April 6, 2006

Mr. Cornelius J. Gannon, Vice President
Shearon Harris Nuclear Power Plant
Carolina Power & Light Company
Post Office Box 165, Mail Code: Zone 1
New Hill, North Carolina 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 - RELIEF REQUESTS 2R1-016 AND 2R1-017 FOR THE SECOND 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NO. MC8961)

Dear Mr. Gannon:

By letter dated November 16, 2005, Carolina Power and Light Company submitted Relief Requests (RRs) 2R1-016 and 2R1-017 for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP). RR 2R1-016 pertains to the inspection requirements for pressure retaining dissimilar metal welds, and RR 2R1-017 covers the inspection requirements for the reactor pressure vessel (RPV) shell-to-flange weld. The subject requests are for the second 10-year inservice inspection (ISI) interval at HNP.

The Nuclear Regulatory Commission (NRC) staff's evaluation and conclusions are contained in the enclosed safety evaluation. For RR 2R1-016, the NRC staff concludes that compliance with the root mean square (RMS) error value required by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Also, by adding the difference between the ASME Code-required RMS error and the demonstrated accuracy to the measurements acquired from flaw sizing, in addition to the use of the acceptance standards specified in Section IWB-3500 of the ASME Code, provides reasonable assurance of structural integrity. Therefore, the NRC authorizes your proposed alternative in accordance with Title 10 *Code of Federal Regulations* (10 CFR), 50.55a(a)(3)(ii) for the second 10-year ISI interval at HNP.

For RR 2R1-017, the NRC staff concludes that your proposed alternative to use the performance demonstration initiative qualified procedure to complete the ultrasonic testing of the RPV shell-to-flange weld in accordance with ASME Code, Section XI, 1995 Edition (with 1996 Addenda), Appendix VIII, Supplements 4 and 6 as approved for use with modifications by 10 CFR 50.55a will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the second 10-year ISI interval at HNP.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in these relief requests remain applicable, including third-party review by the authorized nuclear inservice inspector.

Sincerely,

/RA/

Michael L. Marshall, Jr., Branch 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/encl: See next page

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in these relief requests remain applicable, including third-party review by the authorized nuclear inservice inspector.

Sincerely,

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Division of Operating Reactor Licensing
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cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUESTS 2R1-016 AND 2R1-017

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

CAROLINA POWER AND LIGHT COMPANY

DOCKET NO. 50-400

1.0 INTRODUCTION

By letter dated November 16, 2005, Carolina Power and Light Company (the licensee) submitted Relief Requests (RRs) 2R1-016 and 2R1-017 for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP). RR 2R1-016 pertains to the inspection requirements for pressure retaining dissimilar metal welds and RR 2R1-017 covers the inspection requirements for the reactor vessel shell-to-flange weld. The subject requests are for the second 10-year inservice inspection (ISI) interval at HNP.

2.0 REGULATORY EVALUATION

The ISI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda, as required by Title 10 *Code of Federal Regulations* (10 CFR) 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) of 10 CFR states, in part, that alternatives to the requirements of paragraph (g) may be used when authorized by the Nuclear Regulatory Commission (NRC), if the licensee demonstrates that: (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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in 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. The ISI Code of record for the second 10-year ISI interval for HNP is the 1989 Edition (no Addenda) of the ASME Code, Section XI. The

components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to commission approval.

3.0 TECHNICAL EVALUATION FOR RELIEF REQUEST 2R1-016

3.1 Components For Which Relief Is Requested

ASME Category B-F Pressure Retaining Dissimilar Metal Welds, Item No. B5.10 Nozzle-to-Safe End Butt Welds as listed in the table below:

CATEGORY B-F DISSIMILAR METAL WELDS

Description	Weld Number	Inside Diameter	Minimum Thickness	Base Material	Weld Material
Safe-end to Loop A RPV Inlet Nozzle	II-RV-001RVNOZAI-N-01SE	29"	2.33"	SA508/SA376	82/182
Safe-end to Loop A RPV Outlet Nozzle	II-RV-001RVNOZAO-N-06SE	27.5"	2.21"	SA508/SA351	82/182
Safe-end to Loop B RPV Inlet Nozzle	II-RV-001RVNOZBI-N-03SE	29"	2.33"	SA508/SA376	82/182
Safe-end to Loop B RPV Outlet Nozzle	II-RV-001RVNOZAO-N-02SE	27.5"	2.21"	SA508/SA351	82/182
Safe-end to Loop C RPV Inlet Nozzle	II-RV-001RVNOZCI-N-05SE	29"	2.33"	SA508/SA376	82/182
Safe-end to Loop C RPV Outlet Nozzle	II-RV-001RVNOZAO-N-04SE	27.5"	2.21"	SA508/SA351	82/182

