Progress Energy

Crystal River Nuclear Plant
Docket No. 50-302
Operating License No. DPR-72

Ref: 10 CFR 50.55a

September 13, 2007
3F0907-05

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

Subject: Crystal River Unit 3 – Relief Request #07-003-RR, Revision 1, and Response to Request for Additional Information

Reference: Crystal River Unit 3 to NRC letter dated May 15, 2007, "Crystal River Unit 3 – Relief Request #07-003-RR, Revision 0"

Dear Sir:

Pursuant to 10 CFR 50.55a(a)(3)(i), Florida Power Corporation (FPC), doing business as Progress Energy Florida, Inc., is hereby submitting Revision 1 of Relief Request 07-003-RR and a response to a request for additional information for review and approval. This submittal is in response to a Nuclear Regulatory Commission (NRC) request for additional information (RAI) received by email on August 6, 2007. Enclosure A includes Revision 1 of Relief Request #07-003-RR with revision bars to denote the changes from the previous submittal, as referenced. Changes have been made to address and incorporate elements of the request for information. Enclosure B of this letter includes responses to the RAI.

This submittal contains Regulatory Commitments as shown in Enclosure C.

If you have any questions regarding this submittal, please contact Paul Infanger, Supervisor, Licensing and Regulatory Programs at (352) 563-4796.

Sincerely,

Dale E. Young

Dale E. Young
Vice President
Crystal River Nuclear Plant

DEY/seb

Enclosures:

A. Relief Request #07-003-RR, Revision 1, Attachments 1 through 4
B. Response to Request for Additional Information
C. List of Regulatory Commitments

xc: NRR Project Manager
Regional Administrator, Region II
Senior Resident Inspector

Progress Energy Florida, Inc.
Crystal River Nuclear Plant
15760 W. Powerline Street
Crystal River, FL 34428

A001
NRR

STATE OF FLORIDA

COUNTY OF CITRUS

Dale E. Young states that he is the Vice President, Crystal River Nuclear Plant for Florida Power Corporation, doing business as Progress Energy Florida, Inc.; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

Dale E. Young

Dale E. Young
Vice President
Crystal River Nuclear Plant

The foregoing document was acknowledged before me this 13th day of Sept., 2007, by Dale E. Young.

Ellen Deppolder

Signature of Notary Public
State of Florida

ELLEN DEPPOLDER
MY COMMISSION # DD 408539
EXPIRES: July 8, 2009
Bonded Thru Notary Public Underwriters

____

(Print, type, or stamp Commissioned Name of Notary Public)

Personally Known ✓ -OR- Produced Identification ______

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE A

RELIEF REQUEST #07-003-RR, REVISION 1

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE A
ATTACHMENT 1

Proposed Alternative in Accordance with 10 CFR 50.55a(a)(3)(i)

USE OF WELD OVERLAYS AS AN ALTERNATIVE REPAIR TECHNIQUE

--Alternative Provides Acceptable Level of Quality and Safety--

INSERVICE INSPECTION
RELIEF REQUEST #07-003-RR, REVISION 1
THIRD TEN YEAR INTERVAL

REFERENCE CODE: The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME), Section XI, 1989 Edition with no Addenda.

1.0 ASME Code Components Affected

ASME Code components associated with this request are high safety significant (HSS) Class 1 dissimilar metal welds (DMWs) with Alloy 82/182 weld metal and Alloy 600 base material that are believed to be susceptible to Primary Water Stress Corrosion Cracking (PWSCC). There are seven (7) DMWs and the pressurizer spray nozzle safe end that are scheduled to have preemptive full structural weld overlays (SWOLs) applied. These items are scheduled to have SWOLs applied during the upcoming Crystal River Unit 3 (CR3) 15th Refueling Outage scheduled to start on November 3, 2007.

1.1 Category and System Details:

Code Class:	Class 1
System Welds:	Reactor Coolant System
Examination Categories:	R-A*

*Welds are included in the Risk Informed Inservice Inspection Program

1.2 Component Descriptions:

This alternative is to apply SWOLs on the pressurizer surge nozzle safe end-to-nozzle weld, three (3) relief nozzle flange-to-nozzle welds, spray nozzle safe end-to-nozzle weld, spray pipe-to-spray nozzle safe-end weld, spray nozzle safe end and "A" hot leg surge pipe-to-surge nozzle weld. The applicable items and their identifications are as follows:

1. Pressurizer Weld No. B4.1.9 Surge Nozzle Buttering and B4.1.10 Safe End-to-Surge Nozzle Weld
2. Pressurizer Weld No. B4.1.3 Relief Nozzle #1 Buttering and B4.1.4 Flange-to-Relief Nozzle #1 Weld
3. Pressurizer Weld No. B4.1.5 Relief Nozzle #2 Buttering and B4.1.6 Flange-to-Relief Nozzle #2 Weld
4. Pressurizer Weld No. B4.1.7 Relief Nozzle #3 Buttering and B4.1.8 Flange-to-Relief Nozzle #3 Weld
5. Pressurizer Weld No. B4.1.1 Safe End-to-Spray Nozzle-Weld
6. Pressurizer Spray Nozzle Safe End Mk No. 45
7. Spray Pipe-to-pressurizer Spray Nozzle Safe End Weld No. B4.5.52

8. "A" Hot Leg Pipe Weld No. B4.1.11 Surge Nozzle Buttering and B4.1.12 Surge Pipe-to-Surge Nozzle Weld

1.3 Component Materials:

1. Pressurizer nozzles are carbon steel A 508 Class 1 (P-No. 12A Sub 1)
2. "A" Hot Leg pipe surge nozzle is carbon steel A 105 Grade II (P-No. 1)
3. Pressurizer surge nozzle safe end is A 336 Class F8M (P-No.8)
4. Relief nozzle flanges are SA-182 Grade F316 (P-No. 8)
5. Welds are Alloy 82/182 (F-No. 43)
6. Pressurizer spray nozzle safe end is NiCrFe SB-166 Alloy 600 (P-No. 43)
7. Elbow attached to the pressurizer surge nozzle safe end is A 403 WP316 (P-No. 8)
8. Piping attached to the "A" hot leg surge nozzle buttering and to the pressurizer spray nozzle safe end is wrought seamless austenitic stainless steel A 376 TP 316 (P-No. 8)

2.0 Applicable Code Edition and Addenda

CR3 is currently in the third 10-year Inservice Inspection (ISI) interval. The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) of record for the current 10-year ISI interval is Section XI, 1989 Edition, no Addenda (Reference 1). This is also the version used for the Repair/Replacement Program.

3.0 Applicable Code Requirement

The applicable Code requirement for which the relief is requested is ASME Code Section XI, 1989 Edition, no Addenda (Reference 1), IWA-4120(a), IWA-4340(a) and Section XI, 1995 Edition, including Addenda through 1996, Appendix VIII, Supplement 11 (Reference 2).

IWA-4120(a) states in part the following:

"Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used. ...If repair welding cannot be performed in accordance with these requirements, the applicable requirements of IWA-4500 and the following may be used:
(1) IWB-4000 for Class 1 components.."

IWA-4340(a) states in part the following:

"After final grinding, the affected surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication has been reduced to an acceptable limit in accordance with IWA-3000. The original defect shall be removed: (2) when repair welding is required in accordance with IWA-4520 or IWA-4530, and the defect penetrates the base material."

Appendix VIII provides requirements for performance demonstration for ultrasonic examination systems. Supplement 11 provides qualification requirements for full structural overlay wrought austenitic piping welds.

4.0 Reason for Request

DMWs, primarily consisting of Alloy 82/182 weld metal, are frequently used in pressurized water reactor (PWR) construction to connect stainless steel pipe and safe ends to vessel and pipe nozzles, generally constructed of carbon or low alloy ferritic steel. These welds have shown a propensity for PWSCC degradation, especially in components subjected to higher operating temperatures, such as the pressurizer and the hot leg pipe. See EPRI MRP-169, "Technical Basis for Preemptive Weld Overlays for Alloy 82/182 Butt Welds in PWRs," October 2005 (Reference 3). Alloy 600 base material is also susceptible to PWSCC.

For the upcoming CR3 15th Refueling Outage, SWOLs are scheduled to be applied to DMWs on pressurizer nozzles, the pressurizer spray nozzle safe end, the spray pipe-to-spray nozzle safe end DMW and the "A" hot leg surge pipe-to-nozzle DMW. Repair/replacement activities associated with SWOL repairs are required to address the materials, welding parameters, ALARA concerns, operational constraints, examination techniques and procedure requirements for repairs.

ASME Code Section XI, 1989 Edition, no Addenda (Reference 1), IWA-4120(a) and IWA-4340(a), does not address all the needed requirements for this type of repair since potential existing defects will not be removed or reduced in size, and weld overlay of potential existing flaws in DMWs or associated Alloy 600 base material will be performed. Also comprehensive and generic NRC approved criteria are not currently available for application of SWOL repairs to DMWs constructed of Alloy 82/182 weld material or associated Alloy 600 base material for mitigation of potential PWSCC.

In addition, ASME Code Section XI, 1995 Edition including Addenda through 1996, Appendix VIII Supplement 11 (Reference 2) cannot be implemented as written for ultrasonic examination of a structural weld overlay repair. Attachment 2 includes a discussion of the Performance Demonstration Initiative (PDI) Program alternatives and their bases with respect to Appendix VIII Supplement 11 requirements.

The alternative described in Section 5.0 is proposed to permit the implementation of SWOLs at CR3 as an alternative for the repair/replacement requirements of the ASME Code Section XI, 1989 Edition, no Addenda (Reference 1), IWA-4120(a), IWA-4340(a) and ASME Code Section XI, 1995 Edition, including Addenda through 1996, Appendix VIII, Supplement 11 (Reference 2).

5.0 Proposed Alternative and Basis for Use

This proposal requests the use of the alternative shown in Attachment 3 for implementing the SWOLs for potentially PWSCC susceptible items. This request applies to each of the DMWs and the pressurizer spray nozzle safe end base material listed in Section 1.2, which are generically depicted in Figures 1 through 4 of this Attachment. The proposed alternative is scheduled to be performed during the CR3 15th Refueling Outage.

This alternative is the result of the industry's experience with mitigative weld overlay modifications for flaws suspected or confirmed to be caused by PWSCC and directly applies to the Alloy 52M weld material that is primarily being used for these SWOLs.

Attachment 3 refers to IWB-3640 for flaw evaluation. IWB-3640 refers to Appendix C as an acceptable methodology for performing flaw evaluations on austenitic stainless steel and Ni-Cr-Fe alloys. Section XI, 1989 Edition, Appendix C, C-3320(d), specifies a maximum limit of a = 0.60t for flaw depth to thickness ratio in welds deposited using the shielded metal-arc welding process [C-3320(c)] whereas a limit of a = 0.75t for flaw depth to thickness ratio in welds deposited using gas metal-arc or gas tungsten-arc [C-3320(b)]. ASME Code Section XI, 1995 Edition, 1996 Addenda, Appendix C, C-3320(d), and later versions of Section XI, Appendix C, specifies a maximum limit of a = 0.75t for flaw depth to thickness ratio in welds deposited using the shielded metal-arc welding process [C-3320(c) as well as the gas metal-arc and gas tungsten-arc welding processes [C-3320(b)]. Since ASME Code Section XI, 1995 Edition, including Addenda through 1996 Addenda has been approved by the NRC as indicated in 10 CFR 50.55a, Appendix C of this version will be used for flaw evaluation associated with Ni-Cr-Fe and austenitic stainless steel materials. Use of the later version of ASME Code Section XI version will result in less SWOL thickness being necessary to attain the desired design life and therefore resulting in less personnel exposure, in some cases.

The ultrasonic examination of the completed SWOLs will be accomplished with personnel and procedures qualified in accordance with ASME Code Section XI, 1995 Edition including Addenda through 1996 (Reference 2) Appendix VIII, Supplement 11 as specified in Attachment 3 Section 3 therein, with the alternatives used for complying with the PDI Program. See Attachment 2 for the PDI Program changes to Appendix VIII Supplement 11.

5.1 SWOL Design

The SWOLs satisfy all the structural design requirements of the pipe as specified in the Alternative Requirements shown in Attachment 3 for the original DMWs and the pressurizer spray nozzle safe end. As shown in Figures 1 through 4 of this Attachment, the SWOLs will completely cover the existing DMWs, will extend onto the ferritic nozzle and austenitic stainless steel material on each end of the weld and completely cover the pressurizer spray nozzle safe end. The SWOLs extend around the entire circumference of the nozzle. Alloy 52M and 52 filler metals are compatible with all the wrought base materials and the DMWs and similar metal welds that will be covered by the SWOL.

The SWOLs will be designed as full structural overlays. Postulated 100% through-wall flaws shall be assumed as specified in 2(b)(6), Attachment 3, for all PWSCC susceptible welds and pressurizer spray nozzle safe end for SWOL length and thickness sizing per 2(b)(7) of Attachment 3. No ultrasonic examination will be performed prior to SWOL application. For flaw growth evaluations, since no ultrasonic examination will be performed prior to weld overlay application, postulated 75% through-wall flaws will be assumed as specified in 2(a)(2)(b), Attachment 3, for the welds and Alloy 600 pressurizer spray nozzle safe end. Surface examination in accordance with 1(d), Attachment 3, will be performed on all surfaces where the SWOL will be deposited. Planar flaws detected during the acceptance examination will be characterized and flaw growth calculations performed using the flaw(s) detected plus the assumed 75% through-wall flaws. The expected life will be determined by analysis. Residual stress distributions will be included.

Leak-before-break is not applicable and has not been approved by NRC for the pressurizer surge line.

Note that the details surrounding the design analysis for the SWOLs are being developed to support the CR3 15th Refueling Outage and the vendor will supply this analysis to Florida Power Corporation (FPC). The analysis will be available at CR3 for NRC review at the beginning of the CR3 15th Refueling Outage.

5.2 Welding

The welding will be performed in accordance with Attachment 3 using a remote machine gas tungsten-arc welding (GTAW) process and using the ambient temperature temper bead method with ERNiCrFe-7A (Alloy 52M) weld metal. Manual GTAW, using ERNiCrFe-7 (Alloy 52) or Alloy 52M will be used if local repairs of weld defects are necessary or additional weld metal is required locally to form the final SWOL contour in locations at least 3/16 inch away from the carbon steel nozzles.

The Cr content on the first layer was verified by weld deposition on an ASTM A 106 Grade B pipe mockup using double up progression (starting at bottom and welding upward to top on each side). Welding was performed in the 6G position with Cr measured at 90 degree increments starting at 45 degrees from top. All welding parameters were recorded and the 28% minimum Cr specified in 1(e), Attachment 3, was attained. The same heat of wire will be used in situ for the first layer and the exact same welding parameters will be specified in the Welding Procedure Specification (WPS) as was used in the mockup for the first layer. The Field Welding Supervisor will assure the proper parameters and wire heat are used in situ.

The SWOL design will require welding on more than 100 square inches of surface area on the pressurizer and hot leg surge nozzle carbon steel base material, but less than 300 square inches which is permitted in Appendix I-1(b), Attachment 3. The SWOL will extend to the transition taper of the carbon steel nozzle so that qualified ultrasonic examination of the required volume can be performed after the SWOL is applied.

