July 25, 2005

Mr. D. M. Jamil
Vice President
Catawba Nuclear Station
Duke Energy Corporation
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2 RE: REQUEST FOR RELIEF 04-CN-001, FROM VOLUMETRIC WELD INSPECTION REQUIREMENTS (TAC NOS. MC2209 AND MC2210)

Dear Mr. Jamil:

By letter dated April 21, 2005, Duke Energy Corporation, the licensee, submitted Request for Relief 04-CN-001 for Catawba Nuclear Station, Units 1 and 2. This submittal superseded letters dated February 19 and December 7, 2004, on the same subject. In this relief request, the licensee proposed an alternative to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements pertaining to ultrasonic testing (UT) of selected branch connections to the reactor coolant piping system. In lieu of the ASME Code-requirements, the licensee proposed examining the upper two-thirds of the weld volume with UT techniques.

The Nuclear Regulatory Commission (NRC) staff has determined that achieving the Code-required demonstration and UT examination coverage for the subject welds are impractical at this time. Therefore, the NRC staff concludes that the licensee's request for relief and proposed alternative provides reasonable assurance of the structural integrity for the subject welds. Pursuant to Title 10 of the Code of *Federal Regulations*, Section 50.55a(g(6)(i), the NRC staff grants the request for relief for the remainder of the second 10-year inservice inspection interval for the subject welds at Catawba Nuclear Station, Units 1 and 2. All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

The NRC staff's evaluation and conclusions are contained in the Safety Evaluation provided in the enclosure.

Sincerely,

/RA/

Evangelos C. Marinos, Chief, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF NUMBER 04-CN-001

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DUKE ENERGY CORPORATION

DOCKET NOS. 50-413 AND 50-414

1.0 INTRODUCTION

By letter dated April 21, 2005 (Agencywide Documents Access Management System (ADAMS) Accession No. ML051230324), Duke Energy Corporation (Duke), the licensee, submitted Request for Relief 04-CN-001 for Catawba Nuclear Station, Units 1 and 2. This submittal superseded letters dated February 19 and December 7, 2004 (ADAMS Nos. ML040610109 and ML043570133) on the same subject. In this relief request, Duke proposed an alternative to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements pertaining to ultrasonic testing (UT) of selected branch connections to the reactor coolant piping system. In lieu of the ASME Code requirements, the licensee proposed examining the upper two-thirds of the weld volume with UT techniques.

2.0 REGULATORY EVALUATION

Title 10 of the Code of Federal Regulations (10 CFR) Section 50.55a(g) requires that the inservice inspection (ISI) of the ASME Code Class 1, Class 2, and Class 3 components be performed in accordance with Section XI of the ASME Code and applicable edition and addenda, except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(I). 10 CFR 50.55a(a)(3) 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 pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection (ISI) 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 the second 10-year interval for Catawba Nuclear Station, Units 1 and 2 is the 1989 Edition. The second 10-year ISI interval for Unit 1 began June 29, 1995, and ends June 28, 2005. The second 10-year ISI interval for Unit 2 began August 19, 1996, and ends August 18, 2006. 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

3.1 Component for Which Relief is Requested

The component welds affected by the relief are the 14-inch nominal diameter, forged stainless steel, SA-182 F304N, nozzle (2NC11-WN7), and 12-inch nominal diameter, forged stainless steel, SA-182 F304N, nozzles (2NC11-WN8 and 1NC22-WN8).

These nozzles are branch pipe connections inserted into a 29-inch (inside diameter), SA-351 CF8A, centrifugally cast, stainless steel, reactor coolant pipe line. The branch connections are welded to the reactor coolant pipe with SFA-5.9 ER-308 weld material. The wall thicknesses for the 12-inch, 14-inch, and 29-inch pipes are 1.125 inches, 1.406 inches and 2.56 inches, respectively.

3.2 Code Requirements

The applicable code of record is ASME Section XI, 1989 Edition, no Addenda, Class 1, Table IWB-2500-1, Examination Category B-J, Pressure Retaining Piping Welds, Item B9.31, subject to ultrasonic examination using procedures, personnel, and equipment qualified to the 1995 Edition through 1996 Addenda of Supplement 10 to Appendix VIII of Section XI of the ASME Code.

For pipe 4 inches Nominal Pipe Size (NPS) and larger, B9.31 requires both volumetric and surface examinations with the examination volume defined in Figure IWB-2500-11, C-D-E-F.

Section XI, Appendix III, III-2200(b) requires, in part, “The qualification shall include demonstrated proficiency in discrimination between flaw indications and indications of geometric or metallurgical origin.”

3.3 Licensee’s Proposed Alternative

As described in the letter dated April 21, 2005, the licensee proposed to perform a best effort UT examination using 70 degree and 60 degree refracted longitudinal wave search units manufactured by RTD to interrogate the outer two-thirds of the weld volume and the adjacent base material. The calibration will be performed using an existing calibration block made of ASME Code, Section II, SA-351 CF8A centrifugally cast stainless steel with side-drilled holes at depths of 0.632 and 1.86 inches. In addition, Duke will use the Code required pressure testing, liquid penetrant examination, and VT-2 visual examination.

3.4 Basis for Use of the Proposed Alternative

The licensee has determined that the compliance with certain requirements of ASME Section XI, 1989 Edition with no addenda is impractical pursuant to 10 CFR 50.55a(g)(6)(I).

ASME Section XI, Appendix III, III-2200 (b) requires personnel who perform recording or determine which indications are to be recorded to successfully complete the qualification requirements of IWA-2300 using the examination procedure for UT of piping. "The qualification shall include demonstrated proficiency in discriminating between flaw indications and indications of geometric or metallurgical origin."

