March 28, 2001

Mr. H. B. Barron
Vice President, McGuire Site
Duke Energy Corporation
12700 Hagers Ferry Road
Huntersville, NC 28078-8985

SUBJECT: MCGUIRE NUCLEAR STATION, UNIT 1 - RE: REQUEST FOR RELIEF NO. 99-003 (TAC NO. MA9034)

Dear Mr. Barron:

By letter dated May 10, 2000, as supplemented by letters dated September 7 and 25, 2000, Duke Energy Corporation requested the NRC staff to grant relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code inservice inspection requirements for the McGuire Nuclear Station, Unit 1.

Based on the information provided and as discussed in the enclosed Safety Evaluation, the staff grants relief for the volumetric examinations of the pressurizer nozzle-to-vessel welds and nozzle inside radius section, steam generators (SG) inner nozzle radius and nozzle-to-safe-end dissimilar metal welds, containment spray heat exchanger tubesheet-to-shell weld, and SG auxiliary feedwater nozzle-to-safe-end welds, pursuant to 10 CFR 50.55a(g)(6)(i).

The staff considers this matter resolved and is closing out TAC No. MA9034.

Sincerely,

/RA by M. Banerjee Acting for:/

Richard L. Emch Jr., Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-369

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SECOND 10-YEAR INSERVICE INSPECTION INTERVAL

REQUEST FOR RELIEF NO. 99-003

DUKE ENERGY CORPORATION

MCGUIRE NUCLEAR STATION, UNIT 1

DOCKET NO. 50-369

1.0 INTRODUCTION

The inservice inspection (ISI) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (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 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i).

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will 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 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 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 McGuire Nuclear Station, Unit 1, second 10-year interval is the 1989 Edition of the ASME Code. 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.

By letter dated May 10, 2000, as supplemented by letters dated September 7 and 25, 2000, Duke Power Company (the licensee), requested relief from certain ultrasonic testing (UT) requirements for the second 10-year inservice inspection interval at McGuire Nuclear Station, Unit 1. Specifically, the licensee requested relief from volumetric examinations of nozzle-to-vessel welds and inner nozzle radii sections for a steam generator (SG), pressurizer (PZR), and heat exchanger (HX). The licensee determined that compliance with the volumetric examinations (coverages) required by Code was impractical.

2.0 RELIEF REQUEST NO. 99-003

The staff has reviewed the information concerning the licensee's request for relief on the bases of impracticality. The licensee's request was evaluated against the criteria in effect at the time of construction and later endorsed editions and addenda of the Code, as applicable. The subject welds and sections in the SG, PZR, and HX were inspected by the licensee to the requirements in the 1989 Edition of the Code.

2.1 PZR Nozzle-to-Vessel Welds

Code Requirements

The Code requires volumetric examination of the steel PZR nozzle butt weld to the steel vessel according to IWB-2500-1, Examination Category B-D, Item B3.110. The weld examination volume is defined in Figure IWB-2500-7(b), and weld examination is performed according to Section XI, Appendix I, which references ASME Code, Section V, 1989 Edition, Article 4, "Ultrasonic Examination Methods for Inservice Inspection," Subarticle T-441.3.2. Specifically, Subarticle T-441.3.2.1 states that "...volumes shall be scanned by straight and angle beam techniques as described in detail in T-441.3.2.3(a) and (b), and T-441.3.2.5. Three angle beams, having nominal angles of 45 degrees, 60 degrees, and 70 degrees with respect to a perpendicular to the examination surface, shall generally be used. Beam angles other than 45 degrees and 60 degrees are permitted provided the measured difference between angles is at least 10 degrees." T-441.3.2.3 states that prior to the initial angle beam examination, the base material through which the angle beams will travel shall be scanned with a straight beam search unit. T-441.3.2.5 states that the examination volume shall be scanned with angle beam search units directed both at right angles to the weld axis and along the weld axis. Wherever feasible, each examination shall be performed in two directions. The licensee invoked Code Case N-460 which accepts an examination coverage of 90% or greater.

Component: PZR safety nozzle-to-upper head weld identified as 1PZR-13 in Table 1.