There have been a number of temper bead SWOLs applied to safe-end to nozzle welds in the nuclear industry, and SWOLs having more than 100 square inch surface area on the nozzle ferritic steel surfaces have been used. The ASME Committee has indicated the inside diameter compressive stress levels remain essentially the same for both 100 square inches and 500 square inches related to SWOL applications. The justification entitled "Bases for 500 Sq. In. Weld Overlay Over Ferritic Material", was provided to the NRC staff in the January 10, 2007 meeting (Accession No. ML070470565). Additional justification is provided 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 (Reference 5).

The thickness of the SWOLs may exceed ½ the carbon steel nozzle base metal thickness as specified in Code Case N-638-1. The requirement therein applies to excavated cavities in the ferritic steel base material that are subsequently welded flush. This requirement is not applicable to SWOLs since they are applied to the nozzle surface and limited to 3/8 inch depth into the ferritic steel as specified in Attachment 3, Appendix I, I-1(d). Additional justification is provided in Appendix F of 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 (Reference 5).

I-3.0(d), Appendix I, Attachment 3, specifies the maximum interpass temperature shall be limited to 350°F maximum, even though the maximum interpass temperature is limited to 150°F maximum for the first three layers in the test assembly specified in I-2.1(c). This is greater than the maximum 100°F interpass temperature increase permitted by ASME Code Section IX,-406.3. This is a clarification of the intent of Code Case N-638-1 that has been included in Code Case N-638-2. The limitation on the procedure qualification maximum interpass temperature is to ensure the cooling rates achieved during procedure qualification are more servere than those encountered during field welding (are not slower than those achievable during field welding). The higher interpass temperature is permitted during field welding because it would only result in slower cooling rates which could be helpful in producing more ductile transformation products in the ferritic steel heat affected zone (HAZ). Additional justification information is also included in Reference 5.

5.3 Examination

For the portions of the ferritic carbon steel nozzle base material beneath the SWOLs, where their thicknesses are 1-1/2 inches and less, and the SWOL thickness is ¾ inch or less, 1(c)(1) of Attachment 3 applies thereto. Temper bead welding will be performed thereon even though temper bead welding would not be required by Attachment 3. The pressurizer spray nozzle ferritic carbon steel base material (ASTM A 508 Class 1, 0.35% C max. specified) thickness is less than 1-1/2 inches thick beneath the SWOL. The relief nozzles ferritic carbon steel base material (ASTM A 508 Class 1, 0.35% C max. specified), with the possible exception of a small portion of the nozzle transition taper beneath the SWOLs, is less than 1-½inches thick and is a function of the final SWOL thickness. The "A" hot leg surge nozzle (ASTM A 105 Grade II, 0.35% C max. specified) and pressurizer surge nozzle ferritic carbon steel base material (ASTM A 508 Class 1, 0.35% C max. specified), with the exception of a portion of the nozzle transition taper beneath the SWOLs, is less than 1-1/2 inches thick. The final SWOL ultrasonic and surface examination may be performed after welding completion since the temper bead technique would not be required, even though temper bead welding will be used, on the nozzles ferritic carbon steel base materials, on the spray nozzle and applicable portions of the other nozzles. Since elevated preheat and/or post-weld heat treatment (PWHT) is not required by Attachment 3 for welding on the spray nozzle and the thin portions of the relief nozzles, depending on final SWOL thickness, where the ferritic carbon steel nozzle base material is less than 1½ inches thick, ultrasonic and surface examinations shall be performed on the SWOLs and these examinations may be performed prior to 48 hours after completion of the third temper bead layer.

The clarifications in 1(c)(1), Attachment 3 are conservative with respect to the intent of the Construction Code post weld heat treatment (PWHT) exemption requirements [Table NB-4622.7(b)-1, ASME Code Section III, 1989 Edition, no Addenda] since all weld overlays are deposited on the surfaces of the ferritic carbon steel nozzles instead of partial or complete through thickness welds applicable for the cases described in the Construction Code.

Typically, preheat and post weld heat treatment are used to mitigate the effects of the solution of atomic hydrogen in ferritic materials prone to hydrogen embrittlement cracking. The susceptibility of ferritic steels is directly related to their ability to transform to martensite with appropriate heat treatment. The P-No. 1 Group No. 2 material of the carbon steel nozzles is much less susceptible to martensite formation than P-No. 3 Group No. 3 base material. Therefore, P-No. 1 Group No. 2 HAZ is less susceptible to hydrogen induced cracking than P-No. 3 Group No. 3 since it has lower hardenability and reduced propensity to produce untempered martensite. Additional justification for the PWHT exemptions for P-No. 1 materials are provided in "Technical Justification for Applying the PWHT Exemptions of NB-4620 to Weld Overlays on P-No. 1 Materials", ASME Section XI Working Group Welding and Special Repair Processes, Tracking No. BC06-1651, August 10, 2007 Handout (Reference 6). This document has been submitted to the NRC staff.

Temper bead welding is required since elevated preheat and/or PWHT will not be used on nozzle ferritic steel base material greater than 1½ inches thick as specified in Attachment 3. Therefore, ultrasonic and surface examinations will be performed on the temper bead welded portion of the SWOLs on these areas of the ferritic steel nozzle shoulder transition tapers beneath the SWOLs, which are greater than 1-½ inches thick for a minimum of 48 hours after completion of the third temper bead layer, as specified in 3(a)(2) and 3(a)(3), Attachment 3. These areas may include a portion of the pressurizer relief nozzles, depending on final SWOL thickness, and will include a portion of the "A" hot leg surge nozzle and the pressurizer surge nozzle.

The 48 hour delay provides time for delayed hydrogen cracking occurrence. Appendix I, Attachment 3 requires the machine or automatic gas tungsten arc welding (GTAW) process to be used for temper bead welding thereby eliminating the use of welding processes requiring flux for arc shielding.

The machine GTAW temper bead process uses a welding process that is inherently free of hydrogen. The GTAW process relies on bare welding electrodes and bare wire filler metal with no flux to absorb moisture. An inert gas blanket provides shielding for the weld and surrounding metal, which protects the region during welding from the atmosphere and the moisture it may contain and typically produces porosity free welds. In accordance with the weld procedure qualification, welding grade argon is used for the inert gas blanket. To further reduce the likelihood of any hydrogen effects, specific controls will be used to ensure the welding electrodes, filler metal and weld region are free of all sources of hydrogen.

In addition, the use of the machine GTAW temper bead process provides precise control of heat input, bead placement, bead size and contour. The very precise control over these factors afforded by the machine GTAW process provides effective tempering of the nozzle ferritic steel HAZ resulting in achievement of lower hardness and tempered martensite. This further reduces susceptibility to hydrogen induced cracking.

EPRI Report 1013558, "Temperbead Welding Applications, 48 Hour Hold Requirements for Ambient Temperature Temperbead Welding, Technical Update," December 2006 (Reference 4), provides justification for the 48 hour hold time on P-No. 3 Group No. 3 ferritic steel base material to start after completion of the third temper bead layer, rather than after completion of welding and return to ambient temperature, as specified in Code Case N-638-1. Report 1013558 addresses microstructural issues, hydrogen sources, tensile stress and temperature, and diffusivity and solubility of hydrogen in steels.

The base materials studied in the EPRI report are primarily P-No. 3. The pressurizer nozzles and "A" hot leg surge nozzle ferritic steel base materials are P-No. 1 and P-12A Sub 1. The concerns associated with hydrogen assisted cracking are generally more significant for P-No. 3 than P-No.1 and P-12A Sub 1 base materials due to P-No. 3 base materials increased hardenability.

Also, post weld heat treat exemptions shown in ASME Section III, Table NB-4622.7(b)-1 are provided for P-No. 1 Group No. 2 materials (this P-No. and Group Number is the current base material classification in ASME Code Section IX for the applicable nozzle base materials where the SWOLs will be applied at CR3 which were formerly classified as P-No. 1 and P-No. 12A Sub 1), including temper bead welding, whereas no post weld heat treat exemptions, other than temper bead welding, are permitted for P-No. 3 Group No. 3 materials.

Furthermore past industry experience with the use of the machine or automatic GTAW process has resulted in no detection of hydrogen induced cracking after the 48 hour hold Nondestructive Examination (NDE) or subsequent in-service inspections.

ASME Section XI Code Case N-638-4, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique Section XI Division 1," specifies NDE may be performed no sooner than 48 hours after completion of the third temper bead layer.

The PWSCC susceptible pressurizer spray nozzle safe end base material will be considered the same as the DMWs for purposes of ultrasonic examination, which will include the outer 25% of the base metal for preservice and in service examination.

All examinations will meet the requirements of Attachment 3, excluding qualification of the ultrasonic examination for the completed SWOLs. The ultrasonic examination qualification will be in accordance with ASME Code Section XI, 1995 Edition including Addenda through 1996, Appendix VIII, Supplement 11 (Reference 2) with the alternatives that are used to comply with the PDI Program. See Attachment 2 for the PDI Program changes to Appendix VIII Supplement 11.

The final ultrasonic examination report will be submitted to the NRC within 60 days after completion thereof. Any flaws detected that exceed the acceptance standards of Table IWB-3514-2 will be reported to the NRC as soon as possible.

The PDI Program allows closer spacing of flaws provided they don't interfere with detection or discrimination. The specimens used to date for qualification to the Tri-party (NRC/BWROG/EPRI) agreement have a flaw population density greater than allowed by current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI Program has merged the Tri-party test specimens into their structural weld overlay program.

Ultrasonic examination will not be performed on the DMWs prior to the SWOLs being applied. Since the structural integrity at the DMW locations will be restored by the SWOLs, the ultrasonic examination of the DMWs prior to SWOL application is unnecessary and the increased personnel dose that would be incurred performing the examinations is also undesirable and not consistent with good ALARA practice.

Ultrasonic and surface examination of the 1.5T wide ferritic steel nozzle preheated band will not be performed.

Ultrasonic and surface examination of the SWOL (welded region) will be performed. Because this is a surface application of the temper bead process, there will be minimal impact to the volume of the ferritic steel nozzles in the area surrounding the weld. Also, there is no additional useful information that can be gained by a volumetric examination of the area surrounding the SWOLs. The SWOL and HAZ below will be post weld volumetrically examined to the extent possible. This reduction in the post welding inspection will provide additional dose reduction for this repair while still ensuring sound weld metal is deposited and that the process has not introduced flaws in the base material. Surface examination of both the weld and ½ inch wide adjacent band on the ferritic steel nozzles will be performed, which includes the surrounding adjacent HAZ. This is sufficient to verify that defects have not been induced in the ferritic steel nozzle material due to welding.

Later editions of Section XI, as well as Code Case N-638-2, have deleted the requirement for the 1.5T examination band for both ultrasonic examination and surface examination. This is consistent with the less restrictive requirements for ultrasonic examination of the ferritic nozzle because hydrogen cracking away from the temper bead weld is not considered a concern. The NDE requirements in these documents apply to any type of welding where a temper bead technique is to be employed (which includes weld repairs of excavated flaws) and is not specifically written for SWOLs. However, it is believed that for the SWOL type of repair, any ferritic steel base material cracking would occur in the HAZ directly below or adjacent to the SWOL and not in the 1.5T examination band of ferritic material beyond the SWOL. If this type of cracking were to occur it should be detected by the NDE of the SWOL and adjacent ferritic steel surfaces.

The ultrasonic examination requirements specified in NRC Regulatory Guide 1.147, Revision 14, as conditional acceptance of Code Case N-638-1 are not applicable to SWOLs. The ultrasonic examination requirements herein are based on the latest industry experience and practice and are completely satisfactory for the SWOL application.

The additional dose received due to performing these examinations would result in a hardship without a compensating increase in the level of quality and safety.

5.4 Pressure Test

CR3 Third Interval ISI Program utilizes Code Case N-416-2 (approved for use in Regulatory Guide 1.147, Rev. 12) for pressure testing of welded repairs and replacements. ASME Section XI Code Case N-416-2 permits a system leakage test in lieu of a hydrostatic test provided NDE is performed in accordance with the methods and acceptance criteria of NB-2500 or NB-5000, as applicable, Section III, 1992 Edition. NB-5222 requires radiographic examination in this edition. The ultrasonic examination to be performed is considered to be an equivalent volumetric examination method to radiography. Ultrasonics is the only method that is qualified to determine the depth of an indication and as such must be used for evaluation in consideration of an assumed 75% through wall flaw. Based on this, N-416-2 will be applied in order to perform a system leak test with a substitution of the ultrasonic method.

5.5 Conclusion

Similar NRC approved requests have been used to produce acceptable weld overlays when applied to DMWs. The proposed alternative shown in Attachment 3 has been developed to cover the most recent operating experience and NRC approved criteria that are associated with similar SWOL applications. Therefore FPC considers that the alternatives to ASME Section XI, 1989 Edition as described herein and the PDI Program ultrasonic examination qualification alternative to ASME Section XI, 1995 Edition, 1996 Addenda, Appendix VIII, Supplement 11, provide an acceptable level of quality and safety, consistent with provisions of 10 CFR 50.55a(a)(3)(i)).

6.0 Precedents

Similar requests have been submitted to address the issues that are contained in this request. These include requests from the Indiana Michigan Power Company's D. C. Cook Unit 2. NRC verbal approval was received on March 23, 2006, for their request, which included the application of full SWOLs applied to their pressurizer nozzle DMWs.

Recently, Virginia Electric and Power Company (Dominion) submitted a similar request on March 13, 2007, for North Anna 1 and 2, CMP-022R1 and CMP-023R1, Serial No. 06-1007A, Docket Nos. 50-338/339, "Supplemental Information to Support Use of Weld Overlays as an Alternative Repair Technique" (ADAMS Accession No. ML070730563). Verbal NRC approval was granted to Dominion on March 29, 2007.

Union Electric Company's Callaway Plant submitted a similar request on August 14, 2006, (ADAMS Accession ML062360200) for weld overlays to pressurizer nozzle welds to be performed during their Refuel 15 outage in the Spring 2007.

Additionally, the following requests associated with weld overlay repairs have been approved by the NRC: AmerGen Energy Company, Three Mile Island Nuclear Station, Unit 1, on July 21, 2004 (Reference 7); Constellation Energy's Calvert Cliffs Nuclear Power Plant, Unit 2, on July 20, 2005 (Reference 8); Millstone Unit 3, on January 20, 2006 (Reference 9); and Indiana Michigan Power Company, Donald C. Cook Unit 1, on February 10, 2006 (Reference 10).

7.0 Duration of Proposed Alternative

The alternative requirements of this request will be applied for the duration of up to and including the last outage of the current third 10-year ISI interval which includes inservice examination requirements of Attachment 3 for any applied weld overlays. The current ISI interval ends in August 2008. Future inservice examinations of weld overlays at CR3 beyond this inspection interval will be as required by the NRC in the regulations.

