May 22, 2008

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 UNIT 3 – RELIEF REQUEST #08-001-RR, REVISION 1, TO INSTALL A WELD OVERLAY ON THE DISSIMILAR METAL WELD IN THE DECAY HEAT DROP LINE (TAC NO. MD8237)

Dear Mr. Young:

By letter dated March 7, 2008, with supplements dated March 12 and 26, 2008, Florida Power Corporation (the licensee) submitted for the U.S. Nuclear Regulatory Commission (NRC) staff review and approval, Relief Request #08-001-RR, Revision 1, for the installation of a full structural weld overlay on a degraded dissimilar metal weld in the decay heat drop line at Crystal River Unit 3. The relief request proposed an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section XI.

The NRC staff has reviewed the licensee's submittal and determined that the proposed alternative will provide an acceptable level of quality and safety. Therefore, pursuant to paragraph 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations*, the NRC staff authorizes the use of Relief Request #08-001-RR, Revision 1, for the spring 2008 maintenance outage.

On March 14, 2008, the NRC staff granted a verbal authorization on the use of Relief Request #08-001-RR, Revision 1. The enclosed safety evaluation is a written confirmation of the verbal authorization. If you have any questions regarding this issue, please contact Crystal River Project Manager, Farideh E. Saba at (301) 415-1447 or farideh.saba@nrc.gov.

Sincerely,

/RA/

Thomas H. Boyce, Chief
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosure: Safety Evaluation

cc w/enclosure: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST #08-001-RR, REVISION 1

CRYSTAL RIVER NUCLEAR PLANT, UNIT 3

FLORIDA POWER CORPORATION

DOCKET NO. 50-302

1.0 INTRODUCTION

By letter dated March 7, 2008, Florida Power Corporation (the licensee) submitted for the U.S. Nuclear Regulatory Commission (NRC) staff review and approval, Relief Request #08-001-RR, Revision 1, for the installation of a full structural weld overlay on a degraded dissimilar metal weld (DMW) in the decay heat drop line at Crystal River Unit 3. The relief request proposed an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME) Code, Section XI. The licensee proposed the relief request to be implemented during the spring 2008 maintenance outage.

By letters dated March 12 and 26, 2008, the licensee responded to the NRC staff's request for additional information and submitted the revised Relief Request #08-001-RR, Revision 1. The NRC staff evaluated Revision 0 and Revision 1 of the proposed relief request. However, Relief Request #08-001-RR, Revision 1, dated March 12, 2008 is the version upon which this safety evaluation is based.

A DMW is a weld that joins two pieces of metal that are not of the same material. In the proposed alternative, the DMW joins the ferritic (i.e., carbon steel) nozzle to the austenitic stainless steel safe end or piping. The DMW itself is made of nickel-based Alloy 82/182. The proposed weld overlay is a process by which weld filler metal that is resistant to stress corrosion cracking is deposited on the outside surface of the degraded pipe including the original pipe weld.

2.0 REGULATORY REQUIREMENTS

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must 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 (ISI) 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 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. Pursuant to 10 CFR 50.55a(a)(3) alternatives to requirements may be 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.

The code of record for the current third ISI interval is the 1989 Edition, no Addenda. In addition, the licensee will use Appendix VIII, "Performance Demonstration for Ultrasonic Examinations" of the 1995 Edition through 1996 Addenda of the ASME Code, Section XI, for ultrasonic examination of the weld overlay.

3.0 LICENSEE'S PROPOSED ALTERNATIVE

3.1 ASME Code Components Affected

The ASME Code component associated with this request is a high safety significant Class 1 DMW fabricated with Alloy 82/182 weld metal that is believed to be susceptible to primary water stress corrosion cracking (PWSCC). This alternative is to apply a full structural weld overlay (FSWOL) on the decay heat drop line nozzle to hot leg pipe weld (No. B4.5.254) on the "B" hot leg. The subject weld connects an ASME Code Class 1 component and is a part of the reactor coolant system. The examination category is R-A, which belongs to the Risk Informed ISI Program.

