10 CFR 50.55a(a)(3)(i)

APS

Palo Verde Nuclear Generating Station

Dwight C. Mims
Vice President
Regulatory Affairs and Plant Improvement

Tel. 623-393-5403
Fax 623-393-6077

Mail Station 7605
P. O. Box 52034
Phoenix, Arizona 85072-2034

102-05856-DCM/RJR
May 08, 2008

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

Dear Sirs:

SUBJECT: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2 and 3 Docket Nos. STN 50-528, 50-529 and 50-530 Submission of Relief Requests 18, 34, and 36 to the American Society of Mechanical Engineers Section XI, Inservice Inspection Program Third Interval

The enclosures to this letter contain Inservice Inspection Relief Requests 18, 34 and 36 which are being resubmitted for use during the third inservice inspection interval. These Relief Requests have been previously submitted by Arizona Public Service Company (APS) and approved by the NRC for use during the second inservice inspection interval.

APS requests the Staff's approval of these Relief Requests to support the Unit 1's fall 2008 refueling outage, U1R14. Approval is requested by October 31, 2008.

This letter contains no new commitments or revisions to existing commitments. If you have any questions, please telephone Glenn A. Michael at (623) 393-5750.

Sincerely,

D.C. Mims

DCM/TNW/RJR/gat

Enclosures:
1. Relief Request 18 - 10 CFR 50.55a Alternative Repair Request - Third Interval - Units 1, 2 and 3
2. Relief Request No. 34 - Request to Extend the Second 10-Year, American Society of Mechanical Engineers Section XI, Inservice Inspection Program Interval for Reactor Vessel Weld Examinations - Unit 1

A047
NRR

3. Relief Request 36 - Proposed Alternative: Use of Full-Structural Weld Overlays in the Repair of Dissimilar Metal Welds - Third Interval - Units 1 and 3

cc:	E. E. Collins Jr.	NRC Region IV Regional Administrator
	M. T. Markley	NRC NRR Project Manager
	R. I. Treadway	NRC Senior Resident Inspector for PVNGS

ENCLOSURE 1

Relief Request 18 – 10 CFR 50.55a Alternative Repair Request
Third Interval – Units 1, 2 and 3

Attachment: Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique

Background

By letter dated July 1, 2003 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML031830660), the Nuclear Regulatory Commission (NRC) staff approved Relief Request No. 18, authorizing the proposed alternative to the Gas Tungsten Arc Welding (GTAW) machine temper bead welding requirements of IWA-4500 and IWA-4530 of ASME Section XI at Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3 for the second 10-year inservice inspection (ISI) interval.

In support of the original Relief Request No. 18, APS submitted letters dated May 2, 2003 and December 11, 2002, (ADAMS Accession Nos. ML021580283 and ML023520068). This letter requests the same relief that was previously approved for Palo Verde Units 1, 2 and 3 be re-approved for Palo Verde Units 1, 2 and 3 until the end of the third inservice inspection (ISI) interval. Section 5.C has been updated to reflect a revised welding procedure qualification record.

Specifically, APS is requesting authorization to use an ambient temperature automatic or GTAW machine temper bead process for certain repairs to J-groove welds on the Reactor Vessel Head Penetrations. The repair welds performed using an ambient temperature temper bead procedure, which utilizes an automatic or GTAW machine process, exhibit mechanical properties equivalent or better than those of the surrounding base material. As detailed in this enclosure, the proposed alternatives will provide an acceptable level of quality and safety.

1.0 ASME Code Component(s) Affected

Component number:	Table IWB02500-1 does not list these items (B4.12, B4.11 from Table IWB-2500-1 1992 Edition, 1992 Addenda)
Description:	97 Control Element Drive Mechanism (CEDM) nozzle penetration 1 Reactor Head Vent nozzle penetration
Code Class:	1

2.0 Applicable Code Addition and Addenda

The applicable version of The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, for the third 10-year inservice inspection (ISI) interval is the 2001 Edition through 2003 Addenda for PVNGS Units 1, 2 and 3.

Interval Dates:

Unit 1 – July 18, 2008 through July 17, 2018
Unit 2 – March 18, 2007 through March 17, 2017
Unit 3 – January 11, 2008 through January 10, 2018

The applicable version of the ASME Construction Code for PVNGS Units 1, 2 and 3 is Section III, 1971 Edition with 1973 Winter Addenda.

The applicable version of the ASME Installation Code for PVNGS Units 1, 2, and 3 is Section III, 1974 Edition with 1975 Winter Addenda.

3.0 Applicable Code Requirement

Subarticle IWA-4411 of ASME Section XI, 2001 Edition, 2003 Addenda states: "Welding, brazing, and installation shall be performed in accordance with the Owner's Requirements and, except as modified below, in accordance with Construction Code of the item." IWA-4411(e) states, "The requirements of IWA-4600(b) may be used when welding is performed without the postweld heat treatment required by the Construction Code."

Subarticle IWA-4600(b) of ASME Section XI, 2001 Edition, 2003 Addenda establishes alternative repair welding methods for performing temper bead welding. IWA-4600(b)(1), states in part that when postweld heat treatment is not to be performed the welding methods of IWA-4600, IWA-4630 or IWA-4640 may be used in lieu of the welding and nondestructive examination requirements of the Construction Code or Section III, provided the requirements of IWA-4610 are met.

IWA-4630 applies to dissimilar materials such as welds that join P-Number 43, nickel alloy to P-Number 3, low alloy steels. According to IWA-4630, "Repairs to welds that join P-No. 8 or P-No. 43 material to P-Nos. 1, 3, 12A, 12B, and 12C material may be made without the specified postweld heat treatment, provided the requirements of IWA-4630 through IWA-4634 are met. Repairs made to this paragraph are limited to those along the fusion line of a nonferritic weld to ferritic base material where 1/8-inch or less of nonferritic weld deposit exists above the original fusion line after defect removal."

Temper bead repairs of the Reactor Pressure Vessel (RPV) head penetration nozzle J-welds are performed in accordance with IWA-4600 and IWA-4630 whenever the repair cavity is within 1/8-inch of the ferritic base materials of the RPV head. When the Gas Tungsten Arc Welding (GTAW) process is used in accordance with IWA-4600 and IWA-4630, then temper bead welding is performed as follows:

- Only the automatic or GTAW machine process using cold wire feed can be used. Manual GTAW cannot be used.

- A minimum preheat temperature of 300°F is established and maintained throughout the welding process. Interpass temperature cannot exceed 450°F.

- The weld cavity is buttered with at least three (3) layers of weld metal.

- Heat input of the initial three layers is controlled to within +/-10% of that used for the first six layers during procedure qualification testing.

- After the first three weld layers, repair welding is completed with a heat input that is equal to or less than that used in the procedure qualification for weld layers seven and beyond.

- Upon completion of welding, a postweld soak or hydrogen bake-out at 450°F (minimum) for a minimum of 4 hours is required.

- Preheat, interpass, and postweld soak temperatures are monitored using thermocouples and recording instruments.

- The repair weld and preheated band are examined in accordance with IWA-4634 after the completed weld has cooled to ambient temperature.

4.0. Reason for Request

The RPV head penetration nozzles at PVNGS Units 1, 2 and 3 are considered to have a moderate susceptibility to Primary Water Stress Corrosion Cracking (PWSCC). This is based upon a susceptibility ranking of greater than 5 effective full power years (EFPY) but less than 30 EFPY from the Oconee Nuclear Station 3 time-at-temperature condition.

Should repair welding of RPV head penetration nozzle J-welds encroach (within 1/8-inch) on the ferritic base material of the RPV head, temper bead weld repairs would be required. See the following figures for additional details.

- Figure 1: Typical RPV Head Penetration Nozzle

- Figure 2: Example Repair of an RPV Head Penetration Nozzle J-Weld

5.0 Proposed Alternative and Basis for Use

Proposed Alternative

Pursuant to 10CFR50.55a(a)(3)(i), APS proposes alternatives to the GTAW machine temper bead welding requirements of IWA-4600 and IWA-4630 of ASME Section XI. Specifically, APS proposes to perform ambient temperature temper bead welding in accordance with Attachment 1 to this letter, "Dissimilar Metal Welding Using Ambient Temperature GTAW Machine Temper Bead Technique," as an alternative to IWA-4600 and IWA 4630.

APS has reviewed the proposed ambient temperature temper bead welding techniques of Attachment 1 against the GTAW machine temper bead welding requirements of IWA-4600 and IWA-4630. This review was performed to identify differences between Attachment 1 and IWA-4600 and IWA-4630. Based upon this review, APS proposes alternatives to the following ASME Section XI requirements of IWA-4600 and IWA-4630:

1. **IWA-4600(b)** specifies that repairs to base materials and welds identified in IWA-4630 may be performed without the specified postweld heat treatment of the construction code or ASME Section III provided the requirements of IWA-4600 and IWA-4630 are met. IWA-4630 includes temper bead requirements applicable to the Shielded Metal Arc Welding (SMAW) and the machine or automatic GTAW processes. As an alternative, APS proposes to perform temper bead weld repairs using the ambient temperature temper bead technique described in the attachment to this enclosure. Only the machine or automatic GTAW process can be used when performing ambient temperature temper bead welding in accordance with the attachment.

2. **IWA-4610(b)(2)** specifies that if repair welding is to be performed where physical obstructions impair the welder's ability to perform, the welder shall also demonstrate the ability to deposit sound weld metal in the positions, using the same parameters and simulated physical obstructions as are involved in the repair. This limited accessibility demonstration applies when manual temper bead welding is performed using the SMAW process. It does not apply to "welding operators" who perform machine or automatic GTAW welding from a remote location. Because the proposed ambient temperature temper bead technique described in Attachment 1 utilizes a machine GTAW welding process, limited access demonstrations of "welding operators" are not required. Therefore, the requirement of IWA-4610(b)(2) does not apply.

3. **IWA-4610(a)** specifies that the weld area plus a band around the repair area of at least 1½ times the component thickness or 5 inches, whichever is less, shall be preheated and maintained at a minimum temperature of 300°F for the GTAW process during welding; maximum interpass temperature shall be 450°F. As an alternative, APS proposes that the weld area plus a band

around the repair area of at least 1½ times the component thickness or 5 inches, whichever is less, shall be preheated and maintained at a minimum temperature of 50°F for the GTAW process during welding; maximum interpass temperature shall be 350°F.

4. **IWA-4610(a)** specifies that thermocouples and recording instruments shall be used to monitor process temperatures. As an alternative, APS proposes to monitor preheat and interpass temperatures using an infrared thermometer.

5. **IWA-4610(a)** specifies that thermocouple attachment and removal shall be performed in accordance with ASME Section III. Because APS will use an infrared thermometer to monitor preheat and interpass temperatures, thermocouples will not be used. Therefore, the thermocouple attachment and removal requirements of IWA-4610(a) do not apply.

6. **IWA-4633.1** establishes procedure technique requirements that apply when using the SMAW process. Because the proposed ambient temperature temper bead technique of Attachment 1 utilizes the machine or automatic GTAW welding process, the SMAW temper bead technique requirements of paragraph IWA-4633.1 do not apply.

7. **IWA-4633.2** establishes procedure technique requirements that apply when using the GTAW process but do not address joint design qualification of the repair cavity. As an alternative, APS proposes to qualify the joint design of the proposed repair cavity by requiring that the root width and included angle of the repair cavity in the test assembly be no greater than the minimum specified for the repair.

8. **IWA-4633.2(c)** specifies that the repair cavity shall be buttered with the first three layers of weld metal in which the heat input of each layer is controlled to within +/-10% of that used in the procedure qualification test, and heat input control for subsequent layers shall be deposited with a heat input equal to or less than that used for layers beyond the sixth in the procedure qualification. APS is not proposing any changes to the heat input requirements of IWA-4633.2(c).

9. **IWA-4633.2(c)** specifies that the completed weld shall have at least one layer of weld reinforcement deposited and then this reinforcement shall be removed by mechanical means. As an alternative, the proposed ambient temperature temper bead technique does not include a reinforcement layer.

10. **IWA-4633.2(d)** specifies that, after at least 3/16-inch of weld metal has been deposited, the weld area shall be maintained at a temperature of 450°F (minimum) for a minimum of four (4) hours (for P-No. 3 materials). As an alternative, the proposed ambient temperature temper bead technique does not include a postweld soak.

11. **IWA-4634** specifies that prior to welding, surface examination shall be performed on the area to be welded. Surface examination and acceptance criteria shall comply with IWA-4611.2. For GTAW, the nondestructive examinations shall be performed after the completed weld has cooled to ambient temperature. The examination of the welded region shall include both volumetric and surface examination.

    APS will perform the liquid penetrant examination of the completed repair weld and preheated band as required by IWA-4634. As an alternative to the volumetric examination of IWA-4634, APS proposes the following examinations for repair welds in RPV penetration nozzle J-welds.

    - Repair welds will be progressively examined by the liquid penetrant method in accordance with NB-5245 of ASME Section III. The liquid penetrant examinations will be performed in accordance with NB-5000. Acceptance criteria shall be in accordance with NB-5350.

This request for alternative is specific to localized weld repair of RPV head penetration nozzle J-welds where 1/8-inch or less of Inconel weld metal exists between the J-weld repair cavity and the ferritic base material of the RPV head. See Figures 1 and 2. Flaws in the J-weld will be removed prior to performing any temper bead repairs in accordance with this relief request.

Basis for Use

The RPV heads are manufactured from P-Number 3, Group 3 low alloy steels. If repairs are performed in accordance with ASME Section III, APS would have two options: (1) perform a weld repair that includes a postweld heat treatment (PWHT) at 1100°F – 1250° F in accordance with NB-4622.1; or (2) perform a temper bead repair using the SMAW process in accordance with NB-4622.11. Each option is discussed below.

1. PWHT of the RPV head is an impractical option that would permanently damage the RPV head assembly. ASME Section III NB-4600 requires PWHT to be performed at 1100° - 1250°F. PWHT of the RPV head will result in ovalization and misalignment of CEDM penetrations and changes in clearances.

2. NB-4622.11 provides temper bead rules for repair welding of dissimilar materials using the SMAW process. Because NB-4622.11 does not include temper bead rules for the machine or automatic Gas Tungsten Arc Welding (GTAW) process, a manual temper bead process must be used. However, a manual SMAW temper bead repair is not a desirable option due to radiological considerations. First of all, scaffolding must be built and heating blankets, thermocouples, and insulation must be installed. Secondly, the manual SMAW temper bead welding process is a time and dose intensive

process. Each weld layer is manually deposited in a high dose and high temperature (350°F) environment. The manual SMAW temper bead process of NB-4622.11 also requires that the weld crown of the first weld layer be mechanically removed by grinding. Upon completing repair welding, heating blankets, thermocouples, insulation, and scaffolding must be removed. Thermocouples and heating blanket mounting pins must be removed by grinding. The ground areas must be subsequently examined by the magnetic particle or liquid penetrant examination.

APS estimates that the dose associated with an SMAW temper bead repair on the RPV head to be at least 20 to 25 REM more than the proposed method of repair per weld repair. In addition, APS estimates the dose associated with the set-up and disassembly of the elevated preheat and postweld soak to be at least 15 REM.

APS has not requested an alternative to NB-4622.11; rather, this request proposes an alternative to IWA-4600 and IWA-4630. Owners are allowed by ASME Section XI IWA-4411(e) and IWA-4600(b) to perform temper bead repairs of dissimilar materials. IWA-4411(e) and IWA-4600(b) provide requirements and controls for performing such repairs.

IWA-4600(b) and IWA-4630 of ASME Section XI establish requirements for performing temper bead welding of "dissimilar materials". According to IWA-4633.2, either the automatic or GTAW machine process or SMAW process may be used. When using the GTAW machine process, a minimum preheat temperature of 300°F must be established and maintained throughout the welding process while the interpass temperature is limited to 450°F. Upon completion of welding, a postweld soak is performed at minimum of 450°F for a minimum of 4 hours.

The IWA-4600(b) and IWA-4630 temper bead welding process is a time and dose intensive process. Heating blankets are attached to the RPV head; typically a capacitor discharge stud welding process is used. Thermocouples must also be attached to the RPV head using a capacitor discharge welding process to monitor preheat, interpass, and postweld soak temperatures. Prior to heat-up, thermal insulation is also installed. Upon completion of repair welding (including the postweld soak), the insulation, heating blankets, studs, and thermocouples must be removed from the RPV head. Thermocouples and stud welds are removed by grinding. Ground removal areas are subsequently examined by the liquid penetrant or magnetic particle method. A significant reduction in dose could be realized by utilizing an ambient temperature temper bead process. Because the ASME Code does not presently include rules for ambient temperature temper bead welding, APS proposes the alternative described in Section 5.0.

A. Evaluation of the Ambient Temperature Temper Bead Technique

Research by the Electric Power Research Institute (EPRI) and other organizations on the use of an ambient temperature temper bead operation using the GTAW machine process is documented in EPRI Report GC-111050. According to the EPRI report, repair welds performed with an ambient temperature temper bead procedure utilizing the GTAW machine welding process exhibit mechanical properties equivalent or better than those of the surrounding base material. Laboratory testing, analysis, successful procedure qualifications, and successful repairs have all demonstrated the effectiveness of this process.

The effects of the ambient temperature temper bead welding process of Attachment 1 on mechanical properties of repair welds, hydrogen cracking, and restraint cracking are addressed below.

1. Mechanical Properties

   The principal reasons to preheat a component prior to repair welding is to minimize the potential for cold cracking. The two cold cracking mechanisms are hydrogen cracking and restraint cracking. Both of these mechanisms occur at ambient temperature. Preheating slows down the cooling rate resulting in a ductile, less brittle microstructure thereby lowering susceptibility to cold cracking. Preheat also increases the diffusion rate of monatomic hydrogen that may have been trapped in the weld during solidification. As an alternative to preheat, the ambient temperature temper bead welding process utilizes the tempering action of the welding procedure to produce tough and ductile microstructures. Because precision bead placement and heat input control is characteristic of the GTAW machine process, effective tempering of weld heat affected zones is possible without the application of preheat. The temper bead procedure is carefully designed and controlled such that successive weld beads supply the appropriate quantity of heat to the untempered heat affected zone such that the desired degree of carbide precipitation (tempering) is achieved. The resulting microstructure is very tough and ductile.

   The IWA-4630 temper bead process also includes a postweld soak requirement. Performed at 450°F for 4 hours (P-Number 3 base materials), this postweld soak assists diffusion of any remaining hydrogen from the repair weld. As such, the postweld soak is a hydrogen bake-out and not a postweld heat treatment as defined by the ASME Code. At 450°F, the postweld soak does not stress relieve, temper, or alter the mechanical properties of the weldment in any manner.

   Section 2.1 of Attachment 1 establishes detailed welding procedure qualification requirements. For base materials, filler metals, restraint, impact properties, and other procedure variables. The qualification requirements of Section 2.1 provide assurance that the mechanical properties of repair welds will be equivalent or superior to those of the surrounding base material. It should also be noted that the qualification requirements of Section 2.1 of Attachment 1 are identical to those in IWA-4630. Ambient temperature temper bead WPS 3-43/52-TB MC-GTAW-N638 was qualified in accordance with Attachment 1. Based upon the procedure qualification test results, the impact properties of the base material heat affected zone were superior to those of the unaffected base material. The mechanical testing results for the procedure qualification are summarized in Section 5.C "Mechanical Properties of WPS 3-34/52-TB MC-GTAW-N638."

2. Hydrogen Cracking

Hydrogen cracking is a form of cold cracking. It is produced by the action of internal tensile stresses acting on low toughness heat affected zones. The internal stresses are produced from localized build-ups of monatomic hydrogen. Monatomic hydrogen forms when moisture or hydrocarbons interact with the welding arc and molten weld pool. The monatomic hydrogen can be entrapped during weld solidification and tends to migrate to transformation boundaries or other microstructure defect locations. As concentrations build, the monatomic hydrogen will recombine to form molecular hydrogen – thus generating localized internal stresses at these internal defect locations. If these stresses exceed the fracture toughness of the material, hydrogen induced cracking will occur. This form of cracking requires the presence of hydrogen and low toughness materials. It is manifested by intergranular cracking of susceptible materials and normally occurs within 48 hours of welding.

IWA-4600 establishes elevated preheat and postweld soak requirements. The elevated preheat temperature of 300°F increases the diffusion rate of hydrogen from the weld. The postweld soak at 450°F was also established to bake-out or facilitate diffusion of any remaining hydrogen from the weldment. However, while hydrogen cracking is a concern for SMAW which uses flux covered electrodes, the potential for hydrogen cracking is significantly reduced when using the GTAW machine welding.

The GTAW machine welding process is inherently free of hydrogen. Unlike the SMAW process, GTAW welding filler metals do not rely on flux coverings that are susceptible to moisture absorption from the environment. Conversely, the GTAW process utilizes dry inert shielding gases that cover the molten weld pool from oxidizing atmospheres. Any moisture on the surface of the component being welded will be vaporized ahead of the welding torch. The vapor is prevented from being mixed with the molten weld pool by the inert shielding gas that blows the vapor away before it can be mixed. Furthermore, modern filler metal manufacturers produce wires having very low residual hydrogen. This is important because filler metals and base materials are the most realistic sources of hydrogen for automatic or GTAW machine temper bead welding. Therefore, the potential for hydrogen induced cracking is greatly reduced by using machine GTAW process.