8.0 References

1. ASME Code, Section XI, 1989 Edition, no Addenda.
2. ASME Code, Section XI, 1995 Edition, including Addenda through 1996, Appendix VIII, Supplement 11.
3. EPRI MRP-169, "Technical basis for Preemptive Weld Overlays for Alloy 82/182 Butt Welds in PWRs," October 2005.

4. EPRI Report 1013558, "Temperbead Welding Applications, 48 Hour Hold Requirements for Ambient Temperature Temperbead Welding, Technical Update," December 2006.
5. EPRI Report 1014351, Topical Report Supporting an Expedited NRC Review of the Content of the Code Case needed for Dissimilar Metal Weld Overlay Repairs, Final Report, July 2006.
6. "Technical Justification for Applying the PWHT Exemptions of NB-4620 to Weld Overlays on P-No. 1 Materials," ASME Section XI Working Group Welding and Special Repair Processes, Tracking No. BC06-1651, August 10, 2007 Handout.
7. NRC letter, "Safety Evaluation of Request for Relief from Flaw Removal, Heat Treatment and Nondestructive Examination (NDE) Requirements for the Third 10-Year Inservice Inspection Interval," Three Mile Island Nuclear Station, Unit 1 (TMI-1), Docket No. 50-289, (TAC No. MC1201), dated: July 21, 2004, (ADAMS Accession No. ML041670510).
8. NRC letter, "Safety Evaluation for Calvert Cliffs Nuclear Power Plant, Unit No. 2, Docket No. 550-318, Relief Request for Use Weld Overlay and Associated Alternative Inspection Techniques (TAC Nos. MC6219 and MC6220)," dated July 20, 2005, (ADAMS Accession No. ML051930316).
9. NRC letter, "Safety Evaluation of Relief Request IR-2-39 Pertaining to the Repair and Inspection of Nozzle to Safe End Weld, Weld No. 03-X-5641-E-T at Millstone Power Station Unit No. 3 (MPS3) Docket No. 50-423, (TAC No. MC8609)," dated January 20, 2006, (ADAMS Accession No. ML053260012).
10. NRC letter, "Safety Evaluation of Alternative Regarding Repair of Safe-End-To-Elbow Weld 1-RC-9-01F at the Donald C. Cook Nuclear Plant Unit 1, Docket No. 50-315, (TAC No. MC8807)," dated February 10, 2006, (ADAMS Accession No. ML060240355).