The "B" Hot Leg pipe decay heat nozzle is carbon steel A 105 Grade II (P-No. 1). Piping attached to the "B" hot leg decay heat nozzle weld is wrought seamless austenitic stainless steel A 376 TP 316 (P-No. 8). The diameter of the decay heat pipe is 12 inches and schedule 160. The nominal inside and outside diameters are 10.126 inches and 12.75 inches, respectively. The nominal pipe thickness is 1.312 inches. Weld and butter are Alloy 82/182 (F-No. 43).

3.2 Code Requirements

Crystal River Unit 3 is currently in the third 10-year ISI interval. The code of record for the current 10-year ISI interval is the ASME Code, Section XI, 1989 Edition, no Addenda. This is also the edition used for the Repair/Replacement Program.

The applicable Code requirements for which the relief is requested are:

> ASME Code Section XI, 1989 Edition, no Addenda, IWA-4120(a), IWA-4340(a).
>
> ASME Boiler and Pressure Vessel Code, Section XI, 1995 Edition through 1996 Addenda, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds"

3.3 Reason for Request

PWSCC has been identified as a degradation mechanism for Alloy 82/182 welds and weld buttering. During a maintenance outage that commenced on March 1, 2008, the licensee detected an indication via a linear phased array ultrasonic testing (UT) in the decay heat drop

line nozzle to “B” hot leg. The indication originated from the inner diameter of the weld and was approximately 65 percent through-wall at the outermost extent. The licensee had concluded that the application of a FSWOL over the decay heat nozzle Alloy 82/182 weld was the most appropriate course of action to ensure the integrity of the reactor coolant pressure boundary. The licensee would apply a full structural overlay during the March 2008 maintenance outage. The overlay was designed to improve the configurations for future examinations.

ASME Code Section XI, 1989 Edition, no Addenda does not provide rules for the design of weld overlays or for repairs without removal of flaws. In addition, ASME Code Case N-504-3, which has been approved by the NRC for use, does not address overlaying nickel alloy welds joining austenitic and ferritic base materials; therefore, the licensee proposed the following alternative.

3.4 Proposed Alternative

The licensee proposed a FSWOL for the nozzle weld identified above using Alloy 52M weld metal. References to Alloy 52M weld metal in the relief request were intended to include the use of 52M or 152 weld metal. According to the licensee, the FSWOL would extend around the full circumference of the existing nozzle Alloy 82/182 weld, overlapping the neighboring sections of low alloy steel nozzle and stainless steel piping. A FSWOL configuration typical of the one to be applied is shown in Enclosure 1, Figure 1 of the relief request.

The design of the overlay was based on the applicable rules of ASME Code Section XI and ASME draft Code Case N-740-2. The rules to be used for design and implementation are summarized in Enclosure 1, Attachments 1 and 2, of Relief Request #08-001-RR, Revision 1. For ease of reference, the licensee compared the requirements of ASME Code Case N-504-3 to the proposed method as shown in Enclosure 1, Attachment 3, of the March 12, 2008, submittal.

3.5 Duration of the Alternative

This proposed alternative was for application during the spring 2008 maintenance outage. The proposed alternative, once installed, would remain in place for the remaining service life of the affected components.

4.0 NRC STAFF EVALUATION

As stated above, Relief Request #08-001-RR, Revision 1, is based on ASME Code Case N-740-2, which contains most of the requirements in ASME Code Case N-504-3, “Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1,” and ASME Code Case N-638-1, “Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [gas tungsten arc welding] Temper Bead Technique Section XI, Division 1.”

The staff has endorsed ASME Code Cases N-504-3 and N-638-1 in Regulatory Guide (RG) 1.147, Revision 15, “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1,” but not ASME Code Case N-740-2. Therefore, the staff evaluated the acceptability of the proposed relief request based on the requirements of ASME Code Case N-504-3 and N-638-1. RG 1.147 requires that Appendix Q to the ASME Code Section XI, be used when using ASME Code Case N-504-3.

