April 13, 2001

Mr. W. R. McCollum, Jr.
Vice President, Oconee Site
Duke Energy Corporation
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION, UNIT 3 RE: USE OF ALTERNATIVE FOLLOWING WELD REPAIR OF REACTOR VESSEL HEAD-TO-CONTROL ROD DRIVE MECHANISM, REQUEST FOR RELIEF NO. 01-03 (TAC NO. MB1572)

Dear Mr. McCollum:

By letter dated March 29, 2001, Duke Energy Corporation requested relief for Oconee Nuclear Station, Unit 3, from certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (Code) inservice inspection requirements associated with the repair of selected control rod drive mechanism (CRDM) nozzle-to-reactor vessel head welds.

Based on the enclosed safety evaluation, the staff has concluded that compliance with the Code requirements to perform Code-required radiographic examinations of the repairs to selected CRDM nozzle-to-reactor vessel head welds (CRDM Nos. 3, 7, 11, 23, 28, 34, 50, 56, and 63) would result in hardship or unusual difficulty for the licensee without a compensating increase in the level of quality and safety. Therefore, the staff authorizes use of ultrasonic examinations as an alternative to the Code-required radiographic examination for the subject CRDM nozzle-to-reactor vessel head weld repairs pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii).

Sincerely,

/RA/

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

Docket No. 50-287

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN

REQUEST FOR RELIEF

DUKE ENERGY CORPORATION

OCONEE NUCLEAR STATION, UNIT 3

DOCKET NO. 50-287

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). 10 CFR 50.55a(a)(3) states in part 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) 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 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 Oconee Nuclear Station, Unit 3, for the third 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 March 29, 2001, Duke Energy Corporation (the licensee) submitted Relief Request No. 01-03, requesting relief from certain Code-required radiographic testing (RT) criteria for the third 10-year inservice inspection interval at the Oconee Nuclear Station,

Unit 3, for repair of selected control rod drive mechanism (CRDM) nozzle-to-reactor pressure vessel (RPV) head welds.

2.0 RELIEF REQUEST 01-03, REPAIR OF SELECTED CRDM NOZZLE-TO-REACTOR VESSEL HEAD WELDS

The subject CRDMs for this request for relief are numbers: 3, 7, 11, 23, 28, 34, 50, 56, and 63.

2.1 Code Requirement for which Relief is Requested

The licensee selected to use a more current edition of the Code referenced in the 10 CFR 50.55a(b) for this repair. The Code for this repair is the 1992 Edition with no addenda.

Paragraph IWA-4533 of the ASME Code requires that the weld repair as well as the preheated band shall be examined by the liquid penetrant testing (PT) method after the completed weld has been at ambient temperature for at least 48 hours. The repaired region shall be examined by the RT method and, if practical, by the ultrasonic testing (UT) method following repair of dissimilar materials using the temper bead process in accordance with IWA-4530. IWA-4500(e)(2) defines the band around the weld repair area as 1-1/2 times the component thickness or 5 inches, whichever is less.

2.2 Licensee's Proposed Alternative to Code

In lieu of the requirements of IWA-4500(e)(2) and IWA-4533, the licensee proposed the following:

1. Within the band around the weld repair, as defined by IWA-4500(e)(2), an interference exists that would prevent using PT over 100 percent of the band area. The licensee has proposed that the band area around the weld repair exclusive of the interference be examined with PT for the subject CRDMs.

2. Due to the thickness of the RPV head and the complex geometry of the Oconee Unit 3, the RPV head in the area of the CRDM nozzles, the licensee has proposed that the repair regions be examined with UT in lieu of RT.

2.3 Evaluation

The licensee identified boron deposits at the subject nozzle-to-RPV penetrations, indicating head weld leakage. Examinations of the CRDMs revealed the existence of crack indications in the base metal of the nozzles and J groove partial penetration welds. There were no indications found in the low alloy steel RPV head material. The leakage was from cracks on the inside surface of the RPV head starting at the base of the weld and ending in the CRDM nozzle. Removal of the crack resulted in a partial penetration repair up to 3-inches deep on the inside surface of the RPV head. The licensee used 152 Inconel weld material for the repairs, which made dissimilar metal welds with the carbon steel RPV head material and provided the surface cladding protection for the inside surface of the RPV head. The repairs joined the remaining

original 182 Inconel weld material and replaced the removed Alloy 600 CRDM nozzle material. The licensee determined that the resulting Section III of the Code weld repairs could not be nondestructively examined according to Section III Code-requirements. The Code requires that the welds be examined using surface and RT techniques.

