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A Duke Energy Company

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January, 2 2001

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

SUBJECT: Oconee Nuclear Station - Unit 1
Docket No. 50-269
Request for Authorization to Use Alloy 690 Welding Filler Material Per Code Cases 2142-1 and 2143-1 in accordance with 10 CFR 50.55a(a)(3)(i)

Pursuant to 10 CFR 50.55a(a)(3)(i), Duke Energy Corporation (DEC) requests the NRC to authorize the use of Alloy 690 welding filler material along with the associated ASME Boiler and Pressure Vessel Code, Section IX, Code Cases 2142-1 and 2143-1. These code cases would be applied as an alternative to the ASME Boiler and Pressure Vessel Code, Section XI, 1992 Edition with no addenda for Oconee Unit 1.

This request is to allow the application of Alloy 690 type weld filler material (Inconel 52/152) for the repair of thermocouple nozzles and a Control Rod Drive Mechanism (CRDM) nozzle on the Oconee Unit 1 Reactor Vessel head. Industry studies show that Alloy 690 weld filler materials possess a high resistance to primary water corrosion. DEC has evaluated and determined that the alternative material will provide an acceptable level of quality and safety, when compared to the materials allowed by the referenced code because of its superior corrosion resistant properties.

The NRC has previously approved the use of Inconel 52/152 associated with replacement steam generators. In particular, DEC received approval on September 10, 1999 to apply Alloy 690 (and the associated Code Cases) to the Oconee replacement steam generators (TAC Nos MA6209, MA6210, and MA6211).

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A detailed description of this proposed alternative, including a background discussion and justification is included as an attachment to this letter. Oconee Unit 1 restart is presently scheduled for January 9, 2001.

Questions regarding this request may be directed to Robert Douglas at (864) 885-3073.

Very truly yours,

William R. McCollum

Attachment:

Request for Alternative, Serial Number 00-06

xc w/att:

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U.S. Nuclear Regulatory Commission, Region II
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U.S. Nuclear Regulatory Commission
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xc(w/o attch):

M. E. Shannon,
NRC Senior Resident Inspector
Oconee Nuclear Station

Mr. Virgil Autrey
Division of Radioactive Waste Management
Bureau of Land and Waste Management
SC Dept. of Health & Environmental Control
2600 Bull St.
Columbia, SC 29201

DUKE ENERGY CORPORATION
Oconee Nuclear Station, Unit 1

Request for Alternative Material than approved by the ASME Boiler and Pressure Vessel Code, Section XI

Applicable Code Edition and Addenda

ASME Boiler and Pressure Vessel Code, Section XI, 1992 Edition with no addenda.

Description of Code Requirement(s) for Which an Alternative is Requested

The Code being utilized for the repairs described in this request is the 1992 ASME Code Section XI with no addenda. The 1992 code allows, by reference, the use of Alloy 600 based weld filler material (Inconel 82/182) but does not include the use of Alloy 690 based weld filler material (Inconel 52/152).

Code cases 2142-1 and 2143-1 introduce and classify new nickel based weld metals that closely match Alloy 690. Code Case 2142-1 establishes welding classifications and other requirements for 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.

Description of Proposed Alternative

In lieu of the requirements of the 1992 code, the use of Alloy 690 weld filler material is proposed for the repair of eight unused thermocouple nozzles and one Control Rod Drive Mechanism (CRDM) located on the Oconee Unit 1 Reactor Vessel (RV) head. Details of the repair are provided in the background section of this request.

In addition, DEC requests the use of ASME Code Cases 2142-1 and 2143-1 that group the new weld filler material in the

same welding category as other commonly employed nickel based weld filler metals. This allows the use of appropriate existing welding procedures and performance qualifications with the new weld metals.

Justification for Using the Proposed Alternative

Industry studies have demonstrated that Alloy 690 weld materials possess a high resistance to primary water corrosion. The use of Alloy 690 has been previously approved for specific applications at Oconee in NRC Safety Evaluation dated September 10, 1999.

The material properties of the existing Alloy 600 (182 weld material) material were compared to the new proposed Alloy 690 (152 weld material). The thermal expansion coefficient of 152 weld material is somewhat higher than the coefficient for 182 weld material (at 600F, the difference is about 4%), however the modulus of elasticity is lower for the 152 weld material than the 182 weld material. Since the thermal stress is a function of the product of modulus of elasticity and thermal expansion coefficient ($\sigma = E\alpha\Delta T$), the effects tend to cancel each other; at 600F for example, the difference in the products is only 2%. Thus, the presence of the two weld materials will have an insignificant effect on the thermal stresses in the total weld.

An evaluation of the weld dilution concluded that the percentage of chromium in the deposited welds, in all cases given above, exceeded 22%. Materials with chromium concentrations above 22% have demonstrated resistance to Primary Water Stress Corrosion Cracking (PWSCC). In summary, the chromium content of all repaired surfaces containing the proposed Alloy 690 material, considering chromium dilution, will exceed that of the original Alloy 600 material, and thus afford superior corrosion resistance.