3. Cold Restraint Cracking

   Cold cracking generally occurs during cooling at temperatures approaching ambient temperature. As stresses build under a high degree of restraint, cracking may occur at defect locations. Brittle microstructures with low ductility are subject to cold restraint cracking. However, the ambient temperature temper bead process is designed to provide a sufficient heat inventory so as to produce the desired tempering for high toughness. Because the GTAW machine temper bead process provides precision bead placement and control of heat, the toughness and ductility of the heat affected zone is typically superior to the base material. Therefore, the resulting structure is tempered to produce toughness that is resistant to cold cracking.

In conclusion, no elevated preheat or postweld soak above ambient temperature is required to achieve sound and tough repair welds when performing ambient temperature temper bead welding using the GTAW machine process. This conclusion is based upon strong evidence that hydrogen cracking will not occur with the GTAW process. In addition, automatic or machine temper bead welding procedures without preheat will produce satisfactory toughness and ductility properties both in the weld and weld heat affected zones. The results of previous industry qualifications and repairs further support this conclusion. The use of an ambient temperature temper bead welding procedure will improve the feasibility of performing localized weld repairs with a significant reduction in radiological exposure.

B. Evaluation of Proposed Alternatives to ASME Section XI, IWA-4600 and IWA-4630

1. According to **IWA-4600(b)(1)**, repairs may be performed to dissimilar base materials and welds without the specified postweld heat treatment of ASME Section III provided the requirements of IWA-4610 and IWA-4630 are met. The temper bead rules of IWA-4610 and IWA-4630 apply to dissimilar materials such as P-No. 43 to P-No. 3 base materials welded with F-No. 43 filler metals. When using the GTAW machine process, the IWA-4600 and IWA-4630 temper bead process is based fundamentally on an elevated preheat temperature of 300°F, a maximum interpass temperature of 450°F, and a postweld soak of 450°F. The proposed alternative of Attachment 1 also establishes requirements to perform temper bead welding on dissimilar

material welds that join P-No. 43 to P-No. 3 base materials using F-No. 43 filler metals. However, the temper bead process of Attachment 1 is an ambient temperature technique which only utilizes the GTAW machine or GTAW-automatic process. The suitability of the proposed ambient temperature temper bead technique is evaluated in this section. The results of this evaluation demonstrate that the proposed ambient temperature temper bead technique provides an acceptable level of quality and safety.

2. According to **IWA-4610(a)**, the weld area plus a band around the repair area of at least 1½ times the component thickness or 5 inches, whichever is less, shall be preheated and maintained at a minimum temperature of 300°F for the GTAW process during welding while the maximum interpass temperature is limited to 450°F. The ambient temperature temper bead technique of Attachment 1 also establishes a preheat band of at least 1½ times the component thickness or 5 inches, whichever is less. However, the ambient temperature temper bead technique requires a minimum preheat temperature of 50°F, a maximum interpass temperature of 350°F. The suitability of an ambient temperature temper bead technique with reduced preheat and interpass temperatures is addressed in Section 5 A "Evaluation of the Ambient Temperature Temper Bead Technique."

3. According to **IWA-4610(a)**, thermocouples and recording instruments shall be used to monitor process temperatures. As an alternative to IWA-4610(a), APS proposes to monitor preheat and interpass temperatures using an infrared thermometer. Infrared thermometers are hand-held devices that can be used to monitor process temperature from a remote location. To determine the preheat and interpass temperatures during the welding operation, the infrared thermometer is pointed at a target location adjacent to the repair weld. The target location is identified by a circle consisting of eight laser spots. A single laser spot in the center of the circle identifies the center of the measurement area. As the distance (D) from the object being measured increases, the diameter of the target location or "spot size" (S) also increases. The optics of the infrared thermometer sense emitted, reflected, and transmitted energy from the target location that is collected and focused onto a detector. The infrared thermometer's electronics translate the information into a temperature reading that is displayed on the unit. The infrared thermometer measures the maximum, minimum, differential, and average temperatures across the target location. This data can be stored and recalled until a new measurement is taken. APS plans to use an infrared thermometer such as the Raytek Raynger ST80 (or equivalent). The Raytek Raynger ST80 infrared thermometer measures temperatures from -25°F to 1400°F over the target location with the following accuracy: +/-3°F over the 0°F - 73°F temperature range and +/-1% of reading or 2°F, whichever is greater, above 73°F. Display resolution is 0.1°F. The distance (D) to "spot size" (S) is 50:1 for the Raytek

Raynger ST80 infrared thermometer. Since the "distance" (D) to the target location on the RPV penetration nozzle or J-weld is estimated to range from 3 feet to 6 feet, the "spot size" (S) will also range from 0.72 inch to 2.22 inches. The infrared thermometer will be appropriately calibrated prior to use.

4. **IWA-4633.2** establishes procedure technique requirements but do not address joint design access qualification of the repair cavity. As an alternative to IWA-4633.2, APS proposes to qualify the root width and included angle of the proposed repair cavity. Paragraph 2.1(c) of Attachment 1 requires that the root width and included angle of the repair cavity in the test assembly be no greater than the minimum specified for the repair. This requirement ensures that the welding procedure is only used in repair cavity configurations where it has demonstrated capability (i.e. sufficient access to deposit root passes, tie-in to the beveled or tapered walls of the repair cavity, provide appropriate tempering, and ensure complete weld fusion).

5. According to **IWA-4633.2(c)**, the repair cavity shall be buttered with three layers of weld metal in which the heat input of each layer is controlled to within +/-10% of that used in the procedure qualification test, and heat input control for subsequent layers shall be deposited with a heat input equal to or less than that used for layers beyond the third in the procedure qualification. As an alternative to IWA-4633.2, APS proposes to butter the repair cavity or weld area with at least three layers of weld metal to obtain a minimum butter thickness of 1/8-inch. The heat input of each layer in the 1/8-inch thick buttered section shall be controlled to within +/-10% of that used in the procedure qualification test. The heat input for subsequent weld layers shall not exceed the heat input used for layers beyond the 1/8-inch thick buttered section (first three weld layers) in the procedure qualification. When using the ambient temperature temper bead technique of Attachment 1, the GTAW machine process is used. GTAW Machine is a low heat input process that produces consistent small volume heat affected zones. Subsequent GTAW weld layers introduce heat into the heat affected zone produced by the initial weld layer. The heat penetration of subsequent weld layers is carefully applied to produce overlapping thermal profiles that develop a correct degree of tempering in the underlying heat affected zone. When welding dissimilar materials with nonferritic weld metal, the area requiring tempering is limited to the weld heat affected zone of the ferritic base material along the ferritic fusion line.

   After buttering the ferritic base material with at least 1/8-inch of weld metal (first 3 weld layers), subsequent weld layers should not provide any additional tempering to the weld heat affected zone in the ferritic base material. Therefore, less restrictive heat input controls are adequate after depositing the 1/8-inch thick buttered section. It should also be noted that

IWA-4630 does not require temper bead welding except "where 1/8-inch or less of nonferritic weld deposit exists above the original fusion line after defect removal". The proposed heat input techniques of Attachment 1 were utilized in the qualification of Welding Procedure Specification (WPS) 3-43/52-TB MC-GTAW-N638. Based on Charpy V-notch testing of the procedure qualification test coupon, impact properties in weld heat affected zone were superior to those of the unaffected base material. Therefore, the proposed heat input controls of the attachment provide an appropriate level of tempering. Test results of the WPS qualification are provided in Section 5C.

6. According to **IWA-4633.2(c)**, at least one layer of weld reinforcement shall be deposited on the completed weld and with this reinforcement being subsequently removed by mechanical means. In the proposed alternative of Attachment 1, the deposition and removal of a reinforcement layer is not required. A reinforcement layer is required when a weld repair is performed to a ferritic base material or ferritic weld using a ferritic weld metal. On ferritic materials, the weld reinforcement layer is deposited to temper the last layer of untempered weld metal of the completed repair weld. Because the weld reinforcement layer is untempered (and unnecessary), it is removed. However, when repairs are performed to dissimilar materials using nonferritic weld metal, a weld reinforcement layer is not required because nonferritic weld metal does not require tempering. When performing a dissimilar material weld with a nonferritic filler metal, the only location requiring tempering is the weld heat affected zone in the ferritic base material along the weld fusion line. However, the three weld layers of the 1/8-inch thick butter section are designed to provide the required tempering to the weld heat affected zone in the ferritic base material. Therefore, a weld reinforcement layer is not required. While APS recognizes that IWA-4633.2(c) does require the deposition and removal of a reinforcement layer on repair welds in dissimilar materials, APS does not believe that this reinforcement layer is necessary. This position is supported by the fact that ASME Code Case N-638 only requires the deposition and removal of a reinforcement layer when performing repair welds on similar (ferritic) materials. Repair welds on dissimilar materials are exempt from this requirement.

7. According to **IWA-4633.2(d)**, the weld area shall be maintained at a minimum temperature of 450°F for a minimum of 4 hours (for P-No. 3 materials) after at least 3/16-inch of weld metal has been deposited. In the proposed alternative of Attachment 1, a postweld soak is not required. The suitability of an ambient temperature temper bead technique without a postweld soak is addressed in Section 5A.

8. According to **IWA-4633.2(e)**, after depositing at least 3/16-inch of weld metal and performing a postweld soak at a minimum temperature of 450°F,

the balance of welding may be performed at an interpass temperature of 350°F. As an alternative, APS proposes that an interpass temperature of 350°F may be used after depositing at least 1/8 inch of weld metal without a postweld soak. The proposed ambient temperature temper bead process of Attachment 1 is carefully designed and controlled such that successive weld beads supply the appropriate quantity of heat to the untempered heat affected zone such that the desired degree of carbide precipitation (tempering) is achieved. The resulting microstructure is very tough and ductile. This point is validated by the qualification of WPS 3-43/52-TB MC-GTAW-N638. Based on Charpy V-notch testing of the procedure qualification test coupon, impact properties in weld heat affected zone were superior to those of the unaffected base material. Test results of the WPS qualification are provided in Section IV.C. The suitability of an ambient temperature temper bead technique without a postweld soak is addressed in Section 5A.

9. **IWA-4634** specifies that the repair weld shall be surface and volumetrically examined after the completed repair weld has been at ambient temperature. As an alternative to the volumetric examinations of IWA-4634, APS proposes the examinations of repair welds in RPV penetration nozzle J-welds described below. The suitability of the alternative examinations is addressed in Section 5.D "Suitability of Alternative Nondestructive Examinations (NDE)."

    - Repair welds will be progressively examined by the liquid penetrant method in accordance with NB-5245 of ASME Section III. The liquid penetrant examinations will be performed in accordance with NB-5000. Acceptance criteria shall be in accordance with NB-5350.

C. Mechanical Properties of WPS 3-43/52-TB MC-GTAW-N638

WPS 3-43/52-TB MC-GTAW-N638 was qualified in accordance with Attachment 1. The welding procedure qualification test assembly was 4 inches thick and consisted of SA-533, Grade B, Class 1 (P-No. 3, Group 3) and SB-166, N06690 (P-No. 43) base materials. Prior to welding, the SA-533, Grade B, Class 1 portion of the test assembly was heat treated for 40 hours at 1,200°F. The repair cavity in the test assembly was 1.5 inches deep. The test assembly cavity was welded in the 3G (vertical) position using ERNiCrF3-7 (F-No. 43) filler metal. Results of the welding procedure qualification were documented on procedure qualification record PQR 742. Results of mechanical testing – tensile testing, bend testing, Charpy V-notch testing, and drop weight testing – are summarized below. WPS 3-43/52-TB MC-GTAW-N638 will be used to perform the repair welding activities described in Section B above.

- Tensile test specimens exhibited a tensile strength that exceeded 80,000 psi and were acceptable per ASME Section IX. The bend testing was also acceptable. Test results are as follows:

Tensile Test Results

Specimen No.	Tensile Specimen	Actual Tensile Strength	Failure
Test 1-A	0.750x0.727	96,000 psi	Ductile/Base
Test 1-B	0.748x0.720	88,500 psi	Ductile/Base
Test 2-A	0.725x0.720	98,000 psi	Ductile/Base
Test 2-B	0.740x0.653	90,000 psi	Ductile/Base

Bend Test Results

Specimen Type and Figure No.	Result
Side Bend 1 QW-462.2	Acceptable
Side Bend 2 QW-462.2	Acceptable
Side Bend 3 QW-462.2	Acceptable
Side Bend 4 QW-462.2	Acceptable

- Drop weight and Charpy V-notch testing of the SA-533, Grade B, Class 1 "unaffected" base material was performed. Based upon drop weight testing of the SA-533, Grade B, Class 1 "unaffected" base material, a nil ductility transition temperature (T_{NDT}) of -60°F was established. Charpy V-notch testing was also performed at +0°F. All three Charpy V-notch specimens exhibited at least 35 mils and 50 ft-lbs. Based upon the above testing, an RT_{NDT} of -60°F was established for the SA-533, Grade B, Class 1 base material. Test results are as follows:

Drop Weight Test: Unaffected Base Material

Specimen ID	Specimen Type	Test Temperature	Drop Weight Break	T_{NDT}
DW1	P-3	-50°F	No	-60°F
DW2	P-3	-50°F	No	-60°F

Charpy V-Notch Tests: Unaffected Base Material

Specimen ID	Test Temperature	Absorbed Energy (ft-lbs)	Lateral Expansion(mils)	% Shear Fracture
1	+0°F	83	.063	40
2	+0°F	82	.060	40
3	+0°F	81	.060	35
Average	+0°F	***82***	***.061***	***38.3***

- Charpy V-notch testing of the SA-533, Grade B, Class 1 heat affected zone was also performed at +0°F. The absorbed energy, lateral expansion, and percent shear fracture of the heat affected zone test specimens were compared to the test values of the unaffected base material specimens. The average values of the three heat affected zone specimens were greater than those of the unaffected base material specimens. Based upon these results, it is clear that the proposed ambient temperature temper bead process improved the heat affected zone properties. Test results are as follows:

Charpy V-Notch Tests: Heat Affected Zone

Specimen ID	Test Temperature	Absorbed Energy (ft-lbs)	Lateral Expansion(mils)	% Shear Fracture
1	+0°F	166	.075	70
2	+0°F	195	.096	70
3	+0°F	178	.087	75
Average	+0°F	***179.1***	***.086***	***71.7***

D. Suitability of Alternative Nondestructive Examinations (NDE)

IWA-4634 specifies that the repaired region shall be examined by the volumetric method. The NDE requirements of IWA-4634 were established based upon a temper bead weld repair to butt welds. Figures IWA-4623.2-1 and IWA-4633.2-1 clearly indicate this. While the requirement to perform a volumetric examination of a butt weld between a nozzle and pipe is appropriate, these examinations are not appropriate for weld repairs of RPV head penetration nozzle J-welds. See Figures 1 and 2.

1. Impracticality of Volumetric Examinations

Radiographic examination of weld repairs of RPV head penetration nozzle J-welds is not practical. Meaningful radiographic examination cannot be performed due to the weld configuration and access limitations. The weld configuration and geometry of the penetration in the head provide an obstruction for the radiography and interpretation would be very difficult. Ultrasonic examination of the J-weld would also be impractical.

2. Suitability of Proposed Alternative

As an alternative to volumetric examinations, APS proposes to perform a progressive liquid penetrant of the J-weld repair weld in accordance with NB-5245 of ASME Section III. It should be noted that ASME Section III does not require volumetric examination of J-welds. According to NB-3352.4(d)(1), "partial penetration welds used to connect nozzles as permitted in NB-3337.3 shall meet the fabrication requirements of NB-4244(d) and shall be capable of being examined in accordance with NB-5245." NB-4244(d) establishes fabrication details for nozzles welded with partial penetration welds as shown in Figures NB-4244(d)-1 and NB-4244(d)-2.

According to NB-5245, "Partial penetration welds, as permitted in NB-3352.4(d), and as shown in Figures NB-4244(d)-1 and NB-4244(d)-2, shall be examined progressively using either the magnetic particle or liquid penetrant method. The increments of examination shall be the lesser of one-half of the maximum weld dimension measured parallel to the centerline of the connection or ½-inch. The surface of the finished weld shall also be examined by either method."

The partial penetration J-welds of the RPV head penetration nozzles were designed and fabricated in accordance with NB-3352.4(d) and NB-4244(d). Therefore, according to NB-3352.4(d), the code required examination for these partial penetration J-welds is a progressive liquid penetrant examination performed in accordance with NB-5245. A volumetric examination is not required.

6.0 Duration of Proposed Alternative

The proposed alternative requested would be applicable for the remainder of the third ISI interval for Units 1, 2 and 3.

7.0. Conclusion

10 CFR 50.55a(a)(3) states:

"Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

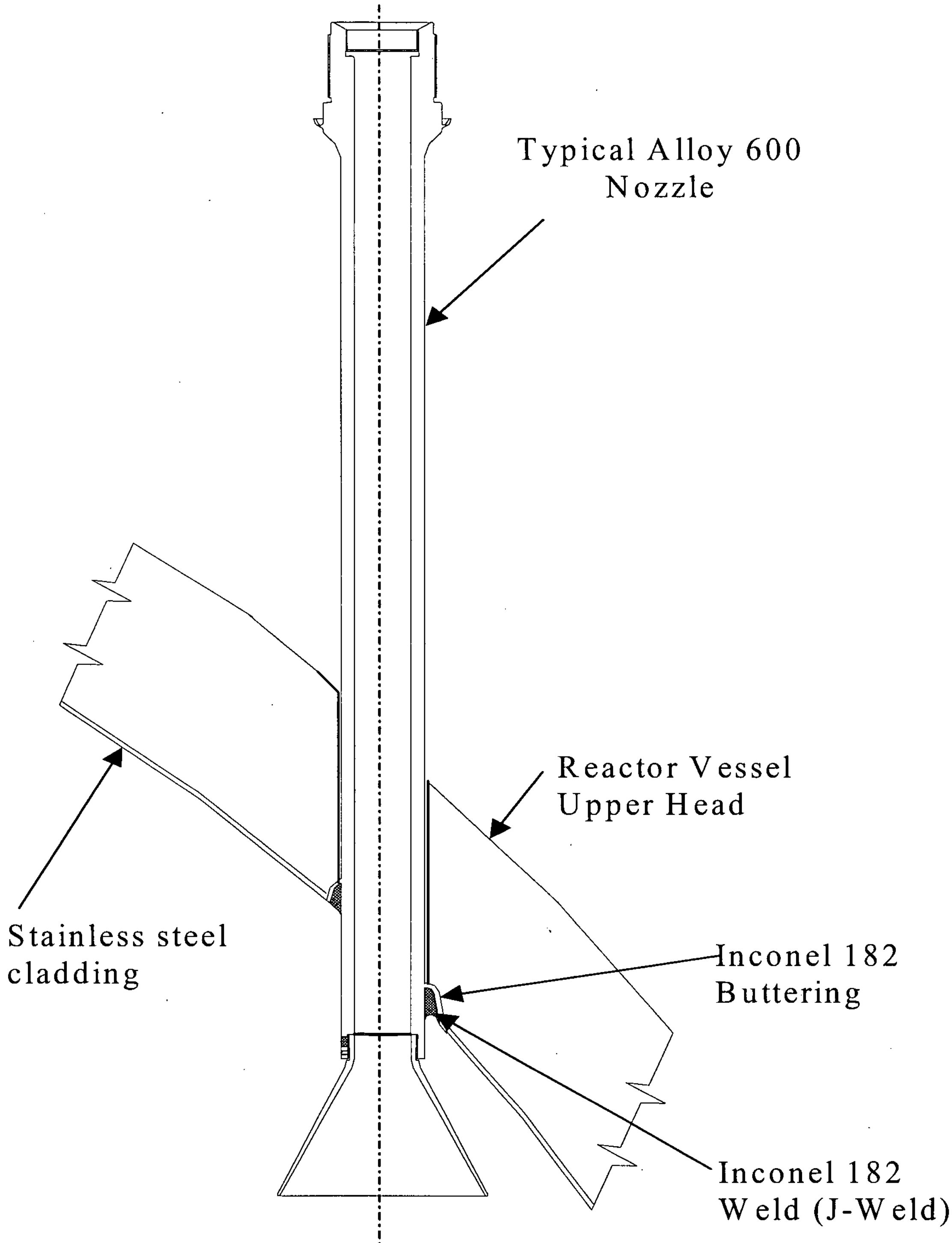
(i) The proposed alternatives would provide an acceptable level of quality and safety, or
(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

APS believes that compliance with the repair rules as stated in Reference 1 and as described in Section III of this request would result in unwarranted damage to the RPV head assembly. The proposed alternative discussed in Section IV would provide an acceptable level of quality and safety without exposing the head to potential ovalization and misalignment of the CEDM penetrations. Additionally, the work required to meet the current Code repair method, automatic or GTAW machine temper bead with 300°F minimum preheat and 300°F post weld hydrogen bake-out, would be extremely difficult and the radiation exposures for set-up, monitoring, and removal of the required equipment is unjustified. Using the proposed method of repair, it is estimated that approximately 15 person-rem could be saved on each required repair. Therefore, APS requests that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

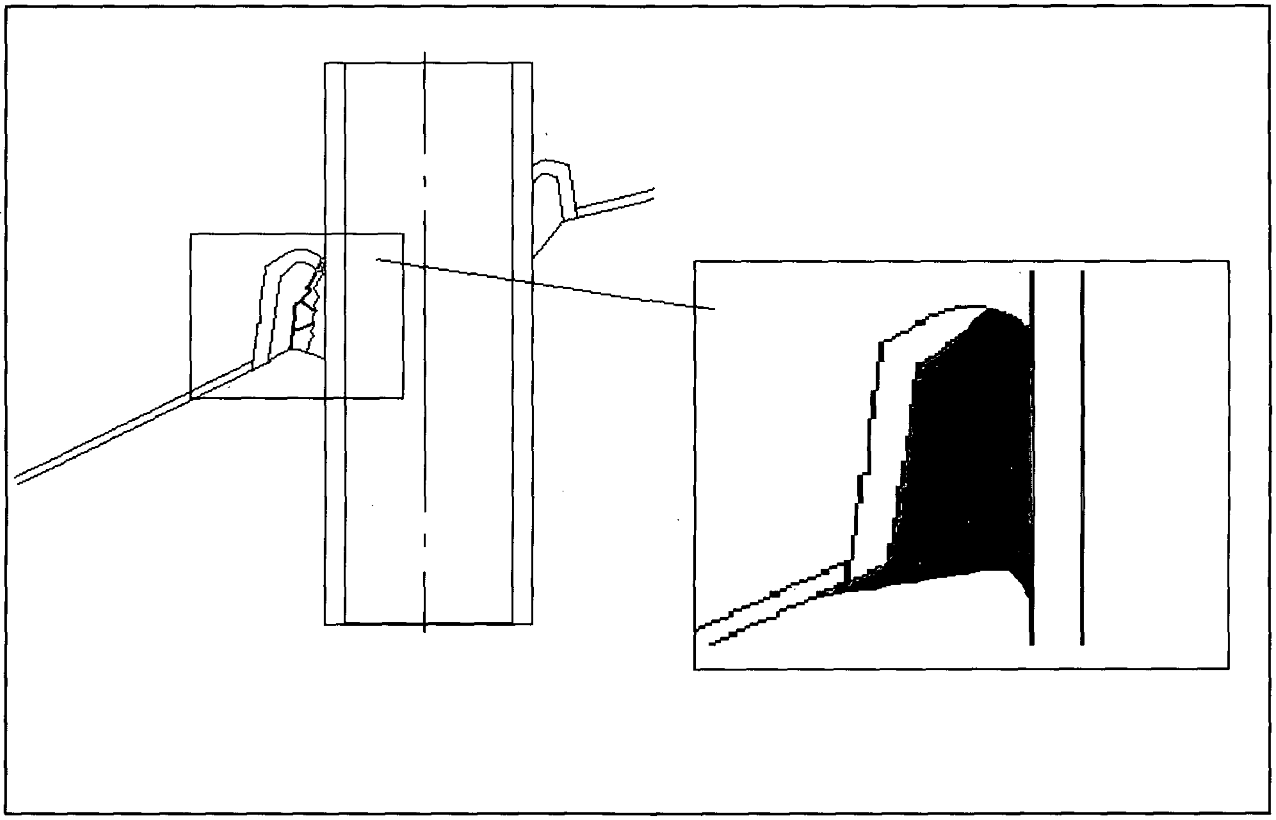
APS requests the Staff's approval of Relief Request 18, which is being submitted as a contingency should APS identify the need to perform reactor head nozzle repairs using the Ambient Temperature GTAW Machine Temper Bead Technique to support the Unit 1 fall 2008, refueling outage. Startup is currently scheduled for October 31, 2008.