The NRC staff finds that, in Relief Request #08-001-RR, Revision 1, the licensee has addressed satisfactorily many technical issues related to the design, analysis, and examination of the weld overlay that the staff raised in its safety evaluations for Arkansas Nuclear One (ANO), Unit 1 weld overlay relief request ANO1-R&R-010, dated April 6, 2007 (Agencywide Documents Access and Management System [ADAMS] Accession Number ML070850915), Farley and Vogtle weld overlay Relief Request ISI-GEN-ALT-06-03, dated April 3, 2007 (ADAMS Accession Number ML070790240), and ANO-2 weld overlay relief request ANO2-R&R-005 dated March 17, 2008 (ADAMS Accession Number ML080660082). It is appropriate to compare Relief Request #08-001-RR, Revision 1 to the Farley , Vogtle, and ANO-2 relief requests because the weld overlay of DMW at Crystal River encounters the same technical issues as at those plants. The significant plant-specific issues and exceptions to ASME Code Cases N-504-3, N-638-1, and Appendix Q are discussed below.

4.1 General Requirements

The general requirements for the weld overlay design such as specifications of the base metal (carbon steel, stainless steel, and Alloy 82/182) and proposed weld overlay filler metal (Alloy 52M), surface condition of the base metal, and chromium content of the weld overlay deposits are provided in Enclosure 1, Attachment 1, Section A1.1, of Relief Request #08-001-RR, Revision 1. Enclosure 1, Attachment 3 of the proposed relief request provides a comparison of the requirements of ASME Code Case N-504-3 and Appendix Q of the ASME Code, Section XI with the requirements of ASME Code, Section A1.1. The technical issues related to the design, crack growth calculations, and nondestructive examination of weld overlay have been addressed in the NRC's safety evaluations of the ANO-1 and Farley and Vogtle relief requests. The NRC staff finds that the requirements of ASME Code, Section A1.1 are consistent with the requirements of ASME Code Case N-504-3 and Appendix Q with the following exception.

Section A1.1(c)(3) of Relief Request #08-001-RR, Revision 0, dated March 7, 2008, states that to reduce the potential of hot cracking when applying an austenitic nickel alloy over P-No. 8 base metal, it is permissible to apply a [buffer] layer of austenitic stainless steel filler metal over the austenitic stainless steel base metal.

Paragraph (e) of ASME Code Case N-504-3 requires weld reinforcement layers that are made of austenitic stainless steel to have a deposited delta ferrite content of at least 7.5 ferrite number (FN, also expressed in percentages). Alternatively, an as-deposited delta ferrite content of 5 FN may also be accepted provided this lower value is substantiated by evaluation. The staff asked the licensee to identify the austenitic stainless steel weld filler metal and to provide the maximum and minimum delta ferrite content for the heat of austenitic stainless steel filler wire to be used, as stated on the Certified Material Test Report (CMTR) to ensure sufficient delta ferrite remaining in the buffer layer.

Subsequently, in Section A1.1(c)(3) of Relief Request #08-001-RR, Revision 1, dated March 12, 2008, the licensee identified that ER308L austenitic stainless steel filler metal will be used for the buffer (transitional) layer. The licensee stated that the ER308L filler metal will have a delta ferrite content of 5 to 15 FN as reported on the CMTR.

The NRC staff notes that the delta ferrite requirement was intended for stainless steel weld overlays that are subject to intergranular stress-corrosion cracking (IGSCC). Weld metals containing even small additions of delta ferrite are less susceptible to sensitization, and thereby, more resistant to IGSCC. As noted in paragraph 2.1 of NUREG-0313, Revision 2, ". . .weld metal with low carbon and controlled ferrite (such as 308L with 7.5 percent minimum ferrite) is resistant to sensitization and IGSCC. . . ." However, NUREG-0313 also considers austenitic stainless steels with 5 percent delta ferrite resistant to sensitization and IGSCC depending on carbon content and other possible factors. As an additional benefit, small additions of 1 to 3 percent delta ferrite in austenitic weld deposits reduce the tendency for hot cracking or fissuring especially when welds are highly restrained.

