December 11, 2001

Mr. Dale E. Young, Vice President
Crystal River Nuclear Plant (NA1B)
ATTN: Supervisor, Licensing & Regulatory Programs
15760 W. Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: CRYSTAL RIVER NUCLEAR PLANT, UNIT 3, SAFETY EVALUATION FOR THIRD 10-YEAR INTERVAL, INSERVICE INSPECTION PROGRAM - RELIEF REQUESTS 01-0002-RR, REVISION 0, AND 01-0003-RR, REVISION 0 (TAC NO. MB2881)

Dear Mr. Young:

In a letter dated September 11, 2001, as supplemented by electronic mail correspondence on October 12 and 14, 2001, Florida Power Corporation (FPC) submitted Relief Requests 01-0002-RR, Revision 0, and 01-0003-RR, Revision 0, seeking relief from certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI, 1989 Edition with no Addenda. Specifically, FPC requested relief from dissimilar metal welding with the temper bead technique and complete flaw removal prior to repair. The relief is requested for the third 10-year inservice inspection interval at Crystal River, Unit 3. Based on the attached safety evaluation, the Nuclear Regulatory Commission (NRC) staff finds Relief Requests 01-0002-RR, Revision 0, and 01-0003-RR, Revision 0, acceptable. Based on initial detailed review of the information provided by FPC, the NRC granted verbal approval of the Relief Requests on October 4, 2001, and reconfirmed approval on October 17, 2001.

If you have any questions, please contact John Goshen at 301-415-1437.

Sincerely,

/RA/

Richard C. Correia, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM

RELIEF REQUESTS 01-0002-RR, REVISION 0

AND 01-0003-RR, REVISION 0

CRYSTAL RIVER NUCLEAR PLANT UNIT 3

FLORIDA POWER CORPORATION

DOCKET NUMBER 50-302

1.0 INTRODUCTION

By letter dated September 11, 2001, the Florida Power Corporation (FPC, the licensee), requested relief from certain welding repair requirements. Specifically, FPC requested relief from the American Society of Mechanical Engineers (ASME) Code, Section XI 1989 Edition, subparagraph IWA-4120(a), which requires repairs be made in accordance with the Owner's Design Specification and the original construction of the component or system. The relief is requested for the third 10-year inservice inspection (ISI) interval at Crystal River Unit 3 (CR-3).

The ISI of the 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, *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). As stated, in part, in 10 CFR 50.55a(a)(3), 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 ISI 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. The ISI code of record for the third 10-year ISI interval at CR-3 is the 1989 Edition with no Addenda of Section XI of the ASME Code.

2.0 REACTOR PRESSURE VESSEL CLOSURE HEAD CONTROL ROD DRIVE MECHANISM NOZZLE PENETRATIONS REPAIRS, RELIEF REQUEST NO. 01-0002-RR, REVISION 0

The Components affected by this request for relief are the 69 control rod drive mechanism (CRDM) penetrations on the reactor pressure vessel (RPV) head.

2.1 Code Requirements for Which Relief Is Requested

CR-3 is currently in its third 10-year ISI interval. Repair welding and inspections will be performed according to the 1989 Edition of Section III and Section XI of the Code. Their Construction Code is the 1968 Edition with Winter 1968 Addenda of the Code, and their ISI Code of record is the 1989 Edition of Section XI of the Code. Pursuant to 10 CFR 50.55a(a)(3)(i), FPC requested relief from the requirements of the following Section II/Section XI Code requirements:

IWA-4120(a), which requires that repairs be performed in accordance with ASME Section III or ASME Section IX;

IWA-4530, which pertains to a half bead weld technique with a specified post weld heat treatment (PWHT);

NB-4622.11, which pertains to a temper bead weld process whenever PWHT is impractical or impossible;

IWA-4330(b), which states “Where repair welding is required, the cavity shall be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding”;

IWA-4700(a), which states “After repairs by welding on pressure retaining boundary, a system hydrostatic test shall be performed in accordance with IWA-5000”;

IWA-5211(d), which states that a system hydrostatic test be conducted during plant shutdown at a pressure above nominal operating pressure or system pressure for which overpressure protection is provided;

NB-3357 which, states “All vessels and vessel parts shall be given the appropriate post weld heat treatment prescribed in NB-4620”;

NB-4622, which gives the PWHT time and temperature requirements; and,

NB-5245, which states for partial penetration welded joints, “. . . shall be examined progressively using either magnetic particle or liquid penetrant (PT) methods.”