8.0. References

1. ASME Section XI, 2001 Edition, 2003 Addenda
2. ASME Section III, 1971 Edition, Winter 1973 Addenda
3. ASME Section III, Subsection NB, 1971 Edition, Summer 1973 Addenda
4. ASME Section III, Subsection NB, 1974 Edition, Winter 1975 Addenda
5. ASME Section XI Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature GTAW Machine Temper Bead Technique"
6. EPRI Report GC-111050, "Ambient Temperature Preheat for GTAW Machine Temper Bead Applications"
7. Letter 102-04603-CDM/SAB/RJR, "Response to NRC Bulletin 2001-01; Circumferential Cracking of VHP Nozzles," dated September 4, 2001
8. CONAM Inspection Laboratory Report 1118-029, dated October 13, 2005



Typical RPV Head Penetration Nozzle
FIGURE 1



Example Repair of an RPV Head Penetration Nozzle J-Weld

FIGURE 2

RELIEF REQUEST 18

ATTACHMENT

DISSIMILAR METAL WELDING USING AMBIENT TEMPERATURE
MACHINE GTAW TEMPER BEAD TECHNIQUE

DISSIMILAR METAL WELDING USING AMBIENT TEMPERATURE MACHINE GTAW TEMPER BEAD TECHNIQUE

1.0 GENERAL REQUIREMENTS:

(a) The maximum area of an individual weld based on the finished surface will be less than 100 square inches, and the depth of the weld will not be greater than one-half of the ferritic base metal thickness.

(b) Repair/replacement activities on a dissimilar-metal weld are limited to those along the fusion line of a nonferritic weld to ferritic base material on which 1/8-inch or less of nonferritic weld deposit exists above the original fusion line. Repair/replacement activities on nonferritic base materials where the repair cavity is within 1/8-inch of a ferritic base material may also be performed.

(c) If a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed provided the depth of repair in the base material does not exceed 3/8-inch.

(d) Prior to welding, the temperature of the area to be welded and a band around the area of at least 1½ times the component thickness (or 5 inches, whichever is less) will be at least 50°F.

(e) Welding materials will meet the Owner's Requirements and the Construction Code and Cases specified in the repair/replacement plan. Welding materials will be controlled so that they are identified as acceptable until consumed.

(f) The area prepared for welding shall be suitably prepared for welding in accordance with a written procedure.

2.0 WELDING QUALIFICATIONS

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

2.1 Procedure Qualification:

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

(b) Consideration will be given to the effects of irradiation on the properties of material, including weld material for applications in the core belt line region of the reactor vessel. Special material requirements in the Design Specification will also apply to the test assembly materials for these applications.

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

(d) The maximum interpass temperature for the first three layers or as required to achieve the 1/8-inch butter thickness in the test assembly will be 150°F. For the balance of the welding, the maximum interpass temperature shall be 350°F.

(e) The test assembly cavity depth will be at least one-half the depth of the weld to be installed during the repair/replacement activity, and at least 1 inch. The test assembly thickness will be at least twice the test assembly cavity depth. The test assembly will be large enough to permit removal of the required test specimens. The test assembly dimensions surrounding the cavity will be at least the test assembly thickness, and at least 6 inches. The qualification test plate will be prepared in accordance with Figure 1.

(f) Ferritic base material for the procedure qualification test will 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 subparagraph (h) below, but shall be in the base metal.

(g) Charpy V-notch tests of the ferritic weld metal of the procedure qualification shall meet the requirements as determined in subparagraph (f) above.

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

1. The specimens will be removed from a location as near as practical to a depth of one-half the thickness of the deposited weld metal. The test coupons for HAZ impact specimens will be taken transverse to the axis of the weld and etched to define the

HAZ. The notch of the Charpy V-notch specimens will 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 will 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 a forging, the axis of the weld will be oriented parallel to the principal direction of rolling or forging.

3. The Charpy V-notch test will be performed in accordance with SA-370. Specimens will be in accordance with SA-370, Figure 11, Type A. The test will 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 will be reported in the Procedure Qualification Record.

(i) The average values of the three HAZ impact tests will be equal to or greater than the average values of the three unaffected base metal tests.

2.2 Performance Qualification:

Welding operators will be qualified in accordance with ASME Section IX.

3.0 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 using cold wire feed.

(b) Dissimilar metal welds shall be made using F-No. 43 weld metal (QW-432) for P-No. 43 to P-No. 3 weld joints.

(c) The area to be welded will be buttered with a deposit of at least three layers to achieve at least 1/8-inch butter thickness as shown in Figure 2, steps 1 through 3, with the heat input for each layer controlled to within ± 10% of that used in the procedure qualification test. Particular care will be taken in placement of the weld layers at the weld toe area of the ferritic base material to ensure that the HAZ is tempered. Subsequent layers will be deposited with a heat input not exceeding that used for layers beyond the third layer (or as required to achieve the 1/8-inch butter thickness) in the procedure qualification.

(d) The maximum interpass temperature field applications will be 350°F regardless of the interpass temperature during qualification.

(e) Particular care will 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.

4.0 EXAMINATION:

(a) Prior to welding, a surface examination will be performed on the area to be welded.

(b) Repair welds in RPV penetration nozzle J-welds shall be examined as follows:

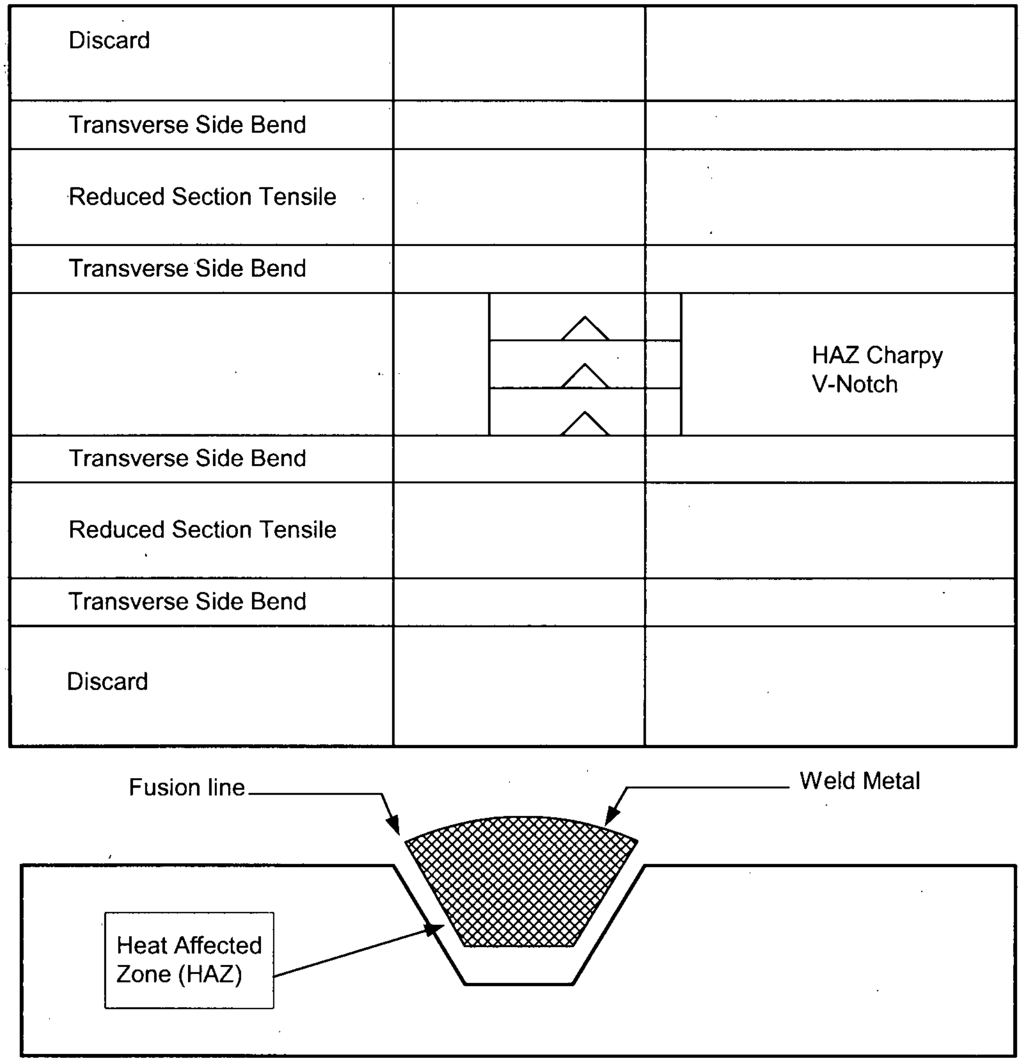
- Repair welds will be progressively examined by the liquid penetrant method in accordance with NB-5245 of ASME Section III. After the completed repair weld has been at ambient temperature for at least 48 hours, repair welds including the preheat band (1.5 times the component thickness or 5 inches, whichever is less) around the repair weld shall be examined by the liquid penetrant method. The liquid penetrant examinations will be performed in accordance with ASME Section III, NB-5000. Acceptance criteria shall be in accordance with NB-5350.

(c) NDE personnel performing liquid penetrant examination will be qualified and certified in accordance with NB-5500.

5.0 DOCUMENTATION

Use of this request shall be documented on NIS-2A. Alternatively, repairs may be documented on Form NIS-2A as described in Code Case N-532-4.

DISSIMILAR METAL WELDING USING AMBIENT TEMPERATURE MACHINE GTAW TEMPER BEAD TECHNIQUE

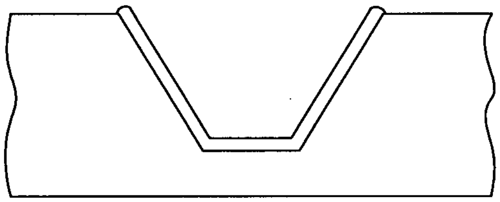


GENERAL NOTE: Base Metal Charpy impact specimens are not shown.

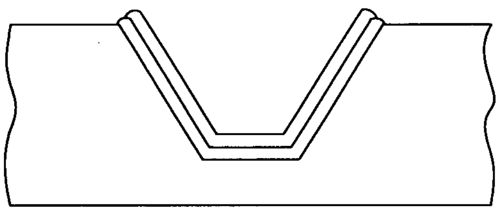
Figure 1 - QUALIFICATION TEST PLATE

DISSIMILAR METAL WELDING USING AMBIENT TEMPERATURE MACHINE GTAW TEMPER BEAD TECHNIQUE

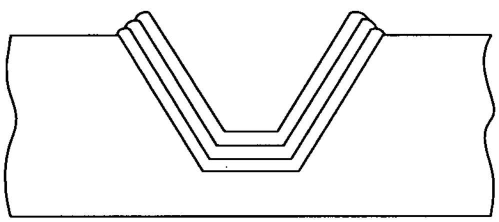
Duration of Proposed alternative



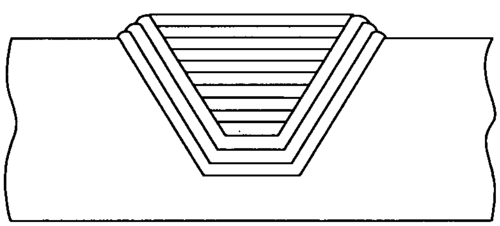
Step 1: Deposit layer one with first layer weld parameters used in qualification.



Step 2: Deposit layer two with second layer weld parameters used in qualification. NOTE: Particular care shall be taken in application of the second layer at the weld toe to ensure that the weld metal and HAZ of the base metal are tempered.



Step 3: Deposit layer three with third layer weld parameters used in qualification. NOTE: Particular care shall be taken in application of the third layer at the weld toe to ensure that the weld metal and HAZ of the base metal are tempered.



Step 4: Subsequent layers to be deposited as qualified, with heat input less than or equal to that qualified in the test assembly. NOTE: Particular care shall be taken in application of the fill layers to preserve the temper of the weld metal and HAZ.

GENERAL NOTE: For dissimilar-metal welding, only the ferritic base metal is required to be welded using Steps 1 through 3 of the temper bead welding technique.

Figure 2 - AUTOMATIC OR MACHINE GTAW TEMPER BEAD WELDING

ENCLOSURE 2

Relief Request No. 34 - Request to Extend the Second 10-Year, American Society of Mechanical Engineers Section XI, Inservice Inspection Program Interval for Reactor Vessel Weld Examinations – Unit 1

Background

By letters dated September 20, 2006, and May 16, 2007, the Nuclear Regulatory Commission (NRC) staff approved Relief Request No. 34, submitted by Arizona Public Service Company (APS), requesting relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements at Palo Verde Nuclear Generating Station (Palo Verde), Units 2 and 3. In these letters (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062490513 and ML071140033), the NRC authorized an alternative to the ASME Code requirements to defer the reactor vessel weld examinations of Palo Verde, Units 2 and 3, for one fuel cycle. In support of the original Relief Request No. 34, APS submitted letters dated May 4 and 26, 2006 and January 4, 2007, (ADAMS Accession Nos. ML061300676, ML061570209, and ML070110359, respectively).

This request for Unit 1 is for the same relief that was approved for Palo Verde Units 2 and 3. The second interval for Unit 1 ends on July 17, 2008. The one year Code allowed extension would encompass the 14^{th} refueling outage (U1R14) scheduled for October of 2008. That extension would end on July 17, 2009, approximately 8-9 months before the 15^{th} refueling outage (U1R15) in the spring on 2010. Without the approval of this request, Palo Verde Unit 1 would be required to perform an examination of the welds listed in Section 1.0 in the fall of 2008 during U1R14.

The guidance for the technical basis to extend the 10-year reactor vessel ISI interval by one refueling cycle is contained in a letter from R. Gramm of the NRC to G. Bischoff of the Westinghouse Owners Group, dated January 27, 2005 (Reference 4). This request provides APS' technical justification that the current ISI interval can be extended while providing an acceptable level of quality and safety in accordance with 10 CFR 50.55a (a)(3)(i).

As stated in this enclosure, this request does not apply to any dissimilar metal welds, including Alloy 600 base metal or Alloy 82/182 weld material where primary water stress corrosion cracking is a concern or any other augmented inspection requirements imposed. The technical justification to extend PVNGS's second inspection interval performance of Category B-A and B-D examinations by an additional 8 to 9 months is consistent with the guidance provided in NRC to Westinghouse Owners Group letter referenced above. APS's proposed extension of the inservice inspection interval for these examinations will continue to provide an acceptable level of quality and safety, as described in the enclosed relief request.

1.0 ASME Code Component(s) Affected

The affected components are the PVNGS Unit 1 Reactor Vessel (RV), specifically the following American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI examination categories and item numbers. These examination categories and item numbers are from IWB-2500 and Table IWB-2500-1 of the ASME BPV Code, Section XI.

Examination Category	Item No	Description
B-A	B1.11	Circumferential Shell Welds
B-A	B1.12	Longitudinal Shell Welds
B-A	B1.22	Meridional Shell Welds (Bottom Head only)
B-A	B1.30	Shell-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Areas

(Throughout this request the above examination categories are referred to as "the subject examinations" and the ASME BPV Code Section XI is referred to as "the Code")

2.0 Applicable Code Edition and Addenda

The PVNGS Unit 1 second 10-year Interval Inservice Inspection (ISI) Program Plan is prepared to comply with the 1992 Edition 1992 Addenda of the Code.

3.0 Applicable Code Requirement

Subarticle IWA-2432 Inspection Program B of ASME Section XI of the 1992 Edition 1992 Addenda states in part that successive Inspection Intervals are 10 years following the previous inspection interval except as modified by IWA-2430(d).

Subarticle IWA-2430(d) of ASME Section XI of the 1992 Edition 1992 Addenda states in part that for components inspected under Program B, each of the inspection intervals may be extended or decreased by as much as 1 year. Adjustments shall not cause successive intervals to be altered by more than 1 year from the original pattern of intervals.

Subarticle IWB-2412(b) of ASME Section XI of the 1992 Edition 1992 Addenda states in part that the inspection interval specified in IWB-2412(a) may be decreased or extended by as much as 1 year to enable an inspection to coincide with a plant outage, within the limitations of IWA-2430(d).

ASME Section XI – Table IWB-2500-1, Examination Category, B-A, requires a volumetric examination on all welds.

ASME Section XI – Table IWB-2500-1, Examination Category, B-D, requires a volumetric examination on all nozzles.

4.0 Reason for Request

The intent of the request is to extend the ISI interval for Examination Category B-A and B-D by an additional 8 to 9 months, to allow time for NRC review of industry efforts to extend the ISI interval for the subject examinations from 10 to 20 years. The industry efforts use ASME Section XI Code Case N-691 (Reference 1) as a basis for using risk-informed insights to show that extending the inspection interval from 10 to 20 years results in a small change in the RV failure frequency that satisfies the requirements of Regulatory Guide 1.174 (Reference 2). Following NRC approval of these efforts, APS intends to submit a separate request to extend the current 10-year interval for each PVNGS unit to coincide with the inspection dates identified in PWR Owners Group letter OG-06-356, "Plan for Plant Specific Implementation of Extended Inservice Inspection Interval per WCAP-16168-NP, Revision 1, 'Risk Informed Extension of the Reactor Vessel In-Service Inspection Interval,' MUHP 5097-99, Task 2059," dated October 31, 2006, or as specified in the final NRC safety evaluation approving WCAP-16168. The inspection interval proposed in this technical report will result in a reduction in man-rem exposure and examination costs.

5.0 Proposed Alternative and Basis for Use

Pursuant to 10 CFR 50.55a(a)(3)(i), Arizona Public Service Company (APS) hereby requests approval to use an alternative to the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, Paragraph IWB-2412, Inspection Program B, for PVNGS Unit 1. The proposed alternative is to defer the Unit 1 reactor vessel (RV) weld examinations until U1R15 in the spring of 2010. This additional 8 to 9 month extension will allow additional time for completing evaluations and staff review associated with Westinghouse Owners Group Topical Report, WCAP-16168 (Reference 3). The NRC has communicated to the Westinghouse Owners Group that the staff would agree to licensees submitting a one cycle relief request for an extension.

Currently, PVNGS Unit 1 is in the third period of its second ten-year ISI interval. The second ISI interval is currently scheduled to end on July 17, 2008. Applying the 12 month extension allowed by IWA-2430(d) would extend the end of the interval until July 17, 2009. The 1R14 refueling outage is currently scheduled for the fall of 2008. However, an additional amount of extension time (8 to 9 months) will be required to perform these examinations in 1R15 (spring 2010) and capture the results in the Second Interval.

The guidance for the technical basis to extend the 10-year RV ISI interval by one refueling cycle is contained in a letter from R. Gramm of the NRC to G. Bischoff of the Westinghouse Owners Group, dated January 27, 2005 (Reference 4). To reach the next refueling outage in Unit 1 (U1R15) APS would require an additional 8 to 9 month extension of the second ISI interval beyond the Code allowed 12 month extension. The following information provides APS' technical justification that the current ISI interval can be extended while providing an acceptable level of quality and safety in accordance with 10 CFR 50.55a (a)(3)(i).

