**PSEG Nuclear LLC**
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10CFR50.55a

OCT 19 2007

LR-N07-0273

PSEG Nuclear LLC

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

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NO. NPF-57
DOCKET NO. 50-354

SUBJECT: RELIEF REQUEST HC-RR-I2-W02
PROPOSED ALTERNATIVE REPAIR METHOD

In accordance with 10 CFR 50.55a, Codes and Standards, paragraph (a)(3)(i), PSEG Nuclear LLC (PSEG) is submitting a proposed alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components. This proposed alternative described in the attachments would permit the use of a full structural weld overlay repair for an indication identified in the N2A recirculation inlet nozzle safe-end to nozzle weld joint.

The Hope Creek Unit 1 Second Ten-Year Interval Inservice Inspection (ISI) Program complies with the requirements of the ASME Code Section XI, 1998 Edition, including Addenda through 2000. The Second 10-year interval began on December 13, 1997 and is currently projected to end December 12, 2007.

Due to the need to obtain approval of this alternative prior to startup of the unit from the current outage, we are requesting your review and approval prior to Operational Condition 2, which is currently scheduled to occur on October 30, 2007. No new commitments are identified in this letter.

If you have any questions or require additional information, please contact Mr. Philip J. Duca at (856) 339-1640.

Sincerely,

George P. Barnes
Site Vice President – Hope Creek

Attachment 1 - Overview
Attachment 2 - Relief Request HC-RR-I2-W02

A047

MRR

95-2168 REV. 7/99

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U. S. Nuclear Regulatory Commission
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## Introduction

During Hope Creek's Refueling Outage (RFO) 14 Inservice Inspection (ISI) ultrasonic examinations (UT), the dissimilar metal joint at the N2A recirculation safe end-to-nozzle is receiving an unscheduled inspection in response to OE24381, "Circumferential Flaw in Reactor Recirculation Riser Nozzle to Safe End Weld." This is a Code examination category R-A, Item R1.14 (formerly classified as B-F, Item No. B5.10) weld. This Alloy 82 weld connects an approximately 13.976 inches outside diameter (OD) by 11.102 inches inside diameter (ID) stainless steel SA-182 Grade F316L safe-end buttered with Alloy 182 to the SA-508 Class 2 low alloy steel nozzle buttered with Alloy 182.

This weld is also contained within the Intergranular Stress Corrosion Cracking (IGSCC) augmented examination program as a category C weld. Accordingly, this re-examination is being performed in accordance with the requirements of Generic Letter 88-01," NRC Position on IGSCC in BWR Austenitic Piping", and BWRVIP-75-A: BWR Vessel and Internals Project, Technical Bases for Revisions to GL 88-01 Inspection Schedules." The weld will be examined with an ASME Section XI, Appendix VIII, Supplement 10 qualified, Electric Power Research Institute (EPRI) – Performance Demonstration Initiative (PDI) procedure. The inspection will use ultrasonic (UT) refracted longitudinal waves in the axial and circumferential directions. Results of the examination will be available upon its completion.

PSEG Nuclear will employ a weld overlay repair using machine gas tungsten arc welding (GTAW) and Alloy 52M weld metal. Weld overlay repairs have been used in the Boiling Water Reactor (BWR) industry since the 1980s to repair flaws due to SCC, including safe end-to-nozzle welds. The experience with weld overlays in the BWR industry has been excellent. Weld overlays have been approved as an effective SCC mitigating technique in USNRC Generic Letter 88-01/ NUREG-0313, Rev. 2 and BWRVIP-75-A.

## Degradation Mechanism

Experience at similar joints on recirculation inlet nozzle (N2K) at Hope Creek in 2004, and at other BWRs in the last few years identified the cause of such flaws were due to stress corrosion cracking (SCC).

The original Construction Code for the reactor vessel is ASME Section III, 1968 Edition, including Addenda through Summer 1970, and Paragraph NB-3338.2(d)(4) of the Winter 1971 Addenda supersedes Paragraph I-613(d) of the 1968 Edition.