Licensee's Basis for Relief

The PZR safety nozzle-to-upper head weld identified as 1PZR-13 in Table 1 of this safety evaluation (SE) was examined to 64.04% of the required coverage using UT techniques in accordance with the requirements of the 1989 Edition of the Code. The nozzle outside radius hindered examination from the nozzle side of the weld and restricted UT examination to the vessel side of the weld. In order to achieve scanning from both sides of the weld, the nozzle would have to be re-designed.

Evaluation

The Code requires that the weld be examined in two axial and two circumferential directions with two different angle beams and that the base material be examined with the same beams and directions plus a straight beam. The volumetric coverage is the sum of the volume examined with each beam and each scan direction. From drawings contained in the submittal, the licensee showed that the examination was restricted by the nozzle outside radius which prevented examination of the Code-required volume. The Code required examination of this

weld for the second 10-year interval is impractical because of obstructions inherent with the design. To satisfy the examination coverage, the licensee would have to replace the nozzles.

The volume at the weld and heat affected zones was completely examined with UT in three directions. The area not examined is the weld root in one direction from the nozzle side of the weld and much of the nozzle base metal volume from four directions. The examination of the weld and adjacent area provided a high probability of detecting flaws, if any existed. The probability of generating a flaw in the base metal away from the weld during power operation is low. The kinds of flaws that normally occur in base metal are from manufacturing. If flaws existed in the base metal, they would have been detected during inspections by the nozzle manufacturer and during preservice inspections. Thus, the staff has determined that the coverage obtained is sufficient to provide reasonable assurance of structural integrity.

Conclusion

Based on the above, the staff has concluded that the Code requirements are impractical. The examinations performed on the subject pressurizer nozzle-to-vessel weld in Table 1 of this SE provides reasonable assurance of structural integrity. Therefore, the requested relief is granted for the subject PZR nozzle-to-head weld, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

2.2 PZR Nozzle Inside Radius Section

Code Requirements

The Code requires volumetric examination of the PZR nozzle inner radius according to ASME Code, Section XI, 1989 Edition, Table IWB-2500-1, Examination Category B-D, Item B3.120. The volumes to be examined are defined in Figure IWB-2500-7(d), and the UT examinations are performed according to Section XI, Appendix I, which references ASME Code, Section V, 1989 Edition, Article 4, “Ultrasonic Examination Methods for Inservice Inspection.”

Components: PZR nozzle inside radius sections identified as 1PZR-13R and 1PZR-14R in Table 1.

Licensee’s Basis for Relief

The PZR nozzle inside radius sections identified as 1PZR-13R and 1PZR-14R in Table 1 of this SE were each examined using UT techniques that resulted in 62.79% of the required coverage. The large nozzle outside diameter in relation to the vessel thickness hindered scanning from the vessel surface. Examinations from the nozzle outside surface and blend radius are not realistic because of the inaccuracy in determining compound beam angles, long beam paths, and beam direction from these surfaces. In order to achieve more coverage, these nozzles would have to be re-designed.

Evaluation

The examinations were conducted with 60° and 70° beam angles from the outer surface of the vessel. These angles were able to interrogate the volume in the vessel, the nozzle-vessel radius, and part way up the nozzle bore. The volume furthest up the nozzle bore could not be reached with selected beam angles from the vessel surface. The obstruction is the nozzle-vessel configuration. The nozzle wall-thickness creates a long metal path from the vessel surface which reduces the volume that can be examined on the nozzle inner radii, and manual examinations on the nozzle outer radii are too inaccurate for meaningful examinations. Therefore, the requirements of the Code are impractical due to the limitations of the current nozzle design. To satisfy the examination volume requirements, the licensee would have to replace the nozzles.

The unexamined volumes are located inside the nozzle bore at low-stressed regions of the base metal. The higher stressed regions of the radii were successfully examined by the licensee. If flaws were to occur, they would appear preferentially in the high-stressed regions. Therefore, the coverage obtained by the licensee provides assurance of structural integrity.

Conclusion

Based on the above, the staff concludes that compliance with the Code coverage requirements is impractical and the examinations performed on the subject PZR nozzle inner radii in Table 1 of the SE provides reasonable assurance of structural integrity. Therefore, the relief is granted for the subject PZR nozzle inside radii, pursuant to 10 CFR 50.55a(g)(6)(i), for the second 10-year interval. The relief granted 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.