3.2 ASME Code Requirements

ASME Code, Section XI, 1995 Edition (with 1996 Addenda), Appendix VIII, Supplement 10, paragraph 3.2(b) states that examination procedures, equipment and personnel are qualified for depth sizing when the RMS error of the flaw depth measurements, as compared to the true flaw depths is less than or equal to 0.125-inch.

3.3 Licensee's Proposed Alternative and Basis

In accordance with 10 CFR 50.55a(a)(3), the licensee proposes an alternative to the requirements of the ASME Code, Section XI, 1995 Edition (with 1996 Addenda), Appendix VIII, Supplement 10, paragraph 3.2(b).

The proposed alternative for depth sizing of flaws that may be found during examination is to add to the measured flaw size the difference between the achieved sizing error and the 0.125-inch RMS acceptance tolerance. Westinghouse Procedure, PDI [performance demonstrated initiative]-ISI-254-SE, Revision 1, "Remote Inservice Examination of Reactor Vessel Nozzle to Safe-End, Nozzle to Pipe and Safe-End to Pipe Welds," has demonstrated RMS depth sizing error of 0.189-inch. Any flaws that may be found during the examination will be evaluated by adding the difference between the 0.189-inch and the 0.125-inch to the measured flaw size.

For demonstrations performed from the inside surface, personnel have been unsuccessful at achieving the 0.125-inch RMS depth sizing criterion. At this time, achieving 0.125-inch RMS appears to be impractical. 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.

Additionally, the licensee proposes to use eddy current examination techniques (ET) to provide examination coverage in areas of complex geometry, where ultrasonic examination (UT) may be limited. An enhanced visual examination will also be performed in conjunction with the ET to help discriminate between relevant indications and non-relevant indications.

3.4 NRC Staff Evaluation

10 CFR 50.55a(g)(6)(ii)(C)(2) requires, in part, the implementation of Appendix VIII, Supplement 10 in the 1995 Edition, 1996 Addenda of the ASME Code, Section XI for qualification purposes. The licensee was previously approved to use the Electrical Power Research Institute (EPRI) PDI alternative to Supplement 10 in a staff safety evaluation dated May 3, 2004. For this current relief request, the licensee proposes to use an RMS error value of 0.189-inch in lieu of the ASME Code-required value of 0.125-inch imposed by Appendix VIII, Supplement 10, and included in the EPRI PDI alternative. The proposed alternative applies to the subject welds examined from the inside surface for through-wall sizing of flaws.

Supplement 10 requires that examination procedures, equipment, and personnel used for examination of dissimilar welds shall meet specific criteria for flaw depth sizing accuracy. The ASME Code requires that the maximum error for flaw depth measurements, when compared with the true flaw depths, must be less than or equal to an RMS error value of 0.125-inch. The nuclear industry is in the process of qualifying personnel in accordance with the Supplement 10 requirements, as implemented through the PDI program. However, personnel have been unsuccessful at achieving the ASME Code-required RMS error value for depth sizing demonstration performed from the inside surface of a pipe weldment. At this time, achieving an RMS error value of 0.125-inch is not feasible, since no vendor has been able to meet the 0.125-inch RMS error value. The performance of the Westinghouse Procedure having an RMS error of 0.189-inch, represents the current achievable practice for through-wall sizing from the inside surface of the reactor vessel nozzle. Therefore, the staff finds that complying with the

specified requirement would be a hardship. As a result, the licensee is proposing to use a depth sizing criterion of 0.189-inch to size any detected flaws during the examination of the subject welds. The licensee will add the difference of 0.064-inches between the ASME Code-required RMS error value of 0.125-inch and the demonstrated accuracy of 0.189-inch to the measurements acquired from flaw sizing.