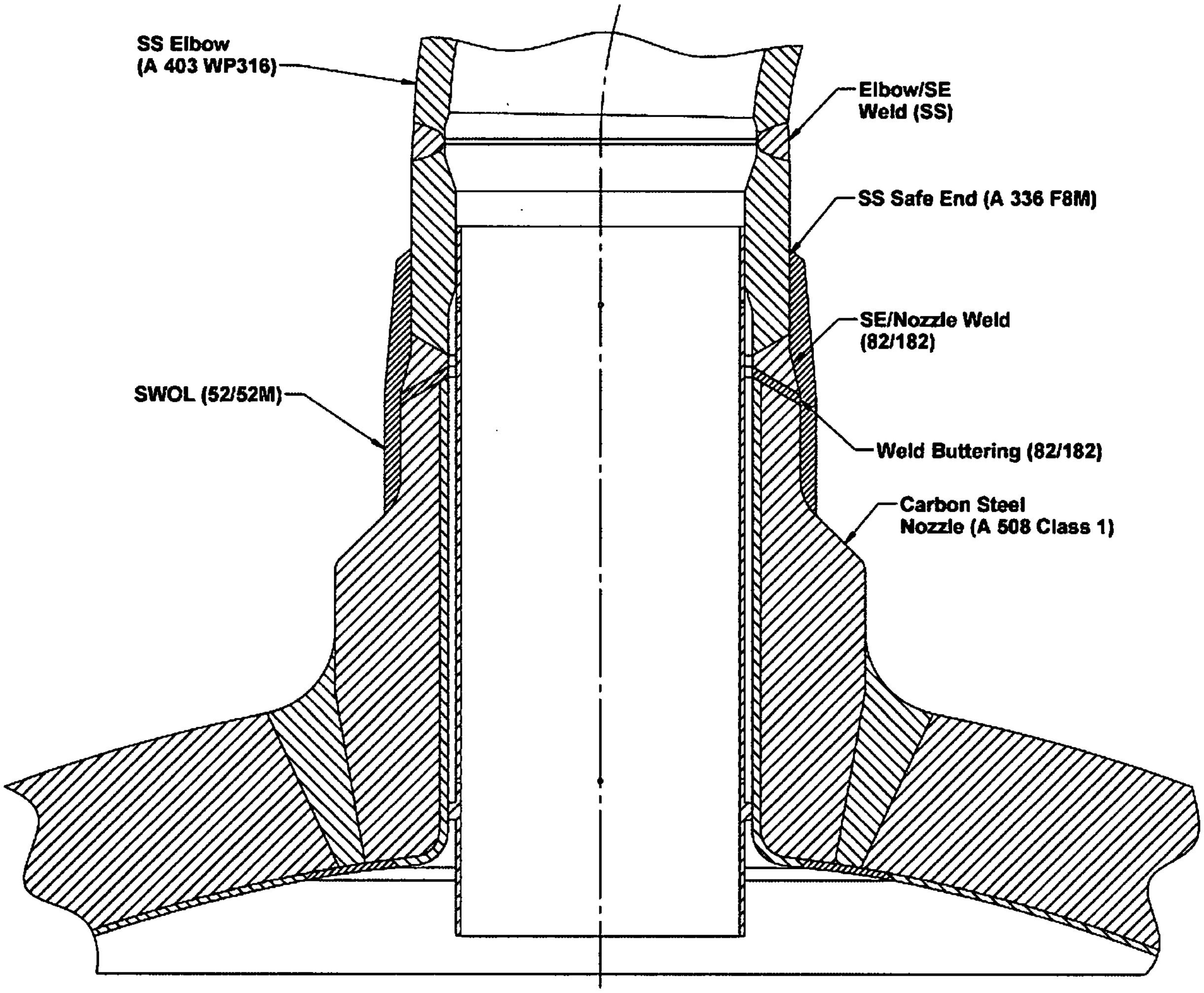


Figure 1 - PZR Surge Nozzle SWOL Configuration

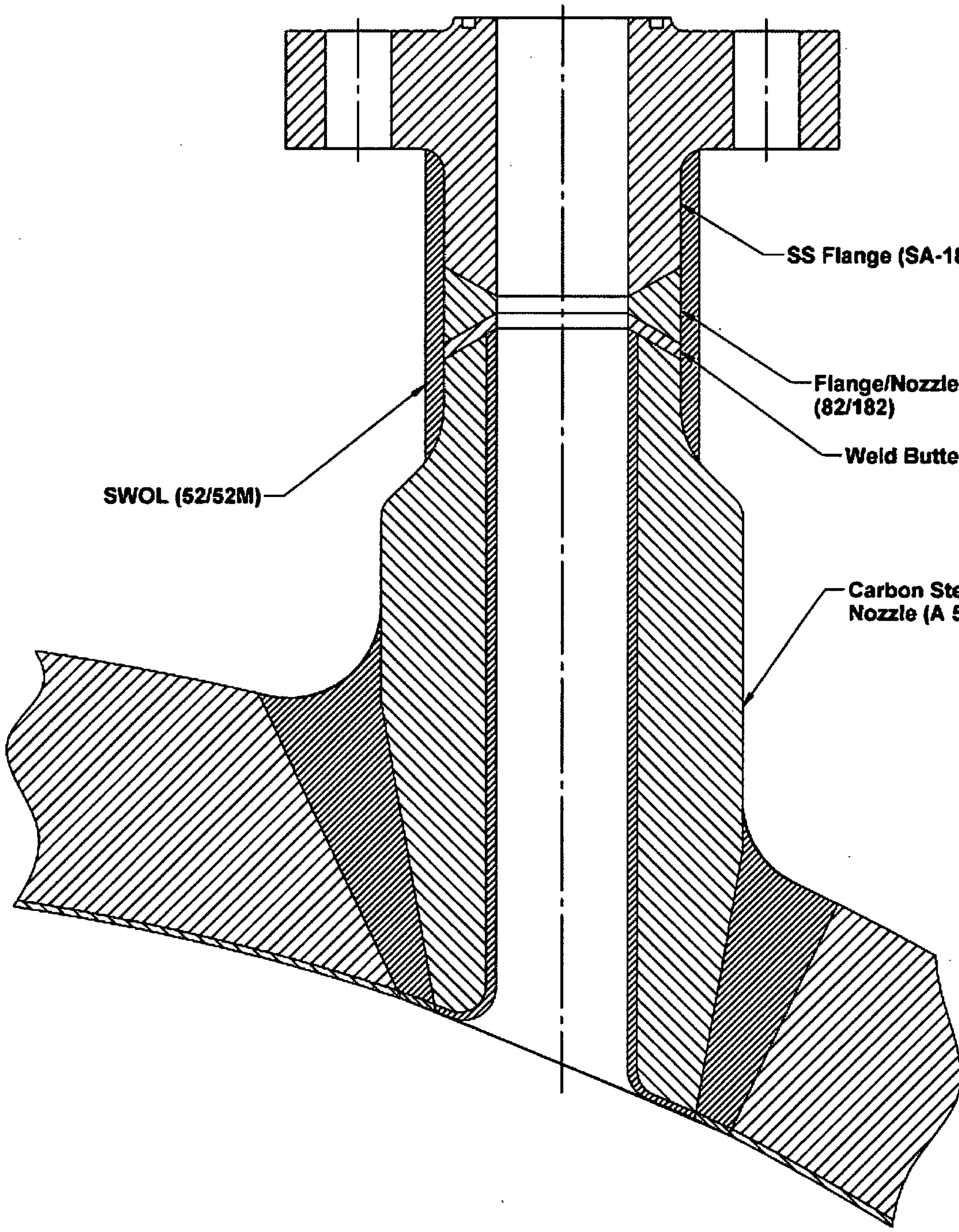


Figure 2 - PZR Relief Nozzle SWOL Configuration

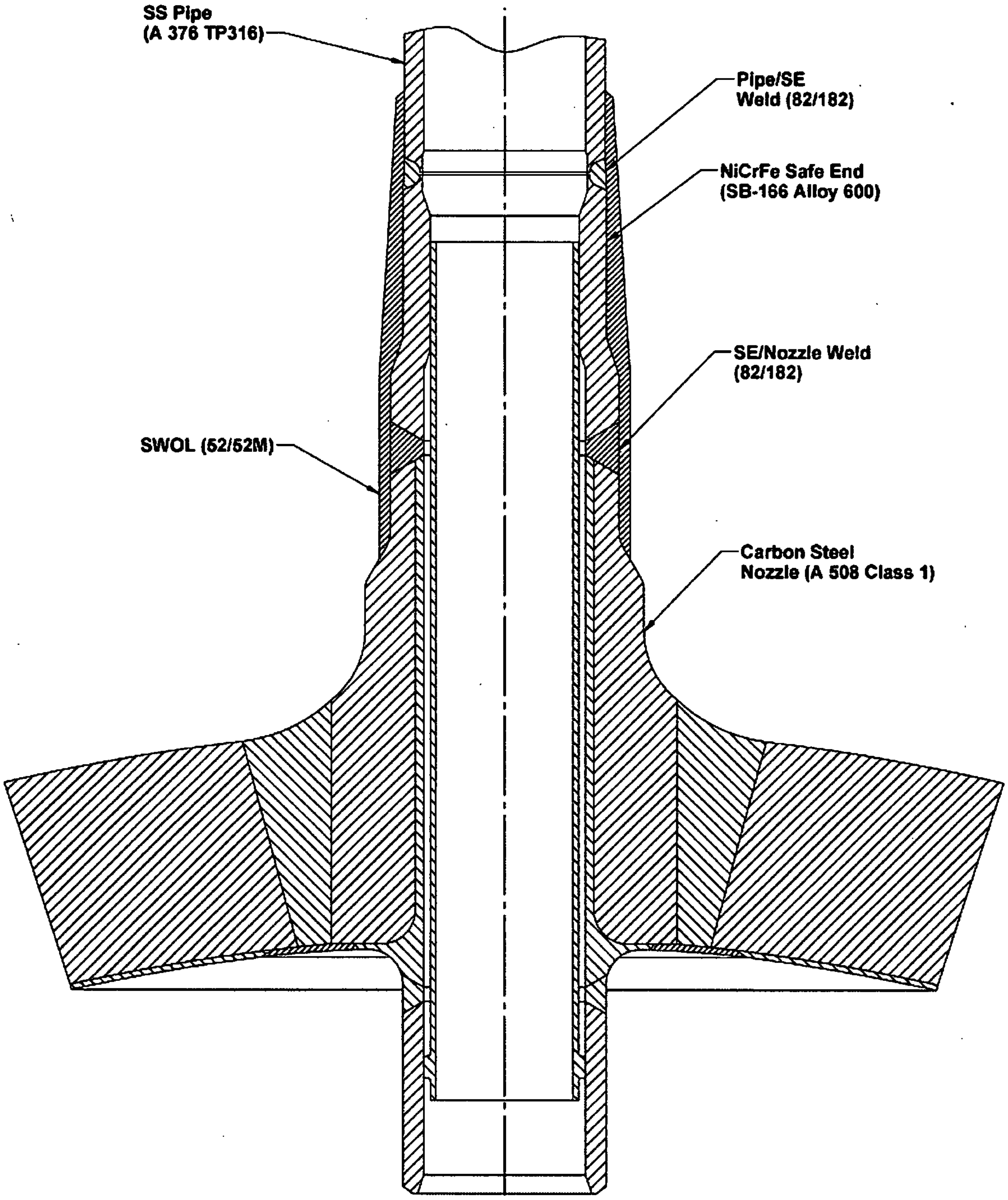


Figure 3 - PZR Spray Nozzle SWOL Configuration

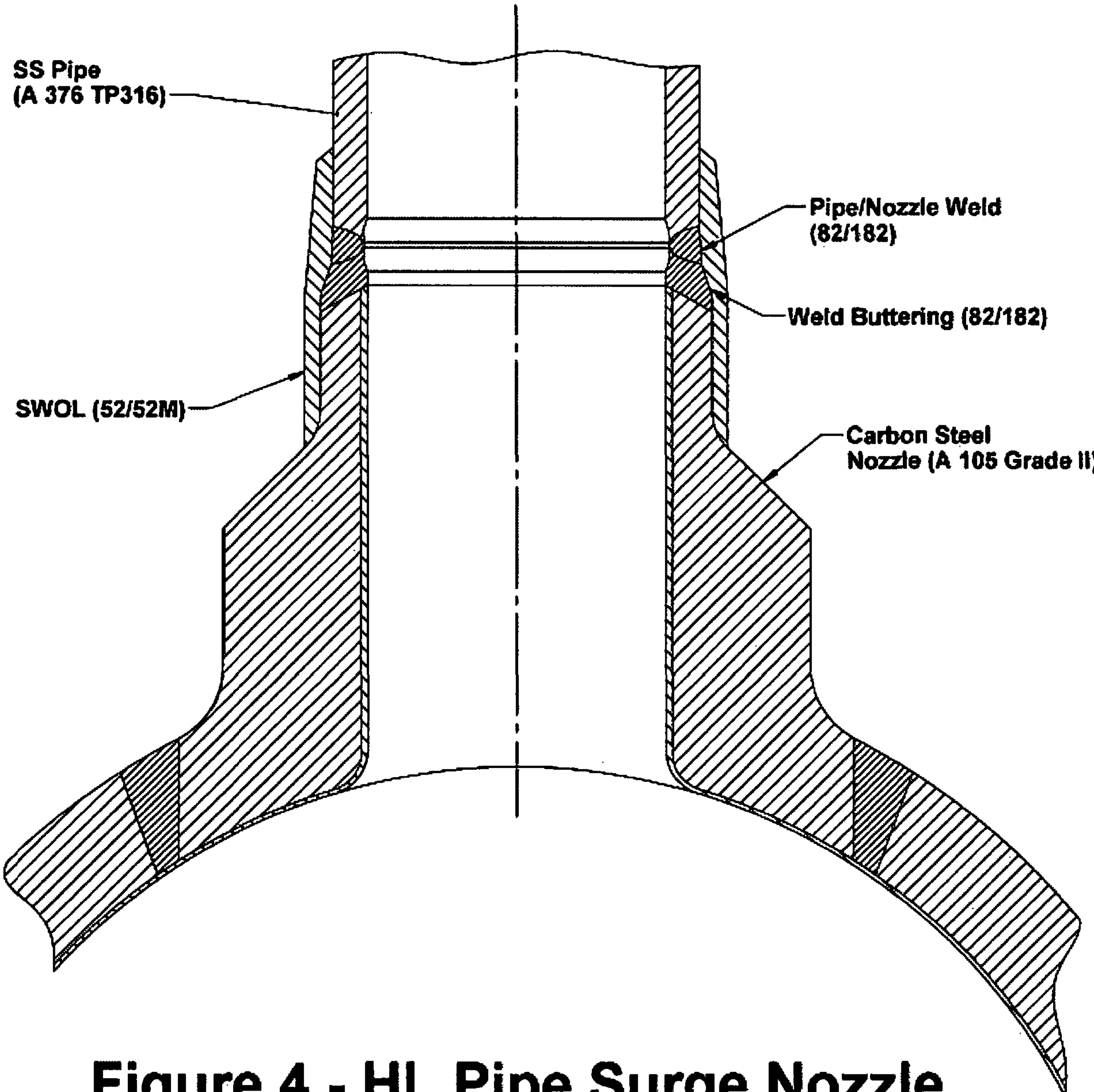


Figure 4 - HL Pipe Surge Nozzle SWOL Configuration

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE A
ATTACHMENT 2

PDI PROGRAM MODIFICATIONS TO ASME CODE SECTION XI, APPENDIX VIII, SUPPLEMENT 11

PDI Program Modifications to ASME Code Section XI, Appendix VIII, Supplement 11

Appendix VIII, Supplement 11	PDI Modification
1.0 SPECIMEN REQUIREMENTS	
1.1 General	
(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 inches or larger, the specimen set must include at least one specimen 24 inches or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 inches to +0.25 inches of the maximum nominal overlay thickness for which the procedure is applicable.	**Modification**: (b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 inches or larger, the specimen set must include at least one specimen 24 inches or larger but need not include the maximum diameter. The specimen set shall include specimens with overlays not thicker than 0.1 inches more than the minimum thickness, nor thinner than 0.25 inches of the maximum nominal overlay thickness for which the examination procedure is applicable. **Basis:** To avoid confusion, the overlay thickness tolerance contained in the last sentence was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence in paragraph 1.1 (d) (1).
(d) Flaw Conditions	
(1) Base metal flaws. All flaws must be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Flaws may extend 100% through the base metal and into the overlay material; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.	**Modification**: (1) Base metal flaws. All flaws must be in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing IGSCC shall be used when available. At least 70% of the flaws in the detection and sizing tests shall be cracks and the remainder shall be alternative flaws. Alternative flaw mechanisms, if used, shall provide crack-like reflective characteristics and shall be limited by the following: (a) The use of alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. (b) Flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches. **Basis:** This paragraph requires that all base metal flaws be cracks. Implanting a crack requires excavation of the base material on at least one side of the flaw. While this

Appendix VIII, Supplement 11	PDI Modification
	may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches, and at least 70% of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws. To avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b) last sentence, was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence. Paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws.
(e) Detection Specimens	
(1) At least 20% but less than 40% of the flaws shall be oriented within ±20 degrees of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.	**Modification:** (1) At least 20% but less than 40% of the base metal flaws shall be oriented within ±20 degrees of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. **Basis:** The requirement for axially oriented overlay fabrication flaws was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated GTAW techniques with the filler metal applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic. The requirement for using IWA-3300 for proximity flaw evaluation was excluded, instead indications will be sized based on their individual merits.
(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.	**Modification:** (2) Specimens shall be divided into base metal and overlay fabrication grading units. Each specimen shall contain one or both types of grading units. Flaws shall not interfere with ultrasonic detection or characterization of other flaws.
(a)(1) A base grading unit shall include at least	**Modification:** (a)(1) A base metal grading unit includes

Appendix VIII, Supplement 11	PDI Modification
3 inches of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal-to-overlay interface.	the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 inch and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50 inch of the adjacent base material. **Basis:** The phrase "and base metal on both sides," was inadvertently included in the description of a base metal grading unit, The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. To avoid confusion several instances of the term "cracks" or "cracking" were changed to the term "flaws" because of the use of alternative flaw mechanisms. Modified to require that a base metal grading unit include at least 1 inch of the length of the overlaid weld, rather than 3 inches.
(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 inch of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	**Modification:** (a)(2) When base metal flaws penetrate into the overlay material, the base metal grading unit shall not be used as part of any overlay fabrication grading unit.
(a)(3) When a base grading unit is designed to be unflawed, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. The segment of weld length used in one base grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.	**Modification:** (a)(3) Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws. **Basis:** Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement.
(b)(l) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.	**Modification:** (b)(l) An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 inch. **Basis:** Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 2 inch requirement.
(b)(2) An overlay grading unit designed to be unflawed shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch around its entire perimeter. The specific area used in one overlay grading unit shall not be used in another overlay grading unit. Overlay grading units	**Modification:** (b)(2) Overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to preclude interfering reflections from adjacent flaws. The

Appendix VIII, Supplement 11	PDI Modification
need not be spaced uniformly about the specimen.	specific area used in one overlay fabrication grading unit shall not be used in another overlay fabrication grading unit. Overlay fabrication grading units need not be spaced uniformly about the specimen. **Basis:** Paragraph 1.1 (e)(2)(b)(2) states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends, rather than around its entire perimeter.
(b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	**Modification:** (b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base metal grading units, ten unflawed base metal grading units, five flawed overlay fabrication grading units, and ten unflawed overlay fabrication grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units. For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(f) Sizing Specimen	
(1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.	**Modification:** (1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be open to the inside surface. Sizing sets shall contain a distribution of flaw dimensions to assess sizing capabilities. For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	**Modification**: (3) Base metal flaws used for length sizing demonstrations shall be oriented circumferentially.
(4) Depth sizing specimen sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 inch in the through-wall direction.	**Modification:** (4) Depth sizing specimen sets shall include at least two distinct locations where a base metal flaw extends into the overlay material by at least 0.1 inch in the through-wall direction.
2.0 CONDUCT OF PERFORMANCE DEMONSTRATION	
The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to	**Modification:** The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the

Appendix VIII, Supplement 11	PDI Modification
grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.	results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited. The overlay fabrication flaw test and the base metal flaw test may be performed separately.
2.1 Detection Test. Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.	**Modification:** 2.1 Detection Test. Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base metal or overlay fabrication) that are present for each specimen.
2.2 Length Sizing Test	
(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	**Modification:** (d) For flaws in base metal grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base metal wall thickness.
2.3 Depth Sizing Test. For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	**Modification:** 2.3 Depth Sizing Test. (a) The depth sizing test may be conducted separately or in conjunction with the detection test. (b) When the depth sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. (c) For a separate depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

Appendix VIII, Supplement 11	PDI Modification
3.0 ACCEPTANCE CRITERIA	
3.1 Detection Acceptance Criteria. Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	**Modification**: 3.1 Detection Acceptance Criteria. Examination procedures are qualified for detection when: (a) All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. (b) At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (c). (c) Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. (d) The criteria in (b) and (c) shall be satisfied separately by the demonstration results for base metal grading units and for overlay fabrication grading units.
3.2 Sizing Acceptance Criteria.	
(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position.	**Modification:** (a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal flaws is measured at the 75% through-base-metal position.
(b) All extensions of base metal cracking into the overlay material by at least 0.1 inch are reported as being intrusions into the overlay material.	**Modification:** This requirement is omitted. **Basis:** The requirement for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the Supplement 2 depth sizing criteria.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE A
ATTACHMENT 3

ALTERNATIVE REQUIREMENTS FOR DISSIMILAR METAL WELD OVERLAYS

Alternative Requirements for Dissimilar Metal Weld Overlays

(Italicized font indicates a revision to Attachment 3 of Revision 0 of Relief Request, #07-003-RR)

In lieu of the requirements of IWA-4410 and IWA-4611, a defect in austenitic stainless steel or austenitic nickel alloy piping, components, or associated welds may be reduced to a flaw of acceptable size in accordance with IWB-3640 by the addition of a repair weld overlay. Alternatively, if mitigation is performed, it may also be developed by treating a postulated flaw in accordance with IWB-3640 by application of a mitigative weld overlay. All Section XI references are to the 2004 Edition with the 2006 Addenda. For the use of this *alternative* with other Editions and Addenda, refer to Table 1. The weld overlay shall be applied by deposition of weld reinforcement (weld overlay) on the outside surface of the piping, component, or associated weld, including ferritic materials when necessary, provided the following requirements are met:

1 GENERAL REQUIREMENTS

(a) A full-structural weld overlay shall be applied by deposition of weld reinforcement (weld overlay) on the outside surface of *circumferential welds in carbon steel (P-No. 1) or* low alloy steel *components, including* nozzles (P-No. 3) *to safe ends or piping components* (P-No. 8 or 43), inclusive of the UNS N06082 or W86182 welds that join the two items *and Alloy 600 base material, when applicable.* The design of the overlay may be extended to include the adjacent stainless steel to stainless steel welds (P-No. 8 to P-No. 8).

(b) This *alternative* applies to dissimilar metal welds between P-No. 8 or 43 and P-No*s*. 1, 3, 12A, 12B, or 12C[1] materials. This *alternative* also applies to dissimilar metal welds between P-No. 8 and P-No. 43 materials joined with austenitic F-No. 43 filler metal, and to welds between P-No. 8 and P-No. 8 materials as described in 1(a) above *and Alloy 600 base material, when applicable.*

(c) Weld overlay filler metal shall be austenitic nickel alloy (28% Cr min., ERNiCrFe-7 or ERNiCrFe-7A) applied 360 degrees around the circumference of the item and deposited using a Welding Procedure Specification (WPS) for groove welding, qualified in accordance with the Construction Code and Owner's Requirements and identified in the Repair/Replacement Plan. As an alternative to the post weld heat treatment (PWHT) requirements of the Construction Code and Owner's requirements, the following provisions may be applied.
  (1) For P-No. 1 base materials, the Construction Code PWHT exemptions permitted for circumferential butt welds may be applied to exempt the weld overlay from PWHT with the following clarifications,
    (a) The nominal weld thickness is defined as the maximum overlay thickness applied over the ferritic base material.
    (b) The base material thickness is defined as the maximum thickness of the ferritic material where the overlay is applied.
  (2) Appendix I may be used for ambient-temperature temper bead welding.

[1] P-Nos. 12A, 12B, and 12C designations refer to specific material classifications originally identified in Section III and subsequently reclassified in a later Edition of Section IX.

(d) Prior to deposition of the weld overlay, the surface to be weld overlaid shall be examined using the liquid penetrant method. Indications *with major dimension* greater than 1/16 inch (1.5 mm) shall be removed, reduced in size, or weld repaired in accordance with the following requirements:

(1) One or more layers of weld metal shall be applied to seal unacceptable indications in the area to be repaired with or without excavation. The thickness of these layers shall not be used in meeting weld reinforcement design thickness requirements. Peening the unacceptable indication prior to welding is permitted. *For the case where the unacceptable indication(s) remain the assumed flaw depth shall be 100% through wall in both the circumferential and axial directions for flaw growth evaluations.*

(2) If *weld* repair of indications identified in 1(d) is required, the area where the weld overlay is to be deposited, including any local *weld* repairs or initial weld overlay layer, shall be examined by the liquid penetrant method. The area shall contain no indications *with major dimension* greater than 1/16 inch (1.5 mm) prior to the application of the structural layers of the weld overlay.

(e) Weld overlay deposits shall meet the following requirements:
The austenitic nickel alloy weld overlay shall consist of at least two weld layers deposited using a filler material with a Cr content of at least 28%. The first layer of weld metal deposited may not be credited toward the required thickness. Alternatively, for PWR applications, a first diluted layer may be credited toward the required thickness, provided the portion of the layer over the austenitic base material, austenitic filler material weld and the associated dilution zone from an adjacent ferritic base material contain at least 24% Cr and the Cr content of the deposited weld metal is determined by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the WPS for the production weld. Alternatively, for BWR applications, a diluted first layer may be credited toward the required thickness, provided the portion of the layer over the austenitic base material, austenitic filler material weld and the associated dilution zone from an adjacent ferritic base material contain at least 20% Cr, and the Cr content of the deposited weld metal is determined by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the WPS for the production weld.

(f) This *alternative* is only for welding in applications predicted not to have exceeded thermal neutron fluence of 1×10^{17} ($E < 0.5$ eV) neutrons per cm^2 prior to welding.

(g) A new weld overlay shall not be installed over the top of an existing weld overlay that has been in service.

2 CRACK GROWTH AND DESIGN

(a) Crack Growth *Calculation of Flaws in the Original Weld or Base Metal.* The size of all flaws detected *or postulated in the original weld or base metal shall be used to define* the life of the overlay. *In no case shall the inspection interval be longer than the life of the overlay. The inspection interval shall be as specified in 3(c). Crack growth in the original weld or base metal, due to both stress corrosion and fatigue, shall be evaluated. Flaw* *characterization and evaluation shall be based on the ultrasonic examination results, if applicable, or the postulated flaw, if ultrasonic examination of the weldment is not performed.*

(1) For repair overlays, the initial flaw size for crack growth in the original weld *or base metal shall be based on the as-found flaw or postulated flaw, if no pre-overlay ultrasonic examination is performed.*

(2) For *postulated flaws in the original weld or base metal t*he axial flaw length shall be set at 1.5 inches (38 mm) or the combined width of the weld plus buttering, whichever is greater, and the *stress corrosion cracking susceptible base material, when applicable.* The circumferential flaw length shall be assumed to be 360 deg.

