March 17, 2005

Mr. James R. Morris
Vice President, Nuclear Support
Duke Energy Corporation
526 South Church Street
P. O. Box 1006
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SUBJECT: CATAWBA NUCLEAR STATION, UNIT 1 AND MCGUIRE NUCLEAR STATION, UNIT 2 - REQUEST FOR RELIEF FOR USE OF AN ALTERNATE CODE CASE TO PERFORM VOLUMETRIC EXAMINATION OF THE REACTOR PRESSURE VESSEL NOZZLE WELDS RR-04-GO-001 (TAC NOS. MC3970 AND MC3972)

Dear Mr. Morris:

By letter to the Nuclear Regulatory Commission (NRC) dated August 6, 2004, as supplemented by letter dated February 3, 2005, Duke Energy Corporation, the licensee for Catawba Nuclear Station (Catawba), Unit 1 and McGuire Nuclear Station (McGuire), Unit 2, requested the use of an alternative to the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, 1989 Edition with no Addenda, Figures IWB-2500-7 (a) and (b). Specifically, the licensee requested to use Code Case N-613-1 to incorporate reduced ultrasonic examination volume requirements for reactor pressure vessel nozzle-to-vessel 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 interval at Catawba, Unit 1 and McGuire, Unit 2. All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

John A. Nakoski, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-413 and 50-370

Enclosure: As stated

cc w/encl: See next page

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SUBJECT: CATAWBA NUCLEAR STATION, UNIT 1 AND MCGUIRE NUCLEAR STATION, UNIT 2 - REQUEST FOR RELIEF FOR USE OF AN ALTERNATE CODE CASE TO PERFORM VOLUMETRIC EXAMINATION OF THE REACTOR PRESSURE VESSEL NOZZLE WELDS RR-04-GO-001 (TAC NOS. MC3970 AND MC3972)

Date: March 17, 2005

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST CODE CASE N-613-1 FOR NOZZLE-TO-VESSEL WELD INSPECTIONS

CATAWBA NUCLEAR STATION, UNIT 1

AND MCGUIRE NUCLEAR STATION, UNIT 2

DOCKET NOS. 50-413 AND 50-370

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC) dated August 6, 2004, as supplemented by letter dated February 3, 2005, Duke Energy Corporation, the licensee for Catawba Nuclear Station (Catawba), Unit 1 and McGuire Nuclear Station (McGuire), Unit 2, submitted a request for relief, Relief Request 04-GO-001, from the requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code), Section XI, 1989 Edition with no Addenda, Figures IWB-2500-7 (a) and (b). Specifically, the licensee requested to use Code Case N-613-1 to incorporate reduced ultrasonic examination (UT) volume requirements for reactor pressure vessel (RPV) nozzle-to-vessel welds for the second 10-year inservice inspection (ISI) interval at Catawba, Unit 2, and for the second 10-year ISI interval at McGuire, Unit 2.

McGuire, Unit 2 will be performing second interval RPV inspections during the Spring 2005 outage. Specific relief had been granted to extend the 10-year ISI interval 92 days beyond the code allowed 1-year extension to complete the reactor vessel inspections. This relief request was approved on July 20, 2004 (RR 03-004 ML042030006).

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 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

ENCLOSURE

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 the units requesting relief. Catawba, Unit 1, is in the second 10-year ISI interval, which started August 19, 1996, and ends August 19, 2006. McGuire, Unit 2, is in the third 10-year ISI interval, which began on March 1, 2004, and ends March 1, 2014. This relief request covers the RPV inspections that are required for the McGuire, Unit 2 second interval ISI inspections that were not completed during specified time period for the second interval. McGuire, Unit 2 was granted relief from completing the second interval RPV inspections until the end of Cycle 16, on or before June 1, 2005. Completion of the second interval inspections at Mcguire, Unit 2 will not affect the inspection requirements for the current third 10-year ISI inspections.

3.0 TECHNICAL EVALUATION

3.1 Systems/Components For Which Relief Is Requested

Relief is being requested for ASME Code, Section XI, Class 1, RPV nozzle-to-vessel welds. There are eight main coolant loop nozzle-to-vessel welds at Catawba, Unit 1 and McGuire, Unit 2. These are listed as follows:

Catawba, Unit 1 Welds;

Component ID	Description	Azimuth	Code Case N-613-1 Figure
1RPV-W15	Outlet Nozzle	22°	1
1RPV-W11	Inlet Nozzle	67°	1
1RPV-W12	Inlet Nozzle	113°	1
1RPV-W16	Outlet Nozzle	158°	1
1RPV-W17	Outlet Nozzle	202°	1
1RPV-W13	Inlet Nozzle	247°	1
1RPV-W14	Inlet Nozzle	293°	1
1RPV-W18	Outlet Nozzle	338°	1

