May 21, 2001

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

SUBJECT: OCONEE NUCLEAR STATION, UNIT 2 - SAFETY EVALUATION OF REQUEST TO USE ALTERNATIVE MATERIALS PER ASSOCIATED CODE CASES FOR REACTOR VESSEL HEAD CONTROL ROD DRIVE MECHANISM WELD REPAIRS (TAC NO. MB1835)

Dear Mr. McCollum:

By letter dated May 2, 2001, Duke Energy Corporation requested approval of the proposed alternative to use Alloy 690 welding filler materials (Inconel or Alloy 52/152) and associated American Society of Mechanical Engineers Code Cases 2142-1 and 2143-1 on Oconee Nuclear Station, Unit 2. The request is associated with the use of Alloy 690 type filler material (Inconel 52/152) on control rod drive mechanism (CRDM) nozzle reactor vessel head penetrations for the repair of CRDM Nozzle Nos. 4, 6, 18, and 30, and associated welds. The staff concludes that the use of the proposed alternative for this repair will provide an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations,* Section 50.55.a(a)(3)(i), the staff authorizes the use of the proposed alternative. Our evaluation addresses the use of Alloy 690 material and not the repair methodology described in the submittal. Our Safety Evaluation is enclosed.

Sincerely,

/RA/

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

Docket No. 50-270

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST TO USE ALTERNATIVE MATERIALS AND ASSOCIATED CODE CASES

FOR REPAIR OF THE REACTOR VESSEL

CONTROL ROD DRIVE MECHANISM NOZZLE AND WELDS

DUKE ENERGY CORPORATION

OCONEE NUCLEAR STATION, UNIT 2

DOCKET NO. 50-270

1.0 INTRODUCTION

By letter dated May 2, 2001, Duke Energy Corporation (the licensee) requested approval under the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i) to use Alloy 690 weld filler materials (Inconel or Alloy 52/152) in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Case 2142-1, "F-Number Grouping for Ni-Cr-Fe, Classification UNS N06052 Filler Metal, Section XI," and Code Case 2143-1, "F-Number Grouping for Ni-Cr-Fe, Classification UNS W86152 Welding Electrode, Section XI," for the repair of certain Control Rod Drive Mechanism (CRDM) penetration nozzles. Specifically, CRDM Nozzle Nos. 4, 6, 18, and 30, and associated welds on the Oconee Nuclear Station (ONS), Unit 2 reactor vessel (RV) head.

The referenced Code cases introduce and classify new nickel base weld metals that are compatible with Alloy 690 base metal materials. Code Case 2141-1 establishes welding classifications and other requirements for a bare wire filler metal. Code Case 2143-1 establishes welding classifications and other requirements for a coated electrode. These two Code cases have not been incorporated by reference into the regulations; therefore, their use requires NRC approval.

Thus, the licensee's request consists of two issues:

a. The use of Alloy 690 (Inconel 52/152) weld filler materials in Code Class 1 weld repair in lieu of Alloy 600 (Inconel 82/182) weld filler materials; and

b. The use of two ASME Code cases that group the new weld filler materials in the same weld categories as other commonly employed nickel base weld metals. This allows the use of appropriate existing welding procedures and performance qualifications with the new weld metals.

The Code of Record to be used to repair the CRDM nozzles is the 1992 ASME B&PV Code Section XI with no addenda. This code allows, by reference, the use of Alloy 600 (Inconel 82/182) weld filler material, but does not include the use of Alloy 690 (Inconel 52/152) weld filler materials. Industry studies indicate that Alloy 690 (Inconel 52/152) weld filler materials are less susceptible to intergranular stress corrosion cracking (IGSCC) than the Inconel 82/182 materials. Alloy 600 type weld metals (Inconel 82/182) were widely used during the construction of nuclear power plants. Operating experience has shown that Inconel 182 weld material is susceptible to IGSCC, although primarily in boiling-water reactor (BWR) environments.

2.0 DISCUSSION

2.1 Alloy 690 weld filler materials (Inconel 52/152)

According to the licensee, industry studies have demonstrated that Alloy 690 weld materials possess a high resistance to primary water corrosion. In addition, an evaluation of the weld dilution has concluded that the percentage of chromium in the deposited welds exceeded 22 percent. Consequently, the chromium content of the repaired surfaces containing the proposed Alloy 690 weld material, considering chromium dilution, will exceed that of the original Alloy 600 material, and thus is expected to have good corrosion resistance.