APS' technical basis for the relief request addresses the following five topics which were identified in Reference 4.

- Plant specific reactor vessel inservice inspection history.
- Fleetwide reactor vessel inservice inspection history.

- Degradation mechanisms in the reactor vessel.
- Material condition of the reactor vessel relative to embrittlement.
- Operational experience relative to RV structural integrity challenging events.

5.1 Reactor Vessel Inservice Inspection History for Unit 1

PVNGS Unit 1 is in its second ISI interval for the reactor pressure vessel examinations. The preservice inspections (PSI) and one ISI have been performed on the Examination Category B-A and B-D welds to date. The PSI was performed in accordance with ASME Section XI, 1974 Edition and Summer 1975 Addenda; and the ISI was performed in accordance with ASME Section XI, 1980 Edition, Winter 1981 Addenda, and Regulatory Guide 1.150 (Reference 5). The examinations performed in Unit 1 have achieved acceptable coverage (i.e., >90% or examination of the maximum practical coverage). No reportable indications were found during these examinations. Based on the examination method and coverage obtained, it is reasonable to conclude that the examinations were of sufficient quality to detect any significant flaws that would challenge RV integrity. A detailed inspection history for the welds to which the subject examinations apply are contained Table 1, Palo Verde Unit 1 Inservice Inspection Results.

5.2 Fleetwide Reactor Vessel Inservice Inspection History

As part of the technical basis for ASME Code Case N-691, a survey of RV ISI history for 14 pressurized water reactors was performed. These 14 plants represented 301 total years of service and included RVs fabricated by various vendors. The plants reported that no reportable findings had been discovered during examinations of Category B-A and B-D welds of their RVs.

It is widely recognized in the fracture mechanics community that fatigue crack growth of embedded flaws is substantially smaller than that of surface breaking flaws. PVNGS Unit 1 contains one layer cladding. The completed cladding was 100% liquid penetrant (PT) examined during construction to assure freedom from lack of fusion or other linear defects open to the surface. This PT examination lowers the probability of surface breaking flaws propagating due to fatigue.

All Pressurized Water Reactor plants have performed their first 10-year ISI of the subject examinations. No surface-breaking or unacceptable near-surface flaws (i.e., defects) have been reported in any of these inspections performed per the requirements of Regulatory Guide 1.150, or ASME Section XI, Appendix VIII.

5.3 Degradation Mechanisms in the Reactor Vessel

The welds for which the subject examinations are conducted are similar metal low alloy steel welds. The only currently known degradation mechanism for this type of weld is fatigue due to thermal and mechanical cycling from operational transients.

Studies have shown that while flaw growth of simulated flaws in a reactor vessel would be small, the operational transient which has the greatest contribution to flaw growth is the cooldown transient. Based on operating experience, the cooldown transient is a low frequency transient and is not expected to occur more than a few instances during the requested inspection extension period. Therefore, any flaw growth during the requested deferral period will be inherently small.

The fatigue usage factors for the welds in the subject examinations are much less than the ASME Code design limit of 1.0 after 40 years of operation. These usage factors are calculated using a very conservative design duty cycle. It is very unlikely that more than a few of these events (e.g. heatup or cooldown) would actually occur during the extension period of this proposed alternative.

It is important to note that this request does not apply to any dissimilar metal welds, including Alloy 600 base metal or Alloy 82/182 weld material, where primary water stress corrosion cracking is a concern or any other augmented inspection requirements are imposed.

5.4 Material Condition of the Reactor Vessel Relative to Embrittlement

The RV beltline is the limiting area in terms of embrittlement for the subject examinations. The composition of each material in the RV beltline, along with fluence and embrittlement data, can be found in the NRC Reactor Vessel Integrity Database (RVID) (Reference 6). This information is provided for PVNGS Unit 1 in Table 2, Palo Verde Unit 1 Material Values Contained in the RVID. Note: The RT_{PTS} values in Table 2 have been updated as discussed below.

10 CFR 50.61 currently provides pressurized thermal shock (PTS) screening criteria of RT_{PTS} equal to 270°F for plates and axial welds and RT_{PTS} equal to 300°F for circumferential welds. Based on current projections, the intermediate shell plate in Unit 1 is the most limiting material. The projected RT_{PTS} value of 123°F at 32 EFPY for this material is well below the PTS screening criteria. Furthermore, it is recognized by the NRC and industry that a large amount of conservatism exists in the current PTS screening criteria (Reference 7). In the NRC PTS Risk Re-evaluation, results have shown that it may be possible to remove an amount of conservatism equivalent to reducing a plant's RT_{PTS} value by at least 70°F. While the exact amount of conservatism that will be removed has not been determined, it is clear that PVNGS Unit 1 will be well below the current PTS screening criteria during the extension period and further below the potential revised PTS screening criteria.

5.5 Operational Experience Relative to RV Structural Integrity Challenging Events

It is widely recognized that the greatest possible challenge to reactor pressure vessel integrity for a PWR is PTS. A PTS event can be generally described as a rapid cooling of the RV followed by a late repressurization. Plants (including

PVNGS) have taken steps such as implementing emergency operating procedures (EOPs) and operator training to lower the likelihood of a PTS event occurring. Due to the implementation of such measures, industry experience indicates the number of occurrences of PTS events fleetwide is very small. When considered over the combined fleetwide PWR operating history, the frequency of PTS events is very small. When considering the frequency of PTS events and the length of the requested extension, the probability of a PTS event occurring during the requested extension is also very low. Combining the low probability of a PTS event with the low probability of a flaw existing in the RV (given the previously discussed inspection history), the probability of RV failure due to PTS is also very small.

PVNGS Unit 1 has implemented EOPs and operator training to prevent the occurrence of PTS events. Consistent with the Combustion Engineering (CE) Emergency Response Guidelines (ERGs), the PVNGS EOPs allow operators to identify the onset of PTS conditions and provide the steps required to mitigate any cold pressurization challenge to RV integrity. The basic PTS mitigation strategy of the PVNGS EOPs involves 1) termination of the primary system cooldown, 2) termination of emergency core cooling system flow (if proper criteria are met), 3) depressurization of the primary system, 4) establishment of stable primary system conditions in the normal operating range, and 5) implementation of a thermal "soaking" period prior to any cooldown outside of the normal operating region. By combining 1) the basic requirements of the CE ERGs, 2) the use of plant specific setpoints with a defined technical basis, and 3) the formal reconciliation of any differences between the CE ERG reference plant and PVNGS, the PVNGS EOPs provide adequate means for preventing potential PTS transients.

The current requirements for inspection of RV pressure-retaining welds have been in effect since the 1989 Edition of ASME Code, Section XI. The industry has expended significant cost and man-rem exposure that have shown no service-induced flaws in the ASME Section XI Examination Category B-A or B-D RV welds. ASME Section XI, Code Case N-691 and industry efforts have shown that risk insights can be used to extend the reactor vessel ISI interval from 10 to 20 years. The 10-year extension satisfies the change in risk requirements of Regulatory Guide 1.174; and, in accordance with 10 CFR 50.55a (3) (i), maintains an acceptable level of quality and safety. Based on these efforts having shown that the risk of vessel failure with a 10-year inspection interval extension is low and achieves an acceptable level of quality and safety, it is reasonable to conclude that one refueling cycle extension will also achieve an acceptable level of quality and safety. On the basis of the above discussion, the risk associated with extending the inspection interval by one refueling cycle is small. Therefore, APS considers the proposed alternative for the subject examinations at PVNGS Unit1 to provide an acceptable level of quality and safety in accordance with 10 CFR 50.55a(3)(i).

In letter no. 102-05503, dated May 26, 2006, APS provided specific responses to questions asked in reference to Section 5.5 of our original submittal. Those responses are provided below.

NRC QUESTION:

You stated that the technical justification for your request was consistent with the guidance provided in a January 27, 2005, letter from the NRC to Westinghouse Electric Company (Summary of Teleconference with the Westinghouse Owners Group Regarding Potential One Cycle Relief of Reactor Pressure Vessel Shell Weld Inspections at Pressurized-Water Reactors Related to WCAP-16168-NP, "Risk Informed Extension of Reactor Vessel In-Service Inspection Intervals"). Item number six of this guidance is repeated below:

> The licensee could then provide a discussion of how, based on its plant operational experience, fleet-wide operational experience, and plant characteristics, the likelihood of an event (in particular, a significant pressurized thermal shock event) over the next operating cycle which could challenge the integrity of the reactor vessel pressure vessel (RPV), if a flaw was present, is very low.

Section 5.5 of your submittal includes general statements indicating that the likelihood of pressurized thermal shock (PTS) events is small and briefly describes APS operating procedures that provide actions to avoid, or limit thermal shock to the reactor pressure vessel.

The NRC staff is re-evaluating the risk from PTS events in a study done to develop a technical basis for revising Title 10 of the *Code of Federal Regulations,* Part 50, Section 61 (10 CFR 50.61). Although the NRC staff has not yet completed its evaluation, the current results indicate that the following three types of accident sequences cause the more severe PTS events and thereby dominate the risk. Please describe the characteristics of your plant (design and operating procedures) that provide assurance that the likelihood of a severe PTS event over the next operating cycle which could challenge the integrity of the RPV, if a flaw was present, is very low.

Sequence 1:

> Any transient with reactor trip followed by one stuck-open pressurizer safety relief valve that re-closes after about 1 hour. Severe PTS events also require the failure to properly control high-head injection.

Sequence 2:

> Large loss of secondary steam from steam line break or stuck-open atmospheric dump valves. Severe PTS events also require the failure to properly control auxiliary feedwater flow rate and destination (e.g., away from affected steam generators) and failure to properly control high pressure injection.

Sequence 3:

Four to nine-inch loss-of-coolant accidents. Severity of PTS event depends on break location (worst location appears to be in the pressurizer surge line) and primary injection systems flow rate and water temperature.

<u>APS Response:</u>

Sequence 1:

Any transient with reactor trip followed by one stuck-open pressurizer safety relief valve that re-closes after about 1 hour. Severe PTS events also require the failure to properly control high-head injection.

Initially, the control room personnel complete procedure 40EP-9EO01, "Standard Post Trip Actions," (SPTAs). This procedure is used for any event which actuates or requires a reactor trip. It is intended that the operator check each Safety Function and perform the Contingency Actions if necessary. The crew would then enter 40EP-9EO03, "Loss of Coolant Accident," (LOCA). The goals of this procedure are to mitigate the effects of a LOCA, to isolate the break (if possible), and to establish either long term cooling using the safety injection system or the shutdown cooling system. After some verification and notification steps, the crew reaches Step 23 within a few minutes. Steps 24 through 25 include the following guidance:

24. Perform the following:

    a. PERFORM Appendix 5, RCS and PZR Cooldown Log.

    b. Cooldown the Steam Generators using the SBCS.

        b.1 Cooldown the Steam Generators using the ADVs by **ONE** of the following:
        - Operation from the Control Room
        - Appendix 18, Local ADV Operation

25. **IF** steaming to atmosphere, **THEN** inform Radiation Protection and the RMS Technician.

26. Depressurize the RCS to less than 385 psia [385 psia] by performing the following:

    a. Operate Main or Auxiliary

Pressurizer spray and PERFORM
Appendix 6, Spray Valve
Actuation Data Sheet.

b. **IF** Safety Injection throttle criteria are met, **THEN** control **ANY** of the following to lower RCS pressure.
   - Charging and letdown flow
   - HPSI flow

Additionally, Step 28 includes the following guidance:

28. **IF** at least one HPSI Pump is operating, **AND ALL** of the following conditions exist:
    - RCS is 24°F or more subcooled
    - Pressurizer level is greater than 10% and **NOT** lowering
    - At least one Steam Generator is available for RCS heat removal with level being maintained within or being restored to 45 - 60% NR
    - RVLMS indicates RVUH level is 16% or more

    THEN throttle HPSI flow or stop the HPSI Pumps one pump at a time.

The steps listed above initiate an RCS cool down and depressurization and allow throttling or stopping high pressure safety injection (HPSI) flow as needed. Flow requirements to maintain the core covered and cooled will decrease as RCS pressure is lowered, or the pressurizer safety relief valve reseats during the cool down. Throttling and/or stopping HPSI prevents or minimizes the magnitude of re-pressurization of the RCS, thereby precluding PTS.

Sequence 2:

Large loss of secondary steam from steam line break or stuck-open atmospheric dump valves. Severe PTS events also require the failure to properly control auxiliary feedwater flow rate and destination (e.g., away from affected steam generators) and failure to properly control high pressure injection.

Initially, the control room personnel complete procedure 40EP-9EO01, "Standard Post Trip Actions." The Operating staff would then enter 40EP-9EO05, "Excess Steam Demand," (ESD). The goals of this procedure are to mitigate the effects of an ESD, maintain the plant in hot standby, or hot shutdown (if the break has been isolated), or to establish Shutdown Cooling System entry conditions while minimizing radiological releases to the environment and maintaining adequate core cooling. 40EP-9EO05 includes the following guidance in Step 14 which is performed after isolating the most affected Steam Generator, including stopping auxiliary feedwater to the faulted SG:

14. Stabilize RCS temperature using the lowest Tc by performing the following:

    a. Maintain Tc within the P/T limits. REFER TO Appendix 2, Figures

    b. Steam the least affected Steam Generator using **ANY** of the following:

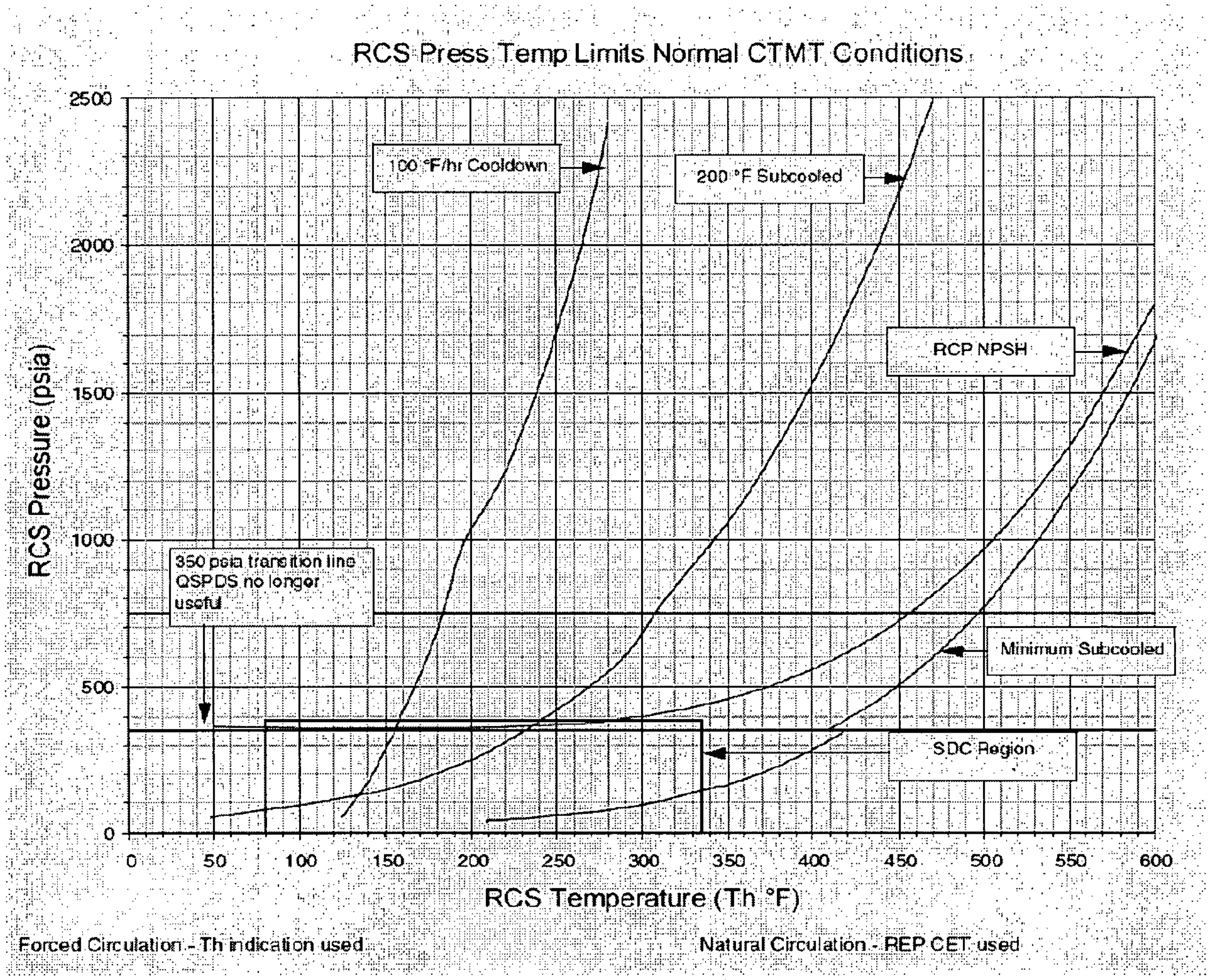
        • SBCS

        • ADVs from the Control Room

        • Appendix 18, Local ADV Operation

Stabilizing Tcold within the Pressure/Temperature (P/T) limits precludes PTS. EOP 40EP-9EO05 also contains the guidance for throttling HPSI when throttle criteria are met (same as Step 28 from LOCA). EOP 40EP-9EO10, "Standard Appendices," contains all of the figures, tables, charts, graphs and sub-procedures associated with performance of the EOPs.

Appendix 2 of 40EP-9EO10 (provided below) shows the acceptable areas of operation and delineates where PTS becomes a concern (the 200 degree subcooled line).



Sequence 3:

Four to nine-inch loss-of-coolant accidents. Severity of PTS event depends on break location (worst location appears to be in the pressurizer surge line) and primary injection systems flow rate and water temperature.

The response to this sequence would be the same as Sequence 1.

Additionally, as part of a recent power uprate (PUR) amendment request, APS performed fluence calculations using the existing analysis of record (AOR) at the 4200 MWt power level. An out-in type of fuel loading was assumed, however, the proposed PUR was for 3990 MWt and the loading pattern has been low leakage for a number of cycles. Both conditions are conservative and the AOR bounds the values calculated for the PUR. With the issuance of Amendment No. 157 to Facility Operating License No. NPF-41, dated November 16, 2005, the NRC acknowledged that the P-T curves currently approved for Unit 1 are valid for 32 effective full power years (EFPY). Since Unit 1 is estimated to be at only 18.5 EFPY at the end of operating cycle 15, sufficient margin exists until the examinations are performed during U1R15 outage.

6.0 Duration of Proposed Alternative

The proposed alternative requested would extend the second ISI interval of PVNGS Unit 1 for an additional 8 to 9 months beyond the currently allowed Code extension of 12 months and would apply to the Examination Category B-A and B-D RV welds. This request is applicable to the second inspection interval only. If this relief request is approved, the second ISI interval will end at the conclusion of the spring 2010 (U1R15) outage for the subject examinations.

7.0 Conclusion

10 CFR 50.55a(a)(3) states:

“Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or
(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.”

APS's proposed extension of the inservice inspection interval for these examinations will continue to provide an acceptable level of quality and safety, as described in the enclosed relief request. Therefore, APS requests that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i). APS requests staff approval by October 31, 2008 to support restart from Unit 1's fall 2008 refueling outage, U1R14.

8.0 References

1. ASME Boiler and Pressure Vessel Code, Code Case N-691, "Application of Risk-Informed Insights to Increase the Inspection Interval for Pressurized Water Reactor Vessels," Section XI, Division 1, November 2003.

2. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," November 2002.

3. Westinghouse Owners Group Topical Report, WCAP-16168-NP, "Risk-Informed Extension of Reactor Vessel In-Service Inspection Interval," December 2005.

4. R. Gramm of the NRC to G. Bischoff of the WOG, "Summary of Teleconference with the Westinghouse Owners Group Regarding Potential One Cycle Relief of Reactor Pressure Vessel Shell Weld Inspections at Pressurized Water Reactors Related to WCAP-16168- NP, 'Risk-Informed Extension of Reactor Vessel In-Service Inspection Intervals,'" dated January 27, 2005.

5. Regulatory Guide 1.150, "Ultrasonic Testing of Reactor Vessel Welds during Preservice and Inservice Examinations," February 1983.

6. Nuclear Regulatory Commission Reactor Vessel Integrity Database, dated July 22, 1995.

7. NRC Memorandum, Thadani to Collins, "Technical Basis for Revision of the Pressurized Thermal Shock (PTS) Screening Criteria in the PTS Rule (10 CFR 50.61)," dated December 31, 2002.