2.3 Steam Generator Inner Nozzle Radius

Code Requirements

The Code requires volumetric examination of the steam generator nozzle inner radius according to ASME Code, Section XI, 1989 Edition, Table IWB-2500-1, Examination Category, B-D, Item B3.140. The inner radius volume to be examined is defined in Figure IWB-2500-7(b), and the UT examination is performed according to Section XI, Appendix I, which references ASME Code, Section V, 1989 Edition, Article 4.

Components: SG nozzle inner radius sections identified as 1SGB-INLET and 1SGB-OUTLET in Table 1.

Licensee's Basis for Relief

The SG nozzle inner radius sections identified as 1SGB-INLET and 1SGB-OUTLET in Table 1 of this SE were each examined using UT techniques that resulted in 83.28% of the required coverage. The large nozzle outside diameter in relation to the vessel wall thickness hindered scanning from the vessel surface. Examinations from the nozzle outside diameter and blend radius are not realistic because of the inaccuracy in determining compound beam angles, long

beam paths, and beam direction from these surfaces. In order to achieve more coverage, these nozzles would have to be redesigned.

Evaluation

The examinations were conducted with 60° and 70° beam angles from the outer surface of the vessel. These angles were able to interrogate the volume in the vessel, the nozzle-vessel radius, and part way up the nozzle bore. The volume furthest up the nozzle bore could not be reached with beam angles originating from the vessel surface. The obstruction is the nozzle-vessel configuration. The nozzle wall-thickness creates a long metal path which shortens the distance that can be examined up the nozzle bore. Thus, the requirements of the Code are impractical due to the limitations of the current nozzle design. To satisfy the examination volume, the licensee would have to replace the nozzle.

The unexamined volumes are located inside the nozzle bore at low stressed regions. The higher stressed regions of the radii were successfully examined by the licensee. If flaws were to occur, they would appear preferentially in the high-stressed regions. Therefore, the coverage obtained by the licensee provides assurance of structural integrity.

Conclusion

Based on the above, the staff concludes that compliance with the Code coverage requirements is impractical. The examinations performed on the subject SG nozzle inner radii in Table 1 of this SE provides reasonable assurance of structural integrity. Therefore, relief is granted for the subject SG nozzle inner radii, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

2.4 SG Nozzle-To Safe-End, Dissimilar Metal Welds

Code Requirements

The Code requires volumetric examination of SG nozzle-to-safe-end dissimilar metal welds according to IWB-2500-1, Examination Category B-F, Item B5.70 (B5.70). The weld examination volume is defined in Figure IWB-2500-8(c), and the weld examination is performed according to the 1989 Edition, ASME Code, Section XI, Appendix III, Subarticle III-4420, “Reflectors Parallel to the Weld Seam.” Subarticle III-4420 states that the volume must be examined in two beam path directions. The examinations shall be performed from two sides of the weld, where practicable, or from one side of the weld, as a minimum. The sum of the volume examined from each direction equals the inspection coverage. The licensee invoked Code Case N-460 which accepts an examination coverage of 90% or greater.

Components: SG nozzle-to-safe-end welds identified in Table 1 as 1SGB-INLET-W5SE and 1SGB-OUTLET-W6SE.

Licensee's Basis for Relief

The SG nozzle-to-safe-end welds identified in Table 1 as 1SGB-INLET-W5SE and 1SGB-OUTLET-W6SE of this SE were each examined using UT techniques that resulted in 75.0% of the required coverage. These welds join steel nozzles to stainless steel safe-ends. The nozzles have a larger outside diameter than the safe-ends. The differences in outside geometry prevented examinations from both sides of the welds. In order to obtain the required coverage, the nozzles would have to be redesigned.

Evaluation

Item B5.70 provides the examination requirements for dissimilar metal welds, i.e. carbon steel welded to stainless steel. The Code requires that the weld volume be examined in two beam path directions and that the examination be performed from two sides of the weld where practicable, or from one side of the weld, as a minimum. Compliance with the code coverage requirement for these welds is impractical. Due to material characteristics of the weld joint and component geometry, examination of the weld could only be achieved from the stainless steel safe-end side of the weld and the weld surface. To satisfy the examination coverage requirement, the licensee would have to replace the nozzle.