McGuire, Unit 2 Welds;

Component ID	Description	Azimuth	Code Case N-613-1 Figure
2RPV-W15	Outlet Nozzle	22°	1
2RPV-W11	Inlet Nozzle	67°	1
2RPV-W12	Inlet Nozzle	113°	1
2RPV-W16	Outlet Nozzle	158°	1
2RPV-W17	Outlet Nozzle	202°	1
2RPV-W13	Inlet Nozzle	247°	1
2RPV-W14	Inlet Nozzle	293°	1
2RPV-W18	Outlet Nozzle	338°	1

3.2 Code Requirements From Which Relief Is Requested

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee is requesting relief from ASME Code, Section XI, 1989 Edition, Table IWB-2500-1, Examination Category B-D, Full Penetration Welds of Nozzles in Vessels, Code Item B3.9; Figures IWB-2500-7 (a) and (b), for defining the examination volume requirements for UT of nozzle-to-vessel welds. Specifically, the licensee is requesting relief from the $t_s/2$ (t_s is equal to the vessel wall thickness) examination volume requirements of Figures IWB-2500-7 (a) and (b).

3.3 Licensee's Proposed Alternative

The licensee proposes to use a reduced UT volume, which extends to ½-inch from the widest part of the weld, in lieu of the examination volume requirements of ASME Code, Section XI, Figures IWB-2500-7 (a) and (b), that specify a UT volume extending to a distance of $t_s/2$ from the widest part of the weld.

3.4 Licensee's Basis for Use of Proposed Alternative

The required examination volume for the RPV nozzle-to-vessel welds extends far beyond the weld into the base material and is unnecessarily large. The ASME Code, Section XI examination volume for the pressure retaining nozzle-to-vessel welds extends from the edge of the weld on the nozzle side and includes a substantial portion of the nozzle forging (inward) and the RPV upper shell course (outward). This large volume causes a major increase in examination time with no resultant increase in quality or safety. The proposed alternative would define the examination volume as the weld and ½-inch of base material on each side of the widest portion of the weld. This base material examination volume was ultrasonically examined during preservice and subsequent ISIs. The examination results showed that there were no recordable indications outside of the volume defined in Code Case N-613-1.

As an alternative to the requirements of ASME Code, Section XI, Figures IWB-2500-7 (a) and (b), the licensee proposes to reduce the examination volume as described by Code Case N-613-1 and as represented in illustrative vendor scan plans that were included as part of the licensee's submittal. The scan plans are derived from the vessel manufacturer design drawings which are the most dependable source for weld location, size, and thickness. Code Case N-613-1, Figure 1, will be used for the RPV main coolant loop nozzle-to-vessel welds at Catawba, Unit 1 and McGuire, Unit 2. As added conservatism, the vendor scan plans have included an additional ½-inch of scan path to ensure that the boundaries of the weld are covered by the ultrasonic beams.

Stresses caused by welding are concentrated at the weld and heat affected zone. Post weld heat treatment reduces these stresses and any residual stresses decrease as a function of the distance from the weld.

Operational stresses originate from internal pressure in the vessel and temperature changes occurring during transients. These stresses are limited by design to ensure that ASME Code stress limits are not exceeded. Additionally, a fatigue analysis is required by ASME Code, Section III, to ensure that flaws are unlikely to initiate during operation. Compared to the code limit of 1.0, the fatigue usage in the nozzle-to-shell weld regions are as follows:

Catawba, Unit 1	0.1290
McGuire, Unit 2	0.113

Because stresses are reduced by post weld heat treatment and design requirements, the occurrence of flaws during service is unlikely.

During preceding UTs conducted in the first 10-year interval at Catawba, Unit 1 and McGuire, Unit 2, no indications were found in the RPV nozzle-to-vessel weld examination volume excluded by Code Case N-613-1. These examinations were conducted from the inside surface of the RPV and the inside diameter (ID) of the nozzle in accordance with ASME Code, Section V, Article 4, and Regulatory Guide (RG) 1.150, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," Rev. 1. The previous UTs used an automated system to acquire, analyze and store data. The UTs scheduled for the current interval will use personnel, automated equipment, and procedures qualified in accordance with ASME Code, Section XI, Appendix VIII, Supplements 4, 6, and 7, 1995 Edition through the 1996 Addenda. The licensee is confident that satisfactory comparisons can be made between past and present examinations if necessary. Use of the proposed alternative will provide an acceptable level of quality and safety.