9.0 Precedent

Palo Verde Units 2 and 3	September 20, 2006 May 16, 2007	ML062490513 ML071140033
Palisades Nuclear Plant	November 29, 2005	ML053200296
Indian Point, Nuclear Generating Unit No. 2	March 16, 2006	ML060740187
Sequoyah Nuclear Plant, Unit 1	February 3, 2006	ML060100080

Table 1
Palo Verde Unit 1 Inservice Inspection Results

Weld ID	ASME Weld Category	Date Last Inspected	% Coverage obtained	# of reportable indications*	# of indications currently being monitored*	Growth of indications currently being monitored* (in)
1-001-001	B-A	10/16/99	25% **	None	None	None
1-001-002	B-A	10/16/99	90.1%	None	None	None
1-001-003	B-A	10/16/99	100%	None	None	None
1-001-004	B-A	10/16/99	100%	None	None	None
1-001-005	B-A	10/16/99	100%	None	None	None
1-001-006	B-A	10/17/99	93%	None	None	None
1-001-007	B-A	10/16/99	95%	None	None	None
1-001-008	B-A	10/16/99	95%	None	None	None
1-001-009	B-A	10/16/99	95%	None	None	None
1-001-010	B-A	10/16/99	91.2%	None	None	None
1-001-011	B-A	10/16/99	100%	None	None	None
1-001-012	B-A	10/17/99	100%	None	None	None
1-001-013	B-A	10/17/99	100%	None	None	None
1-001-014	B-A	10/16/99	92%	None	None	None
1-001-016	B-D	10/16/99	96.5% coverage for reflectors parallel to weld. 80.1% coverage for reflectors transverse to weld. ***	None	None	None
1-001-016-IR	B-D	10/15/99	90%	None	None	None
1-001-017	B-D	10/16/99	96.5% coverage for reflectors parallel to weld. 80.1% coverage for reflectors transverse to weld. ***	None	None	None
1-001-017-IR	B-D	10/15/99	90%	None	None	None
1-001-019	B-D	10/15/99	96.5% coverage for reflectors parallel to weld. 80.1% coverage for reflectors transverse to weld. ***	None	None	None
1-001-019-IR	B-D	10/14/99	90%	None	None	None
1-001-020	B-D	10/15/99	96.5% coverage for reflectors parallel to weld. 80.1% coverage for reflectors transverse to weld. ***	None	None	None
1-001-020-IR	B-D	10/14/99	90%	None	None	None

Notes:

* Due to improvement in inspection technology, the most recent inspection is considered to be of the greatest quality of the inspections performed. Therefore, the inspection data provided in this table is for the most recent inservice inspection.

** Coverage of the lower head meridional weld is limited by scan interference with the nozzle penetrations (Instrument Nozzles) and flow baffle.

*** Coverage of the nozzle to vessel circumferential weld scans limited by saddle geometry and nozzle boss interference.

Table 2
Palo Verde Unit 1 Material Values Contained in the RVID

Major Material Region Description			Cu [wt%]	Ni [wt%]	Un-Irradiated RT_{NDT}		RT_{PTS} @32 EFPY
Type	Heat	Location			[°F]	Method	
Plate	M-6701-2	Intermediate Shell	0.060	0.610	40	Plant Specific	123
Plate	M-4311-1	Lower Shell	0.040	0.650	-10	Plant Specific	58
Weld	MIL B-4	Axial Weld 101-142A, B, C	0.040	0.040	-80	Plant Specific	-7

ENCLOSURE 3

Relief Request No. 36 – Proposed Alternative: Use of Full–Structural Weld Overlays in the Repair of Dissimilar Metal Welds Third ISI Interval - Units 1 and 3

Attachments

1. Ambient Temperature Temper Bead Welding Procedure
2. Comparison of APS proposed Alternative Verses Code Cases N-504-2 and N-638-1
3. APS Response to Questions Asked Regarding Proposed Alternative ISI-GEN-ALT-06-03, Southern Company

Background

In preparation for performing full-structural weld overlays in the repair of dissimilar metal welds at Palo Verde Units 1, 2 and 3 and pursuant to 10 CFR 50.55a(a)(3)(i), Arizona Public Service Company (APS) proposed alternatives to the requirements of the ASME Boiler and Pressure Vessel Code, 2001 Edition, 2003 Addenda, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components." In letter dated June 21, 2007, the Nuclear Regulatory Commission (NRC) approved the use of the alternatives for Palo Verde Units 1 and 3 during the second Inservice Inspection (ISI) interval which ended with outages U1R13 and U3 R13. Although the required pressurizer dissimilar metal welds were completed in these outages, two additional dissimilar metal welds on the hot-leg shutdown cooling lines were not. These two welds are not required by MRP-139 to be completed until December 2009, as they are over 14 inches in diameter. APS is requesting that Relief Request 36 be reapproved for use in Units 1 and 3 for the remainder of the third ISI interval. Palo Verde Unit 1 will enter the third ISI interval on July 18, 2008. Palo Verde Unit 3 entered the third ISI inspection interval on January 11, 2008. Relief Request 36 was approved for Unit 2's third ISI interval and no reapproval for Unit 2 is required.

Specifically, Relief Request 36 proposes alternatives to Section IWA-4410 which stipulates that weld repairs be performed in accordance with Sub-article IWA-4400 and IWA-4420 which requires that defects be removed or reduced to an acceptable size. The proposed alternatives and request for relief are discussed in this enclosure. Attachment 1 contains the Ambient Temperature Temper Bead Welding procedure and Attachment 2 a comparison of APS proposed alternative verses Code Cases N-504-2 and N-638-1. Any required material tables and drawings of the proposed weld overlays are contained in the previous submittal dated February 8, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML070470525).

In developing Relief Request 36, APS has reviewed various sets of questions posed by the NRC and the responses from Licensees who have proposed similar alternatives. APS has reviewed our previous responses and is providing these in Attachment 3 of this request. Although the questions were generally left in their original format, the responses address the question as if it were asked of APS and any specific questions related to the pressurizer dissimilar metal welds have been deleted.

1.0 ASME Code Component(s) Affected

PVNGS Unit: 1 and 3
Description: Category B-J welds
Item numbers: B9.11
Code Class: 1

U-1	Description	Zone	Size	DM Weld Item Number	SM Weld Item Number
Hot Leg	SDC nozzle to safe end	21	16	6-11	21-20
Hot Leg	SDC nozzle to safe end	22	16	7-9	22-1

U-3	Description	Zone	Size	DM Weld Item Number	SM Weld Item Number
Hot Leg	SDC nozzle to safe end	21	16	6-11	21-20
Hot Leg	SDC nozzle to safe end	22	16	7-9	22-1

2.0 Applicable Code Edition and Addenda

The American Society of Mechanical Engineers (ASME) ISI Code of Record for the third 10-year inservice inspection (ISI) interval is 2001 Edition and Addenda through 2003.

In addition, as allowed by 10 CFR 50.55a, ASME Section XI, 2001 Edition will be used for Appendix VIII, "Performance Demonstration for Ultrasonic Examinations."

3.0 Applicable Code Requirements

Subarticle IWA-4410 of ASME Section XI requires that repairs of welds shall be performed in accordance with Sub-article IWA-4400. IWA-4420 requires that defects be removed or reduced to an acceptable size.

Code Case N-504-2[1], Alternative Rules for Repair of Class 1, 2 and 3 Austenitic Stainless Steel Piping, Section XI, Division 1," with requirements of ASME Section XI, Non-mandatory Appendix Q, "Weld Overlay Repair of Class 1, 2 and 3 Austenitic Stainless Steal Piping Weldments."

Code Case N-638-1[2], "Similar and Dissimilar Metal Welding using Ambient Temperature Machine GTAW Temper Bead Technique."

NOTE: See Attachment 2 for a comparison of APS proposed alternative verses Code Cases N-504-2 and N-638-1

Currently, pressurizer nozzle and hot leg dissimilar weld examinations are required to be performed at Palo Verde in accordance with MRP-139. The examinations are the same as the volumetric examinations specified in Section XI, Table IWB-2500-1, Category B-J and B-F.

4.0 Reason for Request

Primary Water Stress Corrosion Cracking (PWSCC) has been identified as a degradation mechanism for Alloy 82/182 welds and weld buttering. While no PWSCC flaws have been detected in Palo Verde piping, there are geometric limitations such that the required examination volume cannot be met with qualified ultrasonic (UT) techniques.

1 Regulatory Guide 1.147, Revision 15, Table 5 identifies this Code Case as Superseded
2 Regulatory Guide 1.147, Revision 15, Table 2 identifies this Code Case as Conditionally Acceptable

APS has concluded that the application of a full-structural weld overlay (FSWOL) over the Alloy 82/182 welds is the most appropriate course of action to ensure the integrity of the reactor coolant pressure boundary. In addition, the overlays will be designed to improve the configurations for future examinations.

The 2001 Edition and Addenda through 2003 of the Code does not provide rules for the design of weld overlays or for repairs without removal of flaws. In addition, Code Case N-504-2[3], which had been approved by the NRC for use and subsequently superseded, does not provide the methodology for overlaying nickel alloy welds joining austenitic and ferritic base materials; therefore, APS proposes the following alternative.

5.0 Proposed Alternative and Basis for Use

Proposed Alternative

A preemptive full-structural Alloy 52 overlay will be applied to each of the hot leg Alloy 82/182 dissimilar metal welds identified in this request, Section 1.0, ASME Code Component(s) Affected. For a preemptive FSWOL, a flaw will be assumed. Paragraph 5.2(a) below defines crack-growth requirements and paragraph 5.2(b) below defines the design requirements.

For the welds identified in section 1.0, in lieu of performing ultrasonic examinations, the flaw will be assumed to be 100% through the original wall thickness for the entire circumference for preemptive as well as contingency full-structural weld overlay design.

Due to the proximity of the adjacent similar metal piping welds, preemptive or contingency overlay of the dissimilar metal welds may preclude the examination of the adjacent similar metal piping welds; therefore, the overlay will be extended over the adjacent similar metal piping welds, if required. However, which similar metal welds will be overlaid will be determined after designing the dimensions of the dissimilar metal weld overlay.

These similar metal welds will not be inspected prior to installing the overlay. After the overlay is applied, these welds will be examined in accordance with the proposed alternative.

In lieu of using the existing IWA-4000 Repair Procedures in the 2001 Edition and Addenda through 2003 Section XI Code, APS proposes to use the following alternative for the design, fabrication, pressure testing, and examination of the weld overlays. This will provide an acceptable methodology for reducing a defect in austenitic nickel alloy welds to an acceptable size by increasing the wall thickness through deposition of a weld overlay.

3 This revision of Code Case N-504 was used in the previous submittal of Relief Request 36 and is compared to the proposed alternative in Attachment 2

ASME Code references in this alternative are to the 2001 Edition and Addenda through 2003 for Section III and 2001 Edition and Addenda through 2003 for Section XI as modified by 10 CFR 50.55a. This methodology is based upon ASME Code Case N-740 and only applicable requirements of the Code Case are presented below as alternatives.

5.1 General Requirements:

(a) A full-structural weld overlay will be applied by deposition of Alloy 52 weld reinforcement (weld overlay) on the outside surface of the carbon steel (P-No. 1 or P-No. 3) to the stainless steel safe end (P-No. 8), inclusive of the Alloy 82/182 weld that joins the two items. In addition, the overlay will be extended (when required) to include the adjacent wrought stainless steel to stainless steel welds (P-No. 8 to P-No. 8).

There are no requirements specified in this proposed alternative for these stainless steel to stainless steel welds (such as flaw growth calculations) because they are not susceptible to stress corrosion cracking in a PWR water environment. Specific dimensions of the overlay thickness will be in the design package.

(b) The Alloy 52 weld overlay filler metal is an austenitic nickel alloy having a chromium (Cr) content of at least 28%. The weld overlay is applied 360 degrees around the circumference of the item, e.g., safe end to nozzle weld, and will be 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 requirements of the Construction Code and Owner's requirements, the provisions for Ambient Temperature Temper Bead Welding will be used on the ferritic nozzles. (See "Ambient Temperature Temper Bead Welding," which is located in Attachment 1 to this proposed alternative). The maximum area of an individual weld overlay on the finished surface of the ferritic material shall be no greater than 300 square inches.

(c) Prior to deposition of the weld overlay, the surface will be examined by the liquid penetrant method. Indications larger than 1/16-inch shall be removed, reduced in size, or corrected 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.

2. If correction of indications identified in 5.1(c) is required, the area where the weld overlay is to be deposited, including any local repairs or initial weld overlay layer, shall be examined by the liquid penetrant method. The area

shall contain no indications greater than 1/16-inch prior to the application of the structural layers of the weld overlay.

(d) 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 identified in 5.1(b) above. The first layer of weld metal deposited will not be credited toward the required thickness because of chemical dilution.

Alternatively, the 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 contains at least 24% Cr. The Cr content of the deposited weld metal shall be at least 24%. Content may be determined 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.

(e) Welding will only be performed for applications predicted not to have exceeded a thermal neutron fluence of 1×10^{17} ($E < 0.5$ eV) neutrons per cm^2 prior to welding.

5.2 Crack Growth Considerations and Design

(a) Crack Growth Considerations

Crack growth calculations will be performed as part of a design package. Flaw characterization and evaluation requirements shall be based on the as-found flaw in the case of a contingency overlay. For a preemptive overlay, a flaw in the original dissimilar metal weld with a depth of 75% and a circumference of 360 degrees that originates from the inside of the pipe is postulated for crack growth purposes. A 75% through-wall depth flaw is the largest flaw that could remain undetected during the FSWOL preservice examination. This preservice examination will verify there is no cracking in the upper 25% of the original weld wall thickness, and thus verify that the assumption of a 75% through-wall crack is conservative. However, if any crack-like flaws are found during the preservice examination in the upper 25% of the original weld or base materials, the as-found flaw (postulated 75% through wall, plus the portion of the flaw in the upper 25%) would be used for the crack growth analysis. The size of all flaws will be projected to the end of the design life of the overlay or until the next scheduled inservice inspection. Crack growth, including both stress corrosion and fatigue crack growth, shall be evaluated in the materials in accordance with IWB-3640. If the flaw is at or near the boundary of two different materials, evaluation of flaw growth shall consider the most limiting of the two materials.

(b) Design of the FSWOL

The design of the weld overlay shall satisfy the following, using the assumptions and flaw characterization restrictions in 5.2(a) above. The following design analysis shall be completed in accordance with IWA-4311.

APS letter 102-05641, dated February 8, 2007, contains diagram of the proposed FSWOL (ADAMS Accession No. ML070470525).

1. The axial length and end slope of the weld overlay shall cover the weld and the 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 ASME Section III, NB-3200. 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 full 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 5.2(b)1 above, the end transition slope of the overlay shall not exceed 45 degrees.

3. The thickness of the FSWOL shall be determined based on a flaw 100% through the original wall thickness for the entire circumference in the underlying pipe. The overlay will be applied, so that the criteria of IWB-3640 are met for the assumed flaw after the overlay is applied.

4. 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, changes in system flexibility and weight due to the weld overlay) shall be evaluated. (There are no pre-existing flaws previously accepted by analytical evaluation in the Palo Verde welds to be considered in this evaluation).

   i. Prior to plant restart following the outage, a stress analysis will be performed that demonstrates that the nozzles will perform their intended design function with the FSWOL installed. The stress analysis report will include results showing that the requirements of Subarticles NB-3200 and NB-3600 of the ASME Code, Section III are satisfied. The stress analysis will also include results showing that the requirements of IWB-3000 of the ASME Code, Section XI, are satisfied. The results will show that the postulated crack including its growth in the nozzles will not adversely affect the integrity of the overlaid welds. This analysis will be performed as part of the overlay design package and will be available for NRC review.

ii. The original leak-before-break (LBB) analyses will be confirmed to be valid after the weld overlays are applied, the amount of shrinkage is determined, and the shrinkage stresses are calculated.

5.3 Examination and Inspection

In lieu of all other examination requirements, the examination requirements proposed herein shall be met. 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, Section XI, as implemented through the EPRI Performance Demonstration Initiative (PDI).

The PDI Program Status for Code Compliance and Applicability developed in June 2005 indicates that the PDI Program is in compliance with Appendix VIII, 2001 Edition of Section XI as amended by 10 CFR 50.55a, Final Rule dated October 1, 2004. Ultrasonic examination will be performed to the maximum extent achievable.

Pre-Overlay Examinations

Palo Verde Units 1 and 3 are scheduled for full-structural overlays during the upcoming refueling outages. APS does not plan to perform UT of the hot leg nozzles dissimilar metal welds or the adjacent similar metal welds on these units prior to the installation of the overlays. Since APS intends to apply full-structural overlays designed for a worst case through-wall flaw that is 360 degrees in circumference, the dose received from the examination of these welds would result in a hardship without a compensating increase in the level of quality and safety.

Post-Overlay Examinations

There are two examinations to be performed after the overlay is installed, the Acceptance Examination of the Overlay and the Preservice Examination. The purpose of the Acceptance Examination is to assure a quality overlay was installed. The purpose of the Preservice Examination is to provide a baseline for future examinations and to locate and size any cracks that might have propagated into the upper 25% of the original wall thickness and to evaluate them accordingly. While listed below as two separate examinations they will be performed during the same time period. An identification of the examination coverage of each overlay will be developed and available for NRC review prior to plant startup.

The NDE requirements listed below cover the area that will be affected by the application of the overlay. Any PWSCC degradation would be in the alloy 82/182 weld or the adjacent heat affected zone (HAZ). Further, the original weld and adjacent base materials have received a radiographic examination (RT) during installation. The proposed surface and volumetric examinations provide adequate assurance that any defects produced by welding of the overlay or by extension of pre-existing defects will be identified.

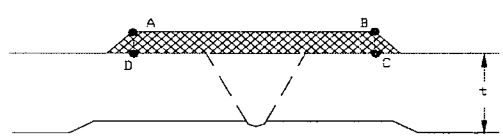
(a) Acceptance Examination

1. The weld overlay shall have a surface finish of 250 micro-inches RMS or better and a flatness sufficient to allow for adequate examination in accordance with procedures qualified per Appendix VIII. The weld overlay shall be examined to verify acceptable configuration.

2. The weld overlay and the adjacent base material for at least 1/2 inch from each side of the weld shall be examined using the liquid penetrant method. The weld overlay shall satisfy the surface examination acceptance criteria for welds of the Construction Code or ASME Section III, NB-5300. The adjacent base metal shall satisfy the surface examination acceptance criteria for base material of the Construction Code or ASME Section III, NB-2500. If ambient temperature temper bead welding is used, the liquid penetrant examination shall be conducted at least 48 hours after the completed overlay has returned to ambient temperature.

3. The examination volume A-B-C-D in Figure 1 below shall be ultrasonically examined to assure adequate fusion (i.e., adequate bond) with the base metal and to detect welding flaws, such as interbead lack of fusion, inclusions, or cracks. The interface C-D shown between the overlay and the weld includes the bond and the heat affected zone from the overlay. If ambient temperature temper bead welding is used, the UT shall be conducted at least 48 hours after the completed overlay has returned to ambient temperature. APS will be using Relief Request 37 approved on June 21, 2007. The 48-hour hold will start at the completion of the third layer of the weld overly.

Figure 1:
ACCEPTANCE EXAMINATION



Examination Volume A-B-C-D

4. Planar flaws shall meet the preservice examination standards of Table IWB-3514-2. In applying the acceptance standards, wall thickness "t_w" shall be the thickness of the weld overlay. For weld overlay examination volumes with unacceptable indications, the unacceptable indications will be removed and the volume will be re-welded. Re-examination per IWB-2420 is not required because unacceptable indications will be removed and the volume will be re-welded.

5. 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. Additional requirements are:

   i. The reduction in coverage of the examination volume in the aforementioned Figure 1 due to laminar flaws shall be less than 10%. The dimensions of the uninspectable volume are dependent on the coverage achieved with the angle beam examination of the overlay.

   ii. 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 inservice examination standards of Table IWB-3514-2. In applying the acceptance standards, wall thickness "t_w" shall be the thickness of the weld overlay. Both axial and circumferential planar flaws shall be assumed.

   iii. If the preservice acceptance criteria of Table IWB-3514-2 are not met, the lamination shall be removed or reduced in area such that the assumed flaw is acceptable per IWB-3514-2.

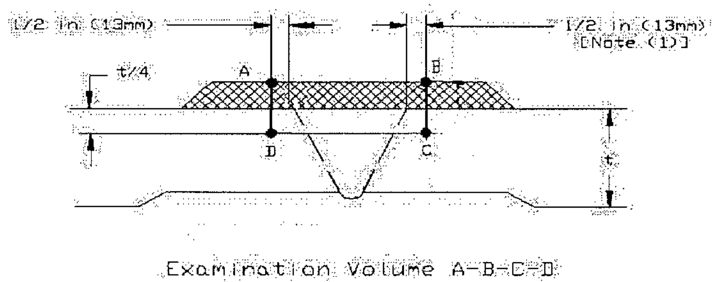
6. After completion of all welding activities, affected restraints, supports, and snubbers shall be VT-3 examined to verify that design tolerances are met.

(b) Preservice Inspection

1. The examination volume A-B-C-D in Figure 2, provided below, 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 cracks that might have propagated into the upper 25% of the base material or into the weld overlay.

Figure 2:

PRESERVICE AND INSERVICE EXAMINATION VOLUME



Note 1: For axial or circumferential flaws, the axial extent of the examination volume shall extend at least ½ inch beyond the toes of the original weld, including weld end butter, where applied.

2. The preservice examination acceptance standards of Table IWB-3514-2 shall be applied to planar indications in the weld overlay material. If the indication is found acceptable per Table IWB-3514-2 the weld overlay will be placed in service and the inservice schedule and acceptance criteria of 5.3(c) will be followed. In applying the acceptance standards, wall thickness, t_w, shall be the thickness of the weld overlay. Planar flaws not meeting the preservice acceptance standards of Table IWB-3514-2 shall be repaired. Re-examination per IWB-2420 is not required because unacceptable indications will be removed and the volume will be re-welded.

3. Cracks in the outer 25% of the original wall thickness shall meet the design analysis requirements as addressed in Section 5.2, "Crack Growth Considerations and Design," of this proposed alternative.

(c) Inservice Inspection

APS proposes that the following Inservice Inspection rules be followed.

1. The weld overlay examination volume A-B-C-D in Figure 2 shall be added to the applicable inspection plans and shall be ultrasonically examined during the first or second refueling outage following application.