Background Information

Repairs to the thermocouple nozzles and CRDM #21 nozzle are required because of the discovery of small amounts of boron at those locations during a normal visual inspection of the RV head following shutdown of the reactor for refueling outage 1EOC19. This pressure boundary degradation was reported to the NRC on December 4, 2000 in accordance with 10CFR50.72(b)(2)(i). Subsequent examinations utilizing eddy current, ultrasonic, and liquid penetrant methods identified cracks in the base metal of each of the eight thermocouple nozzles, and cracks in several of the J groove partial penetration welds connecting the thermocouple nozzles to the inside radius of the RV head. Liquid penetrant inspections of CRDM #21 identified a crack in the J groove partial penetration weld connecting the CRDM nozzle to the inside radius of the RV head as the source of the leakage at this location.

Six of the eight thermocouple nozzles will be repaired from underneath the RV head (inside radius). The thermocouple nozzles and defective weld material will first be removed and the existing weld repaired. A plug made of SB 166 Alloy 690[1] will be inserted into the remaining penetrations from the inside radius of the head. A structural weld overlay, using the proposed Alloy 690 weld filler material, will then be applied on the inside radius of the head underneath the plug. See Attachment 1 for a sketch of these thermocouple nozzle repairs.

On two of the eight thermocouple nozzles the excavated weld material included the Alloy 600 weld material, a portion of the Alloy 600 butter to the RV head base material, and a portion of the RV head base material. To reduce radiation dose to workers performing the repairs, a design was chosen to repair the penetrations from the outside radius of the RV head using the temper bead technique. The thermocouple nozzles and any remaining defects will be removed and a plug made of SB-166 Alloy 690 will be inserted into the remaining penetrations. A structural weld overlay, using

[1] Relief is not sought for the use of the SB-166 Alloy 690 plug material since Code Case N-474 is included in Regulatory Guide 1.85, and therefore the material is acceptable for use.

the proposed Alloy 690 weld filler material, will then be applied on the outside radius of the RV head over the plug. See Attachment 2 for these thermocouple nozzle repairs.

CRDM #21 will be repaired from the inside radius of the RV head. All defects will first be removed and replaced with the proposed Alloy 690 weld filler material. An overlay of the proposed Alloy 690 material will then be applied over the remaining Alloy 600 material. See Attachment 3 for CDM #21 repairs.

The Quality and Safety Provided by the Proposed Alternative

Alloy 690 material has been shown to be superior to Alloy 600 material in resisting Primary Water Stress Corrosion Cracking (PWSCC). In a letter to the NRC dated August 6, 1999, DEC requested authorization to use the Alloy 690 material in the construction of the replacement steam generators to be installed at Oconee starting in 2003. NRC approved the request by letter dated September 10, 1999. Similarly, the NRC has authorized the use of Alloy 690 material in the construction of replacement steam generators for McGuire Nuclear Station Units 1 & 2, and Catawba Nuclear Station Unit 1.

ASME Code Cases 2142-1 & 2143-1 establishes the uniform chemical and material properties and the classification of the weld material with respect to its welding characteristics. Code Case 2142-1 establishes the F-No. for the American Welding Society (AWS) specification AWS A5.14 and Unified Numbering System (UNS) designation UNSN06052 conforming to Inconel 52 as F-No. 43 for both procedure and performance qualification purposes. Code Case 2143-1 establishes the F-No. for the AWS and UNS specification for a coated electrode matching Inconel 152 as F-No. 43 for welding purposes. These sets of specifications and F-No. assignments completely describe this material for welding purposes as similar in their welding characteristics to other Code approved nickel based weld metals.