(a) If an examination is performed prior to application of the overlay, which is qualified in accordance with Appendix VIII, Supplement *10 or Supplement 2* and no inside-surface-connected planar flaws are discovered, initial flaws originated from *the inside* surface of the *weldment equal* to 10% of the original wall thickness shall be assumed in both the axial and circumferential directions. *Overlays shall be considered mitigative.*

(b) If no examination is performed prior to application of the overlay, initial inside-surface-connected planar flaws equal to at least 75% through the original wall thickness shall be assumed, in both the axial and circumferential directions, consistent with the overlay *examination* volume in Fig. 2.

(c) There may be circumstances in which an overlay examination is performed using an ultrasonic examination procedure qualified in accordance with Appendix VIII, Supplement 11 for depths greater than the outer 25% of the original wall thickness (Fig. 2). For such cases, initial flaw depths shall be assumed to be the detected depth consistent with the depth to which the examination procedure is qualified *and the available coverage, plus the worst-case flaw in the inner region of the pipe wall thickness that is not qualified for ultrasonic examination.*

(d) *In determining the expected life of the overlay*, any inside-surface-connected planar flaw found by the overlay preservice inspection *of 3(b)* that exceeds the depth of (2)(a), (b) or (c) above shall be used as *part of* the initial flaw depth. *The flaw depth assumed is the detected flaw depth plus the postulated worst-case flaw depth in the unqualified ultrasonic examination region of the pipe wall thickness.* An overlay meeting this condition shall be considered a repair.

(b) Structural Design and Sizing of the Overlay. The design of the weld overlay shall satisfy the following, using the assumptions and flaw characterization restrictions in 2(a). The following design analysis shall be completed in accordance with IWA-4311:

(1) The axial length and end slope of the weld overlay shall cover the weld *and heat-affected* zones on each side of the weld and shall provide for load redistribution from the item into the weld overlay and back into the item without violating applicable stress limits of NB-3200 or the Construction Code. Any laminar flaws in the weld overlay shall be evaluated in the analysis to ensure that load redistribution complies with the above. These requirements will usually be satisfied if the weld overlay *design-thickness* length extends axially beyond the projected flaw by at least $0.75\sqrt{Rt}$, where R is the outer radius of the item and t is the nominal wall thickness of the item.

(2) Unless specifically analyzed in accordance with 2(b)(1), the end transition taper of the overlay shall not exceed 30 deg. A slope of not more than 1:3 is recommended.

(3) For determining the combined length of circumferentially oriented flaws in the underlying base material or weld, multiple flaws shall be treated as one flaw of length equal to the sum of the lengths of the individual flaws characterized in accordance with IWA-3300.

(4) For circumferentially oriented flaws, in the underlying base material or weld, the flaws shall be assumed to be 100% through the original wall *thickness for the entire circumference.*

(5) For axial flaws in the underlying base material or weld, the flaws shall be assumed to be 100% through the original wall thickness of the item for the entire axial length of the flaw or combined flaws, as applicable.

(6) *For full structural overlays, when ultrasonic examination is not performed prior to installation of the weld overlay* the assumed flaw in the underlying base material or weld shall be based on the limiting case of the two below:

(a) 100% through-wall for the entire circumference, or

(b) 100% through-wall for 1.5 inches (38 mm) or the combined width of the weld plus buttering, whichever is greater *in the axial direction, and the stress corrosion cracking susceptible base material, when applicable.*

(7) The overlay design thickness shall be *verified using* only the weld overlay thickness conforming to the deposit analysis requirements of 1(e). The combined wall thickness at the weld *overlay and* the effects of any discontinuities (e.g., another weld overlay or reinforcement for a branch connection) within a distance of $2.5\sqrt{Rt}$ from the toes of the weld overlay, including the flaw size assumptions defined in 2(b)(4), (5), or (6) above, shall be evaluated and meet the requirements of *IWB-3640.*

(8) The effects of any changes in applied loads, as a result of weld shrinkage from the entire overlay, on other items in the piping system (e.g., support loads and clearances, nozzle loads, and changes in system flexibility and weight due to the weld overlay) shall be evaluated. Existing flaws previously accepted by analytical evaluation shall be evaluated in accordance with IWB-3640, IWC-3640, or IWD-3640, as applicable.

3 EXAMINATION

In lieu of all other examination requirements, the examination requirements *herein* shall be met for the life of the weld overlay. Nondestructive examination methods shall be in accordance with IWA-2200, except as specified herein. Nondestructive examination personnel shall be qualified in accordance with IWA-2300. Ultrasonic examination procedures and personnel shall be qualified in accordance with Appendix VIII, Supplement 11.

(a) Acceptance Examination

(1) The weld overlay shall have a surface finish of 250 micro-in. (6.3 micrometers) RMS or better *and a contour that provides for ultrasonic examination* in accordance with procedures qualified in accordance with Appendix VIII. The weld overlay shall be inspected to verify acceptable configuration.

(2) The weld overlay and the adjacent base material for at least 1/2 inch (13 mm) from each side of the weld shall be examined using the liquid penetrant method. *Surface examination shall be performed on thermocouple removal areas in accordance with NB-4435(b)(3).* The weld overlay shall satisfy the surface examination acceptance criteria for welds of the Construction Code or NB-5300. The adjacent base metal shall satisfy the surface examination acceptance criteria for base material of the Construction Code

or NB-2500. *If ambient-temperature temper bead welding is required, the liquid penetrant examination of the completed weld overlay shall be conducted after the three tempering layers (i.e., layers 1, 2, and 3) have been in place for at least 48 hr after completion of the third temper bead layer over the ferritic steel.*

(3) The acceptance examination volume A-B-C-D in Fig. 1(a) *plus the heat-affected zone beneath the fusion zone C-D* shall be ultrasonically examined to assure adequate fusion (i.e., adequate bond) with the base metal and to *detect flaws*, such as interbead lack of fusion, inclusions, or cracks. If ambient-temperature temper bead welding is required, the ultrasonic examination of the completed weld overlay shall be conducted *after the three tempering layers (i.e., layers 1, 2, and 3) have been in place for at least 48 hr after completion of the third temper bead layer over the ferritic steel.*

Planar flaws detected in the weld overlay acceptance examination shall meet the preservice examination *acceptance* standards of Table IWB-3514-2. In applying the acceptance standards to planar indications within the volume E-F-G-H, in Fig. 1(b), the thickness "t_1" shall be used as the nominal wall thickness in Table IWB-3514-2. For planar indications outside this examination volume, the nominal wall thickness shall be "t_2" as shown in Fig. 1(c), for volumes A-E-H-D and F-B-C-G.

Laminar flaws in the weld overlay shall meet the following:

(a) Laminar flaws shall meet the acceptance standards of Table IWB-3514-3 with the additional limitation that the total laminar flaw shall not exceed 10% of the weld surface area and that no linear dimension of the laminar flaw area exceeds 3.0 inches (76 mm) or 10 % of the nominal pipe circumference, whichever is greater.

(b) The reduction in coverage of the examination volume A-B-C-D in Fig. 1(a), due to laminar flaws shall be less than 10%. The uninspectable volume is the volume in the weld overlay underneath the laminar flaws for which coverage cannot be achieved with angle beam examination.

(c) Any uninspectable volume in the weld overlay shall be assumed to contain the largest radial planar flaw that could exist within that volume. This assumed flaw shall meet the preservice examination acceptance standards of Table IWB-3514-2, with nominal wall thickness as defined above for planar *flaws. Both* axial and circumferential planar flaws shall be assumed.

(4) After completion of all welding activities, affected restraints, supports, and snubbers shall be VT-3 visually examined to verify that design tolerances are met.

(b) Preservice Inspection

(1) The examination volume in Fig. 2 shall be ultrasonically examined. The angle beam shall be directed perpendicular and parallel to the piping axis, with scanning performed in four directions, to locate and size any *planar flaws* that might *exist or may* have propagated into the outer 25% of the base material or into the weld overlay. *Any uninspectable volume in the outer 25% of the underlying weld or base material, as applicable, as shown in Fig. 2, shall be assumed to contain the largest planar flaw within that volume for flaw growth evaluation.*

(2) The preservice examination acceptance standards of Table IWB-3514-2 shall be met for the weld overlay. In applying the acceptance standards, wall thickness, t_w, shall be the

thickness of the weld overlay. *Planar flaws* in the outer 25% of the base metal thickness shall meet the design analysis requirements of 2(b).

(3) The flaw evaluation requirements of *IWB-3640 shall* not be applied to planar flaws identified during preservice examination *in the weld overlay,* that exceed the preservice examination acceptance standards of Table IWB-3514-2. *Planar flaws detected in the outer 25% of the base material shall be evaluated in accordance with IWB-3640.*

(c) Inservice Inspection

(1) The weld overlay examination volume in Fig. 2, *including stress corrosion cracking susceptible base material beneath the weld overlay, when applicable,* shall be added to the inspection plan. *The weld overlay inspection interval shall not be greater than the life of the overlay defined in 2(a) above.*

(2) The weld overlay shall be ultrasonically examined during the first or second refueling outage following application.

(3) The weld overlay examination volume in Fig. 2 shall be ultrasonically examined to determine if any new or existing planar flaws have propagated into the outer 25% of the base metal thickness or into the overlay. The angle beam shall be directed perpendicular and parallel to the piping axis, with scanning performed in four directions.

(4) The inservice examination acceptance standards of Table IWB-3514-2 shall be met for the weld overlay. If the acceptance *standards* of Table IWB-3514-2 cannot be met, the weld overlay shall meet the acceptance criteria of IWB-3600. *Planar flaws* in the outer 25% of the base metal thickness shall meet the design analysis requirements of *Paragraph* 2(b). *Flaws due to stress corrosion cracking in the weld overlay shall result in removal of the weld overlay and the item shall be repaired or replaced.*

(5) Weld overlay examination volumes in Fig. 2 that show no indication of planar flaw growth or new planar flaws shall be placed into a population to be examined on a sample basis, except as required by 3(c)(1). Twenty-five percent of this population shall be examined at least once during *each inspection interval.*

(6) If inservice examinations reveal *planar flaw* growth, or new *planar flaws* that meet the acceptance standards of IWB-3514 *or the acceptance criteria of IWB-3600*, the weld overlay examination volume shall be reexamined during the first or second refueling outage following discovery of the growth or new *planar* flaws.

(7) For weld overlay examination volumes with unacceptable indications in accordance with 3(c)(4), the weld overlay shall be removed, including the original defective weld, and the item shall be corrected by a repair/replacement activity in accordance with IWA-4000.

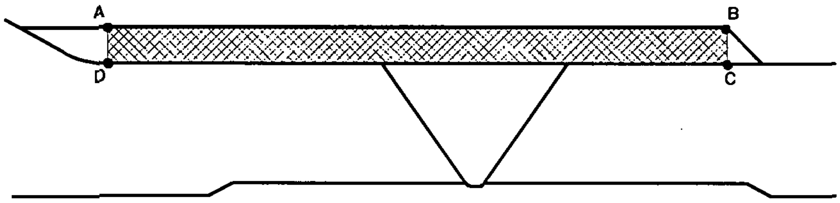
(d) Additional Examinations. If inservice examinations reveal an unacceptable indication according to 3(c)(4), *planar flaw* growth into the weld overlay design thickness, or axial *flaw* growth beyond the specified examination volume, additional weld overlay examination volumes, equal to the number scheduled for the current inspection period, shall be examined prior to return to service. If additional unacceptable indications are found in the second sample, 50% of the total population of weld overlay examination volumes shall be examined prior to return to service. If additional unacceptable indications are found, the entire remaining population of weld overlay examination volumes shall be examined prior to return to service.

4 PRESSURE TESTING

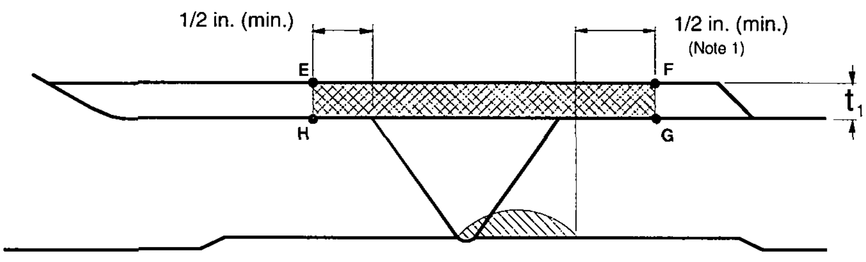
A system leakage test shall be performed in accordance with IWA-5000.

5 DOCUMENTATION

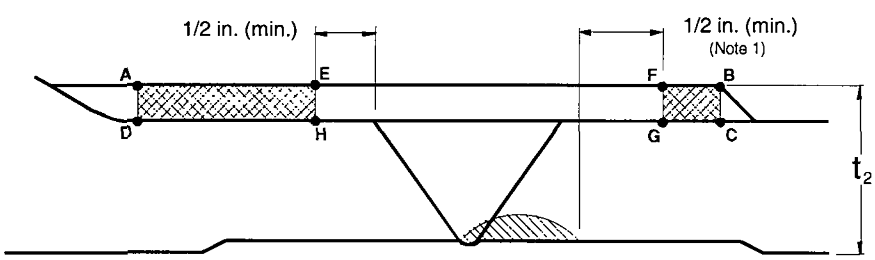
Use of this *alternative* shall be documented on Form NIS-2.



a. Acceptance Examination Volume A-B-C-D



b. Thickness (t) for Table IWB-3514-2



c. Thickness (t_2) for Table IWB-3514-2

Fig. 1 Acceptance Examination Volume and Thickness Definitions

Notes:
(1) For axial or circumferential flaws, the axial extent of the examination volume shall extend at least ½ inch (13 mm) beyond the toes of the original weld.
(2) The weld includes the weld end butter, where applied.

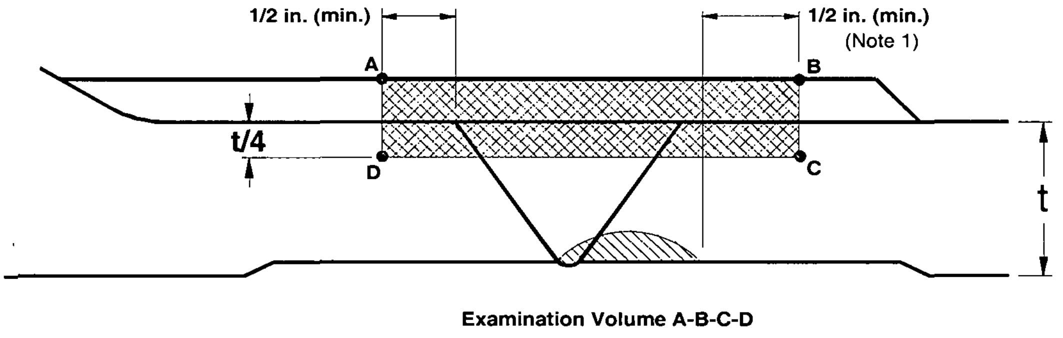


Fig. 2 Preservice and Inservice Examination Volume

NOTES:

(1) For axial or circumferential flaws, the axial extent of the examination volume shall extend at least ½ inch (13 mm) beyond the as-found flaw and at least ½ inch (13 mm) beyond the toes of the original weld.

(2) The weld includes weld end butter, where applied.