The austenitic stainless steel butter layer will not be included in the structural weld overlay thickness as defined in Section A1.1(3)(c) of the proposed relief request. The delta ferrite requirements of ASME Code Case N-504-3, paragraph (e) only apply to the structural layers of a weld overlay. They do not apply to nonstructural weld layers. Conversely, paragraphs (c) and (d) of ASME Code Case N-504-3 do apply to nonstructural weld layers but do not include any delta ferrite requirements. Therefore, if nonstructural layers for a weld overlay subject to IGSCC do not require delta ferrite testing, then a nonstructural stainless steel butter layer (for an Alloy 52M weld overlay) that is not subject to IGSCC certainly does not require delta ferrite testing.

The delta ferrite content of ER308L is consistent with ASME Code Case N-504-3 and NUREG-0313, Revision 2. It is also consistent with ASME Code Section III and RG 1.44, "Control of the Use of Sensitized Stainless Steel." According to paragraph NB-2433.2 of ASME Code, Section III, all austenitic stainless steel filler metals must have a minimum delta ferrite of at least 5 FN as reported on the CMTR. Regulatory Guide 1.44, paragraphs C.4.b and C.5.a provide exceptions to the recommended controls for materials subject to sensitization based on a delta ferrite content of 5 FN. Regarding hot cracking, a minimum delta ferrite of 5 FN provides more than adequate resistance to fissuring as noted in RG 1.31, "Control of Ferrite in Stainless Steel Weld Metal."

The NRC staff finds that the minimum delta ferrite requirement of N-504-3, paragraph (e), does not apply to the buffer layer at Crystal River. The NRC staff finds that the licensee has responded to the staff's concern satisfactorily by providing the delta ferrite number of ER308L from CMTR. The staff concludes that the weld metal ER308L has sufficient delta ferrite to minimize the potential for hot cracking.

4.2 Crack Growth Considerations and Design

The crack growth calculations, weld overlay design, and design-basis flaw size are provided in Enclosure 1, Attachment 1, Section A1.2, of Relief Request #08-001-RR, Revision 1. The crack-growth calculation assures that the growth of the crack in the base metal will be mitigated or minimized by the installation of the weld overlay. The NRC staff finds that the requirements of Section A1.2 are consistent with the requirements of ASME Code Case N-504-3; Appendix Q to the ASME Code, Section XI; the NRC-approved ANO-1 Relief Request ANO1-R&R-010; the NRC-approved Farley and Vogtle Relief Request ISI-GEN-ALT-06-03; and the NRC-approved ANO-2 weld overlay relief request ANO2-R&R-005. The major technical issues regarding crack growth calculations and weld overlay design have been addressed in the NRC's safety

evaluations of the ANO-1 and Farley and Vogtle relief requests. These technical issues are the same in the Crystal River proposed relief requests and Farley, Vogtle, and ANO-2 relief requests. However, plant-specific issues are addressed below.

The licensee stated that the design basis for FSWOs is to maintain the original safety margins for primary loading with no credit taken for the underlying PWSCC-susceptible weldments. The assumed design-basis flaw for the purpose of sizing the weld overlays is 360° and 100 percent through the original wall thickness of the DMWs. The licensee detected a flaw in the subject weld based on the UT examination performed prior to installing the weld overlay during the spring 2008 maintenance outage. Therefore, for the initial flaw size in crack-growth analysis, the licensee stated that it would use the as-found flaw size or the size of any flaw detected in the outer 25 percent of the original material during the overlay preservice examination whichever is greater.

As part of the weld overlay design, the licensee stated that it would perform the following analyses.

1. Nozzle specific stress analyses would be performed to establish a residual stress profile in the nozzle. Severe inside diameter weld repairs will be assumed in these analyses that effectively bound any actual weld repairs that may have occurred in the nozzles. The analysis will then simulate application of the weld overlay to determine the final residual stress profile. Post weld overlay residual stresses at normal operating conditions will be shown to result in beneficial compressive stresses on the inside surface of the components, assuring that further crack initiation due to PWSCC is highly unlikely.

2. Fracture mechanics analyses would be performed to predict crack growth, assuming that cracks exist that are equal to the detected flaw sizes. Crack growth will be evaluated due to PWSCC as well as due to fatigue crack growth in the original DMW. The crack growth analyses will consider all design loads and transients, plus the post weld overlay, through-wall residual stress distributions, and will demonstrate that the detected crack will not grow beyond the design basis for the weld overlay for the time period until the next scheduled ISI.