A small amount of boron was found on the RV head penetrations associated with the CRDM Numbers 4, 6, 18, and 30 during a visual inspection of the RV head following shutdown of the reactor for Refueling Outage 2EOC18. The licensee has removed the reactor vessel head and plans to perform eddy current and ultrasonic examinations of the nozzle base metal of these CRDM nozzles. In addition, liquid penetrant inspections will be performed for each J-groove partial penetration weld connecting these CRDM nozzles to the inside radius of the RV head. These inspections will help identify the probable leakage path.

Based on the experience gained from the repairs performed to the ONS Units 1 and 3 CRDM nozzles, the licensee has developed a more automated repair method for Unit 2 CRDM repairs that significantly reduces the radiation exposure to personnel. Details of the repair method developed by Framatome ANP Incorporated has been submitted as Proprietary and will not be addressed in this relief request. Excavation of the weld and portions of the outside diameter of the nozzles will be performed to clear all indications, and then the excavated material will be replaced with the proposed Alloy 690 weld filler material (Inconel 52/152). Lower portions of the subject nozzles will be cut and removed. A new primary pressure boundary weld using 52/152 material will be fabricated to connect the shortened nozzle to the inside bore of the pressure vessel head base material.

In summary, the licensee has proposed the use of alternative Inconel 52/152 materials for the fabrication and repair of the subject welds. Laboratory test data have shown that Inconel 52/152 materials are resistant to stress corrosion cracking in simulated pressurized-water reactor (PWR) and BWR environments. The staff has approved the use of Inconel 52/152 in the replacement of steam generators for a number of PWRs, including V. C. Summer; St. Lucie, Unit 1; McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Unit 1; and Oconee Nuclear Station, Units 1, 2, and 3. The staff also has approved use of Inconel 52/152 for repair of the cracks found on the ONS Units 1 and 3 CRDMs. Therefore, the licensee-proposed use of Inconel 52/152 filler materials for repairs associated with the CRDM nozzle

weld reactor presseure vessel head penetrations is acceptable since it will provide an acceptable level of quality and safety.

2.2 Code Cases 2142-1 and 2143-1

The purposes of a weld metal code case are the establishment of uniform chemical and material properties and the classification of the weld metal with respect to its welding characteristics. This welding characteristics classification is known as an "F-No." Weld metals with like characteristics are grouped together for welding and welder qualification purposes in order to eliminate unnecessary duplication.

Code Case 2142-1 lists American Welding Society (AWS) specification (AWS A5.14) and Unified Numbering System (UNS) designation (UNS N06052) conforming to Inco 52 (Inconel 52). It establishes the F-No. of this weld metal as F-No. 43 for both procedure and performance qualification purposes. Code Case 2143-1 lists appropriate AWS and UNS specifications for a coated electrode matching Inco 152 (Inconel 152) and establishes F-No. 43 for this material for welding purposes. By this set of specifications and F-No. assignments, these materials are completely described for welding purposes as similar in their welding characteristics to many other Code nickel-based weld metals. Thus, these two weld metals (Inconel 52/152) are exempted from the requirements for specific procedure and performance qualifications for non-Code materials.

The staff finds that these two code cases appropriately specify and classify the necessary weld metal parameters and are acceptable for use. The staff has approved the use of these two Code cases in the replacement of steam generators for a number of PWRs, including St. Lucie, Unit 1; McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station Unit 1; and Oconee Nuclear Station, Units 1, 2, and 3; as well as reactor vessel head penetration repairs for the Oconee Nuclear Station, Unit 1.

3.0 CONCLUSION

The use of Alloy 690 weld filler material (Inconel 52/152) and the associated ASME Code Cases 2142-1 and 2143-1 for the repairs to CRDM Nozzle Nos. 4, 6, 18, and 30, and associated welds will provide superior corrosion protection over that provided by Alloy 600 (Inconel 82/182) material. The use of Alloy 690 has been previously authorized for new construction and other repair activities.

Based on the above evaluation, the staff concludes that the proposed alternative to use Alloy 690 weld filler materials (Inconel 52/152) per Code Cases 2142-1 and 2143-1 for fabrication of weld overlay and weld repairs of CRDM Nos. 4, 6, 18, and 30 RV head penetrations will provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55.a(a)(3)(i), the staff authorizes the use of the proposed alternative.

Principal Contributor: David E. LaBarge

Date: May 21, 2001

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