the eddy current methodology to be used is similar to that used for the V.C. Summer Nuclear Station, Unit 1 refueling outages in 2000, 2002, and 2003. The technique was refined based on examinations performed on a hot leg DSM weld section removed from V. C. Summer during the 2000 refueling outage. The removed section contained PWSCC flaws and nonrelevant indications resulting from surface geometry and metallurgical interfaces.

The NRC staff finds that the licensee's proposed alternative, which combines ultrasonic and eddy current techniques in examining for axial flaws in the presence of rough surfaces, will provide an acceptable level of detectability and sensitivity and an acceptable level of quality and safety. Therefore, the staff concludes that the licensee's proposed alternative continues to provide reasonable assurance of the structural integrity of the subject welds.

5.0 CONCLUSION

The licensee's proposed alternative of adding the difference between the ASME Code-required RMSE and the demonstrated RMSE to the measured through-wall extent, in addition to the use of the acceptance standards specified in Section IWB-3600 of the ASME Code, provides an acceptable level of quality and safety.

Additionally, the licensee's proposal to use surface geometry profiling combined with eddy current examination provides reasonable assurance that any axial flaws in the presence of rough surfaces will be detected, thereby also providing an acceptable level of quality and safety and providing reasonable assurance of the structural integrity of the subject welds is provided.

Although the licensee requested relief pursuant to 10 CFR 50.55a(a)(3)(i), the technical data was inconclusive on determining an acceptable level of quality and safety (i. e., equivalency with the existing requirement) period. However, based on the above evaluation, the NRC staff finds that compliance with the Code Case N-695 required 0.125-inch RMSE, at this time, is impractical. Adding the difference between the performance demonstrate depth sizing RMSE and the N-695 required depth sizing RMSE to a flaw size and applying the standards specified in ASME Section XI, IWB-3500 to determine acceptability, provides reasonable assurance that structural integrity is being maintained for the subject DSM welds.

Therefore, pursuant to 10 CFR 50.55a(a)(6)(i), relief is authorized for the third 10-year ISI interval at HNP, which began on May 2, 2007, and is scheduled to end on May 1, 2017. The granting of relief 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 consideration of burden upon the licensee.

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

Principal Contributor: Carol Nove

Date: December 29, 2010

Therefore, Relief Request I3R-07 is granted pursuant to 10 CFR 50.55a(g)(6)(i), for HNP, Unit 1, for the third ISI interval that began on May 2, 2007, and is scheduled to end on May 1, 2017. 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 giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

The NRC staff's safety evaluation is enclosed. If you have any questions regarding this matter, please contact Brenda Mozafari at 301-415-2020.

Sincerely,

/RA by BMozafari Acting for/

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

Docket No. 50-400

Enclosure: Safety Evaluation

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