2. The weld overlay examination volume in Figure 2 shall be ultrasonically examined to determine if any new or existing cracks have propagated into the upper 25% of the base material or into the overlay. The angle beam

shall be directed perpendicular and parallel to the piping axis, with scanning performed in four directions.

3. The inservice examination acceptance standards of Table IWB-3514-2 shall be applied to planar indications detected in the weld overlay material. If the planar indication is found acceptable per Table IWB-3514-2, the weld overlay will be re-examined in accordance with 5.3(c)5. If the inservice acceptance criteria of Table IWB-3514-2 are not met, the planar flaw may be evaluated in accordance with IWB-3640, provided that the flaw is not caused by PWSCC. If accepted for continued service the weld overlay will be re-examined in accordance with 5.3(c)5. If the flaw is not acceptable for continued service per IWB-3640, then it shall be repaired.

4. Cracks in the outer 25% of the base metal shall meet the design analysis requirements as addressed in Section 5.2, "Crack Growth Considerations and Design," of this proposed alternative. Weld overlay examination volumes that show indication of crack growth or new cracking will be re-examined in accordance with 5.3(c)5. Weld overlay examination volumes that show no indication of crack growth or new cracking shall be placed into a population group for each unit to be examined on a sample basis. Twenty-five percent of this population shall be examined once every ten years.
5. Successive Examinations - The weld overlay examination volume shall be reexamined during the first or second refueling outage following discovery of:
   - Growth of indications in the overlay material or the presence of new indications in the overlay material.
   - Crack growth or new cracking in the outer 25% of the base metal.

(d) Scope Expansion - If inservice examinations reveal an unacceptable indication, crack growth into the weld overlay design thickness, or axial crack 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, a total of 50% of the total population of weld overlay examination volumes shall be examined prior to operation. If additional unacceptable indications are found, the entire remaining population of weld overlay examination volumes shall be examined prior to return to service.

5.4 Pressure Testing

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

5.5 Documentation

Use of this proposed alternative shall be documented on ASME Form NIS-2, "Owner's Report for Repairs or Replacements."

Basis for Use

The use of weld overlay materials resistant to PWSCC (e.g., Alloy 52) that create low tensile or compressive residual stress profiles in the original weld provide increased assurance of structural integrity. The weld overlay is of sufficient thickness and length to meet the applicable stress limits from ASME Section III, NB-3200. Crack growth evaluations for PWSCC and fatigue of any as-found flaws or any conservatively postulated flaws will ensure that structural integrity will be maintained.

As a part of the design of the weld overlay, the weld length, surface finish, and flatness are specified in order to allow qualified ASME Section XI, Appendix VIII UT examinations, as implemented through the EPRI PDI program, of the weld overlay and the required volume of the base material and original weld. The examinations specified in this proposed alternative, versus those limited examinations performed on the original dissimilar metal welds, will provide improved assurance of structural integrity. Further, if no flaws are found in the outer 25% of the original wall thickness by the preservice UT examinations, the postulated 75% through-wall flaw for the preemptive overlays is conservative for crack growth evaluations. If a flaw is detected in the upper 25% of the original material during the preservice examination, the actual flaw size would be used for the crack growth evaluations.

The implementation of the alternative reduces the likelihood for PWSCC in the identified welds and improves piping geometries to permit Appendix VIII UT examinations as implemented through the EPRI PDI program. Weld overlay repairs of dissimilar metal welds have been installed and performed successfully for many years in both PWR and BWR applications. The alternative provides improved structural integrity and reduced likelihood of leakage for the primary system. Accordingly, the use of the alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(a)(3)(i).

6.0 Duration of Proposed Alternative

The proposed alternative requested would be applicable for the remainder of the third Inservice Inspection Interval for Units 1 and 3.

7.0 Conclusion

10 CFR 50.55a(a)(3) states:

"Proposed alternatives to the requirements of paragraphs (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or

(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

The post-overlay examinations and stress analysis, conducted prior to plant restart, discussed in this relief request provide an acceptable level of quality and safety. Additionally, not performing some volumetric examinations prior to applying the FSWOL will reduce the dose to examination personnel and keep exposure ALARA. Therefore, APS requests that the proposed alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(i).

APS requests NRC approval of the proposed relief request by October 31, 2008, to support restart of Unit 1 from the fall 2008 refueling outage, U1R14.

8.0 References

1. ASME Boiler and Pressure Vessel Code, Code Case N-740
2. ASME Boiler and Pressure Vessel Code, Code Case N-504-2
3. ASME Boiler and Pressure Vessel Code, Code Case N-638-1

9.0 Precedent

Palo Verde Units 1, 2, and 3 Approved June 21, 2007 (ML071560008)

RELIEF REQUEST 36

ATTACHMENT 1

AMBIENT TEMPERATURE TEMPER BEAD WELDING

Ambient Temperature Temper Bead Welding

1.0 GENERAL REQUIREMENTS

(a) This appendix applies to dissimilar austenitic filler metal welds joining P-Nos. 8 or 43 materials to P-No. 1 and 3 materials.

(b) The maximum area of an individual weld overlay based on the finished surface over the ferritic base material shall be 300 square inches.

(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, or less of nonferritic weld deposit exists along 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.

(e) Prior to welding the area to be welded, a band around the area of at least 1-1/2 times the component thickness or 5 inches, whichever is less, shall be at least 50 degrees Fahrenheit.

(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.

2.0 WELDING QUALIFICATIONS

The welding procedures and the welding operators shall be qualified in accordance with ASME Section IX and the requirements of 2.1 and 2.2 provided below.

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 degrees Fahrenheit.

(d) The test assembly cavity depth shall be at least 1 inch. The test assembly thickness shall be at least twice the test assembly cavity depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions surrounding the cavity shall be at least the test assembly thickness and at least 6 inches. The qualification test plate shall be prepared in accordance with Figure 1-1.

(e) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner's Requirements. The location and orientation of the test specimens shall be similar to those required in (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 (e) above. Number, location, and orientation of test specimens shall be as follows:

(i) 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.

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

(iii) The Charpy V-notch test shall be performed in accordance with ASME Section II, Part A, SA-370. Specimens shall be in accordance with SA-370, Figure 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.

(g) 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.

2.2 Performance Qualification

Welding operators shall be qualified in accordance with ASME Section IX.

3.0 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 F-No. 43 weld metal (ASME Section IX QW-432) for P-No. 8 or 43 to P-No. 1 and 3 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 overlay thickness with the heat input for each layer controlled to within ±10% of that used in the procedure qualification test. 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.

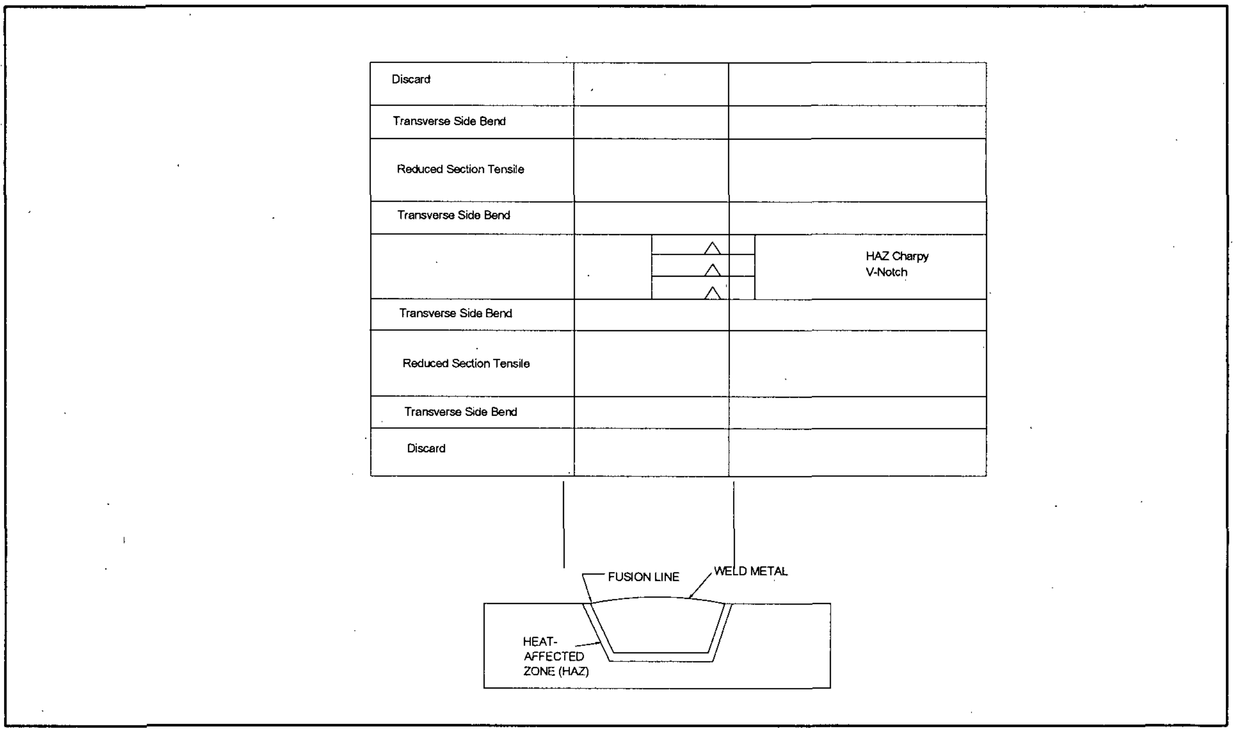
(d) The maximum interpass temperature for field applications shall be 350 degrees Fahrenheit for all weld layers regardless of the interpass temperature used during qualification.

(e) The interpass temperature shall be determined by temperature measurement (e.g., pyrometers, temperature indicating crayons, thermocouples) during welding. If it is not possible to use this method then (e)(1) and (e)(2) may be used in combination.

(1) heat flow calculations using the variables listed below as a minimum:
- (i) welding heat input
- (ii) initial base material temperature
- (iii) configuration, thickness, and mass of the item being welded
- (iv) thermal conductivity and diffusivity of the materials being welded
- (v) arc time per weld pass and delay time between each pass
- (vi) arc time to complete the weld

(2) measurement of the maximum interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded. The maximum heat input of the welding procedure shall be used in the welding of the test coupon.

(f) 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.



GENERAL NOTE: Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

Figure 1-1
QUALIFICATION TEST PLATE

RELIEF REQUEST 36

ATTACHMENT 2

COMPARISON OF APS-PROPOSED ALTERNATIVE VERSUS CODE CASES N-504-2 and N-638-1

Comparison of APS Proposed Alternative Verses Code Cases N-504-2 and N-638-1

Comparison of Proposed Alternative with N-504-2	
CODE CASE N-504-2	**PROPOSED ALTERNATIVE**
N-504-2 for weld overlay repair of SS piping	Proposed alternative is for dissimilar metal weld overlay repairs.
Reply-reduce a flaw to acceptable size by weld overlay on austenitic SS piping	*Reply*- reduce a flaw to acceptable size by weld overlay on austenitic stainless steel or austenitic nickel alloy piping, components and associated welds
Material covered is P-8	Per Section 1.0(a) materials covered are P-8, P-43, P-3 and P-1. Also includes P-8 to P-43, P-8 to P-8 or P-43 to P-43 joined with austenitic filler materials
(b) Filler Material – low C (0.035% max) SS	(b) Austenitic nickel alloy (28% Cr min.)
(c) (d) Repair of indications prior to overlay	(c) Repair of indications prior to overlay (Same as N-504-2)
(e) Weld Reinforcement Min. 2 layers with-7.5 FN. In first austenitic SS layer 5 FN acceptable by evaluation.	(d) Weld Reinforcement (1) Minimum of 2 layers.
(f) (g) Design – Requires flaw evaluation of the existing flaw based on IWB-3640 for design life. Requires postulated 100 % through wall for design of the weld overlay (full-structural) except for four or fewer axial flaws. Meet ASME Section III for primary local and bending stresses and secondary peak stresses. Requires end transition slope less than 45 degrees. Axial length requirement usually met if overlay 0.75 $(Rt)^{1/2}$ beyond flaws. Shrinkage and other applied loads evaluated on other items and other flawed welds in system.	2.0 Design Requires flaw evaluation of the existing flaw based on IWB-3640. Flaw evaluation of both materials required if flaw is at or near the boundary. Requires postulated 100 % through wall for design (full-structural) of the weld overlay. Axial length and end slope shall cover the weld and heat affected zones and shall provide for load redistribution into the item and back into the overlay either out violating stress limits. There is no exception for four or fewer axial flaws. Design analysis per IWA-4311. Meet ASME Section III, NB-3200 applicable stress limits. Any laminar flaws in the weld overlay evaluated to ensure load distribution meets NB-3200. Same as N-504-2 for shrinkage and evaluation of other existing flaws.

Comparison of APS Proposed Alternative Verses Code Cases N-504-2 and N-638-1

Comparison of Proposed Alternative with N-504-2 (Continued)	
N-504-2	**PROPOSED ALTERNATIVE**
(i) No specific reference given for acceptance examination of the weld overlay. Acceptance criteria of the Construction Code and Section III would be applicable. (Causes problems with volumetric acceptance criteria since construction criteria based on RT examination rather than UT examination. Also presents difficulty in determining applicable criteria for laminar flaws in the overlay) Preservice Exams to the methods of IWB-2200. Exam procedures shall be specified in the Repair Program. Acceptance standard-IWB-3514-2 (planar flaws). UT exams to verify integrity of new applied weld reinforcement. Include upper 25% of pipe wall in the examination.	3.0 Examination and Inspection Examinations in the proposed alternative shall be met in lieu of all other exams. NDE methods to IWA-2200 except as specified in the case. NDE personnel qualified to IWA-2300. UT procedures and personnel qualified to Section XI, Appendix VIII. (a) Acceptance Examinations-Surface finish 250 micro-inch and flatness sufficient to allow adequate examination in accordance with Appendix VIII procedures. PT overlay and ½-inch on either side of the overlay. Acceptance standards for PT-weld overlay, Meet weld Construction Code criteria or NB-5300, base material-Meet base material criteria or NB-2500. 48 hr hold time after item reaches room temperature imposed if ambient temperature temper bead welding imposed. UT examination for acceptance-Figure 1 shows the examination volume. 48 hour hold time after item reaches room temperature imposed if ambient temperature temper bead welding imposed. IWB-3514-2 for planar flaw acceptance. IWB-3514-3 for laminar flaw acceptance with additional limitation not to exceed 10% of the surface area and no linear dimension in excess of 3 inches. Reduction in coverage limited to 10%. Criteria for radial planar flaw size in the uninspected volume for IWB-3640 evaluation. VT-3 of affected restraints, snubbers and supports to verify design tolerances are met. (b) Preservice Examinations Figure 2 defines the examination volume. Angle beam exam parallel and perpendicular to piping axis. Scan in four directions to locate and size flaws. Acceptance criteria IWB-3514-2 for the overlay. Wall thickness t_w is the thickness of the overlay. Flaws in outer 25% of base material meet design requirements of 2.0.

Comparison of APS Proposed Alternative Verses Code Cases N-504-2 and N-638-1

Comparison of Proposed Alternative with N-504-2 (Continued)	
N-504-2	**PROPOSED ALTERNATIVE**
	(c) Inservice Examinations Examination required 1st or 2nd refueling outage following application. Examination volume the same as Preservice. Acceptance standards the same as Preservice except IWB-3600 evaluation permitted as an alternative to IWB-3514-2 for the weld overlay. Future examination requirements define depending on examination results. (d) Additional Examinations Similar to Code examination expansion rules.
(h) System Hydrostatic Test if pressure boundary penetrated (leak). System Leakage Test if pressure boundary not penetrated (no leak).	4.0 Pressure Testing System Leakage Test per IWA-5000
(k) VT-3 of snubbers, supports and restraints after welding	Covered under 3.0 (a) Acceptance Examinations
(l) Reference to other applicable requirements of IWA-4000	IWA-4000 requirements will be met unless an alternative provided
(m) Use of case to be documented on an NIS-2 form	5.0 Documentation Use of case to be documented on an NIS-2 form

Comparison of APS Proposed Alternative Verses Code Cases N-504-2 and N-638-1

Comparison of Proposed Alternative with N-638-1	
N-638-1	**APPENDIX 1 OF THE PROPOSED ALTERNATIVE**
Code Case N-638-1 provides rules for automatic or machine GTAW temper bead welding without pre-heat or post weld heat treatment. The case covers similar and dissimilar welding for cavity and overlay repairs. The code case permits the use of NDE examinations in accordance with the case in lieu of those in the Construction Code. This case has a broader scope of use then Attachment 1.	Appendix 1 invoked in 1.0 (b) for use of ambient temperature temper bead welding as an alternative to the post weld heat treatment requirements of the Construction Code and Owner's requirements. The appendix provides the ambient temperature temper bead requirements applicable to dissimilar metal weld overlay repairs. NDE requirements are in lieu of the Construction Code and were covered in Section 3.0 of the alternative.
1.0 General Requirements	1.0 General Requirements
Scope of welds in the Reply	(a) Scope of welds. Same as N-638-1 for RR 36 materials
(a) Max area of finished surface of the weld limited to 100 square inches and half of the ferritic base metal thickness. (Note: the depth requirement is for the ferritic material. There is no need to limit either surface area or depth for welding on austenitic SS or nickel alloys since no post weld heat treatment is required.)	(b) Surface area limitation 300 square inches over the <u>ferritic material</u>. (Note: Code Case N-638-3 which has been approved by ASME but has not been issued. Residual stress analyses results show that stresses for 100 square inches through 500 square inches surface area overlays very similar.)
(b) (c) (d) (e) (f)	(c) (d) (e) (f) (g) same as requirements listed for N-638-1
1.0 Welding Qualifications The welding procedures and welding operators shall be qualified in accordance with Section IX and the requirements of 2.1 and 2.2	2.0 Welding Qualifications The welding procedures and welding operators shall be qualified in accordance with Section IX and the requirements of 2.1 and 2.2
2.1 Procedure Qualification Paragraphs (a) (d) (e) (f) (g) Paragraph (h) Paragraph (i) Paragraph (j) Paragraph (b) Provisions for welding in a pressurized environment	2.1 Procedure Qualification Paragraphs (a) (d) (e) same as in N-638-1 for equivalent paragraphs. Equivalent paragraph not in Appendix 1. Paragraph (f) same as (i) from N-638-1. (j) Paragraph (g) changed the first sentence adding "lateral expansion" in front of "value" both at the beginning and end of the sentence. Not included for overlays in Attachment 1.

Comparison of APS Proposed Alternative Verses Code Cases N-504-2 and N-638-1

Comparison of Proposed Alternative with N-638-1	
N-638-1	**APPENDIX 1 OF THE PROPOSED ALTERNATIVE**
Paragraph (c) Provisions to address radiation effects	Not included in Attachment 1. Thermal neutron limitation imposed in the proposed alternative 1.0(e).
1.1 Performance Qualification Welding operators shall be qualified in accordance with Section IX.	2.2 Performance Qualification Welding operators shall be qualified in accordance with Section IX.
3.0 Welding Procedure Requirements	3.0 Welding Procedure Requirements
(a) (b) (c) (d)	(a) (b) (c) same as N-638-1 except last two sentences deleted in (c) from N-638-1 since not applicable to this proposed alternative. (d) same as N-638-1.
	(e) Paragraph added to clarify temperature measurement requirements. This is identical wording to N-638-2, which has been approved by ASME.
(e)	(f) same as (e) from N-638-1
4.0 Examination	3.0 Examination and Inspection in the proposed alternative for requirements.
5.0 Documentation	5.0 Documentation in the proposed alternative.
	4.0 Pressure Testing in the proposed alternative.

Relief Request 36

Attachment 3

APS Response to Questions Asked Regarding Proposed Alternative ISI-GEN-ALT-06-03, Southern Company

Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant

This enclosure addresses the requests for additional information received by Southern Company

Attachment 3, Part 1 - September 8, 2006, and September 29, 2006, Questions

Attachment 3, Part 2 - November 14, 2006, Questions

APS Responses to Questions Dated September 8, and September 29, 2006

1. <u>NRC Request</u>

Page 1. The NOTE under the Contingency Overlay Repairs heading states that the contingency repair would only be used "If evidence of PWSCC [primary water stress corrosion cracking] is observed during volumetric or visual examinations of one of the pressurizer dissimilar metal welds ..." The visual examination cannot detect a PWSCC flaw that is not connected to the outside surface of the weld. Therefore, the result of a visual examination by itself cannot be used as a criterion in determining whether a repair should be made. There are a total of seven dissimilar metal welds and seven similar metal welds at each unit.

(a) Clarify that both visual examination and ultrasonic examination will be performed on all pressurizer nozzle dissimilar metal and similar metal welds prior to applying contingency overlay repairs.
(b) Clarify whether a weld overlay will be applied to a similar metal weld if an ultrasonic examination will not be performed on that similar metal weld.
(c) Discuss the criteria for determining a PWSCC indication and provide the indication size (the threshold) that requires a contingency overlay repair.
(d) Discuss whether a contingency overlay repair will be performed on a dissimilar metal weld if the indication detected is not caused by PWSCC.
(e) If one of the pressurizer dissimilar metal welds is detected with an indication, clarify whether all the dissimilar metal and similar metal welds in the remaining pressurizers will be repaired.