The current Construction Code for the safe-end is ASME Section III, 1974 Edition, including Addenda through Summer 1976. The existing safe end-to-nozzle weld is Alloy 82 and connects a stainless steel SA-182 Grade F316L safe-end buttered with Alloy

182, to the SA-508 Class 2 low alloy steel nozzle, also buttered with Alloy 182 (see Attachment 2, Figure 1). A portion of the original Alloy 82/182 safe end-to-nozzle weld remains on the nozzle side as a result of installing a modified safe-end with an integrally attached thermal sleeve prior to going into service. The N2A weld underwent Mechanical Stress Improvement Process (MSIP) treatment during RFO8 (1999).

The function of the N2A nozzle is to connect a portion of the recirculation system inlet piping to the reactor vessel (RV).

**SCC Mitigation by Weld Overlay Repairs**

PSEG Nuclear has decided to mitigate the flaw employing a weld overlay repair using machine GTAW and Alloy 52M weld metal. Weld overlay repairs have been used in the BWR industry since the 1980s to repair flaws due to SCC, including safe end-to-nozzle welds. The experience with weld overlays in the BWR industry has been excellent. It is approved as an effective SCC mitigating technique in USNRC Generic Letter 88-01/ NUREG-0313, Rev. 2 and BWRVIP-75-A.

Although MSIP was performed, as a further preventative measure, implementation of an overlay at the N2A safe end-to-nozzle weld will provide further mitigation as discussed below:

1. The overlay is designed as a standard (full structural) overlay per the structural requirements in ASME Code Case N-504-3 and Nonmandatory Appendix Q using paragraph IWB-3640 of ASME Section XI. In the design of a standard overlay, a 360 degree "through the thickness" circumferential flaw is assumed and, therefore, no credit is taken for any portion of the original pipe wall. Hence, all the weld material, where flaw initiation is believed to have occurred, is essentially assumed to be completely flawed. The full ASME Section XI safety margins are restored after the application of a standard overlay.

2. The application of the overlay results in a favorable residual stress field on the inside of the component, which arrests further flaw growth. This is because the overlay establishes compressive residual stresses on the inner half of the pipe, which prevents further SCC.

3. The nickel based Alloy 52M weld wire (ASME Section II, Part C, SFA-5.14, ERNiCrFe-7A, UNS N06054), which is used for the GTAW overlay repair, has been shown to be highly resistant to SCC. This alloy, containing nominally 30 wt. % chromium, and its corresponding wrought material, Alloy 690, have been demonstrated in laboratory testing, in modeling studies, and in the field, to be highly resistant to SCC initiation and growth in the BWR environment.

**Inservice Inspection**

Subsequent inservice examinations of the overlay will be performed in accordance with the requirements of BWRVIP-75-A.

**Similar Plant Experience**

The requested alternatives for the repair at Hope Creek Unit 1 are consistent with the documented safety evaluation reports (SER) previously issued for Hope Creek in 2004 on the recirculation inlet safe end-to-nozzle (N2K) weld, as well as other plants including Duane Arnold (TAC No. MA8663), Perry, Nine Mile Point 2 and Susquehanna 1.

The SER for Palo Verde Units 1, 2, and 3 issued June 21, 2007 (TAC Nos. MD4272, M4273, MD4274, MD5579, MD5580, and MD55810) encompasses the requested alternatives for starting the 48-hour hold period at the completion of the third layer, crediting the first dilution layer based on chromium content, and the use of alloy 52M rather than low carbon austenitic stainless steel.

10 CFR 50.55a Relief Request HC-RR-I2-W02

Proposed Alternative In Accordance with 50.55a(a)(3)(i)
Alternative Provides Acceptable Level of Quality and Safety-

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## 1. ASME Code Components Affected

| | |
|---|---|
| Code Class: | 1 |
| References: | ASME Section XI, 1998 Edition, including and through the 2000 Addenda<br>ASME Section XI, Case N-504-3<br>ASME Section XI, Case N-638-1<br>NUREG-0313 Rev 2<br>Generic Letter 88-01<br>BWRVIP-75-A |
| Examination Category: | R-A (formerly B-F) |
| Item Number: | R1.14 (formerly B5.10) |
| Description: | Alternative Repair for the N2A Recirculation Inlet Nozzle, Safe end-to-Nozzle Weld |
| Component Number: | N2A Recirculation Inlet Nozzle |

## 2. Applicable Code Edition and Addenda

The Hope Creek Unit 1 Second Ten-Year Interval In-service Inspection (ISI) Program complies with the requirements of the ASME Code Section XI, 1998 Edition, including Addenda through 2000. The Second 10-year interval began on December 13, 1997 and is currently projected to end December 12, 2007.