3.5 Staff Evaluation

The licensee has requested relief from the UT volume requirements specified in Table IWB-2500-1, Examination Category B-D, Code Item B3.90, Figures IWB-2500-7 (a) through (d) pertaining to UT Examination of Full Penetration Nozzles in Vessels. The licensee proposes to use a reduced examination volume, extending to ½-inch from each side of the widest part of the nozzle-to-vessel weld in lieu of an examination volume extending to a distance equal to ½ the through-wall thickness from each side of the widest part of the nozzle-to-vessel weld, as required by Figures IWB-2500-7 (a) through (d).

The licensee provided a sketch showing the configuration of the nozzle-to-vessel weld and the revised examination volume. The specific weld configurations and revised examination volumes are depicted in ASME Code Case N-613-1 and the WesDyne sketches attached to the relief request submittal. The revised examination volume depicted in these sketches extends to ½-inch from each side of the widest part of the nozzle-to-vessel weld and is, therefore, consistent with licensee's request for the reduced UT volume. All other aspects of the UT volumes for RPV nozzle-to-vessel welds remain unchanged in the licensee's request. In response to additional information requested by the NRC staff the licensee provided a listing of all nozzle-to-vessel welds included within the scope of this relief request.

The acceptability of the reduced UT volume is based on prior full volumetric examinations of the welds and base metal, as well as the internal stress distribution near the weld. Prior full volumetric examinations of the nozzle-to-vessel welds included within the scope of this relief request cover the full volume of base metal, extending to a distance equal to ½ the through-wall thickness from each side of the widest part of the nozzle-to-vessel weld, as required by the ASME Code. This base metal region included in the original ASME Code volume was extensively examined during construction, preservice inspection, and prior ISIs. These examinations all show the ASME Code volume to be free of unacceptable flaws. The creation of flaws during plant service in the volume excluded from the proposed reduced examination volume is unlikely because of the low stress in the base metal away from the weld. The

stresses caused by welding are concentrated at or near the weld. Cracks, should they initiate, occur in the highly-stressed area of the weld. The highly-stressed areas are within the volume included in the reduced examination volume proposed by the licensee. The prior full volume examinations of the base metal in addition to the examinations of the highly-stressed areas of the weld provide an acceptable level of quality and safety.

The weld volume and the adjacent base metal volume will be examined in accordance with Code Case N-613-1. The examinations shall consist of techniques and procedures qualified in accordance with the ASME Code, Section XI, Appendix VIII, Supplements 4, 6, and 7. The weld and base metal volumes will be interrogated from the nozzle bore using techniques and procedures specifically qualified to inspect the nozzle-to-vessel weld from the nozzle bore. These procedures were qualified in January 2003 in accordance with ASME Code, Section XI, Appendix VIII, Supplement 7, as administered by the Performance Demonstration Initiative.

The nozzle-to-vessel examination volume is accessible from the vessel ID surface and will be examined in four orthogonal directions for the first 15 percent of weld thickness with respect to the vessel ID surface using ASME Code, Section XI, Appendix VIII, Supplement 4, qualified techniques. The remaining 85 percent of weld volume accessible from the vessel ID surface will be examined in two opposing circumferential scanning directions using ASME Code, Section XI, Appendix VIII, Supplement 6, qualified techniques to interrogate for transverse defects.

To ensure the extremities of the weld are included in the examination volume, a margin of 1/2-inch is conservatively added to the scanning path of all transducers in all directions as allowed by component geometry. This is standard practice for nozzle-to-shell, shell welds, and nozzle-to-pipe weld examinations. The sketches included in the licensee's relief request reflect this additional conservatism. Based on this review of the documentation and associated drawings for all RPV nozzle-to-vessel welds, the licensee determined that no weld repairs are encapsulated within the existing nozzle-to-vessel welds. Therefore, since there are no repairs in the area to be examined that could extend past the original weld boundaries, the examination will encompass the entire weld and the examination will provide an acceptable level of quality and safety.

4.0 CONCLUSION

The NRC staff finds that the proposed alternative to reduce the UT volume to ½-inch from the widest part of the nozzle-to-vessel weld on each side of the weld crown, in lieu of ½ the through-wall thickness from the widest part of the nozzle-to-vessel weld on each side of the weld crown 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 ASME Code, Section XI, Class 1, RPV nozzle-to-vessel welds for the second 10-year ISI interval at Catawba, Unit 1 and McGuire, Unit 2, unless Code Case N-613-1 is published in a future version of RG 1.147, "Inservice Inspection Code Case Acceptability-ASME Section XI, Division 1." At that time, if the licensee intends to continue implementing this code case, it must follow all provisions of Code Case N-613-1 with limitations or conditions specified in RG 1.147, if any. All other requirements of the ASME Code, Sections III and XI, for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: J. Shea

Date: March 17, 2005