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: REQUEST FOR RELIEF NO. 01-04 FOR USE OF AMERICAN SOCIETY OF MECHANICAL ENGINEER ALTERNATIVE DEPTH CRITERIA FOR REACTOR VESSEL HEAD WELD CONTROL ROD DRIVE MECHANISM REPAIR (TAC NO. MB1600)

Dear Mr. McCollum:

By letter dated April 2, 2001, Duke Energy Corporation (Duke), the licensee, submitted Request for Relief No. 2001-04 from the depth of weld repair requirements imposed by Section IWA-4530 of the American Society of Mechanical Engineers (ASME) Code. The request is for repair of cracks associated with certain control rod drive mechanism (CRDM) nozzles and welds on the Oconee Nuclear Station Unit 3 reactor pressure vessel head penetrations. Pursuant to 10 CFR 50.55a(a)(3)(ii), Duke requested the use of an alternative to the 3/8-inch depth requirement of ASME Subsection IWA-4530 for CRDMs 50, 56, 34, and 63. In lieu of the 3/8-inch base metal repair depth limit requirement, Duke requested that the repair depth limitation be increased to three inches for repair of these nozzles.

Based on the enclosed safety evaluation, the staff has concluded that compliance with the Code requirements to limit the repair depth to 3/8-inch would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes increasing the 3/8-inch base metal repair depth limit requirement of IWA-4530 to three inches for CRDMs 50, 56, 34, and 63 since the proposed alternative provides an acceptable level of quality and safety and compliance with the specified requirements would result in hardship or unusual difficulty.

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 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.

By letter dated April 2, 2001, Duke Energy Corporation (Duke, the licensee) submitted a request for relief from the depth of repair requirements imposed by Section IWA-4530 in the ASME, Section XI (all references to ASME Section XI in this safety evaluation refer to the ASME Boiler and Pressure Vessel Code, Section XI, 1992 edition). This repair is being made to certain control rod drive mechanisms (CRDMs) on the Oconee Nuclear Station Unit 3 reactor pressure vessel. Pursuant to 10 CFR 50.55a(a)(3)(ii), Duke has requested the use of an alternative to the 3/8-inch depth requirement of IWA-4530 for the repair of these CRDMs. In lieu of the 3/8-inch base metal repair depth limit requirement of IWA-4530, the licensee has proposed that the repair depth limitation be increased to three inches.

Section IWA-4530 of ASME Section XI, "Dissimilar Materials," provides requirements for repair of welds joining dissimilar materials that may be made without post-weld heat treatment. This section imposes a 3/8-inch depth limitation beyond the fusion line of the dissimilar metal weld for repair of defects in low alloy steel base material that may be performed in accordance with IWA-4532.

The staff has reviewed and evaluated the licensee's request and supporting information on the proposed alternative to the Code requirements for Oconee Nuclear Station Unit 3, pursuant to the provisions of 10 CFR 50.55a(a)(3)(ii).

2.0 BACKGROUND

During inspections of the Unit 3 reactor pressure vessel (RPV) head during a forced outage to repair a pressurizer code safety valve, small amounts of boron were discovered emanating from the CRDM nozzle interface with the outside radius of the RPV head. Boron deposits were discovered at this interface for CRDM nozzles Nos. 3, 7, 11, 23, 28, 34, 50, 56, and 63. This pressure boundary degradation was reported to the NRC on February 19, 2001, in accordance with 10 CFR 50.72(b)(3)(ii). Subsequent non-destructive examinations using eddy current and ultrasonic methods have been completed for the base metal of the subject CRDM nozzles. Liquid penetrant examinations have also been completed for each J-groove partial penetration weld connecting the CRDM nozzles to the inside radius of the RPV head. These examinations revealed the existence of indications in the base metal of the nozzles and in the J-groove partial penetration welds. The indications can be grouped into three categories: (1) indications in the J-groove partial penetration weld, (2) indications in the nozzle base metal above the J-groove partial penetration weld, and (3) indications in the nozzle base metal at or below the J-groove partial penetration weld. No indications have been detected in the RPV head low alloy steel.

In order to remove the indications in both the CRDM nozzles and J-groove partial penetration welds, manual grinding and arc air thermal cutting were used. The depth of the excavation necessary to remove the indications and provide access for weld repair in the nozzle walls and welds for CRDM Nos. 50, 56, 34, and 63 resulted in the need to remove portions of the RPV head low alloy steel beyond the 3/8 inch depth limitation imposed by IWA-4530.

3.0 DISCUSSION

3.1 Licensee's Basis for Relief Request

To gain access for the repair of CRDM nozzles 50, 56, 34, and 63 in the RPV head and the associated J-grove partial penetration welds, it was necessary to excavate up to three inches of the RPV head base metal. In lieu of the 3/8-inch base metal repair depth limit requirement of IWA-4530, the licensee proposed that the repair depth limitation be increased to three inches. This increase in the depth limit, while retaining the other restrictions of IWA-4530, would allow repair of the excavations into the RPV head, repairs to the CRDM nozzles, and repairs to the J-groove partial penetration welds by the temper bead technique of IWA-4532, in lieu of repairs requiring additional post weld heat treatment.