MANDATORY APPENDIX I
AMBIENT TEMPERATURE TEMPER BEAD WELDING

I-1 GENERAL REQUIREMENTS

(a) This Appendix applies to dissimilar austenitic filler metal welds between P-No*s*. 1, 3, 12A, 12B, and 12C[1] materials and their associated welds and welds joining P-No*s*. 8 or 43 materials to P-No*s*. 1, 3, 12A, 12B, and 12C[1] materials with the following limitation: This Appendix shall not be used to repair SA-302 Grade B material unless the material has been modified to include from 0.4% to 1.0% nickel, quenching, tempering, and application of a fine grain practice.

(b) The maximum area of an individual weld overlay based on the finished surface over the ferritic base material shall be *300* in.^{2} (*195,000* mm^2).

(c) Repair/replacement activities on a dissimilar-metal weld in accordance with this Appendix are limited to those along the fusion line of a nonferritic weld to ferritic base material on which 1⁄8 inch (3 mm) or less of nonferritic weld deposit exists above the original fusion line.

(d) If a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed in accordance with this Appendix, provided the depth of repair in the base material does not exceed 3⁄8 inch (10 mm).

(e) Prior to welding, the area to be welded and a band around the area of at least 1½ times the component thickness or 5 inch (130 mm), whichever is less, shall be at least 50°F (10°C).

(f) Welding materials shall meet the Owner's Requirements and the Construction Code and Cases specified in the Repair/Replacement Plan. Welding materials shall be controlled so that they are identified as acceptable until consumed.

(g) Peening may be used, except on the initial and final layers.

I-2 WELDING QUALIFICATIONS

The welding procedures and operators shall be qualified in accordance with Section IX and the requirements of *I*-2.1 and *I*-2.2.

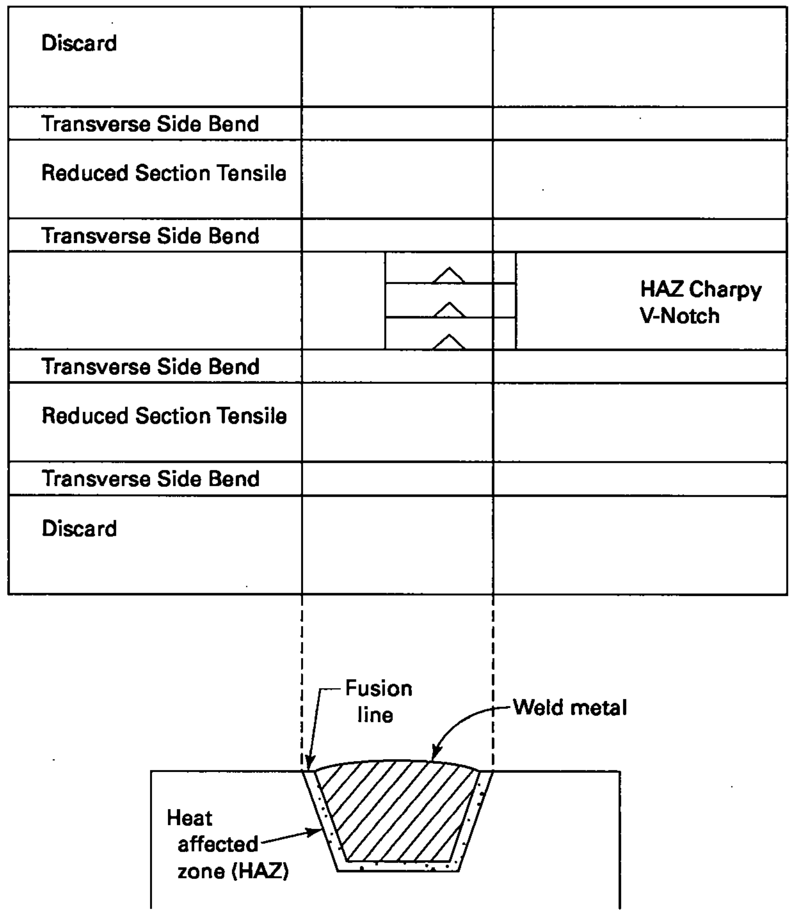
I-2.1 Procedure Qualification

(a) The base materials for the welding procedure qualification shall be of the same P-Number and Group Number as the materials to be welded. The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials being welded.

(b) The root width and included angle of the cavity in the test assembly shall be no greater than the minimum specified for the repair.

(c) The maximum interpass temperature for the first three layers of the test assembly shall be 150°F (66°C).

(d) *The weld overlay shall be qualified using a groove weld coupon. The test assembly groove depth shall be at least 1 inch (25 mm).* The test assembly thickness shall be at least twice the test assembly *groove* depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions *on either side of the groove* shall be at least 6 inches (150 mm). The qualification test plate shall be prepared in accordance with Fig. I-1.



GENERAL NOTE: Base metal Charpy impact specimens are not shown.

FIG. I-1 QUALIFICATION TEST PLATE

(e) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner's Requirements. If such requirements are not in the Construction Code and Owner's Requirements, the impact properties shall be determined by Charpy V-notch impact tests of the procedure qualification base material at or below the lowest service temperature of the item to be repaired. The location and orientation of the test specimens shall be similar to those required in I-2.1(f) below, but shall be in the base metal.

(f) Charpy V-notch tests of the ferritic heat-affected zone (HAZ) shall be performed at the same temperature as the base metal test of I-2.1(d) above. Number, location, and orientation of test specimens shall be as follows:

(1) The specimens shall be removed from a location as near as practical to a depth of one-half the thickness of the deposited weld metal. The coupons for HAZ impact specimens shall be taken transverse to the axis of the weld and etched to define the HAZ. The notch of the Charpy V-notch specimen shall be cut approximately normal to the material surface in such a manner as to include as much HAZ as possible in the resulting fracture.

When the material thickness permits, the axis of a specimen shall be inclined to allow the root of the notch to be aligned parallel to the fusion line.

(2) If the test material is in the form of a plate or forging, the axis of the weld shall be oriented parallel to the principal direction of rolling or forging.

(g)The Charpy V-notch test shall be performed in accordance with SA-370. Specimens shall be in accordance with SA-370, Fig. 11, Type A. The test shall consist of a set of three full-size 10 mm x 10 mm specimens. The lateral expansion, percent shear, absorbed energy, test temperature, orientation, and location of all test specimens shall be reported in the Procedure Qualification Record.

(h)The average lateral expansion value of the three HAZ Charpy V-notch specimens shall be equal to or greater than the average lateral expansion value of the three unaffected base metal *specimens.*

I-2.2 Performance Qualification

Welding operators shall be qualified in accordance with Section IX.

I-3 WELDING PROCEDURE REQUIREMENTS

The welding procedure shall include the following requirements:

(a) The weld metal shall be deposited by the automatic or machine GTAW process.

(b) Dissimilar metal welds shall be made using A-No. 8 weld metal (ASME Code Section IX QW-442) for P-No. 8 to P-No. 1, 3, or 12 (A, B, or C)[1] weld joints or F-No. 43 weld metal (QW-432) for P-No. 8 or 43 to P-No. 1, 3, or 12 (A, B, or C)[1] weld joints.

(c) The area to be welded shall be buttered with a deposit of at least three layers to achieve at least 1/8 inch (3 mm) overlay thickness with the heat input for each layer controlled to within ±10% of that used in the procedure qualification test. The heat input of the first three layers shall not exceed 45 kJ/in. (1.8 kJ/mm) under any conditions. Particular care shall be taken in the placement of the weld layers of the austenitic overlay filler material at the toe of the overlay to ensure that the HAZ and ferritic base metal are tempered. Subsequent layers shall be deposited with a heat input not exceeding that used for layers beyond the third layer in the procedure qualification.

(d) The maximum interpass temperature for field applications shall be 350°F (180°C) for all weld layers regardless of the interpass temperature used during qualification. The interpass temperature limitation of QW-406.3 need not be applied.

(1) The interpass temperature shall be *measured* using thermocouples.

(e) Particular care shall be given to ensure that the weld region is free of all potential sources of hydrogen. The surfaces to be welded, filler metal, and shielding gas shall be suitably controlled.

2001 Edition with 2003 Addenda through 2004 Edition with 2006Addenda	1995 Edition with 1996 Addenda through 2001 Edition with 2002 Addenda	1995 Edition with 1995 Addenda	1989 Edition with 1991 Addenda through 1995 Edition	1986 Edition with 1988 Addenda through 1989 Edition with 1990 Addenda
IWA-4000 Repair/Replacement Activities	IWA-4000	IWA-4000	IWA-4000	IWA-4000 & IWA-7000
IWA-4311 Configuration Changes	IWA-4311	IWA-4311	NA	NA
IWA-4410Welding, Brazing, Metal Removal, and Installation – General Requirements	IWA-4410	IWA-4410	IWA-4170	IWA-4120
IWA-3300 Flaw Characterization	IWA-3300	IWA-3300	IWA-3300	IWA-3300
IWA-4611 Defect Removal	IWA-4611	IWA-4421 & IWA-4424	IWA-4170 (b)	IWA-4120
IWB-3514 Standards for Category B-F	IWB-3514	IWB-3514	IWB-3514	IWB-3514
IWB/C/D -3600 Analytical Evaluation	IWB/C-3600	IWB/C-3600	IWB/C-3600	IWB/C-3600
IWB/C/D-3640 Evaluation Procedures	IWB/C-3640 or IWB/C-3650	IWB/C-3640 or IWB/C-3650	IWB/C-3640 or IWB/C-3650[1]	IWB/C-3640

[1] Starting with the 1989 Edition with the 1989 Addenda

TABLE 1 REFERENCES FOR ALTERNATIVE EDITIONS AND ADDENDA OF SECTION XI

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE A
ATTACHMENT 4

BARRIER LAYER TO PREVENT HOT CRACKING IN HIGH SULFUR STAINLESS STEEL

Barrier Layer to Prevent Hot Cracking in High Sulfur Stainless Steel

Background

During some recent dissimilar metal weld (DMW) overlay activities, where use of ERNiCrFe-7A (Alloy 52M) and ERNiCrFe-7 (Alloy 52) has been used for the filler metal, flaws in the first layer have occurred in the portion of the overlay deposited on the austenitic stainless steel portions (safe ends, pipe etc.) of the assemblies.

The applicable stainless steel base materials at Crystal River Unit 3 (CR3) where the full structural weld overlay (SWOL) will be deposited are as follows:

Pressurizer surge nozzle safe end is A 336 Class F8M.
Relief nozzle flanges are SA-182 Grade F316.
Piping attached to the "A" hot leg surge nozzle buttering and to the pressurizer spray nozzle safe end is wrought seamless austenitic stainless steel A 376 TP 316

Discussion

The flaw characteristics observed above are indicative of hot cracking. This phenomenon has not been observed on the ferritic steel or ENiCrFe-3 (Alloy 182) DMW portions of the assemblies when welding Alloy 52M thereon.

Further studies have determined that this problem may occur when using Alloy 52M filler metal on austenitic stainless steel materials with high sulfur content.

Limited tests and evaluations recently performed by AREVA have resulted in the conclusion that welding with Alloy 52M on stainless steel base material with 0.020 wt% sulfur results in cracking while welding on stainless steel base materials with less than 0.010 wt% have resulted in no cracking.

To reduce the susceptibility of hot cracking occurrence due to welding Alloy 52M on the stainless steel base materials with high sulfur, AREVA has selected ER309L filler metal as the preferred filler metal to provide a barrier layer between the Alloy 52M and the high sulfur stainless steel base material. This filler metal is compatible with the base material and promotes primary weld metal solidification as ferrite rather than austenite. The ferrite is more accommodating of residual elements therein and in the underlying base material thereby significantly reducing the susceptibility to hot cracking. ER309L is also compatible with the Alloy 52M subsequently welded thereon. However, the barrier layer will consist of ERNiCr-3 (Alloy 82) being used locally at the interface between the Alloy 182 DMW and the stainless steel item. ER309L welding on Alloy 182 may result in cracking of the ER309L weld. Welding on high sulfur stainless steel with Alloy 82 has not been a concern relevant to hot cracking occurrence.

AREVA welded a mockup to evaluate the interactive effects, such as hot cracking and lack of fusion between the Alloy 182 DMW, the stainless steel base material, the ER309L and Alloy 82 barrier layer, and the subsequent Alloy 52M weld overlay. The mockup assembly consisted of a stainless steel pipe (0.020 wt% sulfur) with an Alloy 182 groove weld performed therein. The barrier layer and overlay were welded in the same sequence as performed in the field (barrier layer ER309L and Alloy 82 and then two layers of Alloy 52M overlay). The barrier layer and overlay welding parameters used in the mockup were similar to those used in the field however, slightly reduced wire feed rates were used for conservatism.

The following examinations were performed on the final mockup and no recordable indications were detected:

PT was performed on the:

- High sulfur stainless steel base material
- Alloy 182 Groove Weld
- ER309L Barrier Layer
- Alloy 82 Barrier Layer
- Alloy 52M Overlay

Limited PDI UT

- 0° Transducer with Full Coverage
- 45° Transducer with Full Coverage
- OD Creeper Transducer with Full Coverage
- 60° Transducer with limited coverage, (focal depth exceeded UT procedure allowable in places due to overlay being of insufficient thickness. Only two layers of Alloy 52M were deposited)

Initial metallographic examination searching for any type of discontinuity, flaw or other anomaly (single specimen with "rough" polish and etch) has been performed on the first specimen. See Figure 1.

Metallography will also be performed on seven additional specimens (total of eight specimens removed in approximate 45° circumferential increments around the pipe) searching for any discontinuities, flaws or other anomalies. Preliminary evaluations of all the specimens have shown no conditions causing concern at this stage.

Final metallography on all specimens will be performed as soon as possible.