## 3. Applicable Code Requirements

The following information is from ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1998 Edition, including Addenda through 2000, which identifies the specific requirements included in this alternative:

IWA-4421(a) and IWA-4611.1(a) require removal of the detected flaw.

IWA-4610(a) requires that the area to be welded shall be preheated to 300°F minimum for gas tungsten arc welding (GTAW).

IWA-4610(a) requires that thermocouples (TCs) shall be used to monitor process temperatures.

IWA-4631(b) specifies that the surface of the completed weld on the ferritic steel shall not exceed 100 square inches.

## 4. Reason for Request

The request is based on restoring the structural integrity of the N2A recirculation inlet nozzle, safe end-to-nozzle weld joint using technically sound welding practices and non-destructive examination (NDE), while limiting repair personnel radiological exposure to the maximum extent practical. The following cited Code articles identify the actions that would be required if the repair were conducted in accordance with the Code without exception.

IWA-4421(a) and IWA-4611.1(a) require defect removal in this case. The repair cavity would extend through wall since OD removal would be required. ID removal of the indication would be impractical since it would require the removal of the thermal sleeve.

IWA-4610(a) requires the area to be welded shall be preheated to 300°F minimum for GTAW. Since the nozzle will remain full of water, establishing the 300°F minimum preheat temperature cannot be achieved.

IWA-4610(a) also requires the use of TCs to monitor process temperatures. Due to the personnel radiological exposure associated with the installation and removal of the TCs, the nozzle configuration, and since the nozzle will be full of water, a calibrated contact pyrometer will be used in lieu of TCs to verify preheat and interpass temperature limits are met.

IWA-4631(b) specifies the surface of the completed weld on the ferritic steel shall not exceed 100 square inches. Restoring the structural integrity of the safe end-to-nozzle weld with the weld overlay may require welding on more than 100 square inches of surface on the low alloy steel base material.

Pursuant to 10 CFR 50.55a(a)(3)(i), an alternative is requested on the basis that the proposed repair will provide an acceptable level of quality and safety.

## 5. Proposed Alternative and Basis for Use

A full structural weld overlay repair is proposed for the safe end-to-nozzle weldments. The nozzle material is SA-508 Class 2 low alloy steel. The safe-end is austenitic stainless steel SA-182 Grade F316L. The existing weld material is Alloy 82 with Alloy 182 buttering.

The weld overlay will be implemented consistent with the requirements of NUREG-0313, Revision 2 (which was implemented by Generic Letter 88-01), BWRVIP-75-A, Code Case N-504-3 "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping", Nonmandatory Appendix Q, Code Case N-638-1 "Similar and Dissimilar Metal Welding Using Ambient Temperature GTAW Temperbead Technique", and IWB-3640, ASME Section XI 1998 Edition, including Addenda through 2000 with Appendix C.

**Welder Qualification And Welding Procedures**

All welders and welding operators will be qualified in accordance with ASME Section IX and any special requirements of ASME XI or applicable code cases.

Machine GTAW with cold wire feed for welding SFA-5.14, ERNiCrFe-7A, UNS N06054, F-No. 43 (commercially known as Alloy 52M) will be used.

**Welding Wire**

A consumable welding wire highly resistant to SCC was selected for the overlay material. Alloy 52M contains a nominal 30 wt% Cr that imparts excellent resistance to SCC.