3. The analyses would be demonstrate that application of the weld overlay does not impact the conclusions of the existing nozzle stress reports. ASME Code, Section III stress and fatigue criteria will be met for regions of the overlay remote from observed (or assumed) cracks.

4. Shrinkage would be measured during the overlay application. Shrinkage stresses at other locations in the piping systems arising from the weld overlay will be demonstrated not to have an adverse effect on the systems. Clearances of affected supports and restraints will be checked after the overlay repair, and will be reset within the design ranges as required.

5. The total added weight on the piping systems due to the overlay would be evaluated for potential impact on piping system stresses and dynamic characteristics.

6. The as-built dimensions of the weld overlay would be measured and evaluated to demonstrate that they equal to or exceed the minimum design dimensions of the overlay.

The NRC finds that these analyses are consistent with the analyses prescribed in ASME Code Case N-504-3, the NRC-approved ANO-1 Relief Request ANO1-R&R-010, the NRC-approved Farley and Vogtle Relief Request ISI-GEN-ALT-06-03, and the NRC-approved ANO-2 weld overlay relief request ANO2-R&R-005.

4.3 Examination and Inspection

The requirements for the acceptance examination, preservice examination, and inservice examination after FSWOL installation are provided in Enclosure 1, Attachment 1, Section A1.3, of Relief Request #08-001-RR, Revision 1. The required examination volume of the weld overlay is provided in Enclosure 1, Attachment 1, Figures A1-1 and A1-2, of the proposed relief request.

Enclosure 1, Attachment 3 of the proposed relief request provides a comparison of the proposed examination requirements of Section A1.3 with the requirements of ASME Code Case N-504-3 and Appendix Q of the ASME Code, Section XI. The NRC staff finds that the requirements in Section A1.3 are consistent with the requirements of ASME Code Case N-504-3 and/or Appendix Q of the ASME Code, Section XI. Specific examinations are discussed below.

4.3.1 Acceptance Examination

Section A1.3(a), “Acceptance Examination,” Enclosure 1, Attachment 1, to Relief Request #08-001-RR, Revision 1, requires a surface and UT examination of the installed FSWOL prior to placing it in service. The examination volume and surface area are defined in Enclosure 1, Attachment 1, Figure A1-1, of the proposed relief request. The NRC staff finds that the requirements of Section A1.3(a) are consistent with the requirements of ASME Code Cases N-504-3 and N-638-1 and Appendix Q to the ASME Code, Section XI, with the following exception.

The licensee will perform nondestructive examinations of the FSWOL 48 hours after the third temper bead weld layer. ASME Code Case N-638-1 requires that examinations be performed 48 hours after the completed FSWOL reaches ambient temperature. The staff has approved starting the 48-hour hold after completion of the third temper bead layer and the technical issues have been addressed in the NRC staff’s safety evaluations for ANO-1 Relief Request ANO1-R&R-010 and Farley and Vogtle Relief Request ISI-GEN-ALT-06-03. The 48-hour hold time issue is the same in Crystal rive, Farley, Vogtle, and ANO-1.

4.3.2 Preservice Inspection

Section A1.3(b), “Preservice Inspection,” Enclosure 1, Attachment 1, to Relief Request #08-001-RR, Revision 1, requires an UT examination of the installed FSWOL and the upper (outer) 25 percent of the original pipe-wall thickness. The examination volume is defined in Figure A1-2 of Enclosure 1, Attachment 1 of the proposed relief request. The NRC staff finds that the preservice examination requirements are consistent with the requirements of ASME Code Case N-504-3; the ASME Code, Section XI, Appendix Q; the NRC-approved ANO-1 Relief

Request ANO1-R&R-010; and the NRC-approved Farley and Vogtle Relief Request ISI-GEN-ALT-06-03. The technical issues have been addressed in the NRC's safety evaluations of the ANO-1 and Farley and Vogtle relief requests.