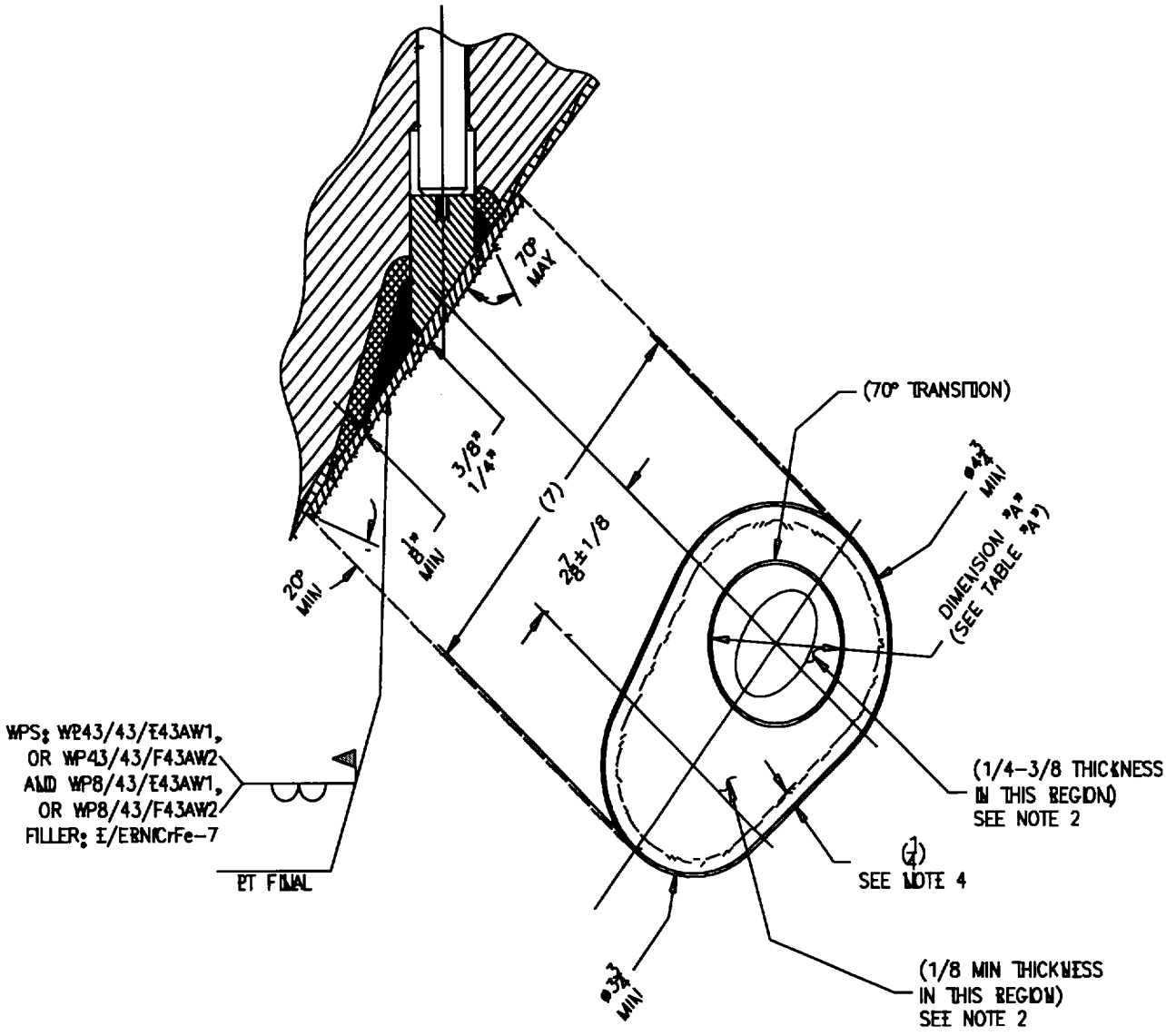
In conclusion, the use of Alloy 690 welding filler material (Inconel 52/152) and the associated AMSE Code Cases 2142-1 and 2143-1 for the repairs to the Oconee Unit 1 thermocouple and CRDM #21 nozzles will provide superior corrosion protection over that provided by Alloy 600 (Inconel 82/182) material. A detailed analysis of the specific application has produced acceptable results. The use of Alloy 690 has been previously authorized for new construction and other repair activities. Therefore, the proposed alternative provides an acceptable level of quality and safety.

