December 18, 2002

Mr. William R. McCollum, Jr.
Vice President, Oconee Site
Duke Energy Corporation
P.O. Box 1439
Seneca, South Carolina 29679

SUBJECT: OCONEE NUCLEAR STATION, UNIT 2 RE: RELIEF REQUESTS (RR) 02-07 AND RR 02-08 (TAC NO. MB6256)

By letter dated September 5, 2002, you submitted RR 02-07 and RR 02-08. This letter requested relief from certain requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, 1992 Edition for the reactor vessel head control rod drive mechanism penetration nozzle leak repair for Oconee Nuclear Station, Unit 2. Specifically, you proposed to perform the weld repair using alternative processes and alternatives to ASME non-destructive examination and flaw evaluation requirements.

The staff has completed its review as documented in the enclosed Safety Evaluation. For RR 02-07 and RR 02-08, the staff determined that complying with the code would result in hardship or difficulty without a compensating increase in the level of quality and safety. Therefore, RR 02-07 and RR 02-08 are authorized pursuant to 10 CFR 50.55a(a)(3)(ii). Both reliefs are authorized for the third 10-year interval through the end of the 20th refueling outage scheduled for the Spring of 2004. Our review and authorization of these reliefs is limited to this time period because you have committed to replace the reactor vessel head during the 20th refueling outage.

Sincerely,

/RA by AHowe for/

John A. Nakoski, 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

INSERVICE INSPECTION FOR OCONEE NUCLEAR STATION, UNIT 2

RELIEF REQUESTS (RR) 02-07 AND RR 02-08

DOCKET NO. 50-270

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 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. Oconee, Unit 1 is currently in its third 10-year ISI interval. Repair welding and inspections will be conducted in accordance with Section XI of the1992 Edition of the Code, Section III of the 1989 Edition of the Code, and alternative requirements discussed herein. Its Construction Code is the 1968 Edition with Winter 1968 Addenda of the Code, and its ISI Code of record is the 1989 Edition of Section XI of the Code. Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested relief from the requirements of certain Section III and Section XI Code requirements.

By letter dated September 5, 2002, the Duke Energy Corporation, the licensee, submitted RR 02-07 and RR 02-08 that requested relief from certain welding repair requirements. Specifically, the licensee requested relief from the ASME Code, Section III, 1989 Edition, subparagraph NB-4622 that requires elevated temperature preheat and post-weld soak, and ASME Code, Section XI, 1992 Edition, subparagraph IWA-4310 that requires defects be removed or reduced to an acceptable size. As an alternative, the licensee proposed a repair using a remotely operated, gas tungsten-arc welding (GTAW) process. The GTAW process utilizes an ambient temperature temper bead method with a 50 °F minimum preheat temperature and no post-weld heat treatment (PWHT). Defects not removed from the original J-groove weldment would be analytically evaluated for acceptability using the worst-case crack growth.

2.0 Reactor Pressure Vessel Closure Head Control Rod Drive Mechanism Nozzle Penetrations Repairs, RR 02-07

The Components affected by this request for relief are the 69 control rod drive mechanism (CRDM) penetrations on the reactor pressure vessel (RPV) head. In its letter, the licensee provided the Code requirements and the licensee's basis for relief. Following is the NRC staff's evaluation of RR 02-07.

2.1 Evaluation

2.1.1 Requirements

The 1989 Edition of ASME Section III, NB-4622.11, "Temper Bead Weld Repair to Dissimilar Metal Welds or Buttering," states that whenever PWHT is impractical or impossible, limited weld repairs to dissimilar metal welds of P-No. 1 and P-No. 3 material or weld filler metal A-No. 8 (Section IX, QW-442) or F-No. 43 (Section IX, QW-432) may be made without PWHT or after the final PWHT, provided the requirements of the subparagraphs NB-4622.11(a) through (g) are met.

The 1989 Edition of ASME Section III, NB-4453.4, "Examination of Repaired Welds," states that examination of a weld repair shall be repeated as required for the original weld. For partial penetration welds, NB-5245 requires a progressive surface examination at the lesser of ½ the maximum weld thickness or ½-inch as well as a surface examination on the finished weld.

The 1992 Edition of ASME Section XI, IWA-4710(a), states that after a welded repair on a pressure retaining boundary or the installation of a replacement by welding, a system hydrostatic test shall be performed in accordance with IWA-5000.

The 1989 Edition of ASME Section III, IWB-4331, states that all welding procedure qualification tests shall be in accordance with the requirements of Section IX as supplemented or modified by the requirements of this Article.