2.2 Licensee’s Proposed Alternative to Code

The alternative proposed, in lieu of IWA-4120(a), IWA-4530, and NB-4622.11, is to perform the repair in accordance with the requirements outlined in Code Case N-638, “Similar and Dissimilar Welding Using Ambient Temperature Machine Gas Tungsten Arc Weld (GTAW)

Temper Bead Technique" as modified to represent the specific repair method. The code case is written for instances when the welding is performed on components that cannot be drained because it is impractical, either for operational or radiological reasons. This condition does not apply to the vessel head. In addition, the code case is written for full penetration welds rather than partial penetration welds.

The alterative proposed for IWA-4330(b) is to use machining in place of grinding because machining provides an acceptable surface.

The alternative proposed for IWA-4700(a) and IWA-5211(d) is to conduct a system leakage test in lieu of a hydrostatic test in accordance with Code Case N-416-1. This is an approved code case that does not require relief.

The alternative proposed for NB-3357 and NB-4622 is based on the methodology in Code Case N-638 where no PWHT will be performed.

The alternative proposed for NB-5245 is to perform PT and ultrasonic testing (UT) on the finished weld. Progressive PT will not performed.

2.3 Licensee's Basis for Relief

The licensee has stated that the use of an ambient temperature temper bead welding process provides and acceptable level of quality and safety when compared to the temper bead welding process described in Section XI. To justify this repair method, the licensee provided the following information.

The licensee will conduct visual inspections for leakage of boric acid deposits in the vicinity of the CRDM nozzle penetrations during Refueling Outage 12. If any nozzles exhibit leakage, they will be repaired using remote machine repair techniques similar to those used at Oconee Unit 2.

Nondestructive examinations (NDE) using ultrasonic methods are planned for the base metal of nozzles determined to have through-wall leakage.

The licensee proposes to roll expand the leaking nozzle above the leak so that the nozzle will not move during the repair process. A semiautomatic machining tool operating under the head will remove the lower portion of the penetration and perform the CRDM nozzle weld preparation. The machine surface will be cleaned and examined using PT. The repair weld will be made using a remotely operated GTAW process using the ambient temperature temper bead process. The filler material will be ERNiCrFE-7 (Alloy 52). The final weld face, not including the taper transition, will be machined then examined using PT and UT.

Recent experience from the performance of manual repairs at other plants CRDM nozzles indicated that the more remote, automated repair methods are needed to reduce radiation dose to repair personnel and still provide acceptable levels of quality and safety.

The applicant estimated that the repair of four leaking nozzles using the proposed repair method would result in a dose of between 12 and 13 rem. The additional dose accumulated by

performing the preheat and PWHT required by the construction code would total 5 to 6 rem. In contrast, using manual repair methods for the same repair would result in a total radiation dose of approximately 100 rem.

The automated repair method leaves a band of low alloy steel exposed to the primary coolant. Framatome-ANP (FRA_ANP) evaluated the effect of corrosion on the exposed area in terms of reduction in reactor vessel head thickness and primary coolant Iron (Fe) release rates. The results of this evaluation concluded that the total corrosion would be insignificant and the Fe release rates would be significantly less than the total Fe release from all other sources. The licensee at FPC has determined that this low rate of material loss and Fe release rates provide an acceptable level of safety.

The licensee conducted a three-dimensional finite element analysis on the new pressure boundary welds. The calculated stress values were compared to the ASME Code, Section III, NB-3000, criteria for: (1) design conditions, (2) normal, operating, and upset conditions, (3) faulted conditions, and (4) testing conditions. The stress values were found to be acceptable. The licensee has determined that this analysis shows that the repair methodology proposed for the CRDM nozzle penetration welds provides an acceptable level of quality and safety.