4.3.3 Inservice Inspection

Section A1.3(c), "Inservice Examination," Enclosure 1, Attachment 1, to Relief Request #08-001-RR, Revision 1, requires inservice UT examination of the FSWOL and the upper (outer) 25 percent of the original pipe-wall thickness. The examination volume is defined in Figure A1-2 of Enclosure 1, Attachment 1 of the proposed relief request. Section A1.3(c) also provides requirements for successive examinations and inspection expansion should the flaw grow or new flaws are detected in the subject weld or FSWOL. The NRC staff finds that the requirements of Section A1.3(c) are consistent with the requirements of ASME Code Cases N-504-3 and N-638-1; the ASME Code, Section XI, Appendix Q; the NRC-approved ANO-1 Relief Request ANO1-R&R-010; and the NRC-approved Farley and Vogtle Relief Request ISI-GEN-ALT-06-03. The technical issues have been addressed in the NRC's safety evaluations of the ANO-1 and Farley and Vogtle relief requests.

4.3.4 Pressure Testing

The licensee stated that "A system leakage test shall be performed in accordance with IWA-5000." This requirement is consistent with ASME Code Case N-504-3.

The licensee stated further that "The NRC previously approved ASME Code Case N-416-2, 'Alternative Pressure Test Requirement for Welded Repairs, Fabrication Welds for Replacement Parts and Piping Subassemblies, or Installation of Replacement Items by Welding, Class 1, 2, and 3,' [would be] for use at Crystal River 3. The code case allows use of a system leakage test, in conjunction with specified nondestructive examination (NDE), in lieu of a system hydrostatic test to detect leakage from welded repairs, fabrication welds for replacement parts and piping subassemblies, or welds for installation of replacement items."

The licensee notes that for a system leakage test to be used, ASME Code Case N-416-2 requires: (a) Performance of NDE in accordance with the methods of Non-Mandatory Appendix Q and acceptance criteria of the applicable Subsection of the 1992 Edition of Section III (as described in Section 5.4), (b) Performance of a visual examination (VT-2) prior to or immediately upon return to service in conjunction with a system leakage test, using the 1992 Edition of Section XI, in accordance with IWA-5000, at nominal operating pressure and temperature, and (c) Documentation of use of this Case on an NIS-2 Form.

The NRC staff notes that ASME Code Case N-416-2 has been superseded by N-416-3 as specified in RG 1.147, Revision 15. The NRC staff has endorsed N-416-3 in RG 1.147, Revision 15. The NRC staff accepted ASME Code Case N-416-2 with condition as discussed in RG 1.147, Revision 13. The condition requires that when using N-416-2, the provisions of IWA-5213, "Test Condition Holding Times," 1989 Edition, be used. The provisions of IWA-5213 requires various holding time after pressurization to test conditions, before the visual examinations commence, for system leakage, functional, hydrostatic and pneumatic tests.

The NRC staff notes that ASME Code Case N-416-2 does not require performance of NDE in

accordance with the methods of Non-Mandatory Appendix Q. However, the staff has no objection if NDE of the subject welds is performed in accordance with Appendix Q because the NDE for the subject welds as required in Relief Request #08-001-RR, Revision 1, is consistent with the requirements of Appendix Q.

The only difference between ASME Code Cases N-416-2 and N-416-3 is that ASME Code Case N-416-3 allows brazed joints to be applicable for system leakage test. The subject weld is not a brazing joint; therefore, using either ASME Code Case N-416-2 or ASME Code Case N-416-3 will not affect the pressure test of the subject weld overlay. The NRC staff does not have concerns regarding the licensee's use of ASME Code Case N-416-2 for the subject weld overlay application.

4.4 Proposed Ambient Temperature Temper Bead Welding

The requirements for the proposed ambient temperature temper bead welding are discussed in Enclosure 1, Attachment 2, to Relief Request #08-001-RR, Revision 1. The NRC staff finds that the requirements proposed ambient temperature temper bead welding are consistent with the requirements of ASME Code Case N-638-1, the NRC-approved ANO-1 Relief Request ANO1-R&R-010, and the NRC-approved Farley and Vogtle Relief Request ISI-GEN-ALT-06-03, with the following exception.