<u>APS Comment</u>:

Preemptive full-structural weld overlays for the hot leg nozzle dissimilar and similar metal welds are planned for units 1 and 3 in the upcoming refueling outages as stated in Section 5.0, Proposed Alternative and Basis for Use, of Relief Request 36. Only visual examination of the welds will be performed prior to the overlay. No UT will be performed prior to the overlay as these are preemptive full-structural weld overlays. If the visual inspection prior to the overlay indicated any leakage, then the overlay will be called a contingency full-structural weld overlay verses a preemptive overlay. However, no additional examinations will be conducted. The similar metal welds will be addressed on a case-by-case bases as discussed in Section 5.0 of the relief request.

<u>APS Response to NRC Items 1(a) through (e)</u>

(a) Only a visual examination will be performed prior to applying a contingency overlay repair for the and hot leg nozzles. Repairs have been completed for Units 1 and 3 pressurizer nozzles.

(b) Similar metal welds may be overlaid on some nozzles as discussed in APS Response 2. Ultrasonic examinations are not planned for the adjacent similar metal welds prior to applying the overlay.
(c) Through-wall leakage during a visual examination will be attributed to PWSCC, and it will be repaired by applying a FSWOL.
(d) Same as (c) above.
(e) Preemptive FSWOLs were completed for Palo Verde Unit 1 pressurizer dissimilar metal welds in the spring of 2007 and Unit 2 pressurizer dissimilar metal welds in the spring of 2008. The Unit 3 pressurizer dissimilar metal welds are scheduled for the fall of 2007. If a through wall leak is detected prior to the planned overlay outage, APS would repair only the nozzle with the leakage.

2. **NRC Request**

[Discussion removed, does not apply to Palo Verde request]

(a) Discuss the criteria for the application of FSWOL to the dissimilar metal and similar metal welds under the preemptive overlay strategy.
(b) Clarify whether the ultrasonic examination and visual examination will be conducted on the dissimilar metal and similar metal welds at Vogtle Unit 2 and Farley Unit 1 prior to applying preemptive overlays.
(c) Identify the number of welds that will be overlaid under the preemptive overlay strategy.

APS Response to NRC Items 2(a) through (c)

(a) A preemptive FSWOL will be extended over each dissimilar weld and in some cases over adjacent similar metal welds to ensure needed ultrasonic examination coverage of the dissimilar metal weld as well as similar metal weld.
(b) APS plans only to conduct visual examinations on the dissimilar metal welds and adjacent similar metal welds prior to applying the preemptive overlays for all nine nozzle welds.
(c) The number of dissimilar welds planned to be overlaid is 2 per unit. The welds to be overlaid include the dissimilar metal welds listed on page one of the proposed alternative and adjacent similar metal welds (shutdown cooling nozzles) when required to satisfy dissimilar weld overlay design dimensions.

3. **NRC Request**

Page 2. In the Applicable Code Requirements section, the licensee stated that examinations of pressurizer dissimilar metal and similar metal welds are performed based on the NRC-approved risk-informed program. Confirm that once the weld overlay is applied to the subject welds, the welds will no longer be part of the risk information program. The examinations of the overlaid welds will follow the inspection strategy in the proposed alternative.

<u>**APS Response**</u>

APS confirms that it will use the inspection strategy in the proposed alternative. However, these dissimilar metal welds and similar metal welds will be part of the Risk Informed ISI program since they are subject to other degradation mechanisms such as thermal fatigue. As stated in APS letter 102-05559-CDM/SAB/RJR, dated August 30, 2006, APS is keeping the dissimilar metal weld (DMW) exam scope separate from the RI-ISI exam scope once Risk Informed ISI is implemented for the third period. For example, if a PWSCC-susceptible weld is also selected for RI-ISI, it will receive the appropriate examination based on the EPRI topical report requirements as well as an exam for PWSCC per MRP-139.

4. <u>**NRC Request**</u>

Page 3. first paragraph. The licensee stated that the proposed alternative will be based on the 2001 edition of the American Society of Mechanical Engineers (ASME), *Boiler* and *Pressure Vessel Code* (Code), Section XI, with Addenda through 2003. As stated in NRC Regulatory Issue Summary 2004-16, licensees need to request the NRC approval for the use of the later edition or addenda of the ASME Code (i.e., later than the edition of the Code of record).

(a) Confirm that the proposed Relief Request 36 also contains a request to use the later edition of the Code.
(b) Confirm that the 2001 edition with addenda through 2003 of the ASME Code is used for Relief Request 36, because this is the latest edition of the Code that the NRC has approved in 10 CFR 50.55a.

<u>**APS Response NRC Items 4(a) and (b)**</u>

a and b) The 2001 Edition of the American Society of Mechanical Engineers (ASME), *Boiler* and *Pressure Vessel Code* (Code), Section XI, with Addenda through 2003 is the Code of Record for Units 1 and 3

5. <u>**NRC Request**</u>

On Page 3:
(a) To clarify the description in Section 1(a) of the proposed alternative, provide a drawing of a typical nozzle-weld-pipe configuration including the nozzle, dissimilar metal weld, safe end, similar metal weld, pipe, and the overlay. Identify the material of each component. Provide dimensions for relief, safety, spray, and surge nozzles and piping (such as diameters and thickness) in a table. Include the thickness of weld overlays.
(b) Clarify when the overlay will be applied and will not be applied to the similar metal welds.

APS Response to NRC Items 5(a) and (b)

(a) Enclosure 2 to the original request (ML 070470525) provided typical sketches of the nozzles and the materials for each nozzle weldment. Specific dimensions and the overlay thickness are being prepared and will be in the design package available for NRC review at the plant site.
(b) Overlay will be applied to similar metal welds when required to satisfy dissimilar metal weld overlay design dimensions.

6. NRC Request

Page 5: Section 2(a) of the proposed alternative states that for a preemptive overlay, a flaw with a depth of 75 percent and a circumference of 360 degrees will be assumed.

(a) Confirm that the 75 percent depth flaw is assumed to be located in the original weld and that the flaw originates from the inside surface of the pipe.
(b) Provide the technical basis of the assumed flaw depth.

APS Response to NRC Items 6(a) and (b)

(a) As stated in Section 5.2(a) of the proposed alternative, a flaw in the original weld with a depth of 75% and a circumference of 360 degrees that originates from the inside of the pipe is postulated for crack growth purposes. A flaw in the original weld having a 100% through-wall depth and a circumference of 360 degrees that originates from the inside of the pipe is assumed for determining overlay thicknesses for the preemptive FSWOL. The design requirement is identical to that of a repair.
(b) A 75% through-wall depth flaw is the largest flaw that could remain undetected. A preservice volumetric examination will be performed after application of the overlay using an ASME Section XI, Appendix VIII [as implemented through performance demonstration initiative (PDI)] examination procedure. This examination will verify there is no cracking in the upper 25% of the original weld and base material, and the assumption of a 75% through-wall crack is conservative. Otherwise, if any crack-like flaws are found during the preservice examination in the upper 25% of the original weld or base materials, the as-found flaw (postulated 75% through wall, plus the portion of the flaw in the upper 25%) would be used for the crack growth analysis.

7. NRC Request

On Pages 5 and 6:
(a) Discuss whether the thickness of the full-structural weld overlay will be the same for a specific nozzle weld between the contingency overlay repair

design and preemptive overlay design because the flaw assumed in the original nozzle weld between these two designs is different as shown in Section 2(b) of the alternative.

(b) Discuss how the thickness of the weld overlay is derived. Use an example to show how an actual overlay thickness is calculated.

APS Response to NRC Items 7(a) and (b)

(a) Overlay thickness may be different for preemptive full-structural overlay and contingency full-structural overlay, the overlay thickness is determined by NB-3200/NB-3600, IWB-3600 rules and crack growth considerations. Thickness is also influenced by the need to produce favorable residual stress improvement and inspectability considerations.

(b) The thickness of the overlay is determined based on the assumption of a through-wall flaw, with a length of 360 degrees in the underlying pipe. The overlay is applied, so that the criteria of IWB-3640 are met after. For example, suppose that the pipe loads in the Alloy 82/182 region are such that an allowable depth of 75% of the pipe wall is determined from IWB-3640. The new thickness of the pipe would have to be such that the postulated flaw would now be 75% of the new total thickness. Simple math results in an overlay thickness of 33% of the original pipe wall thickness in this example.

8. NRC Request

[Other licensees have stated 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. [Other licensees have] also stated that existing flaws previously accepted by analytical evaluation shall be evaluated in accordance with IWB-3640. Confirm that these evaluation results will be completed and available for staff review prior to plant startup.

APS Response

The weld shrinkage loads will be evaluated and examination results will be available for staff review prior to plant startup.

9. NRC Request

Page 6, The licensee stated that ultrasonic examination procedures and personnel shall be qualified in accordance with Appendix VIII of the ASME Code, Section XI [and that] ultrasonic examinations are implemented through the Performance Demonstration Initiative (PDI) program. In similar relief requests by other licensees, a comparison of the ultrasonic examination qualified by the PDI program to the requirements in Appendix VIII of the Code is included to demonstrate the compliance.

(a) Clarify why the proposed alternative did not present such comparison.
(b) Clarify whether the ultrasonic examination will be performed on the maximum extent achievable.

<u>APS Response to NRC Items 9(a) and (b)</u>

(a) As stated in response to NRC request 4(a) for proposed alternative' APS intends to use Appendix VIII of the 2001 Edition of Section XI. The PDI Program Status for Code Compliance and Applicability developed in June 2005 indicates that the PDI Program is in compliance with Appendix VIII, 2001 Edition of Section XI as amended and mandated by 10 CFR 50.55a, Final Rule dated October 1, 2004. Therefore, a comparison is not regarded as necessary.
(b) The ultrasonic examination will be performed on the maximum extent achievable.

10. <u>NRC Request</u>

Page 7, 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 overlay 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 to meet Section 4.0(b) of Code Case N-638-1.

<u>APS Response</u>

The PDI qualified ultrasonic examination procedure in the alternative is designed and qualified to examine the entire volume of the overlay weld as well as the region of the P3 material containing the weld heat affected zone (HAZ) and a volume of unaffected base material beyond the HAZ. In addition to verifying the soundness of the weld, a purpose of these examinations is to assure that delayed cracking that may be caused by hydrogen introduced during the temper bead welding process is not present. In the unlikely event that this type of cracking does occur, it would be initiated on the surface on which the welding is actually performed or in the HAZ immediately adjacent to the weld. The most appropriate technique to detect surface cracking is the surface examination technique that APS will perform on the weld overlay and the adjacent base material on either side of the overlay. The inspection volume includes 100% of the volume susceptible to weld induced flaws.

While it would be possible to extend the examination volume to a larger extent on either side of the weld overlay, it would not be possible with current technology to ultrasonically inspect 100% of the volume within 1.5 times the thickness of the base material because of geometric considerations. Inspection of an increased volume would result in increased dose to inspection personnel without a compensating increase in safety or quality because there is no plausible mechanism for formation of new flaws or propagation of existing flaws in the region. The overlay volume is small relative to the volume of the underlying pipe and does not present the same concerns as those related to welds in deep cavities contemplated by the requirements of Code Case N-638-1. The examinations required by Code Case N-504-2 and Appendix Q as modified in the alternative are tailored for overlay inspection and provide full-assurance that the weld and adjoining base material are fully capable of performing their intended function.

Later revision of this Code Case (N-638-2 and N-638-3) approved by ASME Code in 2005 and 2006 respectively, recognize that inspection of the larger volume is not necessary to assure quality and safety. The NRC has previously granted relief on this specific insure for temper bead welding for use at other plants for the reasons mentioned above. Specifically, San Onofre Nuclear Generating Station Unit 2 in the spring of 2006 and the Millstone Power Station Unit 3 in January of 2006 have received approval to use inspection methods essentially identical to those proposed by APS.

11. <u>NRC Request</u>

Page 8. Section 3(a)5(ii) states that any un-inspectible volume in the weld overlay shall be assumed to contain the largest radial planar flaw that could exist within that volume. The assumed flaw shall meet the standards of Table IWB-3514-2 or the requirements of IWB-3640 by evaluation. Confirm that these evaluation results will be completed and available for staff review prior to plant startup.

<u>APS Response</u>

An identification of the examination coverage of each overlay will be developed and available for NRC review prior to plant startup. The evaluation results of postulated flaws in these regions will be completed and will be available for Staff review prior to plant startup. APS Relief Request 36 does not evaluate an assumed flaw in the un-inspectable volume to IWB-3600 requirements.

12. <u>NRC Request</u>

On Page 8:

(a) The acceptance examination of Section 3(a) is performed 48 hours after the temperature of the weld overlay reaches the ambient temperature. Discuss when the preservice inspection of Section 3(b) is performed in the sequence of the weld overlay installation.

(b) Section 3(a) contains no requirements regarding the disposition of an unacceptable indication in the weld overlay during the acceptance examination. However, Section 3(c)6 requires repair/replacement of the

weld overlay if an unacceptable indication is detected in the overlay during inservice inspection. Explain why similar repair/replacement requirements are not discussed in Section 3(a), or clarify the requirements for unacceptable indications in Section 3(a).

APS Responses NRC Items 12(a) and (b)

(a) The acceptance examination and preservice inspection are performed at the same time.
(b) Section 3(a) now contains the requirements for weld overlay examination. If any volumes with unacceptable indications are identified during the acceptance examinations, the unacceptable indications will be removed and the volume will be re-welded.

13. NRC Request

Page 8. Section 3(c)(3) states that for Class 1, 2,and 3 piping, the acceptance criteria of IWB-3600, IWC-3600, or IWD-3600 shall be met for the weld overlay. However, relief request ISI-GEN-ALT-03 [Southern Company letter number] is specifically requested for pressurizer piping which is Class 1. Please clarify.

APS Response

Only the acceptance criteria of Class 1 piping in accordance with IWB-3600 is referenced in APS' request.

14. NRC Request

On Page 10:
(a) Section 3(c)(4) states that the 25 percent of weld overlays in the population will be examined once every ten years. Clarify whether the population of welds to be examined is based on the plant specific number of weld overlays.
(b) Justify the adequacy of the proposed successive examinations in Section 3(c)(5), because the proposed successive examinations are not consistent with the requirements of IWB-2420 of the ASME Code, Section XI.

APS Response to NRC Items 14(a) and (b)

(a) The population of welds to be examined is based on the plant specific number of weld overlays.
(b) The proposed overlays are mitigative structural replacements rather than analytical acceptance of indications for which IWB-2420 rules apply. There are no known indications or flaws present. Instead a flaw is postulated and mitigative overlay is deposited by welding. The successive proposed ISI examination

schedule is adequate because even after full-structural replacement re-examination is required within two outages. Any crack growth observed would again require successive examinations within the next two outages.

15. NRC Request

Page 9, The licensee stated that if a flaw is detected in the upper 25 percent of the original material during the preservice examination, the actual flaw size would be used for the crack growth evaluations. The staff thinks that this flaw size is not a conservative assumption for the crack growth calculations. The current ultrasonic examination is qualified only to detect flaws in the upper 25 percent of the pipe base metal after a weld overlay is applied. Therefore, the condition in the lower 75 percent of the pipe base metal would be unknown. The conservative assumption would be to assume existence of a crack of 75 percent through wall depth in the lower 75 percent pipe base metal which should be added to the depth of the crack found in the upper 25 percent of the pipe base metal. This worst case crack should be used to calculate crack growth. Discuss why it is acceptable to assume the actual flaw size as you proposed when the ultrasonic examination is only qualified for the upper 25 percent of the pipe metal.

APS Response

As stated in the response to NRC request 6 (b), the as-found flaw size would be the 75% through-wall flaw postulated, plus any flaws present in the upper 25% of the original weldment. For example, if no flaws were identified in the upper 25% of the weldment, the flaw depth for crack growth purposes would be 75% through-wall. However, if a flaw was found extending 10% of the wall thickness into the upper 25% of the original weldment, the as-found flaw for crack growth purposes would be 85% through-wall. This flaw would then be evaluated for the intended period of operation for growth by PWSCC and fatigue mechanisms.

16. NRC Request

(a) Section 2(g) of Appendix 1 to the submittal is different from the corresponding Section (j) in Code Case N-638-1. Section 2(g) of Appendix 1 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. Discuss the technical basis for the requirements in Section 2(g) of Appendix 1.

(b) Section 3.0(c) of Appendix 1 states that the heat input of the first three layers shall not exceed 45,000 J/inch under any conditions. Provide the technical basis for this heat input.

(c) Section 3.0(c) of Code Case N-638-1 requires that for similar metal welding, the completed weld shall have at least one layer of weld reinforcement

deposited. This reinforcement shall be removed by mechanical means, so that the finished surface is flush with the surface surrounding the weld. Discuss whether this requirement should be included in Section 3.0(c) of Appendix 1.

(d) Section 3(d) of Appendix 1 states that the interpass temperature limitation of QW-406.3 does not need to be applied. This condition is not in the corresponding Section 3.0(d) of Code Case N-638-1. Discuss why this condition is included in the proposed alternative.

(e) Discuss the technical basis for the requirements in Section 3(e) of Appendix 1, which are not shown in Code Case N-638-1.

(f) 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. Discuss whether this requirement should be included in Appendix 1 to the alternative.

(g) 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.

(h) For the case when it is impossible to measure the temperature of the weld overlay during installation, confirm that requirements in Sections 3(e)(2) and 3(e)(3) of Appendix 1 to the proposed alternative will be used in combination to determine the weld overlay temperature.

<u>APS Response to NRC Items 16(a) through (h)</u>

(a) This question does not apply to APS since APS' submittal, Attachment 1, Section 2(g) is identical to Code Case N-638-1.

(b) The question does not apply to the APS submittal. APS' proposed alternative is essentially the identical to Code Case N-638-1.

(c) This requirement is not appropriate for inclusion. All weld filler material for this particular application is fully austenitic. This provision is applicable to ferritic filler material. When using a ferritic filler material, it is necessary to remove the last layer since it is not tempered. This is not a concern for the austenitic filler materials.

(d) This question does not apply to the APS submittal. APS' proposed alternative is essentially identical to Code Case N-638-1.

(e) This set of alternative techniques and analytical methods were included to provide a number of ways to determine interpass temperature. This change was included in N-638-2. The basis from the white paper supporting the action is found in ASME Codes and Standards Connect for the action. The basis is shown at the end of this response.

(f) Welded thermocouples will not be used in this application.

(g) The proposed alterative does not use Code Case N-638-1. The NRC staff imposed condition on Code Case N-638-1 regarding ultrasonic examination and the use of associated acceptance criteria based on NB-5330 of the ASME Code, Section III, will not be satisfied by APS. Code Case N-638-1 was not prepared for weld overlay applications; instead, Code Case N-638-1 (and the temper bead welding techniques in IWA-4600) was written to address repair welds where a defect in piping is excavated and the resulting cavity is filled using a temper bead technique. However, an excavated cavity configuration differs significantly from the weld overlay configuration. APS has concluded that the proposed alternative was written to specifically address weld overlays, and not only does it adequately examine the weld overlays, but it provides more appropriate examinations and acceptance criteria than the NRC staff-imposed position. Conversely, the imposition of ASME Section III acceptance standards to weld overlays is inconsistent with years of NRC precedence and without justification given the evidence of past NRC approvals and operating experience. APS' conclusion is based on the following:

i. Weld overlays have been used for repair and mitigation of cracking in Boiling Water Reactors since the early 1980s. In Generic Letter 88-01, the NRC approved the use of Section XI acceptance standards for determining the acceptability of installed weld overlays.

ii. Weld overlays for repair of cracks in piping are not addressed by ASME Section III. ASME Section III utilizes nondestructive examination procedures and techniques with flaw detection capabilities that are well within the practical limits of workmanship standards for welds. These standards are most applicable to volumetric examinations conducted by radiographic examination. Radiography (RT) of weld overlays is not appropriate because of presence of radioactive material in the Reactor Coolant system and water in the pipes. The acceptance standards are written for a range of fabrication flaws including lack of fusion, incomplete penetration, cracking, slag inclusions, porosity, and concavity. However, experience and fracture mechanics have demonstrated that many of the flaws that are rejected using ASME Section III acceptance standards do not have a significant effect on the structural integrity of the component.

iii. The UT examinations performed in accordance with the proposed alternative are in accordance with ASME Section XI, Appendix VIII, Supplement 11, as implemented through the PDI. These examinations are considered more sensitive for detection of defects, either from fabrication or service-induced, than either ASME Section III RT or UT methods. Further, construction type flaws have been included in the PDI qualification sample sets for evaluating procedures and personnel.

iv. Per Enclosure Section 5.3(a)4 of the proposed alternative, any planar flaws found during either the acceptance or preservice examination are required to meet the requirements of Table IWB-3514-2. This approach was previously found acceptable in the NRC Safety Evaluation Report (SER) dated July 21, 2004 for Three Mile Island, Unit 1. However, within the same SER, the NRC had issues regarding the application of Table IWB-3514-3 to laminar flaws in a weld overlay. The SER stated, "Applying Table IWB-3514-3 to a weld overlay exposes several inherent oversights. For instance, the acceptance of a laminar flaw size is independent of the weld overlay size, and the acceptance criteria is silent on the inaccessible volume beneath the lamination which may hide other flaws beneath the lamination". These issues are addressed in the proposed alternative, as follows:

- Per Section 5.3(a)5 of the proposed alternative, Table IWB-3514-3 has been restricted so that the total laminar flaw shall not exceed 10% of the weld surface area and no linear dimension of the laminar flaw shall exceed 3.0 inches.
- Per Section 5.3(a)5i of the proposed alternative, the reduction in coverage due to laminations is limited to less than 10% with the dimensions of the uninspectable area based on the coverage obtained by angle beam examinations.
- Per Section 5.3(a)5ii of the proposed alternative, any uninspectable volume in the weld overlay shall be assumed to contain the largest planar flaw that could exist within that volume. This assumed planar flaw shall meet the requirements of Table IWB-3514-2, or alternately, the flaw evaluation requirements of IWA-3640.