For the portion of the weld that could be examined, ASME Code provides the scanning angle requirements for examinations. The examinations performed from the stainless steel side of the welds are subjected to marked variations in attenuation, sound velocity changes (caused by material composition), and refractions at grain boundaries. The licensee selected a 33° (beam path) longitudinal (L) wave to examine the axial direction and 45°L wave for the circumferential directions. The licensee determined that the 33°L wave provided good sound penetration and signal-to-noise ratio from the safe-end side of the weld. Based on the coverage obtained during the examinations, any significant degradation which may have been present would have been detected during the examination. Thus, the staff has determined that the coverage obtained is sufficient to provide reasonable assurance of structural integrity.

Conclusion

Based on the above, the staff concludes that compliance with the Code coverage requirements is impractical. The examinations performed on the subject nozzle-to-safe-end welds in Table 1 of this SE, as discussed above, provide reasonable assurance of structural integrity. Therefore, relief is granted for the subject SG nozzle-to-safe-ends, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

2.5 Containment Spray HX, Tubesheet-To-Shell Weld

Code Requirements

The Code requires volumetric examination of the containment spray HX tubesheet-to-shell weld according to Table IWC-2500-1, Examination Category C-A, Item C1.30. Footnote (1) to Table 2500-1 states that the extent of examination is essentially 100% of the weld length. The weld

examination volume is defined in Figure IWC-2500-2, and the weld examination is performed according to Section XI, Appendix III, Subarticle III-4420, “Reflectors Parallel to the Weld Seam,” which states that the examination shall be performed using a sufficiently long examination beam path to provide coverage of the required examination volume in two beam path directions. The examination shall be performed from two sides of the weld, where practicable, or from one side of the weld, as a minimum. The licensee invoked Code Case N-460 which accepts an examination coverage of 90% or greater.

Component: The containment spray heat exchanger tubesheet-to-shell weld identified as 1BCSHX-SH-48 in Table 1.

Licensee’s Basis for Relief

The containment spray heat exchanger tubesheet-to-shell weld identified as 1BCSHX-SH-48 in Table 1 of this SE was examined using UT techniques that resulted in 22.14% of the required coverage. The examination volume was limited by close proximity of equipment support structures to the weld. In order to achieve the required coverage, these obstructions would have to be moved away from the weld.

Evaluation

The examination was conducted with a 45° beam angle scanned in four directions from the outer surface of the shell on the accessible weld segments. The accessible weld segments were at openings in the support structure holding up the heat exchanger. The support structure cradles the heat exchange and is fixed to the floor. Compliance with the code coverage requirements is impractical. To achieve the code-required coverage, the licensee would have to redesign the heat exchanger supports.

Although the segments that were examined were short in length, they were examined thoroughly by the licensee, i. e. from two beam paths in four directions. If any indications were identified, they were determined to be acceptably within Code requirements. Therefore, coverage obtained by the licensee provides reasonable assurance of structural integrity of the unexamined weld segments.

Conclusion

Based on the above, the staff concludes that compliance with the Code coverage requirements is impractical. The examination performed for the heat exchanger tubesheet-to-shell weld in Table 1 of this SE provides reasonable assurance of structural integrity. Therefore, the requested relief is granted for the subject heat exchanger tubesheet-to-shell weld, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

2.6 SG Auxiliary Feedwater (AFW) Nozzle-To-Safe-End Welds

Code Requirement

The Code requires volumetric examination of the AFW nozzle-to-safe-end welds (1SGB-W261) according to Table IWC-2500-1, Examination Category C-F-1, Item C5.11 (C5.11). The weld examination volume is defined in Figure IWC-2500-7(a), and the weld examination is performed according to Section XI, Appendix III, Subarticle III-4420, "Reflectors Parallel to the Weld Seam," which states that the examination shall be performed using a sufficiently long examination beam path to provide coverage of the required examination volume in two beam path directions. The examination shall be performed from two sides of the weld utilizing one beam path direction from each side of the weld, where practicable, or from one side of the weld utilizing two beam path directions from that side of the weld, as a minimum. The licensee invoked Code Case N-460 which accepts an examination coverage of 90% or greater.

Component: SG AFW nozzle-to-safe-end weld identified as 1SGB-W261 in Table 1.

