October 20, 2004

Mr. Henry B. Barron
Group Vice President and Chief Nuclear Officer
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526 South Church Street
P.O. Box 1006
Charlotte, NC 28201-1006

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, MCGUIRE NUCLEAR STATION, UNIT 2, AND OCONEE NUCLEAR STATION, UNIT 3 - REQUEST FOR RELIEF FOR USE OF AN ALTERNATE TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE, SECTION XI, FOR REACTOR VESSEL EXAMINATIONS RR-04-GO-002 (TAC NOS. MC3804, MC3805, MC3807, AND MC3810)

Dear Mr. Barron:

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated July 14, 2004, as supplemented by letters dated September 1 and September 16, 2004, Duke Energy Corporation, the licensee for Catawba Nuclear Station (Catawba), Units 1 and 2, McGuire Nuclear Station (McGuire), Unit 2, and Oconee Nuclear Station (Oconee), Unit 3, requested the use of an alternative to the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, IWA-2232, 1989 Edition with no Addenda. Specifically, the licensee requested relief from certain qualification requirements for the reactor pressure vessel upper shell-to-flange welds.

The NRC staff has completed its review of the subject request for relief. As documented in the enclosed Safety Evaluation, the NRC staff concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, the NRC staff authorizes the proposed alternative pursuant to Title 10 of the *Code of Federal Regulations,* Section 50.55a(a)(3)(i), for the second 10-year inservice inspection (ISI) interval at Catawba, Units 1 and 2, McGuire, Unit 2, and for the third 10-year ISI interval at Oconee, Unit 3.

All other ASME Code, Section XI requirements for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/*RA* by LOlshan for/

Mary Jane Ross-Lee, Acting Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-413, 50-414, 50-370, and 50-287

Enclosure: As stated

cc w/encl: See next page

All other ASME Code, Section XI requirements for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

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Mary Jane Ross-Lee, Acting Chief, Section 1
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Enclosure: As stated

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATE TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND

PRESSURE VESSEL CODE,

SECTION XI FOR REACTOR VESSEL EXAMINATIONS

CATAWBA NUCLEAR STATION, UNITS 1 AND 2, MCGUIRE NUCLEAR STATION, UNIT 2

AND OCONEE NUCLEAR STATION, UNIT 3

DOCKET NOS. 50-413, 50-414, 50-370, AND 50-287

1.0 INTRODUCTION

By letter to the U.S. Nuclear Regulatory Commission (NRC) dated July 14, 2004, as supplemented by letters dated September 1 and September 16, 2004, Duke Energy Corporation, the licensee for Catawba Nuclear Station (Catawba), Units 1 and 2, McGuire Nuclear Station (McGuire), Unit 2, and Oconee Nuclear Station (Oconee), Unit 3, submitted a request for relief, Relief Request 04-GO-002, from the requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, 1989 Edition with no Addenda, from certain examination requirements for Class 1, Examination Category B-A, pressure retaining welds in the reactor vessel. Specifically, the licensee requested to use an ultrasonic examination (UT) procedure, personnel and equipment qualified in accordance with ASME Code, Section XI, Division 1, Appendix VIII, Supplements 4 and 6, 1995 Edition with the 1996 Addenda as administered by the performance demonstration initiative (PDI) to examine the reactor pressure vessel (RPV) upper shell-to-flange welds. This would apply to the second 10-year inservice inspection (ISI) interval at Catawba, Units 1 and 2, McGuire, Unit 2, and for the third 10-year ISI interval at Oconee, Unit 3.

2.0 REGULATORY EVALUATION

2.1 Applicable Requirements

The ISI of ASME Code, Class 1, 2, and 3, components shall be performed in accordance with Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3)(i) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that (i) the proposed alternatives would provide an acceptable level of quality and

ENCLOSURE

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 pre-service examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulation requires 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.

ASME Code, Section XI, 1989 Edition with no Addenda is the applicable code of record for all units requesting relief. Catawba, Unit 1, is in the second 10-year ISI interval, which started June 29, 1995, and ends June 29, 2005. Catawba, Unit 2, is in the second 10-year ISI interval, which started August 19, 1996, and ends August 19, 2006. McGuire, Unit 2, is in the second 10-year ISI interval, which started on March 1, 1994. The licensee was granted an extension of the second 10-year ISI interval for reactor vessel inspections up to 92 days beyond the 11 years permitted by the ASME Code not to exceed June 1, 2005. This relief request (03-004) was approved on July 20, 2004. Oconee, Unit 3, is in the third 10-year ISI interval, which started December 16, 1994, and ends December 16, 2004.