Duration of the Proposed Alternative

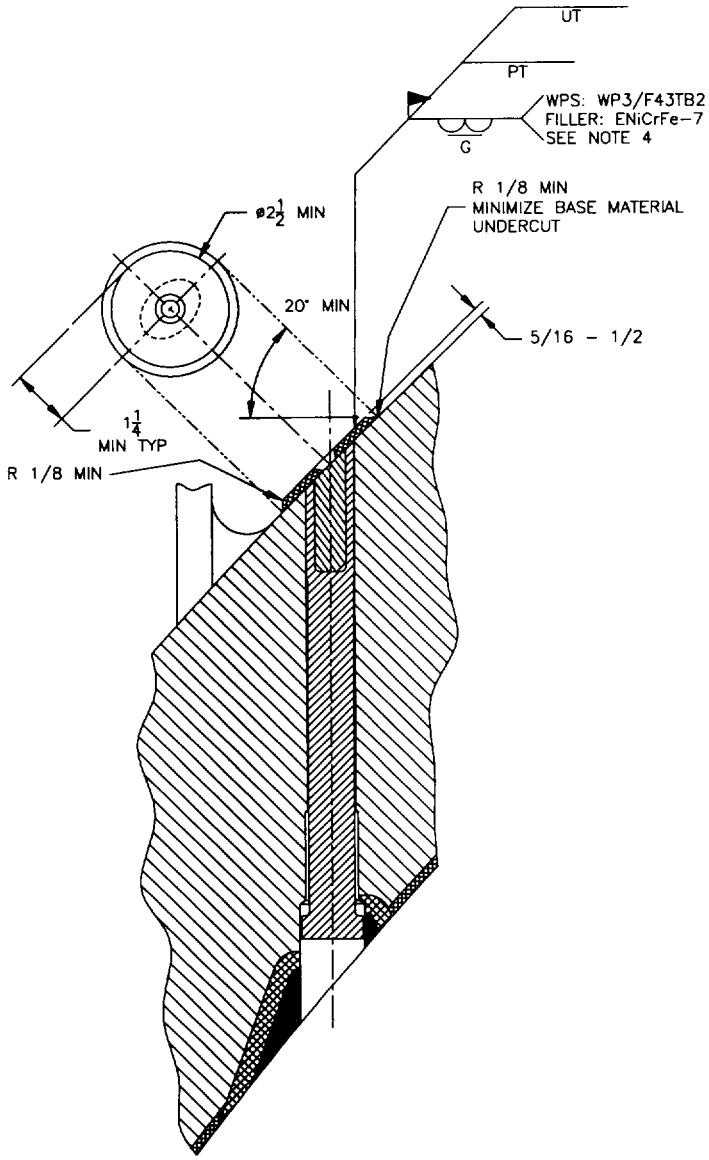
The proposed alternative applies only to the repairs to the Oconee Unit 1 Reactor Vessel head thermocouple and CRDM #21 nozzles.

Originated By: Timothy D. Brown 1-2-01
Timothy D. Brown Date

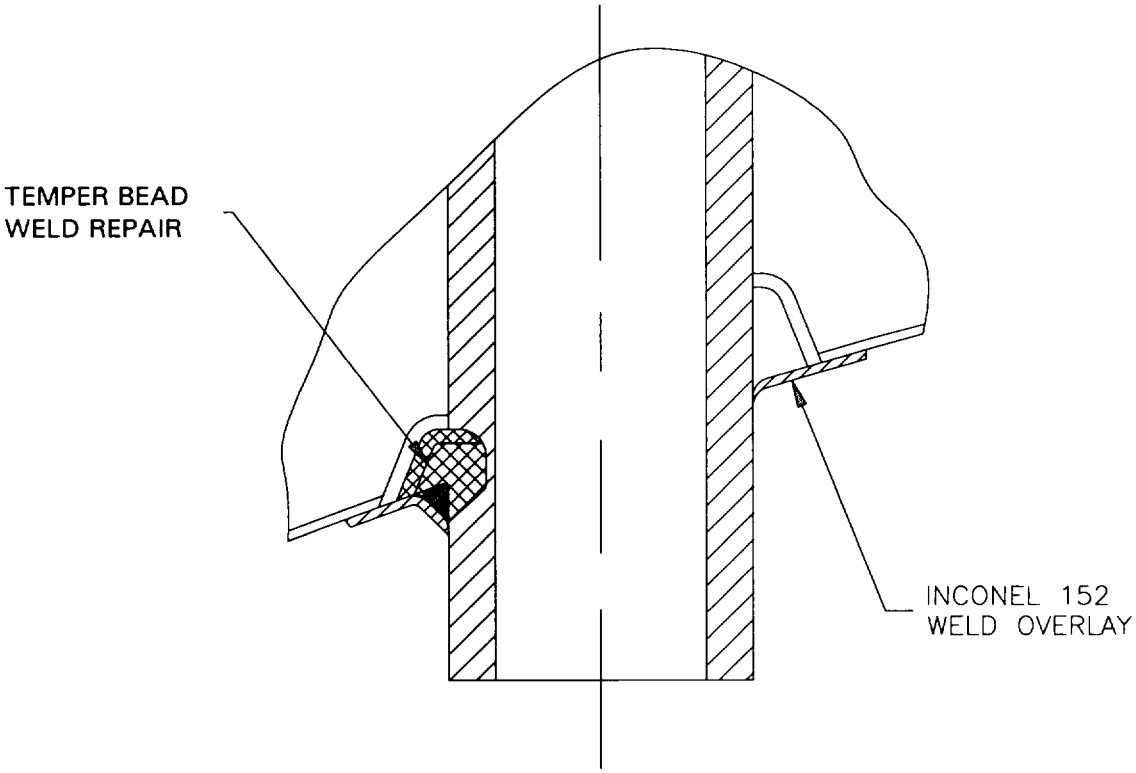
Reviewed By: L. J. Azzarello 1/2/01
Leonard J. Azzarello Date



Attachment 1
Thermocouple Repair Under the RV Head



ATTACHMENT 2
Thermocouple Penetrations # 2 and # 5
Repairs



ATTACHMENT 3
CRDM # 21 Nozzle and Weld Repairs