The 3/8-inch limitation imposed by IWA-4530 to these CRDMs presents an unusual difficulty in the ensuing repairs of the RPV head low alloy steel. Excavation to the 3/8-inch limitation requires precise and exacting removal of material by grinding. Grinding is a slow and time-consuming process that would have resulted in large radiation doses to a large number of repair personnel. Less precise, but still controlled, air thermal cutting of the material allows for the operation to proceed quickly and with less radiation exposure to repair personnel. This excavation technique required the removal of low alloy steel of the RPV head beyond the 3/8-inch cavity depth limitation in the base material imposed by IWA-4530 for temper bead repair.

Repairs of the low alloy steel cavities with similar metal weld material and then restoring the dissimilar weld by the temper bead process also presents an unusual difficulty. This process would require two separate welding operations. The first welding operation would replace the low alloy steel with a similar metal weld to beyond the fusion line with the dissimilar metal weld

butter, grinding to restore the fusion line to its original configuration, and then applying post weld heat treatment. The second operation would then replace the dissimilar metal weld by the temper bead process and then grinding to restore the configuration of the dissimilar metal weld. Such operations would substantially increase the radiation exposure to repair personnel without any compensating increase in the level of quality and safety over replacement of both the low alloy steel and the dissimilar metal weld with a dissimilar metal weld.

The original ASME code restriction on the depth of the dissimilar metal temper bead repair was written for cases where base metal excavation became extensive. For such extensive excavations, the similar metal procedure would be used to repair the base metal. For the repairs described herein, the as-repaired geometry and the choice of filler metal will satisfy the Section III design rules without fully restoring the base metal to its original geometry. In lieu of restoring the RPV head base metal to its original geometry with a similar metal temper bead repair and then completing the attachment weld to the CRDM nozzle with a dissimilar filler material, the licensee proposed that the dissimilar metal temper bead weld procedure be used to repair the base metal as well as the dissimilar metal weld. The temper bead procedure has been fully qualified for the type repairs described herein. The dissimilar metal temper bead weld procedure will produce an acceptable tempering in the heat affected zone (HAZ) of the base metal. The extent of the HAZ is independent of the excavation limit. However, the HAZ is a function of the overall depth of repair and therefore, the current IWA-4530 and Procedure Qualification Record (PQR) joint depth limits will be retained. The PQR qualified a similar P43 material (Alloy 600) to that being used in the repair (Alloy 690).

ASME Section III contains a similar limitation on the 3/8-inch excavation into the low alloy steel for temper bead repairs (NB-4622.11(b))(all references to ASME Section III in this safety evaluation refer to the ASME Boiler and Pressure Vessel Code, Section III, 1989 edition). This limitation is not weld related, but is related to geometry control and design requirements, as noted above. Therefore, the structural characteristics of the modified geometry will be included in a code stress analysis of the RPV head in accordance with ASME Section III, Subsection NB.

Repairs to the RPV head, CRDM nozzles, and J-groove partial penetration welds will be completed in accordance with the other limitations of IWA-4530 and ASME Section III, Subsection NB. Excavations to three inches and the subsequent repairs will not exceed the lesser of one-half the thickness of the RPV head or the PQR qualified depth of repairs of four inches in accordance with IWA-4531. A limit of one-half the thickness of the head is a more appropriate limit than one-half the thickness of the J-groove weld joint. This is because of the uniqueness of the partial penetration J-groove weld versus a repair full penetration weld. The surface of the completed repair will not exceed 100 square inches.

4.0 EVALUATION

The staff has evaluated the licensee's request and supporting information on the proposal to increase the 3/8-inch base metal repair depth limit requirement of IWA-4530 to three inches for repairs to the cracks associated with the CRDM nozzles on the Oconee Nuclear Station Unit 3 RPV head for CRDMs 50, 56, 34, and 63 and concluded that the supporting information provides an acceptable alterative weld depth for the repairs.

Additionally, compliance with the limitation of the 3/8-inch excavation imposed by IWA-4530 would result in an unusual difficulty in excavating the weld cavity without a compensating

increase in the level of quality and safety for repairs to the CRDM nozzles, J-groove welds, and adjacent RPV head low alloy steel. Based on this analysis and pursuant to 10CFR 50.55a(a)(3)(ii), the staff has concluded that the request for relief is authorized for CRDMs 50, 56, 34, and 63.

5.0 CONCLUSION

Based on our review of the information supplied by the licensee, the staff has concluded that the licensee's proposal to increase the 3/8-inch base metal repair depth limit requirement of IWA-4530, to three inches for repairs made to CRDM nozzles 50, 56, 34, and 63 on the Oconee Nuclear Station Unit 3 reactor vessel head provides an acceptable alterative weld depth repair criteria. The licensee has demonstrated that compliance with the limitation of the 3/8-inch excavation imposed by IWA-4530 would result in an unusual difficulty in excavating the weld cavity and performing the repair weld without a compensating increase in the level of quality and safety regarding the repairs to the Oconee Unit 3 CRDM nozzles, J-groove welds, and adjacent RPV head low alloy steel. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii) the relief request is authorized.

Principal Contributor: Edward Andruszkiewicz

Date: April 13, 2001

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