The licensee reviewed the procedure qualification work undertaken to date, which indicates the process produces sound and tough welds. Typical tensile test results have been ductile breaks in the weld metal. Charpy V-notch values in the heat-affected zone (HAZ) were generated by FRA-ANP and the absorbed energy, lateral expansion, and percent shear were significantly greater for the HAZ than the unaffected base material when tested at 50°F and 80°F. The licensee states that “It is clear from these results that the GTAW temper bead process has the capability of producing acceptable repair welds.”

The licensee concluded that quality temper bead welds can be performed with 50°F minimum preheat and no post weld heat treatment based on ASME committee approval of Code Case N-638 and FRA-ANP prior welding procedure qualification test data using machine GTAW ambient temperature temper bead welding. The qualification of the ambient temperature temper bead welding process demonstrates that the proposed alternative provides an acceptable level of quality and safety.

The licensee claims that the proposed alternative repair technique has been demonstrated as an acceptable method for performing RPV repairs. The ambient temperature temper bead technique has been approved by the ASME committee per Code Case N-638. The licensee also claimed that the ambient temperature temper bead technique has been approved by the NRC as having an acceptable level of quality and safety and used successfully at several utilities (Duane Arnold, Nine Mile Point, and Fitzpatrick).

2.4 Evaluation

The 1989 Edition of ASME, Section III, Paragraph 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 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 Using Ambient Temperature Machine GTAW Temper Bead Technique" (Enclosure 1) will be used. Specifically, alternatives are being proposed for the following subparagraphs of ASME, Section III, NB-4622:

NB-4622.1 establishes the requirement for PWHT of welds including repair welds. In lieu of the requirements of this subparagraph the licensee proposes to utilize a temper bead weld procedure, obviating the need for post weld stress relief.

NB-4622.2 establishes requirement for time at temperature recording of the PWHT and their availability for review by the inspector. This requirement of the subparagraph will not apply because the proposed alternative does not involve PWHT.

NB-4622.3 discusses the definition of nominal thickness as it pertains to time at temperature for PWHT. The subparagraph is not applicable in this case because the proposed alternative involves no PWHT.

NB-4622.4 establishes the holding times at temperature for PWHT. The subparagraph is not applicable in this case because the proposed alternative involves no PWHT.

NB-4622.5 establishes PWHT requirements when different P-number materials are joined. This subparagraph is not applicable because the proposed alternative involves no PWHT.

NB-4622.6 establishes PWHT requirements for nonpressure retaining parts. The subparagraph is not applicable in this case because the potential repairs in question will be to pressure retaining parts. Furthermore, the proposed alternative involves no PWHT.

NB-4622.7 establishes exemptions from mandatory PWHT requirements. Sub-subparagraphs 4622.7(a) through 4622.7(f) are not applicable in this case because they pertain to conditions that do not exist for the proposed repairs. Sub-subparagraph NB-4622.7(g) discusses exemptions to weld repairs to dissimilar metal welds if the requirements of subparagraph NB-4622.11 are met. This sub-subparagraph does not apply because the ambient temperature temper bead repair is being proposed as an alternative to the requirements of subparagraph NB-4622.11.

NB-4622.8 establishes exemptions from PWHT for nozzle to component welds and branch connection to run piping welds. Sub-subparagraph 4622.8(a) establishes criteria for exemption of PWHT for partial penetration welds. This is not applicable to the proposed repairs because the criteria involve buttering layers at least 1/4 inch thick which will not exist for the welds in question. Sub-subparagraph NB-4622.8(b) also does not apply because it discusses full penetration welds and the welds in question are specially designed pressure boundary, structural welds.

NB-4622.9 establishes requirements for temper bead repairs to P-No. 1 and P-No. 3 materials and A-Nos. 1, 2, 10, or 11 filler metals. The subparagraph does not apply in this case because the proposed repairs will involve F-No. 43 filler metals.