**Weld Overlay Design**

The weld overlay will extend around the full circumference of the safe end-to-nozzle weldment location in accordance with NUREG-0313, Rev. 2, BWRVIP-75-A, Code Case N-504-3, Nonmandatory Appendix Q, and Generic Letter 88-01. The overlay length will extend across the projected flaw intersection with the outer surface beyond the extreme axial boundaries of the flaw. The design thickness and length has been computed in accordance with the guidance provided in Code Case N-504-3, Nonmandatory Appendix Q, and ASME Section XI, IWB-3640, 1998 Edition including Addenda through 2000 and Appendix C. The overlay will completely cover the area of the flaw and the Alloy 82 and 182 materials with the highly resistant Alloy 52M weld filler material.

To provide the necessary weld overlay geometry, it will be necessary to weld on the low alloy steel nozzle base material. A temperbead welding approach will be used for this purpose following the guidance of ASME Section XI Code Case N-638-1

"Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique". This Code Case provides for machine GTAW temperbead weld repairs to P-No. 3 Group No. 3 nozzle base material at ambient temperature. The temperbead approach was selected because temperbead welding supplants the requirement for post weld heat treatment (PWHT) of the heat-affected zone (HAZ) in welds on low alloy steel material. Also, the temperbead welding technique produces excellent toughness and ductility as demonstrated by welding procedure qualification in the HAZ of welds on low alloy steel materials. This results in compressive residual stresses on the inside piping surface in addition to those imparted by MSIP which assists in inhibiting SCC initiation and growth.

The overlay length conforms to the guidance of Code Case N-504-3 and Nonmandatory Appendix Q, which satisfies the stress requirements.

**Examination Requirements**

Table 1 summarizes the examination requirements for the weld overlay repair.

Code Case N-504-3, and Nonmandatory Appendix Q, specify UT using methods and personnel qualified in accordance with ASME Section XI, Appendix VIII. The UT techniques to be used for the final post-weld examination have been qualified through the Performance Demonstration Initiative (PDI) which satisfies the requirements of ASME Section XI, Appendix VIII. Therefore, the acceptance criteria that will be used for the UT will be ASME Section XI Nonmandatory Appendix Q, Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments as clarified under Exceptions to Code Case N-638-1 Paragraph 4.0(b).

**Pressure Testing**

The completed repair shall be given a system leakage test in accordance with ASME Section XI, IWA-5000.

**Preheat and Post Weld Heat Treatment (PWHT) Requirements**

Preheat and PWHT are typically required for welding on low alloy steel material. ASME Section III specifies PWHT on P-No. 3 Group No. 3 base materials unless temperbead welding is performed under limited restrictions (area and depth limits). ASME Section XI, 1998 Edition including Addenda through 2000, specifies 300°F minimum preheat be used for temperbead welding. PWHT cannot be performed and the preheat requirements would necessitate draining the reactor vessel (RV) and a portion of the recirculation system piping. This would create unacceptable levels of airborne contamination. Therefore, consistent with ALARA practices and prudent utilization of outage personnel, the RV will not be drained for this activity. The nozzle and connected piping will be full of water.

**Alternatives to Code Case N-504-3**

Code Case N-504-3 Applicability to Nickel Based Austenitic Steel

Code Case N-504-3 was prepared specifically for austenitic stainless steel material. An alternate application for nickel based austenitic materials (Alloy 52M) is needed due to the specific materials and configuration of the existing nickel based alloy weld and buttering.

Exception to Code Case N-504-3, Requirement (b)

Code Case N-504-3, Requirement (b) requires the weld overlay shall be low carbon (0.035% maximum) austenitic stainless steel. A nickel-based filler Alloy 52M will be used.

Exception to Code Case N-504-3, Requirement (e)

Code Case N-504-3, Requirement (e) requires the first two layers of the weld overlay to have a ferrite content of at least 7.5 FN (Ferrite Number). These measurements will not be performed for this overlay since the nickel alloy filler is a fully austenitic material.

Exception to Code Case N-504-3, Requirement (h)

Code Case N-504-3, Requirement (h) specifies that a system hydrostatic test shall be performed in accordance with IWA-5000 if the flaw penetrates the pressure boundary. In the event the flaw becomes through wall, a system leakage test in accordance with ASME Section XI, IWA-5000, will be performed in lieu of the system hydrostatic test.