3.0 TECHNICAL EVALUATION

3.1 Systems/Components For Which Relief Is Requested

This relief request applies to the ASME Code, Section XI, Class 1, Examination Category B-A, Item No. B1.30 welds identified below:

a. 1RPV-W07 (Catawba, Unit 1)

b. 2RPV-101-121 (Catawba, Unit 2)

c. 2RPV-W07 (McGuire, Unit 2)

d. 3RPV-WR19 (Oconee, Unit 3)

3.2 Code Requirements From Which Relief Is Requested

The licensee is required to perform UT of the RPV upper shell-to-flange weld using ASME Code, Section XI, Appendix I which in turn references ASME Code Section V, Article 4. The additional guidance of Regulatory Guide (RG) 1.150, Revision 1 also applies. This is the only circumferential weld in the RPV that is not examined in accordance with the requirements of ASME Code, Section XI, Appendix VIII since the issuance of Federal Register Notice 64 FR 51370, dated September 22, 1999, which mandated use of ASME Code, Section XI, Appendix VIII, Supplements 4 and 6 for RPV examinations.

The 1989 Edition, no Addenda of the ASME Code, Section XI specifies the examination requirements for the RPV upper shell-to-flange welds. Paragraph IWA-2232 requires UTs to be conducted in accordance with ASME Code, Section XI, Appendix I, which makes reference to the ASME Code, Section V, Article 4. The licensee is requesting relief from performing examinations in accordance to the ASME Code, Section V, Article 4. The applicable ASME Code of record for Catawba, Units 1&2, McGuire, Unit 1, and Oconee, Unit 3 is listed in the table as follows:

Facility	Applicable Code of record	ISI interval
Catawba, Unit 1	1989 Edition, no Addenda	Second (June 29, 1995 to June 29, 2005)
Catawba, Unit 2	1989 Edition, no Addenda	Second (August 19, 1996 to August 19, 2006)
McGuire, Unit 2	1989 Edition, no Addenda	Second (March 1, 1994 to March 1, 2004)*
Oconee, Unit 3	1989 Edition, no Addenda	Third (December 16, 1994 to December 16, 2004)

* The NRC granted an extension of the second 10-year ISI interval for McGuire, Unit 2 to perform the required reactor vessel examinations beyond the ASME Code allowable one-year extension period, which encompasses the entire duration of the spring 2005 refueling outage. This extension (which the licensee requested through Relief Request No. 03-004) and the NRC staff's evaluation of the relief request are documented in a letter to the licensee dated July 20, 2004 (ADAMS Accession No. ML042030006). As a result, the licensee is required to request relief from the applicable ASME Code requirements for the second 10-year ISI interval.

3.3 Licensee's Proposed Alternative

The licensee proposes to use a UT procedure, personnel and equipment qualified in accordance with ASME Code Section XI, Division 1, Appendix VIII, Supplements 4 and 6, 1995 Edition with the 1996 Addenda as administered by the PDI to examine the RPV upper shell-to-flange welds at Catawba, Units 1 and 2, McGuire, Unit 2, and Oconee, Unit 3.

3.4 Licensee's Basis for Use of Proposed Alternative

ASME Code, Section V, Article 4, describes the required techniques to be used for the UT of welds in ferritic pressure vessels greater than 2 inches in thickness. These techniques were first published in ASME Code, Section V, Article 4, 1974 Edition, Summer 1975 Addenda. The calibration technique, recording criteria and flaw-sizing methods are based on the use of a distance-amplitude-correction (DAC) curve derived from machined reflectors in a basic calibration block.

Prior UT of the RPV welds used recording thresholds of 50 percent DAC for the outer 80 percent of the examination volume and 20 percent DAC from the clad/base metal interface to the inner 20 percent of the examination volume. Therefore, ultrasonic indications below the 20 percent DAC threshold at the clad/base metal interface and below 50 percent DAC in the remaining volume were not required to be recorded. Use of the ASME Code, Section XI,

Appendix VIII qualified procedure would enhance the detection sensitivity because the procedure requires the vendor to evaluate all indications determined to be flaws regardless of amplitude. The recording thresholds in ASME Code, Section V, Article 4 and RG 1.150, Revision 1 are arbitrary and do not consider flaw orientation which affects amplitude response.

EPRI [Electric Power Research Institute] Report NP-6273, March 1989, indicates that flaw-sizing techniques based on tip diffraction are the most accurate. The ASME Code, Section XI, Appendix VIII qualified procedure uses tip diffraction for flaw sizing and is considered technically superior to the prescriptive methodology of ASME Code, Section V, Article 4. The proposed alternative ultrasonic detection technique uses echo dynamics as an analysis tool which has been validated through performance demonstration. The flaw-sizing technique uses tip diffraction, also validated through performance demonstration, which is considered to be more accurate than the method prescribed in ASME Code, Section V, Article 4.

UTs performed in accordance with ASME Code, Section V, Article 4 require the use of 0°, 45°, 60°, and 70° beam angles with recording criteria that are time consuming and require equipment changes that increase personnel radiation exposure without a compensating increase in quality or safety. The use of an ASME Code, Section XI, Appendix VIII qualified procedure for all RPV shell welds would relieve the licensee's inspection vendor from making equipment changes just to examine one weld with consequent savings in personnel exposure and examination time.