2.1.2 Alternatives

The requirements of paragraphs NB-4451, 4452, 4453, and 4622 of the 1989 Edition of ASME Section III are also applicable to the contemplated repairs. As an alternative to the PWHT time and temperature requirements of NB-4622, the requirements of "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique" will be used as described in Enclosure 1 of the submittal. NB-4622.1 through NB-4622.10 are not applicable for the proposed alternative because they apply to a different welding process. The proposed alternative specifically applies to the following subparagraphs of ASME Section III, NB-4622.11.

The proposed alternative is a partial penetration weld described by NB-4244(d) that will meet the weld design requirements of NB-3352.4(d). In lieu of NB-5245, the proposed alternative for examination of the repair weld is to perform a liquid penetrant and ultrasonic examination no sooner than 48 hours after the weld has cooled to ambient temperature.

2.1.3 Basis for Relief with Evaluation

NB-4622.11 states that “Whenever PWHT is impractical or impossible, limited weld repairs to dissimilar metal welds of P-No. 1 and P-No. 3 material or weld filler metal A-No. 8 (Section IX, QW-442) or F-No. 43 (Section IX, QW-432) may be made without PWHT or after the final PWHT provided the requirements of the following subparagraphs are met.” The licensee will be using F-No. 43 Inconel filler weld material to join Inconel pipe to P-No. 3 carbon steel RPV head. The proposed alternative will significantly reduce radiation dose to repair personnel. The total radiation dose (assuming two nozzles for estimation purposes) for the proposed remote repair method is projected to be about 13 to 15 REM. The licensee estimates the dose accumulated to provide access, install heating pads and perform the preheat and post weld heat treatment required by the Construction Code would total an additional 11 to 12 REM. In contrast, using manual repair methods previously used for Oconee, Unit 3 would result in a total radiation dose of approximately 64 REM (4 times as much as the proposed alternative).

The function of PWHT is to minimize hydrogen cracking after welding, and to a lesser extent, reduce stresses associated with the transformation from austenitic to ferritic microstructures. The temper bead is expected to reduce transformation stresses. The licensee contends that the tight controls necessary for automatic temper bead GTAW creates a low hydrogen environment around the molten metal during the welding process. The GTAW process uses bare electrodes with no flux to trap moisture, and shields the molten puddle with high purity argon gas (99.999 percent pure). The repair area is essentially free of hydrocarbons and moisture. In addition, the combined effects from the confined welding location under the head, from the absence of external winds, and hydrogen preference for hydrogen crack resistant austenitic weld metal all contribute to the reduction of dissolved hydrogen in the metal, thus lessening the likelihood of hydrogen cracking. Based on the above discussion, PWHT of the CRDM, J-groove, and surrounding vessel head entails significant effort by the licensee with little or no noticeable effect over the same repair made without PWHT. The welding procedures used by the licensee were qualified without PWHT. Therefore, the staff finds that a PWHT will result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The licensee will satisfy the Code-requirements of Sub-subsections NB-4622.11(a), NB-4622.11(b), NB-4622.11(c)(1), NB-4622.11(e), and NB-4622.11(g).

NB-4622.11(c)(2) requires the use of the shielded metal arc welding process with covered electrodes meeting either the A-No. 8 or F-No. 43 classifications. The proposed alternative utilizes GTAW with bare electrodes meeting either the A-No. 8 or F-No. 43 classifications.

NB-4622.11(c)(3) discusses requirements for covered electrodes pertaining to hermetically sealed containers or storage in heated ovens. These requirements do not apply because the proposed alternative uses bare electrodes that do not require storage in heated ovens since bare electrodes will not pick up moisture from the atmosphere.

NB-4622.11(c)(4) discusses requirements for storage of covered electrodes during repair welding. These requirements do not apply because the proposed alternative utilizes bare electrodes that do not require any special storage conditions to prevent the pickup of moisture from the atmosphere.

NB-4622.11(c)(5) requires preheat to a minimum temperature of 350 °F prior to repair welding, a maximum interpass temperature of 450 °F and that thermocouples and recording instruments shall be used to monitor the metal temperature during welding. In lieu of using thermocouples for interpass temperature measurements, calculations show that the maximum interpass temperature will never be exceeded based on the maximum allowable low welding heat input, weld bead placement, travel speed, and conservative preheat temperature assumptions. The calculations show that using the maximum heat input through the third layer of the weld, the interpass temperature returns to near ambient temperature. Heat input beyond the third layer will not have a metallurgical effect on the low alloy steel heat affected zone but will affect grain growth and ultrasonic testing (UT). A welding mockup on the full size Midland RPV head was used to demonstrate the proposed alternative. During welding of the mockup, the temperature variations were less than 15 °F throughout the welding cycle. The proposed ambient temperature temper bead alternative does not require elevated temperature preheat.