NB-4622.10 establishes requirements for repair welding to cladding after PWHT. The subparagraph does not apply in this case because the proposed repair alternative does not involve repairs to cladding.

NB-4622.11 discusses temper bead weld repair to dissimilar metal welds or buttering and would apply to the proposed repairs as follows.

Sub-subparagraph NB-4622.11(a) requires surface examination prior to repair in accordance with NB-5000 (NB-4622.11(d)(3)). The proposed alternative will include surface examination prior to repair consistent with NB-5000.

Sub-subparagraph NB-4622.11(b) contains requirements for the maximum extent of repair. The proposed alternative includes the same limitations on the maximum extent of repair.

Sub-subparagraph NB-4622.11(c) discusses the repair welding procedure and welder qualification in accordance with ASME Section IX and the additional requirements of Article NB-4000. The proposed alternative will satisfy these requirements. In addition, NB-4622.11(c) requires the Welding Procedure Specification include the following requirements:

> NB-4622.11(c)(1) requires the area to be welded be suitably prepared for welding in accordance with the written procedure to be used for the repair. The proposed alternative will satisfy this requirement.
>
> NB-4622.11(c)(2) requires the use of the shielded metal arc welding (SMAW) 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, which 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. 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 NB-4622.11(c)(6), the requirement to remove the weld crown of the first layer is unnecessary and the proposed alternative does not include the requirement.

NB-4622.11(c)(7) requires the preheated area to be heated from 450°F-660°F for a period of 4 hours minimum. The proposed alternative does not require this heat treatment because the use of the extremely low hydrogen GTAW temper bead procedure does not require the hydrogen bake-out.

NB-4622.11(c)(8) requires welding subsequent to the hydrogen bake-out of NB-4622.11(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.

NB-4622.11(d)(1) requires a PT examination after the hydrogen bake-out described in NB-4622.11(c)(7). The proposed alternative does not require the hydrogen bake-out nor does it require the in-process PT examination.

NB-4622.11(d)(2) requires PT and radiographic examinations of the repair welds after a minimum of 48 hours at ambient temperature. UT is required if practical. The proposed alternative includes the requirement to inspect after a minimum of 48 hours at ambient temperature. The geometry of the RPV head and the orientation of the inner bore of the CRDM nozzles make effective radiographic examination impractical. The thickness of the RPV head limits the sensitivity of the detection of defects in the new pressure boundary weld. The density changes between the base and weld metal and residual radiation from the base metal would render the film image inconclusive. Therefore, examinations by the ultrasonic method will be used in lieu of examinations by the radiographic method defined by IWA-4533.

NB-4622.11(e) establishes the requirements for documentation of the weld repairs in accordance with NB-4130. The proposed alternative will comply with that requirement.

NB-4622.11(f) establishes requirements for the procedure qualification test plate. The proposed alternative complies with those requirements, except that the root width and included angle of the cavity are stipulated to be no greater than the minimum specified for the repair. In addition, the location of the V-notch for the Charpy test is more stringently controlled in the proposed alternative than in NB-4622.11(f).

NB-4622.11(g) establishes requirements for welder performance qualification relating to physical obstructions that might impair the welder's ability to make sound repairs which are particularly pertinent to the SMAW process. The proposed alternative involves a machine GTAW process and requires welding operators be qualified in accordance with ASME, Section IX. The use of a machine process eliminates concern about obstructions, which might interfere with the welder's abilities since these obstructions will have to be eliminated to accommodate the welding machine.

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 sound, permanent repair welds to assure adequate structural integrity, and that compliance with the specified Code requirements would result in hardship or difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the proposed alternative is acceptable.

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 PT and UT. 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 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 pressure boundary, structural weld used to reestablish the pressure boundary between the CRDM nozzle and RPV head. The weld configuration is not addressed by the ASME Code. For analysis purposes, the licensee has evaluated the weld to meet the structural requirements of a partial penetration weld, and for integrity purposes, the weld is surface and volumetrically examined. The staff has determined that the proposed surface and volumetric examinations of the repair welds are acceptable.