Conclusion

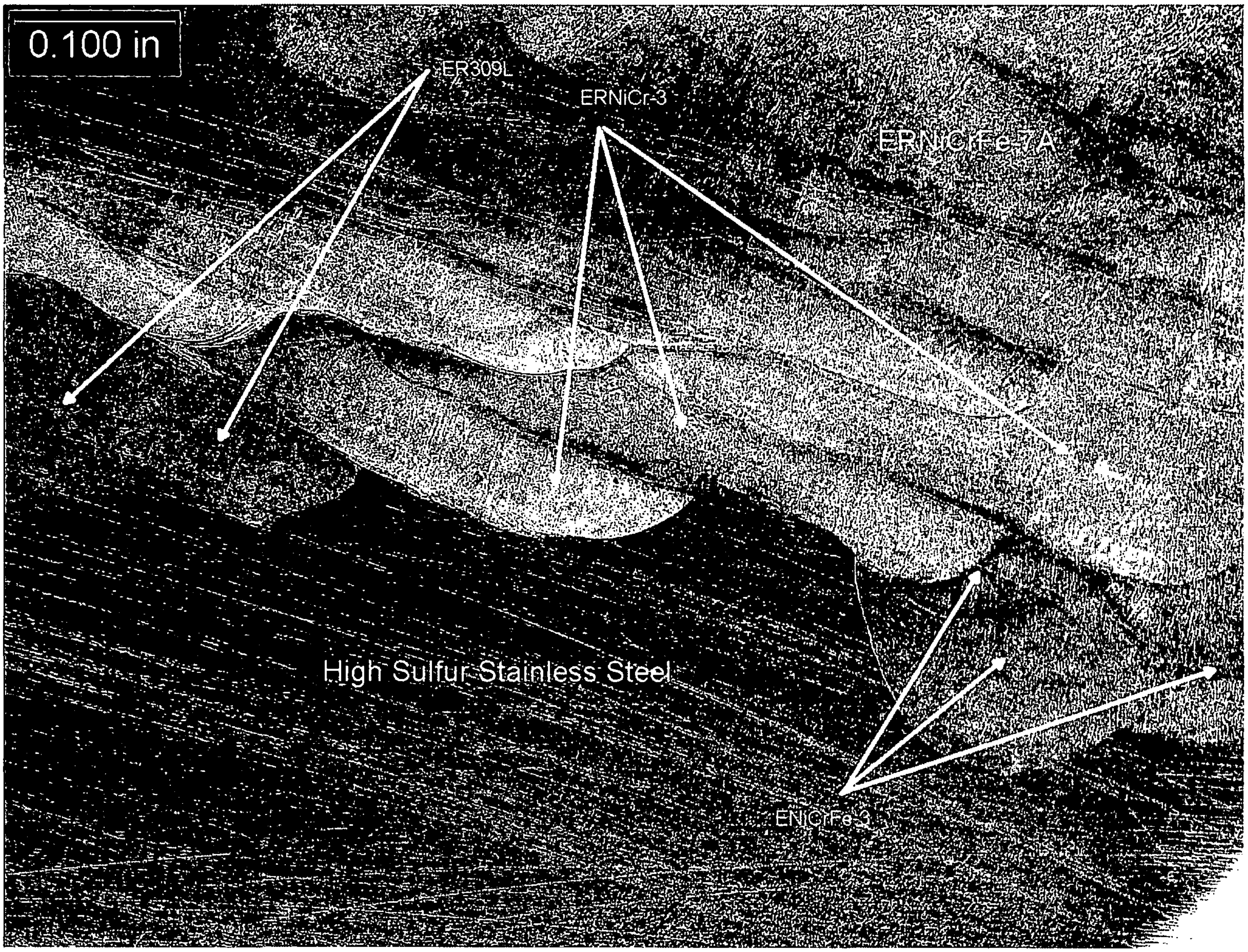
More tests and evaluations would be necessary to accurately determine the threshold where the base metal sulfur content would require barrier layer welding.

CR3 will use the barrier layer on the stainless steel items prior to overlay since all the items have sulfur contents greater than 0.010 wt%. The barrier layer will use ER309L on the stainless steel and Alloy 82 on the stainless steel near the DMW to stainless steel fusion zone only.

Structural credit will not be assumed for the barrier layer in determining the required minimum overlay thickness since ASME Section XI Code Case N-740-1, Draft February 2007 does not address the use of ER309L filler metal.

The barrier layer welding will be performed in accordance with ASME Section IX qualified welding procedure specification(s). PT will be performed on the barrier layer surface and its volume will be included in the final UT of the overlay.

Figure 1; High Sulfur Stainless Pipe Exhibiting Alloy 82 (ERNiCr-3) Deposit Between Alloy 182 (ENiCrFe-3), ER309L, and Alloy 52M (ERNiCrFe-7A) Deposits.



PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

ENCLOSURE B

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Response to Request for Additional Information

NRC Request

1) **ASME draft Code Case N-740-1, has yet to be approved by the ASME Code Committee. Please remove reference to ASME Code Case N-740-1, Draft February 2007, and resubmit based on proposed modifications to an ASME Code Committee approved code case (e.g., N-740) or an NRC approved code case (e.g. N-638-1 and N-540-2) or as a stand alone proposal, addressing the following questions.**

FPC Response

1) The Relief Request has been revised to reflect the NRC comment. A "stand alone" Relief Request has been prepared and is included in this submittal.

NRC Request

2) **The ASME Code Case N-740-1, Draft February 2007, Section 1(e) discusses Chromium (Cr) content and provides for determination of the Cr content by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the Welding Procedure Specification (WPS) for the production weld. There can be sufficient variations in chemistry within a specific weld group to affect the chemical reproducibility in a field weld.**

   a) How will the Cr content be determined for the weld overlays?

FPC Response

a) The Cr content on the first layer was verified by weld deposition on an ASTM A 106 Grade B pipe mockup using double up progression (starting at bottom and welding upward to top on each side). Welding was performed in the 6G position with Cr measured at 90 degree increments starting at 45 degrees from top. All welding parameters were recorded and the 28% minimum Cr was attained.

   b) If the Cr content is to be determined from a representative coupon taken from a mockup prepared in accordance with the WPS, what controls will ensure this is representative of the field weld?

b) The AREVA Field Welding Supervisor will assure the proper parameters and wire heat are used in situ. The same heat of wire will be used in situ for the first layer and the same welding parameters will be specified in the WPS as was used in the mockup for the first layer.

NRC Request

3) **The licensee stated, in the May 15, 2007 letter, Attachment 1, section 5.3, page 7, that Appendix VIII Supplement 10 ultrasonic examination will not be performed on the dissimilar metal welds (DMWs) prior to the structural weld overlays (SWOLs) being applied. Since the structural integrity at the DMW locations will be restored by the SWOLs, the ultrasonic examination of the DMWs is unnecessary. Code Case N-740-1, Draft February 2007, requires the size of all flaws detected or postulated in the original weldment be projected to the end of the expected life of the overlay.**

a) As no examination is planned prior to SWOL installation, what size flaws are postulated and what are the projected sizes of these flaws at the end of the expected life of the overlay?

FPC Response

a) For SWOL design, the initial flaw size is 100% through wall. For crack growth evaluations, the initial flaw size is 75% of the original wall thickness, with the final flaw sizes still being determined by analyses.

b) What is the expected life of the overlay?

b) The design life of the modifications shall be determined by analysis with a goal of achieving a design life to minimally span the remaining life of the current plant license plus 20 years to support extended life of the plant.

c) What amount of ASME Section XI required coverage would be expected if an ultrasonic examination were conducted prior to application of the SWOL?

c) Based on coverage evaluations performed on similar pressurizer nozzle configurations on another plant, it is estimated that the approximate coverage would be as follows:

Pressurizer Surge Nozzle - 19% Axial Scan Coverage - 0% Circumferential Scan Coverage
Hot Leg Surge Nozzle - 35% Axial Scan Coverage - 0% Circumferential Scan Coverage
Spray Nozzle -100% axial Scan Coverage - 75% Circumferential Scan Coverage
Relief Nozzles -100% axial Scan Coverage - 100% Circumferential Scan Coverage

NRC Request

4) Code Case N-740-1, Draft February 2007, Section 2(a)(2)(b) states that if no examination is performed prior to application of the overlay, initial flaws equal to at least 75% through the original wall thickness shall be assumed, in both the axial and circumferential directions, consistent with the overlay inservice inspection volume in Fig. 2. If the preservice inspection of section 3(b) identifies flaws in the outer 25% of the base material or weld, what flaw depths will be used in the crack growth analysis with respect to Section 2(a)(2)(b)?

FPC Response

4) If a flaw is detected in the outer 25% of the base material or original weld the crack growth evaluation will be updated to address the detected flaw(s).

NRC Request

5) Code Case N-740-1, Draft February 2007, Section 2(a)(2)(d) requires that any inside surface connected planar flaw found by the overlay preservice inspection of paragraph 3(b) which exceeded the depth of (a), (b) or (c) above, shall be used as the initial flaw depth in determining the expected life of the overlay.

a) As the majority of ultrasonic examination procedures are qualified to interrogate only the outer 25 percent of the original pipe/weld thickness, are the inspection procedures to be used for the preservice inspection capable of determining if a flaw

is inner surface connected?

FPC Response

a) The ultrasonic examination procedures are qualified for the outer 25% of the original base metal/weld thickness only and are not qualified to detect whether flaws are inner surface connected.

b) **If the ultrasonic examination procedures are not capable of determining if a flaw is inner surface connected, what size flaw will be used in the crack growth analysis?**

b) 75% through wall inside surface connected axial and circumferential flaws will be postulated.

NRC Request

6) **The licensee has stated the SWOLs will be designed as full structural overlays (assumed worst case flaw) in accordance with Code Case N-740-1, Draft February 2007, Section 2.**

a) **The Code Case N-740-1, Draft February 2007, Section 2(b)(6) specifies for mitigative full structural overlays, the assumed flaw in the underlying base material of weld is to based on the limiting case of the two below: (a) 100% through wall for the entire circumference, or (b) 100% through wall for 1.5 in (38mm) or the combined width of the weld plus buttering, whichever is greater, in the axial direction for the entire circumference. Are these the worst case flaws to be assumed?**

FPC Response

a) For SWOL design, the axial and circumferential flaws are assumed to be 100% through wall. The circumferential flaw length is assumed to extend the entire circumference. The axial flaw length is assumed to be the face width of the DMWs plus buttering or 1.5 inches, whichever is greater and the PWSCC susceptible base material length when applicable (Pressurizer spray nozzle safe end).

b) **Since the overlay of the pressurizer spray nozzle DMW will include an overlay of the Alloy 600 safe end, and the Alloy 600 safe end is susceptible to PWSCC, please demonstrate how limiting the assumed flaw to 1.5 inches or the combined width of the weld plus buttering, whichever is greater, is conservative in this application.**

b) The postulated axial flaw length will include the spray nozzle safe end length.

c) **How will the Alloy 600 safe end overlay be sized, and will the general requirements of Code Case N-740-1, Draft February 2007, Section 1(e) be applied to the Alloy 600 safe end overlay?**

c) The overlay over the safe end will be sized in the same manner as that over the DMWs. The Cr content of the SWOL will be applicable for its entire length including over the outboard portion of the carbon steel nozzle, both DMWs, the Alloy 600 safe end, and the attached stainless steel pipe at the pipe to safe end weld.

<u>NRC Request</u>

7) The licensee has stated that weld overlay of potential existing flaws in associated Alloy 600 base material will be performed.

a) What examinations will be conducted on the Alloy 600 base material prior to application of the SWOL? Please identify if an ultrasonic examination will be conducted and if not, explain why.

<u>FPC Response</u>

a) Surface examination only will be performed. Ultrasonic examination prior to weld overlay is unnecessary since qualified ultrasonic examination that includes the outer 25% of the base metal thickness will be performed after weld overlay. See response to 6c above.

b) How will actual or postulated flaws in the Alloy 600 base material be evaluated to the end of the expected life of the overlay?

b) Actual or postulated flaws in the Alloy 600 base material will be evaluated in the same manner as those in the DMWs.

c) Code Case N-740-1, Draft February 2007 is not explicit on examination requirements associated with an Alloy 600 safe end SWOL. The figures generally depict examination volumes associated with the weld. What acceptance examinations, preservice examinations, and inservice examinations are planned for the SWOL of the Alloy 600 safe end and what are the volumes to be examined?

c) The SWOL, including the HAZ beneath the SWOL will be included in the acceptance ultrasonic examination. The outer 25% of the applicable volumes for both DMWs and outer 25% of the Alloy 600 safe end base material wall thickness will apply for preservice and inservice examinations for the weld overlay.

<u>NRC Request</u>

8) Section 3(a)(2) of the proposed alternative requires that the weld overlay and the adjacent base material for at least one-half inch from each side of the weld shall be examined using the liquid penetrant method. This requirement is not consistent with Section 4.0(b) of Code Case N-638-1, which requires surface and ultrasonic examination of a band on either side of the temper bead welded surface with an axial length of at least 1.5 times the component thickness or 5 inches whichever is greater. Discuss why the proposed requirement is sufficient.

<u>FPC Response</u>

8) Ultrasonic and surface examination of the weld overlay (welded region) will be performed. Because this is a surface application of the temper bead process, there will be minimal impact to the volume of the ferritic steel nozzles in the area surrounding the weld overlay. Also there is no additional useful information that can be gained by a volumetric examination of the area surrounding the weld overlay. The weld and HAZ beneath the weld overlay will be post weld volumetrically examined. This reduction in the post welding inspection will provide additional

dose reduction for this repair while still ensuring sound weld metal is deposited and that the process has not introduced flaws in the base material. Surface examination of both the weld and ½ inch wide adjacent band on the ferritic steel nozzles will be performed, which includes the surrounding adjacent HAZ. This is sufficient to verify that defects have not been induced in the ferritic steel nozzle material due to welding.

Later editions of Section XI, as well as Code Case N-638-2, have deleted the requirement for the 1.5T examination band for both ultrasonic examination and surface examination. This is consistent with the less restrictive requirements for ultrasonic examination of the ferritic nozzle because hydrogen cracking away from the temper bead weld is not considered a concern. The NDE requirements in these documents apply to any type of welding where a temper bead technique is to be employed (which includes weld repairs of excavated flaws) and is not specifically written for weld overlay. However, it is believed that for the weld overlay type of repair, any ferritic steel base material cracking would occur in the HAZ directly below or adjacent to the weld overlay and not in the 1.5T examination band of ferritic material beyond the edges of the weld overlay. If this type of cracking were to occur, it should be detected by the NDE of the weld overlay and adjacent ferritic steel surfaces.

NRC Request

9) Code Case N-740-1, Draft February 2007, Section 3(a)(3)(c) specifies any uninspectable volume in the weld overlay shall be assumed to contain the largest radial planar flaw that could exist within that volume.

a) Is the volume limited to the weld overlay material only, or could it also extend into the outer 25% of the base material or weld?

FPC Response

9) The uninspectable volume includes the outer 25% of the underlying base material and weld and the SWOL.

b) If the volume is limited to the weld overlay material only, please justify this limitation.

b) See 9a response above.

NRC Request

10) Paragraph 3(c)(4) requires that "...The inservice examination acceptance standards of Table IWB-3514-2 shall be met for the weld overlay. Alternatively, for Class 1, 2, or 3 piping systems, the acceptance criteria of IWB-3640, IWC-3640, or IWD-3600, as applicable, shall be met for weld overlay...". Weld overlays are designed to mitigate a specific crack growth mechanism in the base metal. The construction flaws are considered benign. If flaw growth occurs in the weld overlay, the initial assumptions for the weld overlay and construction flaws may not be correct and the mechanisms causing degradation in the weld overlay may not be thoroughly understood. Any crack growth in a weld overlay should be investigated to determine its root cause. The staff would accept the acceptance criteria of IWB-3600 for the flaw in the weld overlay if the flaw growth is caused by thermal fatigue which would be insignificant. However, flaw

growth by primary water stress corrosion cracking could be significant and the staff would find such growth mechanism unacceptable. Justify the acceptance criteria of IWB-3600 for the primary water stress corrosion cracking in the weld overlay per paragraph 3(c)(4). N-740-2 specifies that PWSCC flaws in the SWOL are unacceptable.

FPC Response
10) Flaws detected in the weld overlay during inservice examination that are determined to be PWSCC will not be permitted.