(h) The alternative allows any one of the methods listed in Section 3(e) of Appendix 1 to the proposed alternative. A discussion of the change to N-638-2 and its basis, as well as a response to the Main Committee negative, is found in the response to NRC request 16(e) above.

Requirement to Monitor Process Temperatures during the Welding Process (Technical basis for the requirements in Section 3(e) of Appendix 1)

The present revision of Code Case N-638 does not clearly address the monitoring of process temperatures during the production welding operation. The proposed change adds the following requirement in new paragraph 3.0(e):

"The interpass temperature shall be controlled by one of the following methods:

(1) Temperature measurement (e.g. pyrometers, temperature indicating crayons, thermocouples) during welding;
(2) Heat flow calculations using the maximum heat input permitted by the welding procedure;
(3) Mock-up testing using the maximum heat input permitted by the welding procedure."

The proposed change will allow the use of any temperature monitoring or analytical method that ensures that process temperatures are controlled within the interpass temperature limitations of the welding procedure. Because this Code Case is generally used to perform repair welding on Reactor Coolant System (RCS) components where radiological exposure is a significant concern, temperature monitoring has been generally performed remotely using devices such as pyrometers. While thermocouples[1] are certainly allowed under the proposed change, the radiological exposure associated with their installation and removal (which includes NDE) makes them a less attractive option. As an alternative to temperature monitoring methods, analytical evaluations that provide assurance that process temperatures will remain within welding procedure variables can be performed.

[1] Although the use of thermocouples and recording instruments are critical when using traditional temper bead welding procedures that are based on elevated preheat and postweld bake temperatures, their use is not critical to ambient temperature temper bead procedures.

It should be noted that the analytical method included is more specific than that stated above.

17. <u>NRC Request</u>

On Page 3: The code of record for both VEGP units and Farley units is the 1989 editions of the ASME Code, Section XI. On page 1, the licensee stated that the second ISI interval for both VEGP units started on May 31, 1997. For Farley Unit 1, the third ISI interval started on December 1, 1997. For Farley Unit 2, the third ISI interval started on July 30, 2001. Based on the aforementioned starting dates of the ISI intervals, clarify why the code of record for these units is not based on the edition or addenda later than 1989 edition of the ASME Code.

<u>APS Response</u>

[Question on Code of record does not apply to APS.]

18. NRC Request

If the pressurizer surge line in any of the Palo Verde units has been approved for leak-before-break and the weld overlay is applied to the surge line, the licensee needs to confirm that the original leak-before-break analyses are still valid and 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.

APS Response

Not applicable to the the welds identified in Enclosure Section 1.0 of the relief request.

19. NRC Request

By letter dated April 28, 2006, Exelon submitted a relief request for the preemptive weld overlays of the pressurizers lines at Byron and Braidwood. By letter dated September 14,2006, Exelon committed to provide the NRC, within 14 days after the completion of the ultrasonic examination of the weld overlay installations, (1) the examination results of the weld overlays, (2) a discussion of any repairs to the overlay material and/or base metal and the reason for the repair, and (3) commitment to perform the subsequent inservice examination in accordance with Subarticle Q-4300 of Appendix Q to the ASME Code, Section XI. The staff requests that APS submit the same commitments as specified in Exelon's letter dated September 14, 2006, for the contingency and preemptive weld overlay relief requests at Palo Verde Units 1 and 3.

APS Response

Reporting of the completion of the pressurizer welds in Units 1 and 3 is no longer applicable. APS will also perform the subsequent inservice examination in accordance with Subarticle Q-4300 of Appendix Q to the ASME Code, Section XI Regarding the Inservice Inspection requirements of Subarticle Q-4300 of Appendix Q; the proposed alternative has essentially incorporated these Inservice Inspection requirements.

20. NRC Request

If the preservice inspection (ultrasonic examination) of the installed weld overlay detected indications that are unacceptable per the acceptance criteria of Table IWB-3514-2 of the ASME Code, Section XI, discuss the disposition of the unacceptable indications prior to restart of the plant.

APS Response

For weld overlay examination volumes with unacceptable indications detected during the preservice inspections, the unacceptable indications will be removed and the volume will be re-welded.

APS Responses to Questions Dated November 14, 2006

1. <u>NRC Request</u>

In the response to staff's RAI Question 1, the licensee provided a revised schedule for ultrasonic testing (UT) examinations of the pressurizer nozzles and revised weld overlay strategy. For example, the licensee changed from the contingency weld overlay repairs to preemptive weld overlay for Vogtle Unit 1 and Farley Unit 2. The licensee needs to submit a revised ISI-GEN-ALT-06-03 to reflect the changes.

<u>APS Response</u>

APS Relief Request 36 is for preemptive weld overlay. If visual examinations prior to the overlay indicate through wall leakage, the overlay will be considered a full-structural contingency overlay. APS' submittal clearly states this distinction in the proposed alternative.

2. <u>NRC Request</u>

In the response to staff's RAI Question 2, the licensee stated that the crack growth calculations in section 2(a) of alternative ISI-GEN-ALT-06-03 are applicable to the preemptive weld overlay. Discuss at what stage of the weld overlay activities will the crack growth calculations be performed. The staff needs to review the crack growth calculations of the preemptive weld overlay.

<u>APS Response</u>

Crack growth calculations, including both stress corrosion and fatigue crack growth, are performed pre-outage. They are reconciled with respect to actual findings during the outage and as-built overlay conditions. This work is documented as part of the overlay design package and will be available for NRC review prior to plant restart from the outage that the pre-emptive overlays are installed.

3. <u>NRC Request</u>

In the response to staff's RAI Question 2(b), the licensee stated that it does not plan to conduct UT or visual examination on the similar metal welds which are located adjacent to the dissimilar metal welds. However, the licensee will examine the similar metal welds after the overlay is applied. The staff notes that the UT examination of the weld overlay is qualified to interrogate only the outer 25 percent of the original weld wall thickness (i.e., the outside surface of the original weld penetrating into the 1/4 thickness of the weld). The UT method is not qualified to interrogate the inner 75 percent of the original weld wall thickness. Therefore, the condition of the inner 75 percent of the similar metal weld would not be known. (A) Discuss how the structural integrity can

be demonstrated for the inner 75 percent of the wall thickness region of the similar metal weld. (B) The proposed alternative is focused on the requirements for the weld overlay of the dissimilar metal welds and the technical basis and analyses supporting the weld overlay have been based on the material properties of the dissimilar metal welds. Discuss whether the requirements (such as flaw growth calculations) in the proposed alternative are also applicable to the overlaid similar metal welds which have different material properties than the dissimilar metal welds.

APS Response – Part A

The overlay design basis and crack growth calculation for the similar metal welds are identical to those described in the alternative for dissimilar metal welds (even though such welds are not susceptible to PWSCC in the PWR environment). Therefore, the standard weld overlay pre- and inservice inspection volume (the overlay plus the outer 25% of the original weld and HAZ) is adequate to demonstrate the structural integrity of these welds.

APS Response – Part B

The requirements (such as flaw growth calculations) in the proposed alternative will be applied to the overlaid similar metal welds using appropriate stress levels and material properties. Fatigue crack growth analysis will be performed, but PWSCC crack growth evaluation will not be performed for the overlaid similar welds because they are not susceptible to stress corrosion cracking in a PWR water environment.

4. NRC Request

In response to staff's RAI Question 5(a), the licensee stated that the specific dimensions and the overlay thickness are proprietary information and will be in the design package available for NRC review at the plant site. The staff would like to review the design package at the NRC headquarters in Rockville Maryland. The staff assume that the design package includes stress analyses associated with the weld overlay design. (See Comment #13)

APS Response

A stress analysis will be performed pre-outage that demonstrates that the hot leg nozzles will perform their intended design function with the FSWOL installed. This analysis will be documented as part of the overlay design package and will be available for NRC review prior to plant restart from the outage that the pre-emptive overlays are scheduled for installation. The stress analysis report will include results showing that the requirements of Subarticles NB-3200 and NB-3600 of the ASME Code, Section III are satisfied. The stress analysis will also include results showing that the requirements of IWB-3000 of the ASME Code, Section XI, are satisfied. The results will show that the postulated crack, including its growth in the nozzles, would not adversely affect the integrity of the overlaid welds.

5. <u>NRC Request</u>

Staff's RAI Question 14(b) is related to the adequacy of the proposed successive inservice inspection (ISI) of the overlaid welds. In the response to Question 14(b), the licensee stated that "...there are no known indications present [in the dissimilar metal welds]..." The staff does not agree with this statement because without conducting an UT examination prior to weld overlay installation as the licensee has proposed for Vogtle Units 1 and 2 and Farley Unit 1, the condition of the original welds would not be known. In addition, the UT examinations performed after weld overlay installation may not detect flaws in the original welds either because (a) the flaws in the original welds, if exist, may be squeezed tightly by the compressive stresses produced by the weld overlay and would not be detected by the UT. (2) The UT examination is qualified to interrogate only the outer 25 percent of the original weld thickness. Therefore, the condition of the remaining 75 percent of the original weld thickness region would not be known.

The proposed alterative needs to be revised to address the following scenarios which apply to the condition of the original welds:

(A) If the licensee did not perform the UT examination of the original weld prior to weld overlay installation, the licensee needs to assume a worse case indication exists in the original weld and perform ISI of the weld overlay per the successive examination requirements of IWB-2420. The purpose is to ensure that (1) there is no indication in the original weld, and (2) if there is a flaw in the original weld, the flaw will not grow. This scenario applies to Vogtle Units 1 and 2 and Farley Unit 1.

(B) If the licensee performed the UT examination of the original weld prior to weld overlay installation and found no unacceptable indication(s) in the original welds, the proposed ISI schedule in alternative ISI-GEN-ALT-06-03 is adequate. However, if the licensee detected unacceptable indications per Table IWB-3514-2 in the original weld, the licensee needs to perform ISI of the weld overlay per the successive examination requirements of IWB-2420. If acceptable indications are detected in the original weld, the proposed ISI inspection schedule is acceptable. This scenario applies to Farley Unit 2.

APS Response (Part A) -

The proposed alternative, Section 5.3, has been revised to reflect portions of the following discussion. This discussion replaces the response to Question 14(b) in APS' Response to Request for Additional Information.

The NRC has requested that if a weld is not examined prior to overlay installation that the worst case flaw be assumed and that the overlay be examined per the successive examination requirements of IWB-2420. IWB-2420 requires that if a flaw is detected during inservice examinations and is accepted for continued service by analytical evaluation, the areas containing the flaws shall be re-examined during the next three inspection periods. IWB-2420 is not required for the Acceptance Examination and the Preservice Examination because (1) analytical evaluation was not used to accept any actual flaws in the overlay, and (2) any flaw or postulated flaw in the upper 25% of the original weld is reduced to an acceptable size by increasing the wall thickness by deposition of weld overlay on the outside surface of the piping. Below is a synopsis of APS' proposed examinations:

Palo Verde Units 1, 2, and 3 are scheduled for preemptive overlays during the upcoming refueling outages. APS does not intend to perform ultrasonic examinations of the dissimilar metal welds or similar metal welds on these units prior to the installation of the overlays. Since APS intends to apply full-structural overlays, designed for a worse case, through-wall flaw that is 360^0 in circumference, APS believes that the dose received from examination of these welds would result in a hardship without a compensating increase in the level of quality and safety.

The new overlay will have ultrasonic acceptance and preservice examinations to determine if there are any indications in the overlay or if there are indications in the upper 25% of the original weld or base material. Pre-existing indications in the outer 25% of the original weld are not expected to be closed by compressive forces imposed by the weld overlay and thus their delectability is not impacted by the overlay. PDI weld overlay qualification samples include flaws in this region, and thus any potential crack closure effects are addressed in the qualification. Within the next two outages the overlay and the upper 25% of the weld and base material will be re-examined for a second time. If there is no evidence of a new indication or growth of a pre-identified indication during the second ultrasonic examination, then the overlay is functioning as designed and the overlay will be placed into a population to be examined on a sample basis.

In the unlikely event, that at a later time, an indication resumes its growth, the proposed alternative provides sufficient defense-in-depth to ensure structural integrity. First, the overlay material is resistant to PWSCC and if a PWSCC indication grows to the weld overlay interface it would then stop. Second, the proposed alternative design assumes a through-wall flaw that is 360^0 degrees around the circumference as the design basis for the overlays. Therefore, structural integrity will continue to be maintained by the full-structural overlay regardless of crack growth beneath the overlay. Until final overlays are applied and the final contours are known the actual dose received when examining these welds must be estimated. It is estimated that the dose received by personnel for the examination of 9 overlays on a single unit will average about 1 Rem. Therefore, performing the examinations for a third time per IWB-2420 on 21 welds would require about 3 Rem. APS concludes that performing additional examinations on these 27 weld overlays per IWB-2420 would result in extra dose without a compensating increase in the level of quality and safety. Note: If there is evidence of change in the upper 25% during the second examination the overlay will be examined for a third time within the next two refueling outages. This sequence of examinations would be repeated until there was no growth or until a new repair is applied. This meets the intent of IWB-2420.

APS Response (Part B) – Farley Unit 2 (6 overlays)

This question does not apply to APS.

6. NRC Request

Staff's RAI Questions 16(e) and 16(h) are related to the licensee's proposed methods to measure the weld interpass temperature as presented in Section 3.0(e) to Appendix 1. Section 3.0(e) has been incorporated in Code Case N-638-2, but not in N-638-1. The staff has not approved Code Case N-638-2. The staff does not agree with portion of proposed Section 3.0(e). The staff's position is that the licensee should use mainly proposed Section 3.0(e)(1), which is related to use of temperature measurement (e.g., pyrometers, temperature indicating crayons, and thermocouples). However, if it is impossible to measure the weld interpass temperature per Section 3.0(e)(1), Sections 3.0(e)(2) and 3.0(e)(3) shall be used in combination. As it is proposed, any of Sections 3.0(e)1, 3(e)(2), or 3(e)(3) may be used, which the staff finds unacceptable. The licensee needs to revise the proposed Section 3.0(e).

APS Response

Interpass temperature will be directly measured using direct temperature measurement devices. This method of temperature measurement complies with Code Case N-638-2 section 3.0(e)(1). If it is not possible to measure the weld interpass temperature in this manner, sections 3.0(e)(2) and 3.0(e)(3) of Code Case N-638-2 shall be used in combination.

7. <u>NRC Request</u>

In the response to staff's RAI Question 16(g), the licensee stated that due to recent overlay issues at Byron, the licensee proposed to change Section 3(a)3iii in the original proposal. The licensee stated that an uninspectable volume in the weld overlay shall be assumed to contain the largest planar flaw that could exist within that volume. (A) Clarify where is the uninspectable volume in the weld overlay. The staff presumes that there are two regions of the weld overlay that are uninspectable. One uninspectable region would be at the both ends of the weld overlay as shown in Figure 1 of the proposed Request ISI-GEN-ALT-06-06. These are the weld volume outside the examination volume A-B-C-D. The second uninspectable region would be the inner 75 percent of thickness of the original weld. (B) The licensee stated that "...the assumed planar flaw shall meet the requirements of Table IWB-3514-2, or alternatively, the flaw will be repaired...". The statement implies that a repair will be performed on an assumed flaw. The repair should be performed on a real flaw, not an assumed flaw. Please clarify the statement. (C) the licensee needs to submit a revised ISI-GEN-ALT-06-03 to reflect the revised criteria in Section 3(a)3iii.

<u>APS Response</u>

The APS proposed alternative reflects the following discussion and this discussion also replaces the response to Question 16(a) in APS' Response to Request for Additional Information. The new response is:

(A) The only uninspectable volume addressed in this alternative is under detected laminar indications. The presence of laminar indications may limit angle beam examinations by reflecting sound waves. Any uninspectable volume in the weld overlay beneath a laminar flaw shall be assumed to contain the largest radial planar flaw that could exist within that volume. This assumed flaw shall meet the preservice examination standards of Table IWB-3514-2. In applying the acceptance standards, wall thickness "t_w" shall be the thickness of the weld overlay. Both axial and circumferential planar flaws shall be assumed.

(B) If the preservice acceptance criteria of Table IWB-3514-2 are not met, the lamination shall be removed or reduced in area such that the assumed flaw is acceptable.

(C) The proposed alternative, Section 3, has been revised.

8. <u>NRC Request</u>

In the response to staff's RAI Question 18, the licensee stated that it will confirm that the original leak-before-break (LBB) analyses are still valid and

the associated acceptance criteria will still be met after the weld overlays are applied. Discuss why the confirmation of the LBB analysis can not be performed prior to the weld overlay installation.

APS Response

The confirmation of the LBB analysis cannot be performed prior to the weld overlay installation because weld shrinkage stresses are not available. After the weld overlay is installed, the shrinkage will be measured, and the resulting shrinkage stresses calculated. The shrinkage stresses will be applied to the piping loads and APS will confirm that the existing LBB analysis is still valid. This confirmation will be documented by APS.

9. NRC Request

(A) In section 3(c)6 of the proposed alternative, it is stated that "...For weld overlay examination volumes with unacceptable indications as described above in Sections 3(c)2 and 3(c)3, the weld overlay shall be removed...". Section 3(c)3 references acceptance standards of Table IWB-3514-2 and acceptance criteria of IWB-3600. Clarify which acceptance criteria (Table IWB-3514-2 or IWB-3600) the indications will have to meet in order to be characterized as "unacceptable" because an indication could be accepted or rejected per Table IWB-3514-2 or per the analysis of IWB-3600.

APS Response

Section 5.3(c)6 of the proposed alternative was deleted. Section 5.3(c) was revised.

10. NRC Request

Confirm the staff's interpretation of the weld overlay examinations and associated acceptance criteria in the proposed alternative as follows.

> **For the preservice UT examination of the weld overlay, if an indication in the weld overlay is rejected per Table IWB-3514-2, the unacceptable indication will be removed. This criterion will be reflected in the revised section 3(a)3iii of the proposed alternative. If the indication is found acceptable by Table IWB-3514-2, the weld overlay will be placed in service and the ISI schedule and acceptance criteria will follow requirements in Section 3(c) of the proposed alternative.**
>
> **For the inservice UT examination of the weld overlay, if an indication in the weld overlay is accepted per Table IWB 3514-2, the weld overlay will be re-examined in the future refueling outage(s) per section 3(c)5. If the**

indication is found unacceptable by Table IWB-3514-2, the indication will be evaluated by the analysis of IWB-3600 per section 3(c)3 of the proposed alternative. If the indication is found acceptable by IWB-3600, the ISI schedule will follow Section 3(c)5. If the indication is found unacceptable by IWB-3600, the weld overlay will be removed per section 3(c)6.

APS Response

Preservice UT Examination - The staff's interpretation is confirmed. The APS Section number is now 5.3(b)2.

Inservice UT Examination - The staff's interpretation is confirmed. The APS sections are now 5.3(c)3, 5.3(c)4 and 5.3(c)5. The APS request does not contain Section 5.3(c)6.

11. NRC Request

Section 1.0(a) of Code Case N-638-1 limits the thickness of the weld overlay not to exceed the 50 percent of the ferritic base metal thickness. Discuss why this requirement is not included in Section 1.0 of Appendix 1 to the proposed alternative.

APS Response

Section 1.0(a) of Code Case N-638-1 applies to the excavation of base metal. It states, "...the depth of the weld shall not be greater than one-half of the ferritic base metal." Therefore, an excavation can not be made more than one-half of the base metal thickness. The proposed alternative is for an overlay not an excavation; therefore, the requirement is not applicable.

12. NRC Request

In the August 10, 2006 submittal, the licensee presented a list of welds for the weld overlay. Confirm that weld ALA-4504-2&3 at Farley unit 1 and APR1-4504-2&3 at Farley unit 2 are a single weld at each unit.

APS Response

Not applicable to Palo Verde

13. NRC Request

Code Case N-504-2(g)2 and N-504-2(g)3 require evaluations of residual stresses and flaw growth of the repaired weldments. The similar evaluations

are required in Section 2(b) of the proposed alternative. Recently, the staff reviewed a stress analysis submitted by a licensee after the weld overlays were installed on the pressurizer welds but prior to entry Mode 4 from its nuclear plant's outage. The stress analysis showed that the applied stresses per Subarticle NB-3600 of the ASME Code Section III exceeded the allowable stress. In light of that stress analysis, the staff requests Southern Nuclear to submit a stress analysis demonstrating that the pressurizer nozzles after the weld overlay installation will perform their intended design function. The stress analysis report should include results showing that the requirements of Subarticles NB-3200 and NB-3600 of the ASME Code, Section III are satisfied. The stress analysis should also include results showing that the requirements of IWB-3000 of the ASME Code, Section XI, are satisfied. The results should show that the postulated crack including its growth in the nozzles would not adversely affect the integrity of the overlaid welds. The staff requests that the licensee submit the evaluations prior to entry into Mode 4 from the refueling outage. (See Comment # 4).

APS Response

A stress analysis will be performed pre-outage that demonstrates that the hot leg nozzles will perform their intended design function with the FSWOL installed. This analysis will be performed as part of the overlay design package and will be available for NRC review prior to entry into Mode 4 following the outage that the pre-emptive overlays are scheduled for installation. The stress analysis report will include results showing that the requirements of Subarticles NB-3200 and NB-3600 of the ASME Code, Section III are satisfied. The stress analysis will also include results showing that the requirements of IWB-3000 of the ASME Code, Section XI, are satisfied. The results will show that the postulated crack, including its growth in the nozzles, would not adversely affect the integrity of the overlaid welds.