It is stated in IWA-4710(a) and IWA-5214 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 which is described in Code Case N-416-1 for inservice inspection requirements. The NRC has endorsed the use of Code Case N-416-1. One of the conditions imposed by CC-N416-1 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. Therefore, 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 as discussed, in lieu of the Code-required post-repair examination requirements, acceptable. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the proposed alternative is acceptable.

Per the 1989 Edition of ASME Section XI, Paragraph IWB-2200(a), no preservice examination is required for repairs to the J-groove welds between the vessel head and its penetrations (Examination Category B-E). However, the NDE performed after welding will serve as a preservice examination record if needed in the future. Furthermore, the inservice inspection requirement from Table IWB-2500-01, "Examination Category B-E . . . ," is a VT-2 visual inspection of the external surfaces of 25% of the nozzles each interval with IWB-3522 as the acceptance standard. Currently, the licensee performs visual examination, VT-2, of 100% of the nozzles each refueling outage. Bulletin 2001-01 and ongoing deliberations in Code committees will be monitored to determine the necessity of performing any additional or augmented inspections.

2.5 Conclusion

Based on the discussion above for Relief Request No. 01-0002-RR, the staff has concluded that the proposed alternative to use the ambient temperature temper bead process will assure adequate structural integrity, and that the proposed in-process and post-repair examinations as described by the licensee, provides an acceptable alternative to the code required examinations. Therefore, the proposed alternative and is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) for the third 10-year interval.

3.0 EVALUATION OF FLAWS IN THE J-GROOVE WELD, RELIEF REQUEST NO. 01-0003-RR, REVISION 0

The Components affected by this request for relief are the 69 vessel head penetrations on the RPV head.

3.1 Code Requirements for Which Relief Is Requested (as stated)

> ASME XI, IWA-3300 requires that flaws remaining in service be characterized by NDE and evaluated. FPC is requesting relief from ASME Section XI, Subsection IWA-3300(a) & (b). FPC will remove portions of the original weld to limit the size of flaws as allowed by IWA-4310. FPC is not requesting relief from IWA-4310. In lieu of fully characterizing the existing cracks, FPC proposes to utilize worst-case assumptions to conservatively estimate the crack extent and orientation as outlined in the relief request.
>
> The use of the term 'evaluated' with respect to the rules of IWB-3500 may be misleading. FPC proposes to allow potential flaws in the remaining J-groove weld to remain in place and evaluate and accept them in accordance with Section XI criteria as permitted by ASME Section XI 1992 Edition, IWA-4310.

The acceptance standards for flaws in Category B-E welds are described in IWB-3522, and are all based on visual inspection. However, as the reviewer points out, IWB-3600 contains criteria for the analytical evaluation of flaws, including acceptance criteria based on applied stress intensity factor (IWB-3612), which have been used here. Assuming a flaw extends through the entire depth of the chamfered J-groove weld, the evaluation shows that the flaw size in the combined J-groove weld and low alloy head resulting from continued service does not exceed the acceptable size and applied stress intensity factor limits. No relief is requested from IWB-3500 or IWB-3600.

3.2 Licensee's Proposed Alternative to Code

FPC does not plan on completely removing the flaws discovered in the remaining J-Groove partial penetration welds. IWA-4310 requires that the flaws be evaluated using the appropriate flaw evaluation rules of Section XI. Since no additional inspections are planned, the flaws will not be fully characterized. FPC will use worst-case assumptions to conservatively estimate the crack extent and orientation. The postulated crack extent and orientation will be evaluated using the rules of IWB-3500.

3.3 Licensee's Bases for Relief

CR-3 is going to inspect the reactor vessel closure head during the upcoming refueling outage for evidence of boron at the CRDM nozzle interface with the outside radius of the closure reactor vessel head. Supplemental examinations will be performed to confirm the existence of through-wall cracks that may exist in the original J-groove partial penetration welds or in the CRDM nozzle base material at these locations.