3.5 NRC Staff Conclusion

The staff finds that compliance with the ASME Code-required RMS error value would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Also, by adding the difference between the ASME Code-required RMS error and the demonstrated accuracy to the measurements acquired from flaw sizing, in addition to the use of the acceptance standards specified in Section IWB-3500 of the ASME Code, provides reasonable assurance of structural integrity. Therefore, the NRC authorizes the licensee's proposed alternative in accordance with 10 CFR 50.55a(a)(3)(ii).

4.0 TECHNICAL EVALUATION FOR RELIEF REQUEST 2R1-017

4.1 Components For Which Relief Is Requested

ASME Category B-A Pressure Retaining Welds in Reactor Vessel, Item No. B1.30 Shell-to-Flange weld.

Weld No. II-RV-001FTSW-RV-01FA, B, and C

4.2 Code Requirements

The ASME Code, 1989 Edition, Section XI, Appendix I, Subparagraph I-2110 requires that UT of reactor vessel shell-to-flange welds be conducted in accordance with Article 4 of ASME Code, Section V, supplemented by the requirements of Table I-2000-1. In addition, Regulatory Guide (RG) 1.150, Revision 1, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," serves as regulatory guidance for the UT examination of reactor pressure vessel (RPV) welds.

4.3 Licensee's Proposed Alternative And Basis

During the upcoming 10-year RPV weld examination, the licensee will be employing personnel, procedures and equipment that are demonstrated and qualified by PDI and in accordance with ASME Code, Section XI, 1995 Edition (with 1996 Addenda), Appendix VIII, Supplements 4 and 6, as incorporated by reference in 10 CFR 50.55a and approved for use, with modifications, by 64 *Federal Register* 51370-51400, dated September 22, 1999.

The remote examinations will be performed using the Westinghouse UT data acquisition system in accordance with a PDI qualified procedure. The Westinghouse procedure PDI-ISI-254, "Remote Inservice Examinations of Reactor Vessel Shell Welds," in accordance with ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, was demonstrated at the PDI qualification session in 2001, Performance Demonstration Qualification Sheet (PDQS) No. 407. The procedure complies with ASME Code, Section XI, Appendix VIII, 1995 Edition (with 1996 Addenda), as modified by the final rule.

Appendix VIII was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous item-specific performance demonstration. The performance demonstration is conducted on an RPV mockup containing flaws of various sizes and locations. The demonstration establishes the capability of equipment, procedures, and personnel to find flaws that could be detrimental to the integrity of the RPV.

Although Appendix VIII is not a requirement for this weld, the qualification process for Appendix VIII criteria, demonstrates that the examination and evaluation techniques are equal or surpass the requirements of Paragraph IWA-2232 and Appendix I, Subparagraph I-2100, ASME Code, Section V, Article 4, and the guidance in RG 1.150.

A comparison between the UT methods based on ASME Code, Section V, Article 4 and the procedures developed to satisfy the PDI and Appendix VIII, can be best described as a comparison between a compliance-based procedure (ASME Code, Section V, Article 4) and a results-based procedure (PDI/Appendix VIII). ASME Code, Section V, Article 4 procedures use an amplitude-based technique and a known reflector. The proposed alternate UT method was established independently from the acceptance standards for flaw size found in ASME Code, Section XI.

The PDI-qualified sizing method is considered more accurate than the method used in ASME Code, Section V, Article 4. The proposed alternate UT examination technique provides an acceptable level of quality and examination repeatability as compared to the ASME Code, Section V, Article 4 requirements.

The PDI Program's PDQS No. 407 attests that the Westinghouse procedure PDI-ISI-254 is in compliance with the detection and sizing tolerance requirements of Appendix VIII. The PDI qualification method is based on a group of samples, which validate the acceptable flaw sizes in ASME Code, Section XI. The sensitivity necessary to detect these flaws is considered to be equal to or better than the sensitivity obtained through ASME Code, Section V, Article 4, because the sensitivity necessary to detect implanted cracks is generally better than that necessary to calibrate on a machined notch.

The examination and sizing procedure uses echo-dynamic motion and tip diffraction characteristics of the flaw instead of the amplitude characteristics required by ASME Code, Section V, Article 4. The search units are required to interrogate the same examination volume as depicted by ASME Code, Section XI, Figure IWB-2500-4 for the shell-to-flange weld joint.