**Alternatives to Code Case N-638-1**

Exception to Code Case N-638-1 Paragraph 1.0(a)

Code Case N-638-1 paragraph 1.0(a) specifies that the maximum weld area on the finished surface shall be 100 square inches. Restoring the structural integrity of the safe end-to-nozzle weld with the weld overlay may require welding on more than 100 square inches of surface on the low alloy steel base material.

Exception to Code Case N-638-1 Paragraph 4.0(b)

Code Case N-638-1 paragraph 4.0(b) specifies that the final weld surface and band area (1.5T width) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with ASME Section XI Appendix I. Full ultrasonic examination of the 1.5T band will not be performed and the examination will be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic base material. UT examinations will be performed in accordance with ASME Section XI Appendix VIII Supplement 11.

Exception to Code Case N-638-1 Paragraph 4.0(c)

Code Case N-638-1 paragraph 4.0(c) specifies that the area from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method. Thermocouples will not be used.

**Basis For The Alternative to ASME Section XI**

**IWA-4421(a)** and **IWA-4611.1(a)** require defect removal in this case. The repair cavity would extend through wall since OD removal would be required. The ID is inaccessible due to the thermal sleeve. Therefore the flaw will not be removed. Structural weld overlays covering flaws are permitted by Code Case N-504-3, provided the necessary weld overlay geometry is used. Therefore, this alternative provides an acceptable level of quality and safety.

**IWA-4610(a)** requires the area to be welded shall be preheated to 300°F minimum for GTAW. Since the nozzle will remain full of water, establishing the 300°F minimum preheat temperature cannot be achieved. Code Case N-638-1, paragraph 1.0(b) provides for machine GTAW temperbead weld repairs to P-No. 3 Group No. 3 nozzle base material at ambient temperature. The ambient temperature temperbead approach was selected because temperbead welding eliminates the requirement for PWHT of the heat-affected zones in welds on low alloy steel material. Also, the temperbead welding technique produces excellent toughness and ductility, as demonstrated by welding procedure qualification, in HAZ of welds on low alloy steel materials. Therefore, this alternative provides an acceptable level of quality and safety.

**IWA-4610(a)** also requires the use of TCs to monitor process temperatures. Due to the personnel radiological exposure associated with the installation and removal of the TCs, the nozzle configuration, and since the nozzle will be full of water, TCs will not be used to verify that preheat and interpass temperature limits are met. In lieu of TCs, the preheat and interpass temperatures will be measured using a contact pyrometer. In the first three layers, the interpass temperature will be measured every three to five passes. After the first three layers, interpass temperature measurements will be taken every six to ten passes for the subsequent layers. Contact pyrometers will be calibrated in accordance with approved calibration and control program documents. The use of a contact pyrometer provides equivalent temperature monitoring capabilities and is recognized as acceptable calibrated measuring and test equipment (M&TE). Therefore, this alternative provides an acceptable level of quality and safety.

**IWA-4631(b)** specifies the surface of the completed weld on the ferritic steel shall not exceed 100 square inches. Restoring the structural integrity with the weld overlay of the safe end-to-nozzle weld may require welding on more than 100 square inches of surface on the low alloy steel base material.

EPRI Technical Report 1003616, "Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles" provides technical justification for exceeding the size of the temperbead repairs up to a finished area of 500 square inches over the ferritic material. The area of the finished overlay over the ferritic material will be substantially less than this. The weld overlay will extend over the ferritic material so that qualified UT of the required volume can be performed. There have been a number of temperbead weld overlay repairs applied to safe end-to-nozzle welds in the nuclear industry, and a weld overlay repair having a 300 square inches surface area was recently approved for Susquehanna Steam Electric Station and D.C. Cook.

Results of industry analyses and testing performed to date have indicated that there is no direct correlation of amount of surface area repaired when comparing residual stresses using temperbead welding. Residual stresses associated with larger area repairs (>100 square inches) remain compressive at an acceptable level. Therefore, this alternative provides an acceptable level of quality and safety.

