May 23, 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 COOLANT SYSTEM RESISTANCE TEMPERATURE DETECTOR THERMOWELL WELD REPAIRS (TAC NO. MB1918)

Dear Mr. McCollum:

By letter dated May 11, 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) for the partial penetration weld that will be used to install new replacement Reactor Coolant System resistance temperature detector thermowells on the Reactor Coolant System piping.

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* (10 CFR) Section 50.55a(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 outlined in the submittal. Our Safety Evaluation is enclosed.

Sincerely,

/RA by Leonard Olshan for/

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 WELDS ASSOCIATED WITH NEW REACTOR COOLANT SYSTEM

RESISTANCE TEMPERATURE DETECTOR THERMOWELL WELDS

DUKE ENERGY CORPORATION

OCONEE NUCLEAR STATION, UNIT 2

DOCKET NO. 50-270

1.0 INTRODUCTION

By letter dated May 11, 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." The Alloy 690 material would be used for the partial penetration welds associated with the installation of new replacement Reactor Coolant System (RCS) resistance temperature detector (RTD) thermowells on the Oconee Nuclear Station (ONS), Unit 2 RCS piping at Nozzle Locations 2 and 6 (RCS Loop "B" Cold Leg); Locations 10 and 13 (RCS Loop "A" Cold Leg); Locations 23, 24, and 25 (RCS Loop "B" Hot Leg); and Locations 33, 34, and 35 (RCS Loop "A" Hot Leg).

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 RCS RTD thermowells 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.

The licensee has proposed the use of alternative Inconel 52/152 materials for weld repairs associated with the RCS RTD thermocouples. 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 material properties of the existing Alloy 600 (82/182) weld material were compared by the licensee to the new proposed Alloy 690 (52/152) weld material. The thermal expansion coefficient of the 52/152 weld material is somewhat higher than the coefficient of the 82/182 weld material; however, the modulus of elasticity is lower for the 52/152 weld material than the 82/182 weld material. Since the thermal stress is a function of the product of the modulus of elasticity and the thermal expansion coefficient, the effects tend to cancel each other. Thus, the presence of the two weld materials will have an insignificant effect on the thermal stresses in the total weld.

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 Control Rod Drive Mechanisms. Therefore, the licensee-proposed use of Inconel 52/152 filler materials for weld repairs associated with the RCS RTD thermocouples 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 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; 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 weld repairs associated with the RCS RTD thermocouples 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 weld repairs associated with the RCS RTD thermocouples will provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the use of the proposed alternative.

Principal Contributor: David E. LaBarge

Date: May 23, 2001

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