The wrought austenitic stainless steel pressurizer surge line branch connection welds join centrifugally cast stainless steel main coolant piping to forged stainless steel nozzles. The only access for examination is from the main loop piping side of the welds (see attachments [in the submittal]). Demonstration of the ultrasonic procedure was attempted using a mock-up of similar materials with known flaws (thermal fatigue cracks). The flaw depths used in the mock-up were in the range of flaw depths required by ASME Section XI, Appendix VIII, Supplement 2, 1995 Edition with the 1996 Addenda.

The cracks could not be detected using refracted longitudinal, dual element, 1 MHz probes. Techniques using these probes are considered the best available for examination of welds in cast stainless steel piping. Therefore, Duke concludes that no effective ultrasonic examination can be performed on these welds.

The nozzles connected to the main coolant loop piping are made of forged SA-182 type 316 stainless steel. The main coolant loop piping is SA-351 CF8A centrifugally cast stainless steel. These welds were nondestructively examined during fabrication and subsequent inservice inspections in the first 10-year inspection interval. No flaws were detected.

Duke will use Code required pressure testing, liquid penetrant examination and VT-2 visual examination. These examinations will provide adequate assurance of pressure boundary integrity.

In addition to the above Code required examinations (surface and pressure test), there are other activities which provide a high level of confidence that, in the unlikely case that leakage greater than 1.0 [gallons per minute] gpm did occur through these areas/welds, it would be detected and corrected. Specifically, leakage from these areas/welds would be detected by the Reactor Coolant System (RCS) mass balance/system leakage calculation which is performed at least once every three days under procedure PT/1, 2/A/4150/01D, "NC System Leakage Calculation." This RCS leakage calculation is a requirement of Technical Specification 3.4.13, "RCS Operational Leakage." Leakage is also evaluated in accordance with Technical Specification 3.4.15, RCS Leakage Detection Instrumentation. The leakage could be detected through several methods. These include the Reactor Building air particulate capable of detecting any fission products released from coolant leakage. Others include the level indicator in the Ventilation Unit Condensate Drain Tank, and a loss of level in the Volume Control Tank. This will provide reasonable assurance of weld/component integrity.

4.0 NRC STAFF EVALUATION

Duke examined the subject welds with radiography testing during construction and UT examined the welds during the first ISI interval according to the requirements of the 1974 Edition through the Summer of 1975 Addenda of Appendix III of Section XI. The examination requirements for the second ISI interval are according to the 1989 Edition of Appendix III of Section XI. The second ISI interval requirements were changed to include personnel qualification using the UT procedure to demonstrate proficiency in discriminating between flaw indications and indications of geometric or metallurgical origin. For the UT demonstrations, the licensee used mock-ups of statically cast stainless steel and wrought (forged) stainless steel. The mock-up flaws were located in the inner one third of the through-wall thickness and within 1/4-inch from side of the weld crown. Duke stated that their UT personnel were unsuccessful in demonstrating the detectability of the flaws.

Independent evaluations of cast stainless steel components by the Pacific Northwest National Laboratory (PNNL) documented similar experience in NUREG/CR-6594, "Evaluation of Ultrasonic Inspection Techniques for Coarse-Grained Materials," October 1998, and "NDE Assessments of Cast Stainless Steel Reactor Piping Components, Proceedings for 4th International Conference on NDE [Non-Destructive Examination] in Relation to Structural Integrity for Nuclear and Pressurised Components," December 2004. Using state-of-the-art UT techniques, PNNL was unable to reliably detect flaws in the inner one third weld volume of the weld. PNNL's experience with examination of the inner one third of the weld volume agrees with the licensee's experiences. PNNL was, however, successful at detecting flaws in the upper two thirds of the weld volume and adjacent base material. Because of the limited experience, this new technique is considered by the NRC staff as a best effort examination.

The branch configuration of the piping at Catawba only accommodates scanning for circumferential cracks from the centrifugally cast, stainless steel pipe side of the weld. Duke is performing the UT examinations from the centrifugally cast pipe, thus putting the stainless steel, forged nozzles on the opposite side of the welds. The side of the weld attached to the centrifugally cast pipe is shorter than the side of the weld attached to the forged stainless steel nozzle. Therefore, assuming that cracks occur randomly and grow parallel to the weld, the cracks would be detected on the centrifugally cast pipe side of the weld before they grew through the forged nozzle side of the weld.

The licensee proposed using a UT technique identified in the Electric Power Research Institute Report TR-107481, "Status of the Ultrasonic Examination of Reactor Coolant Loop Cast Stainless Steel Materials," to examine the upper two thirds of the weld volume. The UT technique was performed on the through-wall weld volume and it demonstrated limited success in detecting flaws on the near side of the weld in the upper two-thirds of the weld volume. Therefore, the licensee considers the UT examination to be a best effort examination that has a high probability of detecting a flaw if one existed.

The NRC staff believes that a best effort, full volume examination will identify any flaw before it goes through-wall. Therefore, the proposed UT examination of the subject welds will provide reasonable assurance of structural integrity.

5.0 CONCLUSIONS

Based on the above evaluation, the NRC staff has determined that achieving the Code-required demonstration and UT examination coverage of the inner one third weld volume for the subject welds are impractical at this time. Therefore, the NRC staff concludes that the licensee's request for relief, 04-CN-001, and proposed alternative to UT examine the upper two-thirds weld volume in lieu of UT examination of the inner one-third through-wall weld volume and demonstrating the effectiveness of the UT procedure described in the submittal dated April 21, 2005, provides reasonable assurance of the structural integrity for the subject welds. Pursuant to 10 CFR 50.55a(g)(6)(i), the NRC staff grants the request for relief for the remainder of the second 10-year ISI interval for the subject welds at Catawba Nuclear Station, Units 1 and 2.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: D. Naujock

Date: July 25, 2005