The licensee proposes to roll expand the leaking nozzle above the leak so that the nozzle will not move during the repair process. A semiautomatic machining tool operating under the head will remove the lower portion of the penetration and perform the CRDM nozzle weld preparation. The machine surface will be cleaned and examined using PT. The repair weld will be made using a remotely operated GTAW using the ambient temperature temper bead process. The filler material will be ERNiCrFE-7 (Alloy 52). The final weld face, not including the taper transition, will be machined then examined using PT and UT. After the repair is complete, the J-Grove weld will no longer serve as part of the pressure boundary.

The requirements of IWA-3500 allow two options for determining the disposition of flaws. The flaws are either removed as part of the repair process or left as-is and evaluated by the rules of IWB-3500. The repair proposed by FPC will progressively chamfer the J-Groove weld to maintain an acceptable flaw size.

The licensee conducted finite element analysis of the reactor vessel closure head to provide a worst-case flaw size and orientation. The licensee also conducted a fracture mechanics evaluation to determine if degraded J-Groove weld material could be left in the vessel. The maximum flaw size in the J-Groove could be up to 1-3/4 inch deep and would blunt when it hit the low alloy steel vessel material. The licensee postulated that the fatigue cracks growth could occur based on heat-up/cool-down cycles and that the postulated flaws would be acceptable for

150 heat-up/cool-down cycles. Finally, the licensee evaluated the potential for debris generation and could not identify a credible mechanism for debris generation. The licensee responded to questions about reinspection of the flaws as follows:

> IWB-3132.4(b) requires that flaws accepted by analytical evaluation be subsequently reexamined in accordance with IWB-2420(b) and (c). Inherent in the application of IWB-2420(b) and (c) is that the flaw has initially been characterized in accordance with IWA-3300, since this establishes the basis for comparison of subsequent examination results to those used to accept the original flaw in accordance with IWB-3600.
>
> Since the proposed nozzle repair includes relief from the requirements of IWA-3300, no initial characterization data exists. Therefore, there is no basis for comparison to subsequent examination results.
>
> In conclusion, if relief is granted from the requirements of IWA-3300, it follows that the subsequent examination requirements of IWB-2420(b) and (c), as invoked by IWB-3132.4(b), do not apply.

3.4 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 1-3/4 inches with the flaw 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 as a result of leaving the flaws in service and could not find a plausible mechanism for generating debris.

The staff has determined that examination of any flaws in the J-Groove weld region is impractical due to the configuration. The angle of incidence from the outer surface of the closure head base material does not permit perpendicular interrogation by ultrasonic shear wave techniques of 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 which will severely limit a confident examination of the weld material. Radiography of this area is impractical due to orientation of circumferentially oriented flaws being perpendicular to gamma and x-rays. Dye penetrant and magnetic particle examination will not provide useful volumetric information since these are surface techniques.

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 reveals flaws that exceed the acceptance standards listed in Table IWB-3410-1 shall be acceptable for service without the flaw removal, repair, or replacement if an analytical evaluation, as described in

IWB-3600, meets the acceptance criteria of IWB-3600. In the case of the as left J-Groove weld, the licensee has performed an analytical evaluation for a flaw based on the worst case assumptions.

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 junction of the clad, ferritic metal 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 as far as characterizing the flaws based on the impracticality of the examination as described before. Compliance with the specified requirements is impractical.

3.5 CONCLUSION

Based on the discussion above for Relief Request No. 01-0003-RR, the staff has concluded that the proposal to not completely removing the flaws discovered in the remaining J-Groove partial penetration welds is acceptable. IWA-4310 requires that the flaws be evaluated using the appropriate flaw evaluation rules of Section XI. Since no additional inspections are planned, the flaws will not be fully characterized. FPC will use worst-case assumptions to conservatively estimate the crack extent and orientation. The postulated crack extent and orientation will be evaluated using the rules of IWB-3500. Therefore, pursuant to 10 CFR 50.55a(g)(6)(i), the licensee's proposed alternative described Relief Request No. 00-0003-RR is granted for the third 10 year interval.

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