NB-4622.11(c)(6) establishes requirements for electrode diameters for the first, second, and subsequent layers of the repair weld and requires removal of the weld bead crown before deposition of the second layer. Because the proposed alternative uses weld filler metal much smaller than the 3/32, 1/8, and 5/32-inch electrodes required by NB4622.11(c)(6), the requirement to remove the weld crown of the first layer is unnecessary. The smaller diameter weld rods used for the proposed alternative lay down a thinner layer of weld metal with each pass. The controls on the automatic welding process produces a smooth weld surface with sufficient heat to relieve the stresses in the preceding layer. Therefore, the proposed alternative does not include the removal of the weld bead crown or PWHT.

NB-4622.11(c)(7) requires the preheated area to be heated from 450 °F - 660 °F for a period of at least 4 hours after a maximum of 3/16-inch of weld metal has been deposited. As discussed in the licensee’s basis for relief and the Electric Power Research Institute Report GC-111050, “Ambient Temperature Preheat for Machine GTAW Temperbead Applications,” the proposed alternative does not require heat treatment because the GTAW temper bead process uses extremely low hydrogen electrodes and shields the weld area and molten metal with argon thus making a hydrogen bake-out unnecessary.

NB-4622.11(c)(8) requires welding subsequent to the hydrogen bake-out of NB4622.11(c)(7) be done with a minimum preheat of 100 °F and maximum interpass temperature of 350 °F. The proposed alternative limits the interpass temperature to 350 °F and requires the area to be welded be at least 50 °F prior to welding. These limitations have been demonstrated to be adequate to produce sound welds and are the same limits in Code Case N-638, “Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique,” that was endorsed by the staff in the Draft Regulatory Guide DG-1091, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1.”

NB-4622.11(d)(1) requires a liquid penetrant test (PT) examination after the hydrogen bake-out described in NB-4622.11(c)(7). The proposed alternative does not require the hydrogen bake-out because the very low hydrogen ambient GTAW temper bead welding process makes it unnecessary. The PT will be performed as a post-weld examination.

NB-4622.11(d)(2) requires liquid penetrant and radiographic test (RT) examinations of the repair welds after a minimum of 48 hours at ambient temperature. Ultrasonic inspection is required if practical. The proposed alternative includes the requirement to inspect after a minimum of 48 hours at ambient temperature. For an effective RT examination, the radioactive source and film must be placed in a location such that the material thickness between them is fairly constant and that exposure to extraneous radiation is minimized. This special designed weld configuration is not conducive to RT examinations. The proximity of other penetrations would limit the ability to place a source. The RPV head curvature would interfere with the source to film alignment causing image distortion and geometric unsharpness. The effect of the RPV head geometry would involve continuous variation in material thickness from one edge of the radiograph to the other, with consequent difficulty in achieving acceptable film densities. Also, the radiation field on contact with the head would result in fogging of the RT film and affect interpretation of the results. Therefore, examinations by the ultrasonic method will be used in lieu of examinations by the radiographic method defined by IWA-4533. The effectiveness of the UT was demonstrated on a mockup temper bead weld involving the same material as will be used for this repair.

NB-4622.11(d)(3) requires that all nondestructive examinations (NDE) be in accordance with NB-5000. The proposed alternative will comply with NB-5000 for the NDE that will be used. In lieu of the progressive PT required by NB-5245 and RT required by NB-4622.11(d)(2), the proposed alternative will use PT and UT in accordance with NB-5000 for examinations of the final weld.

NB-4622.11(f) establishes requirements for the procedure qualification test plate. The proposed alternative complies with those requirements, except the root width and included angle of the cavity will be no greater than the minimum specified for the repair. This is more stringent in the proposed alternative than in NB-4622.11(f). The proposed alternative also includes the additional provisions of ASME Section III, paragraph NB-4335.2, for adjustment of the nil ductility temperature (RT_{NDT}) if required by the results of the procedure qualification.