The repaired configurations are not amenable to RT. RT is used to identify flaws by detecting changes in material density. These changes can be due to differences in thickness or physical density as compared to the surrounding material. RT is not appropriate for these repairs because the welds connecting the CRDM nozzle-to-RPV head are not full penetration welds. The gap between the CRDM nozzles and RPV head would mask flaws in that location, and the weld depth contour would vary, creating density changes. Also, the repair welds to the CRDM nozzles are not accessible from two directions for film and source placement. In order to use RT, the CRDM nozzle-to-RPV head welds would have to be redesigned which would result in extensive through-wall repairs that would subject the vessel to internal stresses and subject personnel to large radiation doses. Moreover, the results of an RT would be questionable because of density changes between the base and weld metal. Also, residual radiation from the base metal would render the film image inconclusive. Therefore, compliance with the Code RT requirement would create unusual difficulties and hardship.

Instead of performing RT examinations, the licensee has proposed to examine the welds using UT and the Code-required PT, and to perform an additional examination of the inside surface of the CRDM nozzle bore using eddy current testing. UT is used to identify features that reflect sound waves. The degree of reflection depends largely on the physical state of matter on the opposite side of the reflective surface and to a lesser extent on specific physical properties of the matter (density). For instance, sound waves are almost completely reflected at metal-gas interfaces, and partially reflected at metal-to-solid interfaces. Discontinuities that act as metal-gas interfaces, like cracks, laminations, shrinkage cavities, and bonding faults are easily detected. Inclusions and other metal non-homogenities can also be detected by partial reflection of the sound wave.

Because the weld material and deposited weld thickness is similar to weld overlays used to reinforce degraded piping, the licensee chose to use a UT technique that is predominately a subset of the weld overlay technique demonstrated under the “Electric Power Research Institute - Performance Demonstration Initiative” performance demonstration program. The licensee designed the procedure to detect flaws in weld overlays as well as under the overlays. To demonstrate the effectiveness of the procedure, the licensee used a cladded calibration block with side-drilled holes representing reflectors.

The proposed UT examinations will be performed using 0-degree and 60-degree longitudinal wave transducers and an outside diameter creeping wave transducer. The 60-degree longitudinal wave transducer will scan the repaired area in four orthogonal directions except where there are interferences. The licensee will evaluate indications in accordance with Subsection NB-5330, “Ultrasonic Acceptance Standards” of the Code. Any indication with a crack-like signature will be evaluated and sized using tip diffraction techniques.

Based on the above discussion, the staff believes that compliance with the Code requirements to perform radiographic examination of the weld volumes of the selected nozzle-to-RPV head welds would result in hardship or unusual difficulty for the licensee without a compensating increase in the level of quality and safety. The proposal to use UT will provide a reasonable

alternative to RT for identifying detrimental flaws for the CRDM nozzle-to-RPV head weld configurations.

2.4 Conclusion

The staff concludes that compliance with the Code requirements to perform radiographic examinations of the subject weld volumes would result in hardship or unusual difficulty for the licensee without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the use of ultrasonic examination as an alternative to the Code-required radiographic examination for Oconee Nuclear Station, Unit 3, CRDM Nos. 3, 7, 11, 23, 28, 34, 50, 56, and 63 nozzle-to-RV head welds.

Principal Contributor: Donald G. Naujock

Date: April 13, 2001

cc:
Ms. Lisa F. Vaughn
Legal Department (PBO5E)
Duke Energy Corporation
422 South Church Street
Charlotte, North Carolina 28201-1006

Anne W. Cottingham, Esquire
Winston and Strawn
1400 L Street, NW
Washington, DC 20005

Manager, LIS
NUS Corporation
2650 McCormick Drive, 3rd Floor
Clearwater, Florida 34619-1035

Senior Resident Inspector
U. S. Nuclear Regulatory
Commission
7812B Rochester Highway
Seneca, South Carolina 29672

Virgil R. Autry, Director
Division of Radioactive Waste Management
Bureau of Land and Waste Management
Department of Health and Environmental
Control
2600 Bull Street
Columbia, South Carolina 29201-1708

Mr. L. E. Nicholson
Compliance Manager
Duke Energy Corporation
Oconee Nuclear Site
7800 Rochester Highway
Seneca, South Carolina 29672

Ms. Karen E. Long
Assistant Attorney General
North Carolina Department of
Justice
P. O. Box 629
Raleigh, North Carolina 27602

Mr. C. Jeffrey Thomas
Manager - Nuclear Regulatory
Licensing
Duke Energy Corporation
526 South Church Street
Charlotte, North Carolina 28201-1006

Mr. Richard M. Fry, Director
Division of Radiation Protection
North Carolina Department of
Environment, Health, and
Natural Resources
3825 Barrett Drive
Raleigh, North Carolina 27609-7721

Mr. Peter R. Harden, IV
VP-Customer Relations and Sales
Westinghouse Electric Company
5929 Carnegie Blvd.
Suite 500
Charlotte, North Carolina 28209