Licensee's Basis for Relief

The SG AFW nozzle-to-safe-end weld identified as 1SGB-W261 in Table 1 of this SE was examined using UT techniques that resulted in 50% of the required coverage. This weld joins a steel nozzle to a stainless steel (SS) safe-end. The nozzle has a larger outside diameter than the safe-end. The differences in outside geometry prevent scanning from both sides of the weld and material characteristics of the SS safe-end prevent obtaining the two beam paths from the side that can be scanned. In order to obtain the two beam path direction coverage, the nozzles would have to be redesigned.

Evaluation

Item C5.11 provides the examination requirements for dissimilar metal welds, i.e. carbon steel welded to stainless steel. The Code requires that two beam path directions be utilized in examining the weld volume, and that the examination be performed from two sides of the weld utilizing one beam path direction from each side of the weld where practicable, or from one side of the weld, as a minimum. Compliance with the code coverage requirement for this weld is impractical. Due to material characteristics of the weld joint and component geometry, examination of the weld could only be achieved from the stainless steel safe-end side of the weld utilizing one beam path. To satisfy the examination coverage requirement, the licensee would have to replace the nozzle.

For the portion of the weld that could be examined, ASME Code provides the scanning angle requirements for examinations. The examinations performed from the stainless steel side of the weld is subjected to variations in attenuation, sound velocity changes (caused by material composition), and refractions at grain boundaries. The licensee selected a 38° (beam path) shear wave and a 45° L wave to examine the weld. Based on the coverage obtained during the examination, any significant degradation which may have been present would have been detected during the examination. Thus, the staff has determined that the coverage obtained is sufficient to provide reasonable assurance of structural integrity.

Conclusion

Based on the above, the staff concludes that compliance with the Code coverage requirements are impractical. The examination performed on the subject auxiliary feedwater nozzle-to-safe-end weld in Table 1 of this SE provides reasonable assurance of structural integrity. Therefore, the requested relief is granted for the subject auxiliary feedwater nozzle-to-safe-end weld, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

3.0 CONCLUSION

The McGuire, Unit 1, Request for Relief 99-003, seeking relief from certain ASME Code inspection requirements associated with the volumetric examinations of PZR nozzle-to-vessel welds and nozzle inside radius section, SG inner nozzle radius and nozzle-to-safe-end dissimilar metal welds, containment spray HX tubesheet-to-shell weld, and SG AFW nozzle-to-safe-end welds has been reviewed by the staff. A summary of Request for Relief No. 99-003 is presented in Table1. For each component identified, the staff has determined that compliance with the requirements of the Code are impractical, and grants relief from the specified ASME Code requirement, pursuant to 10 CFR 50.55a(g)(6)(i), during the second 10-year interval. The relief granted 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.

Principal Contributor: D. Naujock

Date: March 28, 2001

Table 1

McGuire, Unit 1, component identification, inspection requirements, inspection interference, and percent of volume inspected (coverage).

IDENTIFICATION NUMBER	EXAMINATION CATEGORIES, CODE ITEMS	DESCRIPTION	PERCENT COVERAGE	LIMITATION
1PZR-13	B-D, B3.110.003	Nozzle-to-PZR Vessel Weld	64.04	Nozzle OD blend radius prevents examination from nozzle side of weld
1PZR-13R	B-D, B3.120.003	PZR, Nozzle Inner Radius Blend	62.79	Nozzle -Vessel configuration
1PZR-14R	B-D, B3.120.004	PZR, Nozzle Inner Radius Blend	62.79	Nozzle -Vessel configuration
1SGB-INLET	B-D, B3.140.003	SG, Nozzle Inner Radius Blend	83.28	Nozzle -Vessel configuration
1SGB-OUTLET	B-D, B3.140.004	SG, Nozzle Inner Radius Blend	83.28	Nozzle -Vessel configuration
1SGB-INLET-W5SE	B-F, B5.70.003	SG, Nozzle-to-Safe End Weld	75.00	Nozzle configuration prevents examination from nozzle side of weld
1SGB-OUTLET-W6SE	B-F, B5.70.004	SG Nozzle-to-Safe End Weld	75.00	Nozzle configuration prevents examination from nozzle side of weld
IBCSHX-SH-48	C-A, C1.30.010	Heat Exchanger, Tubesheet-to-Shell	22.14	Support structure limited access to the weld
1SGB-W261	C-F-1, C5.011.220	AFW Nozzle-to-Safe End Weld	50.00	Nozzle -Vessel configuration

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