Procedures used for satisfying the requirements of ASME Code, Section V, Article 4 for the UT examination of the RPV-to-flange weld has not undergone such a rigorous demonstration or received the same qualifications as a PDI qualified procedure.

The PDI qualification specimens are curved vessel shell plate sections and do not have taper transition geometry. However, the procedure is used to examine reactor vessel shell welds, which have taper transitions at weld joints of dissimilar thickness. The PDI qualification for Supplements 4 and 6 allows for examination of material thickness up to 12.3 inches or a metal path distance of 17.5 inches in the case of the 45 degree transducer. This qualified test range bounds a significant percentage of the flange-to-shell weld examination volume even in the thicker portion above the weld centerline.

The HNP RPV flange-to-shell weld was examined during preservice by remote automated inspection in accordance with Section XI. The preservice examination was performed from the vessel ID surface, using Section XI techniques of 0 degree longitudinal and 45 and 60 degree shear beam angles. Examination from the flange surface was performed using 0, 8, and 19 degree longitudinal beam angles. For inservice examinations, during the first interval the weld examination from the flange surface was performed in accordance with Section XI using 0, 8, and 19 degree longitudinal beam angles. The weld ID surface examination was performed using 0 degree, SLIC 40 and 55 degree transducers by remote automated inspection in accordance with Section XI and RG 1.150, Revision 1. No matters of concern were identified.

The use of Appendix VIII and Supplements 4 and 6 for the completion of the RPV vessel-to-flange weld from the shell side (which PDI has qualified) is expected to reduce examination time and reduce personnel radiation exposure.

Additionally, this relief would allow a smooth transition to the adjacent welds which do require examination in accordance with Appendix VIII, Supplements 4 and 6. This would eliminate the need to switch to the different calibrations, procedure, and technique required by ASME Code, Section V, Article 4 and RG 1.150, Revision 1. This would result in a reduction in transition time for the different calibration, procedure and technique. This translates into a reduction in personnel radiation exposure and is more cost effective.

For ultrasonic examination of the reactor vessel shell-to-flange weld conducted from the face of the flange, the examination procedure shall continue to meet the requirements of the ASME Code, 1989 Edition, Section XI, Category B-A and ASME Code, Section V, Article 4 as augmented by RG 1.150, Revision 1.

4.4 NRC Staff Evaluation

The ASME Code requires that ultrasonic examinations of shell-to-flange welds in vessels greater than 2 inches in thickness be conducted in accordance with Article 4 of ASME Code, Section V, as supplemented by the requirements in Table I-2000-1. ASME Code, Section V, Article 4, provides a prescriptive-based process for qualifying UT procedures and the scanning requirements for performing the examinations. The prescriptive-based UT uses detailed criteria for setting up and calibrating equipment, calculating coverage, and detecting indications. The capability of a prescriptive-based UT examination is demonstrated with calibration blocks made from representative material containing holes and notches. Performance-based UT requires that detailed criteria be used for performance demonstration tests. The results are performed on representative mock-ups containing flaws similar to those found in operating plants. The performance-based tests demonstrate the effectiveness of UT personnel and procedures.

The licensee proposes to use procedures and personnel qualified in accordance with the performance-based criteria as implemented by the PDI program for the examination of RPV welds, Section XI, Appendix VIII, Supplements 4 and 6, when scanning from the vessel shell surface. When scanning from the flange side, the licensee will continue to follow the requirements of its current ISI Code of record.

The staff finds the procedures, equipment, and personnel qualified to Appendix VIII through the PDI program as approved for use with modifications by 10 CFR 50.55a have shown a high probability of flaw detection, and which have increased the reliability of examinations of weld

configurations within the scope of the PDI program. Therefore, the proposed alternative provides an acceptable level of quality and safety.

4.5 NRC Staff Conclusion

Based on the above evaluation, the staff concludes that the licensee's proposed alternative (RR 2R1-017) to use the PDI qualified procedure to complete the UT of the RPV shell-to-flange weld in accordance with ASME Code, Section XI, 1995 Edition (with 1996 Addenda), Appendix VIII, Supplements 4 and 6 as approved for use with modifications by 10 CFR 50.55a will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the second 10-year ISI interval at Shearon Harris Nuclear Plant, Unit 1.

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.

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