As part of the preparation for the weld repair[1], the licensee's contractor fabricated a weldment for demonstrating a CRDM field repair. An examination of an as-welded cross-section revealed a defect identified by the contractor as a weld solidification anomaly. This anomaly is located where three different metals come together (triple point): Alloy 600 CRDM, carbon steel RPV head, and Alloy 690 weld metal. A cross-section made of the triple point showed a void between the CRDM and RPV head extending into the weld metal. The void surface was jagged with two crack like projections curving into the weld metal. The cross-section magnification was insufficient to identify the cause of the curved crack like projections. The existence of the void and crack like projections create an indeterminate condition (anomaly). Because of the limited information pertaining to the origin of the anomaly, the staff considers it a defect that must be

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[1] Framatome ANP, "CRDM Nozzle ID Temper Bead Weld Repair Process Qualification," BAW-2409P, September 2001.

monitored, analyzed, or a combination thereof, in the event that Oconee, Unit 2 does not replace the RPV head at the end-of-cycle 20 refueling outage in the Spring of 2004.

Based on the above discussions, the staff has determined that the proposed alternative to use the ambient temperature temper bead process in lieu of the Code-required temper bead process will produce a sound, inspectable, permanent repair weld. The repair weld assures adequate structural integrity. Therefore, compliance with the specified Code-required RT examination would result in hardship or difficulty without a compensating increase in the level of quality and safety.

For the repair welds, the licensee stated that in lieu of the progressive surface examinations required by subparagraph NB-4453.4 and paragraph NB-5245, the examination of the repair weld will include liquid PT and UT examinations of the finished weld. ASME Section III, 1992 Edition, paragraph NB-5245 gives the NDE requirements for partial penetration welds. The requirements are to conduct progressive magnetic particle or liquid PT examinations. The finished surface is also to be examined by one of these methods. However, the licensee has proposed to eliminate the progressive surface examinations and to conduct a surface examination and a UT examination of the finished surface after the completed weld has been at ambient temperature for at least 48 hours. The staff finds that the progressive examinations would be difficult to conduct because of interferences caused by the presence of the automatic GTAW welding equipment. The surface examinations will identify any surface penetrating flaws. The UT examinations should find construction and repair related flaws when performed using appropriately qualified processes and personnel.

The staff has concluded that NB-5245 is not the appropriate Code section that applies to the repair since the weld configuration is not that of a partial penetration weld. The repair weld is actually a specially designed structural weld that is used to reestablish the pressure boundary between the CRDM nozzle and RPV head. The weld configuration is not addressed by the figures referenced by IWB-2500-1. For analysis purposes, the licensee evaluated the weld to meet the structural requirements of a partial penetration weld, and for integrity purposes, the licensee performed surface and volumetric examinations. The staff has determined that the proposed surface and volumetric examinations of the repair welds are acceptable for verification of weld integrity.

IWA-4710(a) and IWA-5214 state that after a repair weld is made on a pressure retaining boundary or the installation of a replacement by welding, a system hydrostatic test shall be performed in accordance with IWA-5000. The licensee has proposed to perform a system leakage test in lieu of the system hydrostatic test, similar to that described in Code Case N-416-1 for ISI requirements. The NRC has endorsed the use of Code Case N-416-1. One of the conditions imposed by Code Case N-416-1 for use of a system leakage test is that the NDE requirements of the applicable subsection of ASME, Section III, 1992 Edition be met. Since the weld configuration of the proposed weld is not addressed in Section III, no Code-required NDE can be referenced, and therefore, the proposed NDE is acceptable for this purpose. Based on the arguments about the acceptability of the licensee’s proposed alternative to NB-5245 as discussed in the preceding paragraphs, the staff finds the performance of a system leakage test as proposed by the licensee to be an acceptable alternative to the Code-required post-repair system hydrostatic test.

Based on the above evaluation, the staff finds that compliance with the Code-required in-process and post-repair examination requirements would result in hardship or difficulty without a compensating increase in the level of quality and safety, and that the licensee's proposed alternative to perform post-repair surface and ultrasonic examinations and a system leakage test, in lieu of the Code-required post-repair examination requirements, is acceptable.

2.2 Conclusion

Based on the discussion above for RR 02-07, the staff has concluded that the proposed alternative to use the ambient temperature temper bead process as verified by the proposed in-process and repair examinations described by the licensee will assure adequate structural integrity, provided no anomaly exists at the triple point. If an anomaly exists and the licensee determines that the anomaly is acceptable for continued service, the licensee must follow the provisions of IWB-2420(b) and (c) regarding successive inspections to ensure weld integrity. Based on the above evaluation, the staff concluded that compliance with the Code-required in-process and post-repair examination requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, the proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the third 10-year interval through the end of the 20th refueling outage in the Spring of 2004.