Paragraph 1.0(a) of ASME Code Case N-638-1 limits the maximum area of an individual weld to 100 square inches on the ferritic-base material using temper bead welding. However, the proposed alternative allowed the weld surface area up to 500 square inches on the ferritic-base material. The licensee stated that technical justification for allowing weld overlays on ferritic materials with surface areas up to 500 square inches is provided in the ASME white paper supporting the changes in ASME Code Case N-638-3 and Electric Power Research Institute Report (EPRI) Report 1011898, "Justification for the Removal of the 100 Square Inch Temper Bead Weld Repair Limitation". The ASME white paper notes that the original limit of 100 square inches in ASME Code Case N-638-1 was arbitrary. The licensee also noted that the ASME white paper cites evaluations of a 12-inch diameter nozzle weld overlay to demonstrate adequate tempering of the weld heat affected zone, residual stress evaluations demonstrating acceptable residual stresses in weld overlays ranging from 100 to 500 square inches, and service history in which weld repairs exceeding 100 square inches were NRC approved and applied to DMW nozzles in several boiling-water reactor (BWR) and pressurized-water reactor applications. In addition, the licensee noted that some of the cited repairs are greater than 15 years old, and have been inspected several times with no evidence of any continued degradation.

The licensee noted that the above theoretical arguments and empirical data have been verified in practice by extensive field experience with temper bead weld overlays, with ferritic material coverage ranging from less than 10 square inches up to and including 325 square inches. Based on the weld area information in Table 1 of the proposed alternative, the original DMW weld overlay was applied over 20 years ago (1986), and weld overlays with low alloy steel coverage in the 100-square inch range have been in service for 5 to 15 years. Several overlays have been applied with low alloy steel coverage significantly greater than the 100 square inches. The licensee stated that these overlays have been examined with performance demonstration initiative (PDI) qualified techniques, in some cases multiple times, and none have shown any

signs of new cracking or growth of existing cracks.

The staff notes that the proposed 500-square-inch weld area has also been addressed in EPRI Report 1014351, "Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs, December 2006." The technical basis for the 500-square-inch weld area was also presented in slides entitled, "Bases for 500 Square Inch Weld Overlay Over Ferritic Material," in an NRC-ASME public meeting held on January 10, 2007 (ADAMS Accession No. ML070470565). Based on EPRI 1014351, the NRC staff finds that the proposed 500-square inch weld area on the ferritic material is acceptable because the stress analysis presented in EPRI Report 1014351 shows that the structural integrity of ferritic material is not adversely affected by a 500-square-inch weld overlay area.

4.5 Performance Demonstration Initiative (PDI) Program

Appendix VIII, Supplement 11 of the 1995 Edition through 1996 Addenda of ASME Code, Section XI, specifies requirements for performance demonstration of ultrasonic examination procedures, equipment, and personnel used to detect and size flaws in full structural overlays of wrought austenitic piping welds. The industry initiated the PDI Program as an alternative to satisfy the requirements of ASME Code, Section XI, Appendix VIII. To this end, the EPRI has developed a program for qualifying equipment, procedures, and personnel in accordance with the UT criteria of Appendix VIII, Supplement 11.

Prior to the Supplement 11 program, EPRI was maintaining a performance demonstration program (the precursor to the PDI program) for weld overlay qualification under the Tri-party Agreement with the NRC, BWR Owner's Group, and EPRI, as discussed in the NRC letter dated July 3, 1984 (ADAMS Accession No. ML8407090122). Later, the NRC staff recognized the EPRI PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement in its letter dated January 15, 2002, to the PDI Chairman (ADAMS Accession No. ML020160532).

The PDI program is routinely assessed by the NRC staff for consistency with the current ASME Code and proposed changes. The PDI program does not fully comport with the existing requirements of Supplement 11. The PDI representatives presented the differences between Supplement 11 and the PDI program at public meetings in which the NRC participated (Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives," March 22, 2002 (ADAMS Accession No. ML010940402), and Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives," November 29, 2001 (ADAMS Accession No. ML013330156). Based on the discussions at these public meetings, the staff determined that the industry's PDI program provides an acceptable level of quality and safety because the PDI program provides rigorous qualification methods for examination.