Previous UTs were performed using an automated and manual ultrasonic system in 1993 at McGuire, Unit 2, 1994 at Oconee, Unit 3, 1993 at Catawba, Unit 1, and 1995 at Catawba, Unit 2. Coverage for the RPV flange-to-upper-shell weld was greater than 90 percent for the volume shown in ASME Code, Section XI, Figure IWB-2500-4 for Catawba, Unit 1, Catawba, Unit 2, and McGuire, Unit 2. Because of interferences from clad patches on the vessel inside surface, coverage for Oconee, Unit 3 was 68 percent from the RPV shell surface using an automated ultrasonic system and 100 percent from the flange seal surface using manual ultrasonic equipment. The licensee does not anticipate any less coverage than previously reported.

3.5 Staff Evaluation

The applicable ASME Code of record during the second 10-year ISI interval for Catawba, Units 1 and 2, and the third 10-year ISI interval for Oconee, Unit 3 is the ASME Code, Section XI, 1989 Edition, no Addenda. For McGuire, Unit 2, the licensee is requesting relief from the applicable requirements in this edition of the ASME Code, after the NRC staff granted an extension to the second 10-year ISI interval. The licensee proposes to use the qualification requirements contained in Supplements 4 and 6 in the 1995 Edition, 1996 Addenda of the ASME Code in lieu of the applicable ASME Code requirements. Supplements 4 and 6 use a performance-based approach for the qualification of procedures, personnel and equipment used for the inspection of welds in the clad/base metal interface of the reactor vessel (Supplement 4) and reactor vessel welds other than clad/base metal interface (Supplement 6).

Qualified prescriptive-based UT procedures in ASME Code, Section V, Article 4 have been applied in a controlled setting containing real flaws in mockups of reactor vessels and the results have been statistically analyzed according to the screening criteria in Appendix VIII of the ASME Code, Section XI. The results show that the procedures in ASME Code, Section V,

Article 4 are less effective than UT procedures qualified through Supplements 4 and 6. Qualification through Supplements 4 and 6 uses fewer transducers than ASME Code, Section V, Article 4, and UT is performed with higher sensitivity, which increases the chances of detecting a flaw when compared to the prescriptive-based requirements in the ASME Code, Section V, Article 4. Also, flaw sizing is more accurately determined with the echo-dynamic motion and tip diffraction criteria used by Supplements 4 and 6, as opposed to the less accurate amplitude criteria for the prescriptive-based requirements in Section V, Article 4. Procedures, equipment, and personnel qualified through the PDI program have shown high probability of detection levels. This has resulted in an increased reliability of inspections for weld configurations within the scope of the PDI program.

In the September 1 and September 16, 2004, letters to the NRC, the licensee provided information about the expected coverage using the proposed alternative versus the examination coverage achieved using current ASME Code requirements. The licensee also provided drawings of the RVP upper shell-to-flange welds for the affected units. The NRC staff reviewed this information and finds that the licensee expects to achieve 90.5 percent coverage with the vessel wall partial exam when using the proposed alternative for Catawba, Units 1 and 2, and McGuire, Unit 2, which is the same coverage achieved using ASME Code requirements. The licensee affirms that this partial exam accounts for 50 percent of the total examination required by the ASME Code. With regard to Oconee, Unit 3, the licensee estimates a 72.6 percent coverage with the vessel flange face partial exam when using the proposed alternative. This is an increase of 4.6 percent from the coverage obtained under current ASME Code requirements. This limitation in achieving more than 90 percent coverage for Oconee, Unit 3 is due to a surface geometry on the weld, that interferes with the positioning of the equipment and does not allow full coverage of the inspection volume. In addition, there are four clad patches above each main coolant loop nozzle that limit coverage of the outer surface of the weld and heat affected zone for 14.4 inches of the weld length above each nozzle. For the vessel flange face partial exam, which accounts for the remaining 50 percent of the total examination required by the ASME Code, the licensee stated that the coverage for the weld and the heat affected zone (100 percent) remains unaffected by the use of the proposed alternative on the four affected units.

The NRC staff has evaluated the information provided by the licensee and concludes that the proposed alternative would provide equivalent or better examination of the RPV upper shell-to-flange welds than current ASME Code requirements, as supplemented by RG 1.150. In addition, the NRC staff concludes that the estimated coverage achieved through the combination of the vessel wall and vessel flange face partial exams would reliably identify any service-related degradation on the affected welds. Therefore, the proposed alternative provides reasonable assurance that flaws that could be detrimental to the integrity of the RPV would be detected.

4.0 CONCLUSION

Based upon review of the information provided by the licensee in support of its request for relief, 04-GO-002, the NRC staff concludes that the licensee's proposed alternative to use Supplements 4 and 6, Appendix VIII, 1995 Edition, 1996 Addenda of the ASME Code, Section XI, as administered by the PDI program, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the use of the

proposed alternative during the fall 2004 outage at Catawba, Unit 2 and Oconee, Unit 3 and the spring 2005 outage at Catawba, Unit 1 and McGuire, Unit 2. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: R. Rodriguez

Date: October 20, 2004