**Basis for the Alternative to the Code Cases Applied**

<u>Exception to Code Case N-504-3, Requirement (b)</u>

A consumable welding wire highly resistant to SCC was selected for the overlay material. This material, designated as UNS N06054, F-No. 43, is a nickel based alloy weld filler material, commonly referred to as Alloy 52M and will be deposited using the machine GTAW process with cold wire feed. Alloy 52M contains nominally 30 wt% chromium, which imparts excellent corrosion resistance to the material. By comparison, Alloy 82 is identified as a SCC resistant material in NUREG-0313 Revision 2 and contains nominally 20 wt% chromium while Alloy 182 has a nominal chromium content of 15 wt%. With its higher chromium content than Alloy 82/182, Alloy 52M provides an even higher level of resistance to SCC consistent with the requirements of the Code Case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-3, Requirement (e)

The composition of nickel-based Alloy 52M is such that delta ferrite does not form during welding. Delta ferrite measurements will not be performed for this overlay because Alloy 52M welds contain no delta ferrite due to the high nickel composition (nominally 60 wt% nickel).

The weld overlay is deposited using Nickel Alloy 52M filler metal instead of austenitic stainless steel filler metals. The basis for crediting the first layer towards the required design thickness will be based on the chromium content of the nickel alloy filler metal. For BWR applications, a diluted layer may be credited toward the required thickness provided the portion of the layer over the austenitic base material, austenitic filler material weld, and the associated dilution zone from an adjacent ferritic base material contain at least 20% chromium, and the chromium content of the deposited weld metal is determined by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the welding procedure specification (WPS) for the production weld.

Structural Integrity Associates report SI-05-030, Rev. 0, "Effect Of Chromium Content On Nickel-Base Alloy SCC Resistance," is available on the ASME website in support of crediting the first overlay layer toward design thickness for both BWR and PWR applications. The report concludes that a minimum of 20% chromium must be present in the first overlay layer to be considered resistant to IGSCC in the BWR environment.

Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-3, Requirement (h)

Code Case N-504-3 requirement (h) specifies a system hydrostatic test shall be performed in accordance with IWA-5000 if the flaw penetrates the pressure boundary. System leakage testing in accordance with ASME Section XI, IWA-5000, will be performed. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-638-1 Paragraph 1.0(a)

Code Case N-638-1 paragraph 1.0(a) specifies that the maximum weld area on the finished surface shall be 100 square inches. Restoring the structural integrity with the weld overlay of the safe end-to-nozzle weld may require welding on more than 100 square inches of surface on the low alloy steel base material.

EPRI Technical Report 1003616 provides technical justification for exceeding the size of the temperbead repairs up to a finished area of 500 square inches over the ferritic material. The area of the finished overlay over the ferritic material will be substantially less than this. The weld overlay will extend over the ferritic material so that qualified UT of the required volume can be performed. There have been a number of temperbead weld overlay repairs applied to safe end-to-nozzle welds in the nuclear industry, and a weld overlay repair having a 300 square inches surface area was recently approved for Susquehanna Steam Electric Station and D.C. Cook.

Results of industry analyses and testing performed to date have indicated that there is no direct correlation of amount of surface area repaired when comparing residual stresses using temperbead welding. Residual stresses associated with larger area repairs (>100 square inches) remain compressive at an acceptable level. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-638-1 Paragraph 4.0(b)

Code Case N-638-1 Paragraph 4.0(b) specifies that the final weld surface and band area (1.5T width) shall be examined using surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The required liquid penetrant examination of 4.0 (b) will be performed. In lieu of the ultrasonic examination in accordance with Appendix I, the ultrasonic examination will be in accordance with Code Case N-504-3, and Nonmandatory Appendix Q which states to perform UT examinations in accordance with ASME Section XI Appendix VIII. Examination of the weld overlay covering the ferritic base material shall be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic base material.