NRC Request
11) Please commit to provide the NRC, within 60 days after the completion of the ultrasonic examination of the weld overlay installations, (1) the examination results of the weld overlays, and (2) a discussion of any repairs to the overlay material and/or base metal and the reason for the repair. As an example of other commitments made by licensees, refer to the commitment provided by Byron Station, Units 1 and 2, Agencywide Documents Access & Management System (ADAMS) accession No. ML062580460. In this Byron Station commitment, the licensee committed to provide the information to the NRC within 14 days. The staff has accepted the results of the ultrasonic examination within 60 days of the examination in the review of relief requests from other licensees. However, if cracks that exceed the acceptance criteria of Table IWB-3514-2 are detected during the preservice examination, the staff would like to be notified as soon as possible.

FPC Response
11) The submittal of the ultrasonic examination results will be within 60 days after completion of the ultrasonic examination of the weld overlays. NRC will be notified as soon as practical if cracks are detected that exceed the preservice examination acceptance standards in Table IWB-3514-2.

NRC Request
12) Code Case N-740-1, Draft February 2007, Section 4.0, Pressure Testing requires a system leak test be performed in accordance with IWA-5000. ASME Code Case N-504-2 is the only code case approved for weld overlay design at this time. ASME Code Case N-504-2 requires a system hydrostatic test in accordance with IWA-5000 if a flaw penetrates the original pressure boundary prior to welding, or if any evidence of the flaw penetrating the pressure boundary is observed during the welding operation. If this situation is encountered, please indicate the type of pressure testing that will be conducted. If different from that required by ASME Code Case N-504-2, please provide justification for any differences.

FPC Response
12) CR3 Third Interval ISI Program utilizes Code Case N-416-2 (approved for use in Regulatory Guide 1.147, Rev. 12) for pressure testing of welded repairs and replacements. ASME Section XI Code Case N-416-2 permits a system leakage test in lieu of a hydrostatic test provided NDE is performed in accordance with the methods and acceptance criteria of NB-2500 or NB-5000, as applicable, Section III, 1992 Edition. NB-5222 requires radiographic examination in this edition.

The ultrasonic examination to be performed is considered to be an equivalent volumetric examination method to radiography. Ultrasonics is the only method that is qualified to determine the depth of an indication and as such must be used for evaluation in consideration of an assumed 75% through-wall flaw. Based on this, N-416-2 will be applied in order to perform a system leak test with a substitution of the ultrasonic method.

NRC Request

13) **Paragraphs g(2) and g(3) of Code Case N-504-2 require evaluations of residual stresses and flaw growth of the repaired weldment. Similar evaluations are required in Section 2 of Code Case N-740-1, Draft February 2007. Paragraph 2(b)(8) of Code Case N-740-1, Draft February 2007, states that the effects of any changes in applied loads, as a result of weld shrinkage from the entire overlay, on other items in the piping system shall be evaluated.**

a) **Confirm that the analysis in Paragraph 2(b) will include results showing that the requirements of Subarticles NB-3200 and NB-3600 of the ASME Code, Section III are satisfied.**

FPC Response

13) Weld shrinkage is not addressed by NB-3200 or NB-3600. A shrinkage evaluation is performed to assure that any other item affected by the shrinkage due to the SWOL has not been adversely affected based on initial assumed axial values. Measurements are performed in situ to confirm the shrinkage limits assumed have been maintained. See 13b) response below.

b) **Confirm that the analysis includes the crack growth calculations to demonstrate that crack growth in the weld overlay or base metal is acceptable and residual stress distribution in the weld overlay and original weld demonstrate favorable stress distribution. The staff requests that the licensee submit the preliminary results of the evaluations prior to entry into Mode 4 from the refueling outage and the final evaluations within 60 days of the plant restart.**

b) These analyses are being performed and the results will be provided. Preliminary results of the evaluations will be submitted to the NRC prior to entry into Mode 4. Final results will be submitted to the NRC 60 days after plant restart of Refuel 15.

NRC Request

14) **ASME Section XI Code Case N-638-1 is currently accepted, with conditions, in regulatory guide 1.147, revision 14, for ambient temper bead welding for the application of weld overlay material. ASME Section XI Code Case N-638-1 limits the maximum area of an individual weld based on the finished surface to 100 square inches, and the depth of the weld to not greater than one-half the ferritic base metal thickness. Please indicate how these requirements will be met, or provide justification for an alternative.**

FPC Response

14) The weld overlay design will require welding on more than 100 square inches of surface on the pressurizer and hot leg surge nozzle carbon steel base material but less than 300 square

inches which is the maximum area permitted in the proposed alternative. There have been a number of temper bead weld overlays applied to safe-end to nozzle welds in the nuclear industry, and weld overlays having more than 100 square inch surface area on the nozzle ferritic steel surfaces have been used. The ASME Committee has indicated the inside diameter compressive stress levels remain essentially the same for both 100 square inches and 500 square inches related to weld overlay applications. The justification titled, Bases for 500 Sq. In. Weld Overlay Over Ferritic Material, was provided to the NRC staff in the January 10, 2007 meeting (Accession No. ML070470565). Additional justification is provided 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 thickness of the weld overlays may exceed ½ the carbon steel nozzle base metal thickness as specified in Code Case N-638-1. The requirement therein applies to excavated cavities in the ferritic steel base material that are subsequently welded flush. This requirement is not applicable to weld overlays since they are applied to the nozzle surface and are limited to 3/8 inch depth into the ferritic steel as specified in Appendix I, I(d) Additional justification is provided in Appendix F of 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 .

NRC Request

15) Section 2(g) of Appendix I to Code Case N-740-1, Draft February 2007, provides additional requirements for the case when the average lateral expansion value of the heat affected zone of Charpy V-notch specimens is less than the average value for the unaffected base metal. This requirement is not shown in Code Case N-638-1. Discuss the technical basis for the requirements in Section 2(g) of Appendix I.

FPC Response

15) The applicable average lateral expansion value of the HAZ is no less than the unaffected base material in the applicable PQR. The additional requirements regarding adjustment temperature have been deleted from the proposed alternative.

NRC Request

16) Section 3.0 (d) of Appendix I to Code Case N-740-1, Draft February 2007, states that the interpass temperature limitation of QW-406.3 need not be applied. This condition is not included in Code Case N-638-1. Discuss why this condition is included in Appendix I and is appropriate for application at Crystal River Unit 3 (CR3).

FPC Response

16) The maximum interpass temperature during welding on the ferritic steel nozzle material will be limited to 350°F maximum, even though the maximum interpass temperature is limited to 150°F maximum for the first three layers in the PQR test assembly. This is greater than the maximum 100°F interpass temperature increase permitted by QW-406.3. This is a clarification of the intent of Code Case N-638-1 that has been included in Code Case N-638-2. The limitation on the procedure qualification maximum interpass temperature is to ensure the cooling rates achieved during procedure qualification are more servere than those encountered during field welding (are not slower than those achievable during field welding). The higher interpass

temperature is permitted during field welding because it would only result in slower cooling rates which could be helpful in producing more ductile transformation products in the ferritic steel heat affected zone (HAZ). Additional justification information is also included in Appendix F of 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.

NRC Request

17) Paragraph 3(e)(1) of Appendix I to Code Case N-740-1, Draft February 2007, permits either paragraph 3(e)2 or paragraph 3(e)3 to be used when it is impractical to measure weld interpass temperature through temperature measurements (e.g., pyrometers, temperature indicating crayons, and thermocouples) due to situations where the weldment area is inaccessible, such as internal bore welding, or when there are extenuating radiological conditions. Please indicate the means of interpass temperature measurement to be used, and if the methods of either paragraph 3(e)2 or paragraph 3(e)3 are to be used, discuss why this is appropriate.

FPC Response

17) Thermocouples will be used to measure interpass temperature.

NRC Request

18) Relief request #07-003-RR section 5.3, page 5 of 12, implies that temper bead welding is not required on certain ferritic nozzles, but, regardless, the temper bead welding process will be used.

a) Please clarify the specific ferritic nozzles for which the ambient temper bead welding process will be applied. Identify if the process will apply to the entire ferritic portion of the nozzle or only certain portions. Provide justification for any portions of the ferritic nozzle for which the ambient temper bead process will not be used.

FPC Response

a) The temper bead technique for SWOL welding will be used on all the ferritic steel nozzles and on all the ferritic carbon steel surfaces.

b) Please clarify what is meant by the statement, "Since temper bead welding is required, ultrasonic and surface examinations will be performed on the temper bead welded portions of the SWOLs on the applicable portions of the nozzle transition tapers beneath the SWOLs greater than 1-1/2 inches thick for the pressurizer nozzles, if applicable...". Please identify what is meant by "the applicable portions" and "if applicable."

b) The spray nozzle, thinner portions of the relief nozzles, pressurizer surge nozzle and hot leg surge nozzle are less than 1½ inches thick. The maximum SWOL thickness over the ferritic carbon steel nozzle base material is ¾ inch thick. PWHT and/or elevated preheat temperature is not required by Section III for welding on certain P-No.1 base materials. The exemptions are based on base metal carbon content, base metal thickness and weld thickness. Using the "weld overlay thickness" definition in N-740-1 for "nominal weld thickness" as specified in NB-4622.3, neither elevated preheat or PWHT would be required for welding on P-No. 1 base materials 1½ inch thick or less, with carbon content greater than 0.30%, for weld overlay thicknesses of ¾ inch or less. For the CR3 nozzles, welding using the temper bead technique will be performed even when these conditions apply, even though it would not be required. In these cases, it will be unnecessary to wait 48 hr after welding the third temper bead layer before performing the final NDE. When welding on P-No. 1 base metal with thickness greater than 1½ inches thick, NDE will be performed no sooner than 48 hr after completion of the third temper bead layer. See 19 below.

c) For welds made to ferritic nozzles which will not receive post-weld heat treatment (PWHT) and will not be performed in accordance with the ambient temper bead welding requirements, what is the maximum carbon content of the ferritic nozzles?

c) See 18a) Response. The maximum specified carbon content is 0.35%. See 19 response below

<u>**NRC Request**</u>

19) Paragraphs 1(c)(1), 1(c)(1)(a), and 1(c)(1)(b) provide an alternative to the PWHT of the Construction Code and Owner's requirements. The alternative eliminates PWHT for weld overlays when the overlay is applied to P-No. 1 base material. As of July 2007, the staff has not decided the acceptability of the elimination of post weld heat treatment in paragraphs 1(c)(1)(a) and 1(c)(1)(b). Therefore, the staff suggests not invoking these paragraphs or provide justification for the proposed alternative in these paragraphs.

<u>FPC Response</u>

19) The clarifications in 1(c)(1) are conservative with respect to the intent of the Construction Code PWHT exemption requirements [Table NB-4622.7(b)-1, ASME Code Section III, 1989 Edition, no Addenda] since all weld overlays are deposited on the surfaces of the ferritic carbon steel nozzles instead of partial or complete through thickness welds applicable for the cases described in the Construction Code.

Typically, preheat and post weld heat treatment are used to mitigate the effects of the solution of atomic hydrogen in ferritic materials prone to hydrogen embrittlement cracking. The susceptibility of ferritic steels is directly related to their ability to transform to martensite with appropriate heat treatment. The P-No. 1 Group No. 2 material of the carbon steel nozzles is much less susceptible to martensite formation than P-No. 3 Group No. 3 base material. Therefore, P-No. 1 Group No. 2 HAZ is less susceptible to hydrogen induced cracking than P-No. 3 Group No. 3 since it has lower hardenability and reduced propensity to produce untempered martensite. Additional justification for the PWHT exemptions for P-No. 1 materials are provided in, "Technical Justification for Applying the PWHT Exemptions of NB-4620 to Weld Overlays on P-No. 1 Materials," ASME Section XI Working Group Welding and Special Repair Processes, Tracking No. BC06-1651, August 10, 2007 Handout. This document has been submitted to the NRC staff.

<u>**NRC Request**</u>

20) Section 4.0(c) of Code Case N-638-1 requires that areas from which weld-attached thermocouples have been removed be ground and examined using a surface

examination method. Please confirm that areas from which weld-attached thermocouples have been removed will be ground and examined using a surface examination method and indicate the acceptance criteria to be applied to the examination.

FPC Response
20) PT or MT in accordance with NB-4435(b)(3) will be performed on thermocouple removal areas.

NRC Request
21) In Regulatory Guide 1.147, Revision 14, the staff imposed a condition on Code Case N-638-1 regarding ultrasonic examination and associated acceptance criteria based on NB-5330 of the ASME Code, Section III. Discuss whether this condition will be satisfied.

FPC Response
21) This requirement will not be met. The ultrasonic examination requirements specified in NRC Regulatory Guide 1.147, Revision 14, as conditional acceptance of Code Case N-638-1 are not applicable to weld overlays. The ultrasonic examination requirements to be performed are based on the latest industry experience and ASME and NRC accepted practice and are completely satisfactory for this application.

NRC Request
22) If the pressurizer surge line and hot leg to surge line in CR3 have been approved for leak-before-break and the weld overlay is applied to the surge line welds, confirm that the results of the original leak before-break analyses are still valid and the associated acceptance criteria (e.g., the safety margin on crack size and leak rates as specified in Standard Review Plan 3.6.3) are still acceptable.

FPC Request
22) Leak-before-break is not applicable and has not been approved by NRC for the pressurizer surge line nor the surge line to hot leg nozzle buttering or surge line to pressurizer surge nozzle safe end weld.

NRC Request
23) When is the CR3 third 10-year Inservice Inspection interval scheduled to end?

FPC Response
23) The third 10-year Inservice Inspection interval ends August 2008.

PROGRESS ENERGY FLORIDA, INC.

CRYSTAL RIVER - UNIT 3

DOCKET NUMBER 50 - 302 / LICENSE NUMBER DPR - 72

Extension Request for Completion of Corrective Actions Associated with Generic Letter 2004-02

ENCLOSURE C

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Florida Power Corporation (FPC) in this document. Any other actions discussed in the submittal represent intended or planned actions by FPC. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Supervisor, Licensing and Regulatory Programs of any questions regarding this document or any associated regulatory commitments.

Commitment	Due Date
After completion of the ultrasonic examination of the weld overlays performed in R15 submit to the NRC the ultrasonic examination results of the weld overlays and a discussion of any repairs to the overlay material and/or base metal and reason for the repair.	60 days after completion of the ultrasonic examination of the weld overlays performed in Refueling Outage 15, scheduled for Fall 2007
NRC will be notified as soon as practical if any cracks are detected that exceed the preservice examination acceptance standards in ASME Code Section XI Table IWB-3514-2.	Prior to Mode 4 of restart from Refueling Outage 15, scheduled for Fall 2007, if necessary
Submit preliminary analysis of the residual stresses and flaw growth of repaired weldment, including crack growth calculations in accordance with Attachment 3 of CR3 to NRC letter 3F0907-05.	Prior to Mode 4 of restart from Refueling Outage 15, scheduled for Fall 2007
Submit analysis of the residual stresses and flaw growth of repaired weldment, including crack growth calculations in accordance with Attachment 3 of CR3 to NRC letter 3F0907-05.	60 days after plant restart from Refueling Outage 15, scheduled for Fall 2007