3.0 Evaluation of Flaws in the J-Groove Weld, RR 02-08

The components affected by this request for relief are the 69 vessel head penetrations on the RPV head of Oconee, Unit 2. In its submittal, the license provided the Code requirements and the licensee's basis for relief. Following is the NRC staff's evaluation of RR 02-08.

3.1 Evaluation

3.1.1 Requirements

The 1992 Edition of ASME Section XI, IWA-4310 requires that "Defects shall be removed or reduced in size in accordance with this paragraph.... the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with the appropriate flaw evaluation rules of Section XI or the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III." ASME Section XI, IWA-3300 requires characterization of flaws detected by inservice examination.

NB-5330(b) requires that "Indications characterized as cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length." The new pressure boundary weld that will connect the remaining portion of the CRDM nozzles to the low alloy RPV head could contain a material "triple point." The triple point is at the root of the weld connecting the Alloy 600 CRDM nozzle, Alloy 690 weld material, and carbon steel RPV head. Welding demonstrations of the repair configuration show that a lack of fusion area may occur at the triple point (triple point anomaly).

IWB-3142.4 references IWB-2420(b) that requires "the areas containing flaws or relevant conditions shall be reexamined during the next three inspection periods listed in the schedule of the inspection program of IWB-2400."

3.1.2 Alternative

The licensee determined that none of the volumetric NDE methods can characterize the cracks in the J-groove weld in accordance with any of the paragraphs or subparagraphs of IWA-3300. In lieu of the requirements of IWA-3300, the proposed repair does not include removal of any cracks discovered in the remaining J-groove partial penetration weld. Therefore, according to the requirements of IWA-4310, the cracks must be evaluated using the appropriate crack evaluation rules of Section XI. The actual dimensions of the cracks cannot be fully determined as required by IWA-3300. Therefore, in lieu of fully characterizing the existing cracks, the licensee proposes using worst-case assumptions to conservatively estimate the crack extent and orientation with the rules of IWB-3600.

In lieu of the requirements of NB-5330(b), the licensee plans on dispositioning the triple point anomaly according to the appropriate flaw evaluation rules of Section XI. The licensee has stated that calculations have been completed that justify this welding solidification anomaly.

3.1.3 Basis for Relief and Evaluation

The repair being proposed by the licensee will move the pressure boundary from the J-groove weld to the temper bead repair weld. The licensee conducted a finite element analysis of the penetration and proposed a maximum flaw depth of 1-3/8 inches with the crack blunting when it enters the low alloy steel vessel material. The licensee conducted a fracture mechanics analysis and proposed that the only way that the flaw could propagate was by thermal fatigue caused by heat-up/cool-down cycles and that the flaw size would remain acceptable for 150 heat-up/cool-down cycles. The licensee evaluated the possibility of debris generation (loose parts) as a result of leaving the flaws in service and could not find a plausible mechanism for generating debris.

The staff has determined that characterization of any cracks in the J-groove weld region is extremely difficult to UT due to the compound curvature and acoustical interference inherent in the materials and between materials. These conditions prevent ultrasonic coupling and control of the sound beam that is necessary for sizing cracks with any degree of confidence. The angle of incidence from the outer surface of the closure head base material does not permit perpendicular interrogation by UT using shear wave techniques for circumferentially oriented flaws and the physical proximity of the nozzle does not allow for longitudinal scrutiny of the area of interest. Cladding will provide an acoustic interface that will severely limit a confident examination of the weld material and characterization of an existing flaw. RT of this area is impractical because flaws oriented perpendicular to gamma and x-rays are difficult to detect and the triple point anomaly would mask any flaws behind it. Dye PT examination will show linear surface growth; however, the linear growth can only indicate if there is large volume growth.

IWA-3300(a) of the ASME Code states that flaws detected by the preservice and inservice examinations shall be sized by the bounding rectangle or square for the purpose of description and dimensioning. IWA-3300(b) of the ASME Code states that flaws shall be characterized in accordance with IWA-3310 through IWA-3390, as applicable. IWB-3132.4(a) of the ASME Code states that components whose volumetric or surface examination reveal flaws that exceed the acceptance standards listed in Table IWB-3410-1 shall be acceptable for service without flaw removal, repair, or replacement if an analytical evaluation, as described in IWB-3600, meets the acceptance criteria of IWB-3600. The licensee proposed that the cracks be accepted by analysis of the worst case that might exist in the J-groove. For the analysis, the licensee assumed that crack growth was limited to the Alloy 600 J-groove weld. The blunting of crack at the carbon steel vessel-to-nozzle is supported by plant experiences.