For the application of the weld overlay repair addressed in this request the appropriate examination methodologies and volumes are provided in Code Case N-504-3 and Nonmandatory Appendix Q. Code Case N-638-1 applies to any type of welding where a technique is to be employed and is not specifically written for a weld overlay repair. EPRI research (Technical Report 1013558, *Temperbead Welding Applications – 48 Hour Hold Requirement for Ambient Temperature Temperbead Welding*) has shown that it is not necessary to wait until ambient temperature is reached before initiating the 48-hour hold in order to assure adequate hydrogen removal. No further tempering or potential hydrogen absorption effects will occur after deposition of the third overlay layer. The described approach has previously been reviewed and approved by the NRC (*Safety Evaluation By the Office of Nuclear Reactor Regulation Related To ASME Code, Section XI, Alternatives for Union Electric Company Callaway Plant, Unit 1, Docket No. 50-483, July 10, 2007*). Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-638-1 Paragraph 4.0(c)

Code Case N-638-1 paragraph 4.0(c) specifies that the area from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method. Due to the personnel radiological exposure associated with the installation and removal of the TCs, the nozzle configuration, and since the nozzle will be full of water, TCs will not be used to verify that preheat and interpass temperature limits are met. In lieu of TCs, a calibrated contact pyrometer will be used to verify preheat temperature and interpass temperature compliance with the WPS requirements. Therefore, this alternative provides an acceptable level of quality and safety.

**Summary**

The use of the 52M overlay filler material provides excellent resistance to IGSCC and develops an effective barrier to flaw growth. Also, temperbead welding techniques produce excellent toughness and ductility in the weld HAZ low alloy steel materials, and in this case result in compressive residual stresses on the inside surface that help to inhibit SCC. The design of the overlay for the safe end-to-nozzle weldment uses methods that are standard in the industry. There are no new or different approaches in this overlay design which are considered first of a kind or inconsistent with previous approaches. The overlay will be designed as a full structural overlay in accordance with Code Case N-504-3. The temperbead welding technique that will be implemented in accordance with Code Case N-638-1 will produce a tough, ductile, corrosion-resistant overlay.

Use of Code Cases N-504-3 and N-638-1 has been conditionally accepted in Regulatory Guide 1.147, Revision 15, as providing an acceptable level of quality and safety.

PSEG concludes that the alternative repair approach described above provides an acceptable level of quality and safety to satisfy the requirements of 10CFR50.55a(a)(3)(i).

**6. Duration of Proposed Alternative**

This alternative repair is requested for the remainder of the plant life.

**7. Precedents**

The requested alternatives for the repair at Hope Creek Unit 1 are consistent with the documented safety evaluation reports (SER) previously issued for Hope Creek in 2004 on the recirculation inlet safe end-to-nozzle (N2K) weld, as well as other plants including Duane Arnold (TAC NO. MA8663), Perry, Nine Mile Point 2 and Susquehanna 1.

The SER for Palo Verde Units 1, 2, and 3 issued June 21, 2007 (TAC Nos. MD4272, M4273, MD4274, MD5579, MD5580, and MD55810) encompasses the requested alternatives for starting the 48-hour hold period at the completion of the third layer, crediting the first dilution layer based on chromium content, and the use of alloy 52M rather than low carbon austenitic stainless steel.

10 CFR 50.55a Relief Request HC-RR-I2-W02

Proposed Alternative In Accordance with 50.55a(a)(3)(i)
-Alternative Provides Acceptable Level of Quality and Safety-

# TABLE 1
# Examination Requirements

| Exam Description | Method | Technique | Reference |
|---|---|---|---|
| As Found Flaw Detection | UT | PDI Qualified Implementing ASME Section XI Appendix VIII Supplement 10 | IWB-3514* |
| Surface Prior to Welding | PT | Color Contrast (Visible) Penetrant | N-504-3(c)<br>Appendix Q* |
| Final Weld Overlay Surface | PT | Color Contrast (Visible) Penetrant | N-504-3(j)<br>Appendix Q* |
| Final Weld Overlay for Thickness (as-built dimensional verification) | Manual Mechanical | Pre and post overlay outside diameter and profile measurement | Appendix Q |
| Final Weld Overlay and Outer 25% of the Underlying Wall Thickness Volumetric Preservice | Manual UT | PDI Qualified Implementing ASME Section XI Appendix VIII Supplement 11 | Appendix Q* |

* Acceptance Criteria

# Figure 1

# N2A Recirculation Inlet Nozzle/Safe-end Configuration with Structural Overlay