The licensee compared the PDI program with Appendix VIII, Supplement 11, of the ASME Code, Section XI as shown in Enclosure 1, Attachment 4 to Relief Request #08-001-RR, Revision 1. The PDI initiatives were used for qualification of ultrasonic examinations to detect and size flaws in the FSWOL of this relief request. The NRC staff evaluated the differences between the PDI

program and Supplement 11. The NRC staff finds that the licensee's justifications for the differences are acceptable because the PDI program provides sufficient examination qualification and that the PDI program provides an acceptable level of quality and safety. Therefore, the proposed PDI program is acceptable for use in lieu of Supplement 11 of Appendix VIII to the ASME Code, Section XI.

4.6 Commitments

As part of Relief Request #08-001-RR, Revision 1, the licensee made the following regulatory commitments as stated in Enclosure 3 of the March 12, 2008, letter:

1. Provide a report of the weld overlay examination results including a listing of indications detected. The recording criteria of the ultrasonic examination procedure to be used for the examination of the overlays requires that all indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, and location. Additionally, the procedure requires that all indications, regardless of amplitude, that cannot be clearly attributed to the geometry of the overlay configuration be considered flaw indications.

2. Provide a report documenting the disposition of indications using the standards of ASME Section XI, IWB-3514-2 and/or IWB-3514-3 criteria and, if possible, the type and nature of the indications. The ultrasonic examination procedure requires that all suspected flaw indications are to be plotted on a cross-sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.

3. Provide a report discussing any repairs to the weld overlay material and/or base metal and the reason for the repairs.

4. Provide a report documenting a stress analysis summary demonstrating that the subject piping will perform its intended design functions after the weld overlay installation. The stress analysis report would include results showing that the requirements of NB-3200 and NB-3600 of the ASME Code, Section III, are satisfied. The stress analysis would also include results showing that the requirements of IWB-3000 of the ASME Code, Section XI, are satisfied. The results would show that the postulated crack including its growth in the nozzles would not adversely affect the integrity of the overlaid welds.

The licensee in its March 12, 2008 letter committed to submit to the NRC reports in Commitment Numbers 1, 2, and 3, above, 14 days after the licensee's acceptance of the ultrasonic examination results. Further, the licensee committed to submit the report in Commitment Number 4 to the NRC within 60 days after entry into Mode 4 startup.

By letter dated March 26, 2008, the licensee submitted results of ultrasonic examination (the 14-day report) of the installed weld overlay on the decay heat drop line. The licensee did not find any indications such as lack of bound, weld flaws, planar flaws or laminar flaws in the required examination volume.

By letter dated May 15, 2008, the licensee submitted the stress analysis summary of the weld overlay (the 60-day report). The stress analysis showed that the subject piping will perform its

intended design functions after the weld overlay installation. The stress analysis showed that the requirements of the ASME Section III, NB-3200 and NB-3600 are satisfied. The stress analysis also showed the requirements of the ASME Code, Section XI, IWB-3000, are satisfied. The residual stress analysis showed that the weld overlay will provide beneficial compressive stresses to minimize any potential PWSCC.

Based on the submitted information, the staff finds that the 14-day and 60-day reports are submitted in a timely manner and provide valuable information on the condition of the decay heat drop line nozzle with associated weld overlay installation and are acceptable.

5.0 CONCLUSION

The NRC staff has reviewed the licensee's Relief Request #08-001-RR, Revision 1, dated March 12, 2008, as supplemented by letter dated March 26, 2008, and determined that the proposed relief request will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), on March 14, 2008, the NRC staff verbally authorized the use of Relief Request #08-001-RR, Revision 1, for the installation of the FSWOL on the degraded dissimilar metal weld (weld Number B4.5.254) of the decay heat drop line at Crystal River Unit 3. The effective period of Relief Request #08-001-RR, Revision 1, was the March 2008 maintenance outage.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: John Tsao

Date: May 22, 2008