IWB-3132.4(b) of the ASME Code states where the acceptance criteria of IWB-3600 are satisfied, the area containing the flaw shall be subsequently reexamined in accordance with IWB-2420(b) and (c). IWB-2420(b) states if the flaw indications or relevant conditions are evaluated in accordance with IWB-3132.4 or IWB-3142.4, respectively, and the component qualifies as acceptable for continued service, the areas containing such flaw indications or relevant conditions shall be reexamined during the next three inspection periods listed in the schedules of the inspection programs of IWB-2410. The remaining flaws (if any are present) are no longer in a pressure retaining weld and, based on industry experience, they would arrest at the weld butter and RPV head interface. The licensee has analyzed the flaw as acceptable for continued service based on the flaw growing to this size. Successive nondestructive examination would not provide any meaningful information because of the difficulty in characterizing the actual flaws. In order to satisfy Code the licensee would have to completely remove the crack from the J-groove weld that experience has shown to stay confined to the J-groove weld. Since the RPV head is scheduled for replacement in the Spring of 2004, the additional effort and dosage associated with the removal of the crack would impose hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The staff's review of a cross-section made of the triple point showed a void between the CRDM and RPV head extending into the weld metal. The void between the CRDM and RPV head do not appear to be connected with the welding process but could be caused by erosion, corrosion, or fabrication. However, the void extending into the weld metal also had two crack like projections curving into the weld metal. The cross-section magnification was insufficient to identify the cause of the curved crack like projections. The existence of the void and crack like projections create an indeterminate condition (anomaly). If the anomaly is inherent to the welding process, the qualification of the welding procedure is in question. Because of the limited information pertaining to the origin of the anomaly, the staff considers it a defect that must be analyzed (if possible, for the different types of flaws common to these materials) and monitored for changes in size, shape, and acoustic characteristics.

The licensee considered crack growth from fatigue and corrosion. An analytical evaluation for fatigue crack growth was performed that determined a crack would only grow 0.003-inches in 20 years. As for corrosion, the licensee determined that the flaw (indeterminate defect) was not exposed to the primary coolant and is on the side of the weld, therefore free of corrosion. If the RPV head were not being replaced in the Spring of 2004, the staff would need a better understanding of the indeterminate defect before any long term projections on its behavior could be made.

The inspection schedule is based on the service life of the repairs described herein. A Framatome ANP evaluation has determined the amount of time needed for a crack to grow 75 percent through-wall in the Alloy 600 nozzle material above the repair weld. The evaluation considered CRDM nozzles both in the as-repaired condition and following abrasive water jet (AWJ) remediation. The evaluation is for initiation and crack growth due to primary water stress corrosion cracking. If AWJ mitigation is used, the estimated corrosion time to breach the AWJ compressive residual stress layer and the estimated crack growth time to 75 percent through-wall would yield 14.6 EFPY estimated service life. The current schedule includes AWJ remediation for the Oconee, Unit 2 CRDM repairs.

3.2 Conclusion

Based on the discussion above for RR 02-08, the staff has concluded that the proposal to leave cracks in the nonpressure boundary portion of the remaining J-groove partial penetration weld and to evaluate crack growth using the appropriate ASME Section XI criteria for a worst case crack growth scenario is acceptable. Also, based on the discussion above, the staff has concluded that flaws left in the J-groove penetration weld need not be reexamined during the next three inspection periods. However, if a triple-point anomaly exists following the new pressure boundary weld repair and the licensee determines that the anomaly is acceptable for continued service, the licensee must follow the provisions of IWB-2420(b) and (c) regarding successive inspections to ensure weld integrity. Further, based on the licensee’s anticipated replacement of the RPV head at the end of the 20th refueling outage in the Spring of 2004, the actions of the licensee provide reasonable assurances of structural integrity for the planned CRDM repair. Therefore, the licensee's proposed alternative for disposition of cracks in the J-groove weld as described in RR 02-08 and addressing the staff’s concerns pertaining to the triple point anomaly provides reasonable assurance of structural integrity for the remaining life of the RPV head. Compliance with the specified Code-requirements 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), Relief Request 02-08 is authorized for the third 10-year interval through the end of cycle 20 in the Spring of 2004.

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Date: December 18, 2002

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